

A COST-EFFECTIVENESS MODELLING STUDY OF STRATEGIES TO PREVENT POST-CAESAREAN SURGICAL SITE INFECTION

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Abstract

Surgical site infections following caesarean section are a preventable problem for women and health services. They are costly and reduce health outcomes for women during an already challenging post-natal period. An estimated 9% of women acquire a surgical site infection following caesarean section in Australia, but health services do not know the most efficient prevention approach. Evidence-based practice for reducing the risk of surgical site infection following caesarean section is not clear, nor is the extent of unwarranted variation from evidence-based practice in Australia. Therefore it is difficult for health services to know if a change to infection prevention and control practice is justified, and what the cost and health consequences of a change are.

The aim of this research is to model the incremental cost-effectiveness of better health service adherence to evidence-based strategies that prevent SSI following caesarean section in Australia.

Three studies were undertaken in this research. The first study was a synthesis of evidence identifying best-practice strategies for preventing surgical site infection following caesarean section. In the second study, Australian Obstetricians were surveyed to identify how much unwarranted variation from best-practice exists. The third study modelled the cost-effectiveness of a change in caesarean section practice. The total economic costs and health outcomes of adopting a better peri-operative and surgical practice for caesarean section were estimated with a Markov decision analytic model. The model was parameterised using Queensland hospital data, data identified in published literature and expert opinion. The uncertainty surrounding the economic modelling results was estimated using probabilistic sensitivity analysis. Economic models were also evaluated for patient and hospital sub-groups.

In the evidence synthesis, an infection prevention bundle was developed. The bundle consisted of three peri-operative strategies and surgical techniques with strong evidence for reducing the risk of surgical site infection following caesarean section. The survey of Australian Obstetricians indicated that 4.5% of respondents usually implement all of the infection prevention bundle and there is poor adherence to evidence-based practice more generally. Adopting the infection prevention bundle only had a 44% probability of being cost-effective at a cost-effectiveness threshold of

\$42 000 per QALY gained. The infection prevention bundle was also associated with 277 more surgical site infections compared to baseline, and consequently cost \$2.9 million more to implement with 98 QALYs lost. There was large uncertainty surrounding the results with a wide distribution of net monetary benefits from adopting the infection prevention bundle. In the sub-group analysis, the infection prevention bundle was only cost-effective for women having an emergency caesarean section.

The results can be explained by the uncertainty regarding how well the infection prevention bundle is implemented in practice in Queensland hospitals. There were differences in treatment patterns between the two groups of hospitals compared in this study, which also might explain the economic modelling results. Furthermore, hospitals that implemented the infection prevention bundle may conduct more active surgical site infection surveillance which would have increased the incidence of surgical site infection in this group.

It is recommended that Queensland maternity hospitals invest resources to adopt the infection prevention bundle for emergency caesarean section. A better understanding of the reasons why a strategy that is shown to have strong efficacy, was not universally cost-effective in this modelling study is needed. Through this research, an economic framework and method for decision-making in maternity health services has been developed. Areas where further research is needed have been identified. Maternity health services research including economic evaluations of interventions is important for finding the best ways of delivering services during a critical time of the lifecycle. Maternity care will always be a high volume service in Australia and achieving optimal maternal and neonatal health outcomes with scarce resources should be a priority for the Australian health system.

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List of Abbreviations

| | |
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| ACHI | Australian Classification of Health Interventions |
| AIC | Akaike's Information Criterion |
| ARIA | Accessibility and Remoteness Index for Australia |
| ASA | American Society of Anesthesiologists |
| AusHSI | Australian Centre for Health Services Innovation |
| BMI | Body Mass Index |
| CDC | Centers for Disease Control and Prevention |
| CDU | Communicable Diseases Unit |
| CHG | Chlorhexidine Gluconate |
| CI | Confidence Interval |
| EVPI | Estimated Value of Perfect Information Analysis |
| GDP | Gross Domestic Product |
| ICD-10-AM | International Statistical Classification of Disease and Health Related Health Problems, Tenth Revision, Australian Modification |
| IHI | Institute for Healthcare Improvement |
| MDRO | Multi-drug Resistant Organisms |
| MRSA | Methicillin-resistant <i>Staphylococcus aureus</i> |
| NICE | National Institute of Health and Care Excellence |
| NMB | Net Monetary Benefit |
| NNIS | National Nosocomial Infections Surveillance |
| NPWT | Negative Pressure Wound Therapy |
| OR | Odds Ratio |
| OECD | Organization for Economic Cooperation and Development |
| PDC | Perinatal Data Collection |
| QALY | Quality-Adjusted Life Year |
| QHAPDC | Queensland Health Admitted Patient Data Collection |
| SD | Standard Deviation |
| SSI | Surgical Site Infection |

Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: 

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Chapter 1: Introduction

1.1 BACKGROUND

Surgical site infections (SSI) following caesarean section are a preventable problem for women and health services. They are costly and reduce health outcomes for women during an already challenging post-natal period¹⁻⁴. SSIs result in pain and delay in returning to normal post-caesarean section functioning, and may exacerbate post-natal depression, however SSIs are rarely associated with maternal mortality⁵. Treating the SSI may require readmission to hospital, necessitating time away from the infant. The woman and her family may incur private costs to attend a General Practitioner clinic, purchase antibiotics and provide unexpected additional care for the infected woman³⁻⁵. Costs for the health system are additional use of staff time, pharmaceutical and health supplies, and increased length of stay or re-admission to hospital, potentially foregoing a hospital bed for another patient^{6, 7}.

Scarce health service resources^{8, 9} mean that maternity and patient safety budgets need to be used efficiently. Allocating budgets to improve caesarean section practice and reduce SSIs is best done after understanding the economic costs and health consequences of the budgetary decision.

Health services do not know the most efficient way of preventing SSIs following caesarean section. Evidence-based practice for caesarean section is not clear, nor is the extent of unwarranted clinical variation from evidence-based practice in Australia. Therefore it is difficult for health services to know if a change to practice is justified, and what the cost and health consequences of a change are. Through this research, clinicians and health service decision makers will have access to new knowledge regarding which SSI risk reduction strategies are cost-effective for caesarean section.

1.2 AIMS AND OBJECTIVES

The aim of this research is to model the incremental cost-effectiveness of better health service adherence to evidence-based strategies that prevent SSI following caesarean section in Australia.

The objectives of this research are to:

1. identify and assess the volume and quality of evidence around the competing caesarean section SSI risk-reducing strategies that are relevant to decision makers;
2. examine adherence to evidence-based practice amongst Australian Obstetricians;
3. model the changes to total economic costs and health benefits for the identified strategies;
4. quantify the effect of uncertainty in the model; and
5. investigate whether cost-effectiveness varies by sub-groups of hospital or patient type.

1.3 SIGNIFICANCE

This is a novel piece of research nationally because no other publically-available cost-effectiveness study that informs SSI risk-reducing caesarean section practice is known to exist. The results of this research will therefore have significant value to Australian health services by informing decisions about the allocation of scarce maternity and patient safety budgets. Translating the knowledge generated through this research into caesarean section practice will mean that health gains from SSI risk-reducing strategies will be maximised. Large numbers of women undergo caesarean section, at least 18.5 million per year worldwide¹⁰ and this increases every year^{11, 12}. Therefore, even small reductions in SSI rates due to improved adherence to evidence-based practice could mean better health outcomes for a large number of women and substantial savings for health services. No change to SSI rates will increase health system costs significantly if the number of caesarean sections performed each year increases.

The problem of SSI following caesarean section and unwarranted variation from evidence-based practice will be highlighted through this research. Very little is known about rates of SSI following caesarean section in Australia. Surveillance has a low priority due to the perceived low rates of SSI¹³ and the complexity of capturing post-discharge SSIs¹⁴. Even less is known about Obstetricians' awareness of their patients' SSI outcomes and implementation of new strategies to prevent SSI. Estimating the

reduction in SSI risk from improved adherence to evidence-based caesarean section practice as part of the cost-effectiveness modelling will raise the profile of SSIs as a problem in Australian maternity health services. Furthermore, quantifying the effect of uncertainty in the cost-effectiveness model will identify where more research is needed to increase the confidence in a decision to change caesarean section practice.

The strategic directions of several state and national organisations will be informed by the results of this research. The strategic policy context for this research is summarised in Appendix A. Organisations informed by this research include any state or territory organisations coordinating healthcare associated infection surveillance and the Australian Commission on Safety and Quality in Health Care. Improved monitoring of caesarean section SSI and identifying an appropriate post-discharge surveillance method¹⁵ may become a priority following this research. Translating the research results in to practice will involve engaging professional organisations representing clinicians and public and private health services such as the Royal Australian and New Zealand College of Obstetricians and Gynaecologists, Women's Healthcare Australasia and the Australian Private Hospitals' Association. Together with consumer health advocacy groups like Maternity Choices, these organisations can support the knowledge translation and encourage appropriate budget allocations to maternity and patient safety services in Australia.

1.4 THESIS OUTLINE

The thesis consists of 8 chapters beginning with this introduction (Chapter 1). The remaining chapters are organised as follows.

The problem of SSI following caesarean section and strategies to prevent SSI are described in Chapter 2. The caesarean section procedure and significance of the SSI risk, relative to other risks of caesarean section, is outlined. Potential peri-operative and surgical infection prevention strategies that have been evaluated in other studies are also described through a brief literature synthesis in Chapter 2. The competing strategies that are relevant to decision makers for the prevention of post-caesarean SSI are identified in this chapter.

The relevance of economic evaluation methods to informing a decision to change caesarean section practice is covered in Chapter 3. A summary of cost-effectiveness

studies is presented, outlining what economic evidence already exists to assist health services allocate budgets appropriately.

A transparent and reproducible synthesis of evidence-based peri-operative and surgical practice that is unique and important to caesarean section is presented in Chapter 4. Existing systematic reviews and meta-analyses are synthesised qualitatively with the aim of identifying and assessing the volume and quality of evidence that surrounds key SSI prevention strategies. An infection prevention bundle for caesarean section is developed from the evidence synthesis in this chapter.

Adherence to the evidence-based infection prevention bundle amongst Australian Obstetricians is examined in Chapter 5. The analysis of survey data identifying regional adherence and the types of Obstetricians least likely to be compliant with the infection prevention bundle is described. The results presented in Chapter 5 inform a baseline comparator for a proposed improvement in adherence with the infection prevention bundle described in Chapter 4.

The development of the economic model for the cost-effectiveness analysis is outlined in Chapter 6. The methods used to evaluate the model, quantify the effect of uncertainty in the model and investigate sub-group variation in the cost-effectiveness results is also covered in the chapter.

The modelled changes to total economic costs and health benefits from improved adherence to evidence-based strategies that prevent SSI following caesarean section are presented in Chapter 7. Results of the analysis to quantify the effect of uncertainty in the model and investigate sub-group variation are also presented.

A discussion of the results and conclusion to the thesis is provided in Chapter 8. The results of Chapters 4, 5 and 7 are interpreted, considering how they might inform maternity and patient safety services in Australia. The strengths and limitations the methods used in the research are outlined, as are the opportunities for future research in the area. A summary of the contribution of the research to improving maternity and patient safety services concludes the thesis.

Chapter 2: Literature Review

An introduction to caesarean section (Section 2.1) is provided in this chapter, followed by a summary of the literature on healthcare associated infections (Section 2.2), including the relevant infections for caesarean section, the SSI incidence rates and risk factors. Strategies to prevent SSIs are reviewed (Section 2.3) examining inconsistencies in the literature, widely agreed-upon strategies and new innovations.

2.1 CAESAREAN SECTION

A caesarean section is the operative delivery of a baby through an incision in the mother's abdomen and uterus. The story that Julius Caesar was born by caesarean section and the procedure has Roman origins is likely a myth, however the word 'caesarean' is derived from the Latin verb 'caedere' which means 'to cut'¹⁶. It is thought that the procedure originated in Babylonian times (1800BC to 500BC) and performed only when a woman was dying or had died in childbirth¹⁷.

The main indications for caesarean section are where there is maternal or foetal compromise which can be either urgent, or not immediately life threatening¹⁸. Examples of maternal compromise are the presence of conditions such as very high blood pressure (eclampsia), infection, haemorrhage or an amniotic fluid embolism¹⁹. Examples of conditions that compromise foetal health are major placental abruption, major placenta praevia, cord prolapse, foetal congenital anomalies, and general foetal distress indicated by raised or decelerating heart rate¹⁹.

Mortality and morbidity associated with caesarean section has decreased since the routine adoption of a transverse abdominal incision and a low transverse uterine incision instead of the previous vertical abdominal and classical uterine incision (Figure 2.1 and Figure 2.2²⁰) and availability of antibiotics in the last 50 years²¹.

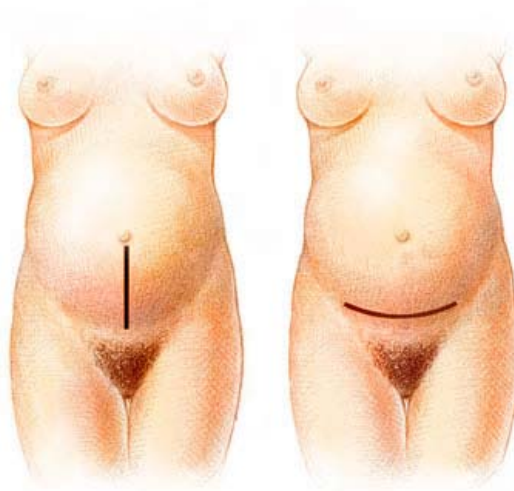


Figure 2.1.
A vertical (left) and transverse (right) abdominal incision for caesarean section

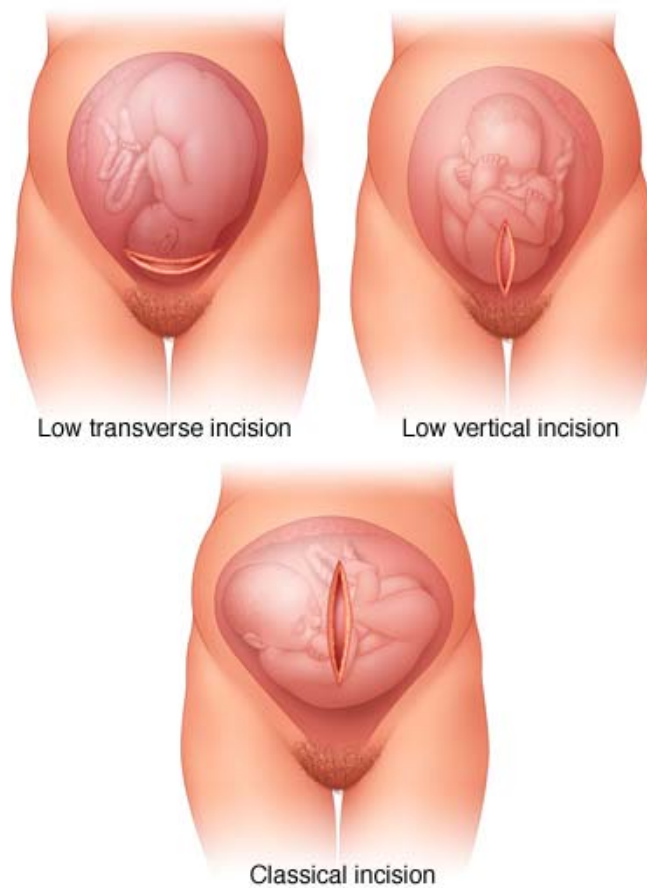


Figure 2.2.
Types of uterine incisions for caesarean section

2.1.1 Rates of caesarean section

Caesarean section is now the most common surgical procedure performed on women worldwide²²⁻²⁴, and rates are increasing^{11, 12}. In Australia, 33.1% of the 307 823 live births were by caesarean section in 2014, an increase from 30.8% in 2010¹¹,¹². Caesarean section rates in Australia have increased from 18.5% in 1990²⁵. More caesareans are performed in Australia than in New Zealand (25.8%) and the United Kingdom (23%), while Australian rates are comparable to the United States (32.5%)¹¹. The highest caesarean rate of Organization for Economic Co-operation and Development (OECD) member countries was 50.4% in Turkey. Iceland had the lowest rate of 15.2% in 2013¹¹. A large proportion of caesarean sections are performed in Australian private hospitals (36%)¹², with 38.7% of caesarean sections in Queensland occurring in a private hospitals²⁶. Caesarean section rates in Queensland private hospital are estimated to be 44.2% and 28.2% in public hospitals²⁷, in line with national estimates¹². In 1985, the World Health Organization (WHO) recommended that no region in the world should have caesarean section rates higher than 10-15%²⁸, although a revision of the recommendation suggested this be raised²⁹. A 2015 analysis of maternal and neonatal mortality data recommended a rate of 19% is more appropriate³⁰.

The increase in caesarean section rates is due to:

- increased incidence of twin or multiple gestations - older women are more likely to birth multiples and in-vitro fertilisation is becoming more common^{21, 31};
- decreased number of vaginal breech deliveries being performed^{21, 31};
- increase in the proportion of overweight and obese pregnant women^{12, 32};
- Obstetricians' fear of litigation due to uncontrollable risks associated with vaginal birth³³;
- decreased incidence of vaginal birth after a previous caesarean delivery due to maternal preference^{21, 31, 34}; and
- increase in women's requests for elective caesarean section^{21, 31, 35}.

Increasing rates of caesarean section are a concern because of the greater morbidity and mortality risk for both mother and baby compared to vaginal delivery³⁶, and SSI

plays a large role in maternal morbidity^{23, 37-39}. While the maternal population characteristics listed above remain, and the caesarean section rate continues to increase, SSI will become a more frequent adverse event.

2.2 HEALTHCARE ASSOCIATED INFECTIONS

The Australian Guidelines for the Prevention and Control of Infection in Healthcare defines healthcare associated infections (HAI) as:

“Infections acquired in healthcare facilities (“nosocomial” infections) and infection that occur as a result of healthcare interventions (iatrogenic infections), and which may manifest after people leave the healthcare facility”⁴⁰.

Healthcare facilities can be any setting including office-based practices or long-term care facilities. Both patients and staff are at risk, however HAI is potentially preventable rather than an unpredictable complication and the risk can be reduced through effective infection prevention and control^{40, 41}. It is important to reduce the risks of HAI because they cause pain and suffering and use up scarce healthcare resources.

HAIs are considered to be the most frequent adverse event in healthcare delivery in Australia, Europe and the United States⁴⁰⁻⁴². Approximately 200 000 HAIs are reported in Australian healthcare facilities each year and are thought to occupy 2 million bed days that could be redirected in the absence of HAI⁴³. In the European Union alone, approximately 37 000 lives are lost to HAI annually with an associated monetary cost of 7 billion Euros mainly attributable to increased length of hospital stay⁴².

2.2.1 Surgical site infections

HAI is one of the two main potential adverse events following caesarean section; the other being haemorrhage^{44, 45}. Two common types of healthcare associated infectious morbidity are SSI and endometritis^{44, 45}.

SSI refers to the infection of the skin and subcutaneous tissue at the surgical incision site and is typically caused by skin flora such as *Staphylococcus* species, *Streptococcus* species, or mixed anaerobic/aerobic bacteria^{7, 46, 47}. SSI is the third most common HAI, accounting for approximately 15% of all HAIs⁴⁸. The Centres for

Disease Control and Prevention (CDC) categorise SSI into three groups: superficial incisional, deep incisional and organ space^{49, 50}. Symptoms for the three types of SSI following caesarean section are described in Table 2.1, Table 2.2 and Table 2.3^{49, 50}. They are classified by the presence of purulent drainage, isolation of organisms from the wound, fever, pain, spontaneous wound dehiscence and/or the presence of an abscess^{49, 50}. Infectious symptoms usually become evident between two and 10 days after the caesarean section procedure^{44, 51-54}.

Table 2.1

Criteria for diagnosing a superficial incisional SSI⁵⁰

| Superficial Incisional SSI |
|---|
| Infection occurs within 30 days after caesarean section |
| <i>and</i> |
| Infection involves only skin or subcutaneous tissue of the incision |
| <i>and at least one of the following:</i> |
| 1. Purulent drainage, with or without laboratory confirmation, from the superficial incision; |
| 2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision; |
| 3. At least one of the following signs or symptoms of infection: pain or tenderness, localised swelling, redness, or heat <i>and</i> superficial incision is deliberately opened by surgeon, <i>unless</i> incision is culture-negative; and/or |
| 4. Diagnosis of superficial incisional SSI by the surgeon or attending physician. |

Table 2.2

Criteria for diagnosing a deep incisional SSI⁵⁰

| Deep Incisional SSI |
|--|
| Infection occurs within 30 days after caesarean section |
| <i>and</i> |
| Infection involves deep soft tissues (e.g. fascial and muscle layers) of the incision |
| <i>and at least one of the following:</i> |
| 1. Purulent drainage from the deep incision by not from the organ/space component of the surgical site; |
| 2. A deep incision spontaneously or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38°C), localised pain, or tenderness, unless site is culture-negative; |
| 3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination; and/or |
| 4. Diagnosis of a deep incisional SSI by a surgeon or attending physician. |

Table 2.3

Criteria for diagnosing an organ/space SSI⁵⁰

| Organ/Space Incisional SSI |
|---|
| Infection occurs within 30 days after caesarean section |
| <i>and</i> |
| Infection involves any part of the anatomy (e.g. organs or spaces), other than the incision, which was opened or manipulated during the caesarean section |
| <i>and at least one of the following:</i> |
| 1. Purulent drainage from a drain that is placed through a stab wound into the organ/space; |
| 2. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space; |
| 3. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination; and/or |
| 4. Diagnosis of an organ/space SSI by a surgeon or attending physician. |

In this research, endometritis is defined as an infection of the lining of the uterus, which typically results from the exposure of the uterus to organisms during the caesarean section procedure and ascending vaginal flora through the cervix⁴⁷. Symptoms of endometritis include maternal fever one to two days after delivery, lower abdominal pain with a raised white blood cell count. Blood cultures are usually taken and are positive in up to 20% of cases. It is often only able to be diagnosed after physical or laboratory evidence fails to identify any other possible infection sites⁵⁵. HAI epidemiologists often group endometritis as an organ space infection, notably the CDC⁴⁹. However the source of infection, which is ascension of vaginal flora into the uterus, is different to organ/space SSI which is usually from organisms on surgical personnel, equipment or the mother's abdomen^{47, 54}. The different source of infection for endometritis compared to SSI has implications for the choice of interventions to prevent the infection and hence costs. However, treatment for organ/space SSI and endometritis is often identical, and therefore costs are similar in this respect. Hence, it is appropriate to consider endometritis a type of organ/space SSI and combine the cost of preventing and treating endometritis with superficial and deep SSI.

Another HAI associated with caesarean section is urinary tract infection^{44, 45, 56}, although it has been excluded from this study. Urinary catheterisation is a usual part of the caesarean section procedure. Urinary tract infections are an adverse event associated with the use of a urinary catheter in many healthcare procedures and are not unique to caesarean section⁵⁷.

The primary treatment for SSI is oral or parenteral antibiotics, awaiting the results of wound cultures and antibiotic sensitivities. Preferred antibiotics for both SSI and endometritis include combination clindamycin-gentamicin therapy, cephalosporins, beta-lactam antimicrobials, or extended spectrum penicillins^{47, 55, 58}. An infected surgical wound may be irrigated with normal saline, incision and drainage, and debridement (removal of infected tissue)^{55, 58}. Wounds are covered using a non-touch dressing technique. Women who have persistent fever, continued signs of infection despite oral antibiotic therapy, multiple comorbidities or suspected abscess are likely to be readmitted or have a prolonged hospital stay^{55, 58}.

A new challenge in treating SSI and endometritis is the emergence of organisms resistant to antimicrobial treatment⁵⁵. In Australia, methicillin-resistant strains of *Staphylococcus aureus* have been found in both health care settings and in communities^{59, 60}. Amongst post-caesarean SSIs identified in a Darwin hospital, Australia, 64% (18 of 28) of the bacteria cultured from surgical wound swabs were *Staphylococcus aureus*, and 8 of the 18 were community-associated methicillin-resistant strains (MRSA)⁷. Of the 28 infecting isolates, 13 were not susceptible to cephalosporin therapy⁷. Treating both healthcare-associated and community-acquired multi-drug resistant organisms is an emerging and widespread challenge across eastern Australia, particularly the tropical north^{60, 61} and amongst Aboriginal and Torres Strait Islander people⁶². What is unknown, is the extent of the problem in Australia for SSI following caesarean section.

Mortality as a result of post-caesarean infection is a rare occurrence^{63, 64}. In the United Kingdom from 2006-2008, the leading direct cause of maternal death was from genital tract Group A streptococcus sepsis for which caesarean section is a risk factor⁶⁵. Mortality from Group A increased from 0.85 deaths per 100 000 pregnant women in 2003-2005 to 1.13 in 2006-2008⁶⁵. Necrotizing fasciitis resulting from a Group A organism is a rare but very serious infection of soft tissues around the caesarean incision site that results in death for approximately 50% of patients⁵⁵. In Australia between 2008 and 2012, there were no reported deaths from necrotising fasciitis, two deaths from sepsis secondary to endometritis and one death from sepsis secondary to caesarean section wound SSI⁶⁴. In the United States though, it was found that 37.5% of the pregnancy-associated deaths secondary to infection were reported more ambiguously. Maternal deaths were under-reported and infection either directly or

indirectly causing death were not recorded on death certificates⁶⁶. Maternal mortality and death attributable to SSI following caesarean section is likely to be rare in Australia, but may be underestimated⁵⁵.

Even though mortality is rare, there are significant short and long term consequences of post-caesarean SSI. The infection may result in pain and delay returning to normal activities³⁹, chronic pelvic pain⁴, persistent seroma⁶⁷, and depression⁶⁸, as well as out of pocket costs^{1, 2}. Costs for a health system include additional staff time, use of pharmaceutical and healthcare supplies, and increased length of stay or re-admission to hospital, potentially occupying a hospital bed that could be used by another⁶.

2.2.2 Post-caesarean infection rates

Rates of SSI following caesarean section are usually under-reported because infections that are diagnosed and treated outside the hospital setting are rarely captured. The trend toward a very short length of initial stay following caesarean section^{69, 70} also makes it difficult to detect SSI using hospital surveillance infrastructure that does not exist in the primary care setting. Australian data is not routinely collected by state or national authorities, with the exception of Queensland, Victoria and Western Australia that monitor SSIs diagnosed in hospital^{13, 71, 72}. Some individual Queensland hospitals collect post-caesarean SSI data, as part of a suite of general SSI data, and voluntarily provide caesarean SSI data centrally⁷³.

Published Australia rates of post-caesarean SSI for women diagnosed during the initial hospital admission or subsequent readmission range from a 2016 Western Australia estimation of 0.62%⁷¹ to 3.3% at the Royal Darwin Hospital in 2011⁷ (New Zealand 5%⁷⁴; United Kingdom 0.01%⁴⁶). However, approximately 95% of SSI following caesarean are identified post-discharge^{46, 75-77}. Three 30-day post-discharge surveillance programmes for caesarean section in the United Kingdom reported that total infection rates for those diagnosed and treated in both the hospital and primary care setting were 4.9% in 2010-2011 (a reduction from 16% following a change in infection control practice)⁷⁷, 9.6% in 2009-2010⁴⁶ and 8.9%⁷⁸ in 2003-2005. The CDC definitions of infections were used. Corcoran et al.⁷⁷ reported that of 824 women, 40 were diagnosed with SSI, and 4.4% of these were superficial incisional, none were deep incisional, and 0.5% were organ/space infection. Readmission for treatment occurred for 0.21% (n=7)⁷⁷. In the Wloch et al. study⁴⁶, of a total 394 infections, 88.3%

were superficial incisional, 4.8% were deep incisional and 6.9% were organ/space infection. Readmission to hospital for infection treatment was required for 0.6% of the women (n=23)⁴⁶. However, at the Royal Darwin Hospital, a much larger proportion were readmitted (25%; n=10) to treat an SSI⁷. In all three United Kingdom studies, more than 97% of women were administered prophylactic antibiotics, but timing – before or after cord clamping – is unknown^{46, 77, 78}. Australian SSI rates have the potential to be lower than these figures if pre-incision antibiotic prophylaxis is being administered routinely. However it is not clear whether this is the current practice.

2.2.3 Sources of post-caesarean SSI

To understand sources of SSI, it is important to define the terms ‘infection’ and ‘colonisation’. A patient is considered ‘colonised’ when the presence of an organism can be detected on a patient and there is no evidence of overt clinical disease or detected immune response. The term ‘infection’ implies the successful multiplication of an organism on or within a host. If the infection provokes an immune response only without overt clinical disease, measured through a serologic reaction, skin test conversion or a proliferative response of white blood cells to antigens from infecting organisms, then it is a subclinical or unapparent infection. The infection becomes an infectious disease when signs and symptoms are present. Sepsis arises when the body’s immune response to the infection is so large, tissues and organs are damaged. Sepsis can be life-threatening⁵⁴.

There are a number of potential sources and routes of post-caesarean SSI. Sources of SSI are either endogenous or exogenous. Endogenous SSIs are caused by the woman’s own vaginal or abdominal skin flora. Exogenous SSIs result from organisms being transmitted from a source other than the woman. For endogenous SSIs, the woman was either admitted to the healthcare facility already colonised or became colonised during her stay at the facility. It is not always possible to determine the source of SSI^{54, 79}. Regardless, endogenous infection from colonised women is a very real scenario in obstetrics and has implications for the infection prevention strategies employed.

2.2.4 Risk factors for SSI

The terms endogenous and exogenous can also be applied to risk factors for SSI. Endogenous risk factors, are known as those intrinsic to the patient such as high BMI

and prolonged membrane rupture before birth. Exogenous risk factors, also called extrinsic, include the surgical and aseptic techniques applied peri-operatively and during surgery⁵⁴.

Understanding the risk factors for SSI following caesarean section is essential to developing targeted prevention strategies to reduce the risk. The National Nosocomial Infection Surveillance (NNIS) risk index for SSI categorises patients using three surgical risk stratification criteria: category 0 (lowest risk), 1, or 2/3 (highest risk), based on length of surgery, how dirty or clean the wound is, and the American Society of Anesthesiologists (ASA) score for patient health. It has been argued though that the NNIS index is insufficient to be used as a prognostic indicator for all types of surgery⁸⁰ and caesarean section⁵⁶. Hence the intrinsic and extrinsic risk factors for infection are important to understand.

Different risk factors have been identified for the three types of SSI: superficial incisional, deep incisional and organ/space. Across studies, contradictory conclusions have also been drawn.

For instance, it is generally agreed that the intrinsic risk factor of BMI above 30kg/m² is significantly associated with both incisional and organ/space SSI^{46, 52, 74, 81}, but not all researchers agree^{82, 83}. The relationship between high BMI and SSI risk is explained by the increased subcutaneous tissue thickness which is relatively avascular, impaired immune function, increased wound area, the need for larger incisions, and the poor penetration of prophylactic antibiotics in adipose tissue⁷⁴.

Emergency caesareans are significantly more likely to result in SSI than elective procedures⁷⁴. This is well-documented and likely due to the urgency of the procedure and consequent reduced attention to good infection control practice⁷⁴. In addition, the membrane may have ruptured in emergency caesareans. Prolonged rupture of the membranes, exposing the uterus to ascension of vaginal flora, is also associated with SSI, particularly organ/space SSI, but this is not seen in all studies^{7, 74, 83}.

Chorioamnionitis, which is an inflammation of the foetal membranes due to a bacterial infection⁴⁷, is significantly associated with overall SSI and organ/space SSI^{82, 83}. Again, the association has not been reported in all studies⁸⁴, or data was not collected on this variable⁷⁴.

Evidence from the last 10 years suggests that other intrinsic factors that may increase the risk of SSI following caesarean section are: smoking⁸³; maternal age <25 or >45⁸²; ASA score >2^{7, 46}; and significant blood loss or anaemia^{7, 82}.

No strong associations have been demonstrated between ethnicity and risk of infection^{46, 74, 82}. However, at the Royal Darwin Hospital, Australia, 16.6% of Aboriginal and Torres Strait Islander women developed an SSI compared with 3.3% of non-Indigenous women⁷, although associations between potential predictive variables were not analysed in this study, such as BMI and ethnicity.

Inconsistent results have been reported regarding the presence of gestational or pre-existing diabetes mellitus, maternal history of previous caesarean sections, and prolonged labour as risks factor for SSI^{7, 46, 82}.

Extrinsic risk factors also play an important role in the emergence of SSI. A large number (>7) of vaginal examinations conducted either before labour or during labour for women who eventually birth via caesarean section is a significant risk factor for SSI^{84, 85}. This approach to monitoring labour, as well as other invasive strategies such as internal foetal monitoring or attempting an instrumental delivery assists the bacteria to enter the uterine cavity through the cervix^{47, 85}.

Other extrinsic risk factors that may increase the incidence of post-caesarean SSI are: removing hair with a razor⁸⁶, surgical techniques used and/or performing a classical caesarean due to the longer operating time and increased blood loss^{87, 88}, inexperience of surgeon and possibly therefore an increased length of surgery^{46, 84}, manually removing the placenta^{89, 90}, and closing the wound with staples⁹¹.

Intrinsic and extrinsic risk factors for post-caesarean SSI have been well studied, although there is only moderately conclusive evidence for some: high BMI, emergency caesarean, presence of Chorioamnionitis, antibiotic prophylaxis after cord clamping, large number of vaginal examinations and hair removal with a razor rather than clippers. The identification of potential risk factors for infection is vital to the categorisation of obstetric patients, as well as to the development of targeted prevention strategies.

2.3 PREVENTING SSI FOLLOWING CAESAREAN SECTION

There are three opportunities to prevent SSI following caesarean section: throughout the peri-operative period and during surgery by applying well-established general infection prevention and control strategies (Section 2.3.1); reducing intrinsic patient-related risk factors pre-operatively (Section 2.3.2); and throughout the peri-operative period and during surgery by applying strategies and techniques unique and important to caesarean section (Section 2.3.3). A fourth approach of combining strategies through an infection prevention and control bundle may also be appropriate for caesarean section (Section 2.3.4).

2.3.1 General infection prevention and control strategies

General infection control and prevention strategies that are recommended for all surgical procedures and healthcare are summarised mostly in clinical guidelines, while new strategies are debated in the literature. The Australian Guidelines for the Prevention and Control of Infection in Healthcare make mostly broad statements for a range of healthcare roles and procedures⁴⁰. In the United States, the CDC has published a general guideline for the prevention of SSI^{49, 50}. The English and Welsh National Institute for Health and Care Excellence (NICE) has published a guideline for the prevention of SSI^{92, 93}, as has the WHO⁹⁴. General strategies recommended in these guidelines include hand hygiene, administering antibiotic prophylaxis, clipping hair that may interfere with the incision site to 1-2mm, hypothermia prevention, maintaining haemostasis and patient skin preparation for decolonisation using any antiseptic product^{40, 92, 93}. Chlorhexidine-gluconate (CHG) with an alcohol additive for abdominal skin preparation before caesarean section is now recommended in the literature⁹⁵, and only reflected in the WHO SSI prevention guidelines⁹⁴. Debate regarding the superiority of specific antiseptic skin preparation products for all surgical procedures is likely to continue while the evidence remains uncertain^{96, 97} and a specific recommendation is not provided in clinical guidelines. The evidence for general infection prevention and control strategies has been well established. Therefore, general healthcare or surgical strategies for infection prevention and control will not be examined in this research.

2.3.2 Strategies addressing intrinsic risk factors

Strategies that address intrinsic patient-related risk factors are implemented in the antenatal period or pre-operatively. Most caesarean incisional SSIs are due to *Staphylococcus aureus*^{7, 46, 47} and strongly associated with nasal carriage of the pathogen, which occurs in 20%-30% of healthy humans⁹⁸. Screening and decolonisation of methicillin sensitive and resistant strains of *Staphylococcus aureus* is recommended by Australian guidelines⁴⁰, explicitly not recommended by the NICE prevention of SSI guidelines⁵⁸, and no other guidelines make statements regarding this strategy. Additional to screening and decolonisation, identifying and treating infections such as chorioamnionitis, is a general SSI prevention strategy recommended in the CDC and Society for Healthcare Epidemiology of America guidelines^{49, 50, 99}. There is a notable absence of published research assessing the effect of BMI reduction on SSI incidence for women who were overweight or obese pre-pregnancy. Women have successfully minimised their gestational weight increases or lost weight from participation in an antenatal health weight program¹⁰⁰⁻¹⁰³, but the subsequent reduced risk of SSI amongst women who go on to have a caesarean section has not been quantified. There is some uncertainty regarding appropriate strategies to address intrinsic risk factors for SSI. This may be due to a dearth of research that includes SSI as an outcome measure.

2.3.3 Peri-operative and surgical strategies

The third opportunity to prevent SSI following caesarean section is in the peri-operative period and during surgery when strategies and techniques unique and important to caesarean section are implemented.

Literature now clearly recommends prophylactic antibiotics administration for caesarean section 15-60 minutes before skin incision. The change to this practice is based on the findings that no prophylactic antibiotics, or prophylactic antibiotics administered after the baby's umbilical cord is clamped is a significant risk factor for SSI^{85, 104, 105}. Previously, there was concern that the antibiotics absorbed by the baby may mask neonatal sepsis or cause other unspecified morbidity, but adverse events have not been observed⁸⁵.

Cleansing the vagina and the baby's head with a povidone-iodine solution before caesarean section significantly reduces the risk of endometritis, particularly for women

with prolonged membrane rupture^{39, 67}. If the baby's head is engaged in the cervix, the head can become colonised with organisms. The surgical site may be colonised during the procedure when the baby's head is pulled back into the sterile environment of the uterus and abdominal cavity. The cleansing process uses additional douches, wipes or sponges⁶⁷, which may increase equipment costs and surgery time.

Surgical and patient safety checklists have been recommended by WHO and the American Congress of Obstetricians and Gynecologists as useful patient safety mechanisms for obstetrics^{106, 107}. Surgical safety checklists clarify roles and responsibilities, a process highly relevant for a caesarean section where a large team is present to support mother and baby, making infection control more complex. Implementing the pre-incision time-out step within checklists will support pre-incision antibiotic prophylaxis and vaginal preparation implementation.

The different stages of the caesarean section procedure have at least two competing options for implementation. Studies have identified the following surgical techniques as possibly having an effect on SSI:

- Joel-Cohen versus Pfannenstiel incisions – in favour of Joel-Cohen^{87, 108, 109} (key difference between each of these techniques is blunt versus sharp abdominal entry respectively);
- Use of the same or separate surgical knives to incise the skin and deeper tissues – in favour of the former¹⁰⁹;
- Exterior versus intra-abdominal repair of the uterus – in favour of intra-abdominal repair¹⁰⁹;
- Closure versus non-closure of the pelvic and parietal peritoneum – in favour of non-closure^{87, 109};
- Closure versus non-closure of the subcutaneous tissue space unless the woman has more than 2cm subcutaneous fat – in favour of non-closure¹⁰⁹;
- Glove change versus no glove change after placenta removal – in favour of glove change¹¹⁰; and
- Use versus no use of superficial wound drains – in favour of no drains¹⁰⁹.

The first randomised-controlled study that assessed the effect of three surgical techniques on maternal infectious morbidity was the CAESAR trial conducted

between 2000 and 2006¹¹¹. The CAESAR trial concluded that there was no difference in infectious morbidity for single versus double-layer uterine closure, closure versus non-closure of the peritoneum, and liberal versus restricted use of a subsheath drain¹¹¹. There is little consensus regarding the closure of the peritoneum and use of a wound drain, and debate regarding the effect of single or double closure of uterus continues with regard to SSI risk⁸⁷.

The CORONIS randomised-controlled trial was inspired by the CAESAR study and examined 5 surgical techniques for caesarean section, and their short term impact including infectious morbidity^{112, 113}. Hospitals from 7 low and middle income countries recruited 15 935 women to assess differences between the surgical techniques and no significant differences in incidence of SSI were seen^{112, 113}. Although the NICE guideline for caesarean section¹⁰⁹ makes clear statements on surgical techniques for caesarean section, the CORONIS trial has concluded that clinicians should be free to use whichever technique they prefer as no strategies convincingly affect short- or long-term maternal outcomes^{112, 114}. The generalisability of the CORONIS trial can be questioned given the very different hospital environments compared to Australia.

Competing strategies also exist for removal of the placenta, which were not examined in the CAESAR or CORONIS trials. The placenta can be removed spontaneously with gentle cord traction, or manual removal. SSI risk appears to be reduced with cord traction as it minimises the exposure of the uterine walls to pathogens^{87, 109}.

Much has been published examining the risks associated with the use of staples compared to absorbable sutures for wound closure^{24, 91, 115, 116}. Most studies conclude that the use of absorbable sutures convincingly reduces infection risk^{24, 91, 115, 117}, while a high quality observational study and a Cochrane meta-analysis showed no difference between the two methods^{52, 116}. A randomised-controlled trial published in 2013 concluded that absorbable sutures reduced the SSI risk following caesarean section⁹¹, which may weigh the evidence overall in favour of sutures. A 1993 study concluded that suturing wounds is significantly more expensive than using staples predominantly due to sutures taking longer to complete¹¹⁸.

There are many competing peri-operative strategies and surgical techniques that have an uncertain effect on reducing the risk of SSI following caesarean section. Given

the range of SSI risk-reducing strategies and techniques unique to cesarean section, the questions that arise are whether there is large variation in current caesarean section practice and how clear evidence-based practice is for maternity and patient safety health services.

2.3.4 Infection prevention and control bundles

There is a fourth approach to preventing SSI following caesarean section which is to use the infection prevention and control bundle concept, and implement multiple strategies together. In 2001, the Voluntary Hospital Association in the United States collaborated with the Institute for Healthcare Improvement (IHI) to re-examine and improve practice in intensive care units¹¹⁹. After seeing little improvement in health outcomes following the introduction of concepts such as enhanced teamwork and communication, the two organisations focused on key elements of care to prevent adverse events including infections in patients on ventilators and those who had central lines¹¹⁹. Consequently, the IHI Ventilator Bundle¹²⁰ and the IHI Central Line Bundle¹²¹ were developed.

The IHI defines a bundle as:

“A small set of evidence-based interventions for a defined patient segment/population and care setting that, when implemented together, will result in significantly better outcomes than when implemented individually”¹¹⁹.

Bundles have three to 5 elements that are ideally based on recommended practice, and science that is well established; ideally randomised controlled trials^{119, 122, 123}. This quality of evidence is not always available to demonstrate links between processes of care and patient outcomes and so the elements need to at least have strong clinician agreement¹¹⁹. Each bundle element should be independent so that if one of the interventions is not implemented, it should not affect implementation of the others¹¹⁹. They should be used with a defined patient population in one location as full bundle adherence is more likely in teams that physically work together in the same location¹¹⁹. Also, if there are too many bundle elements, high reliability in implementing all bundle elements suffers¹²⁴.

All elements of a bundle need to be implemented for it to be successful¹¹⁹. The IHI acknowledges that people do not get things ‘all right very often’ suggesting that

the system surrounding the bundle is reliant on human factors¹²⁴. To overcome the challenges of relying solely on human behaviour in implementing a bundle, the IHI suggests that organisations build systems, processes or queues to support all of the bundle being implemented all of the time¹²⁴.

Multidisciplinary teams should develop the bundle with elements being descriptive rather than prescriptive to allow for customisation and appropriate clinical judgement¹¹⁹. The IHI encourages the content of a bundle to be challenged¹²⁴. Although, what should not be challenged is whether the elements have actually been implemented or not. Organisations can modify the details of how a bundle is implemented, for example a bundle element of ‘antibiotic prophylaxis pre-incision’ can be implemented with 1g cephazolin by one organisation, or 2g by another. The important aspect of the bundle is that the wording of the element e.g. ‘antibiotics pre incision’ is precise and clear so when measuring its implementation, the response is ‘yes’ or ‘no’¹²⁴. The IHI has strict criteria for bundle implementation. Adherence with the bundle means completion of every component, with no score given for partial implementation¹¹⁹. However, partial implementation of bundled strategies in the United States’ Surgical Care Improvement Project is associated with improved SSI outcomes^{125, 126}.

Infection prevention bundles when systematically and reliably applied produce better outcomes for patients. Bundle reliability is the product of each element’s adherence rate. For example, if each of 5 bundle elements is delivered with 90% adherence, then the total bundle is delivered with 59% adherence ($90\% \times 90\% \times 90\% \times 90\% \times 90\%$)¹¹⁹. Bundle implementation also promotes team work and communication such as daily goals being developed and monitored, and debriefs to reflect on adherence and plan improvements¹¹⁹. The development of a bundle in a clinical team stimulates quality improvement activities creating a good patient safety culture¹¹⁹.

Evidence is most persuasive when bundle implementation is associated with improvement in outcomes across multiple hospitals. Experience from individual hospitals can provide additional process information about how change was achieved provided that the data are presented appropriately. Examples of multiple strategies implemented together for the prevention of post-caesarean SSI have only been implemented in individual hospitals. They are not all necessarily ‘bundles’ in the strict

sense of the term, and have been called ‘multi-modal’ interventions for the purpose of this literature review.

Eight multi-modal interventions for preventing post-caesarean SSI have been identified and none included an economic evaluation (see Table 2.4)^{7, 38, 77, 127-131}. One study, conducted in a Queensland metropolitan hospital was not published¹³⁰, and two were conference presentations^{128, 129}. They are all quasi-experimental/observational studies of moderate quality with SSI rates defined according to the CDC definition and reported over the course of the intervention. Post-discharge infections that were diagnosed and treated in a primary care setting were included in data collection in three studies^{77, 130, 131}.

The most common strategies across the interventions were: the use of CHG for skin preparation; providing patients with CHG skin wipes; instructing the women to not shave pubic hair prior to surgery; and commencing pre-incision antibiotic prophylaxis. All studies reported a decrease in post-caesarean SSI.

The limitation that arises across all eight studies is that they do not report other changes that may have occurred in the hospital to affect SSI rates. For interventions that aim to reduce healthcare-associated infection, it is important to document all of the key infection control processes, including those that are not included in the intervention¹³². The study needs to be presented so that change in SSI rates is convincingly attributed to the intervention.

Table 2.4

Multi-modal interventions for preventing post-caesarean SSI

| Author | Year | Country | Strategies |
|-------------------------------|------|---------------|--|
| Corcoran et al. ⁷⁷ | 2013 | Ireland | Change from absorbable sutures to non-absorbable sutures for skin closure; change from razor to clippers for hair removal; change from 0.5% CHG to 2% CHG solution for skin preparation. |
| Dyrkorn et al. ¹³¹ | 2012 | Norway | No hair removal four weeks prior; change from absorbable polyfilament suture to absorbable monofilament coated with antibiotics; sterile gown introduced for midwife receiving baby; change from Mepore bandage to Opsite Post-Op highly absorbent wound dressing; staff education; surgical hand washing and aseptic techniques reinforced. |
| Riley et al. ¹²⁷ | 2012 | United States | Change from povidone-iodine to 2% CHG/70% alcohol solution for skin |

| Author | Year | Country | Strategies |
|-----------------------------------|------|---------------|--|
| | | | preparation, CHG wipes night before caesarean; no hair removal prior to procedure; patient education; change to pre-incision antibiotic prophylaxis from after cord clamping. |
| Harris and Hickson ¹²⁸ | 2012 | United States | CHG surgical scrub; no shaving two days prior; no powder or lotion; CHG wipes night before, morning of and immediately before caesarean; interventions to decrease skin irritation; silver impregnated dressing for high BMI patients; wound dressings changed day three post-operative, staples removed day 7-10 or later; negative pressure wound therapy for high risk patients; patient education programme. |
| Zajac et al. ¹²⁹ | 2012 | United States | No hair removal four weeks prior, CHG sponge shower night before; CHG wipe before entering OR; 1-2mm clip for hair removal; 2g cephazolin antibiotic prophylaxis 60 min pre-incision; patients with MRSA receive vancomycin 60 min pre-incision; sterile towel used to transfer baby from surgical team to midwife; absorbable staples or absorbable sutures for skin closure; if non-absorbable sutures used, remove at day 7; silver impregnated dressings for high risk patients; wound dressings changed day 7, no bathing for 7 days post-op. |
| Henman et al. ⁷ | 2012 | Australia | Gentamicin added to cephazolin for antibiotics pre-incision; 2% CHG solution for skin preparation; staff education. |
| Rauk ³⁸ | 2010 | United States | 2% CHG wipe before entering OR; staff education; change from flash sterilisation of instruments to central sterilisation; 2% CHG/70% alcohol solution for skin preparation. |
| Playford et al. ¹³⁰ | 2007 | Australia | No hair removal four weeks prior; pre-op antiseptic wash with CHG sponge or shower with triclosan; 0.5% CHG/70% alcohol solution for skin preparation; thermoregulation with warmed blankets and forced air blankets; administration of supplemental oxygen intra-operatively; maximum 10 persons in OR; hydrocolloid dressing changed at day 7. |

2.4 SUMMARY AND IMPLICATIONS

In Australia, approximately 102 000 caesarean sections are performed each year. Based on international studies, it is estimated that 9% of these women become infected

with an SSI. The risk of acquiring a SSI increases with intrinsic factors like BMI greater than 30kg/m² and extrinsic factors such as poor infection prevention and control. Strategies to prevent SSI following caesarean section range from administering pre-incision antibiotic prophylaxis, vaginal cleansing and surgical techniques that reduce blood loss, reduce colonisation of the sterile abdominal and uterine cavities, and reduce operating time. There is much research evaluating these strategies as individual elements and as multi-modal interventions. However, best-practice is not certain, nor is the cost-effectiveness of implementing the most effective strategies in reducing the risk of SSI following caesarean section.

Chapter 3: Economic Framework for Caesarean Delivery SSI Prevention

SSI following caesarean section is not only a health problem, but also an economic problem for women and health services. SSIs mainly cost the Australian health system in terms of patients' extra length of stay in hospital^{6, 133}. These are healthcare funds that could be spent elsewhere. The cost and health outcomes of better adherence to evidence-based SSI risk-reducing strategies for caesarean section need to be understood for appropriate allocation of maternity and patient safety services budgets. In this chapter, a rationale for including economics in healthcare decision-making is provided in section 3.1. Economic evaluation methods relevant to this research and how they inform healthcare decision-making are outlined in Sections 3.2, 3.3 and 3.4. In Section 3.5, other research where economic evaluation methods have been applied to a healthcare decision to change caesarean section practice is summarised.

3.1 HEALTHCARE DECISION-MAKING

Nations only have limited funding available to spend on the provision of health and healthcare to its people. Economics can be used to inform decision-making about how resources are allocated.

In Australia, health expenditure was estimated to be \$161.6 billion in 2014-15 which is 10% of gross domestic product (GDP). Spending has increased from \$77.5 billion or 8.2% of GDP in 2000-01¹³⁴. Larger health spending is largely a 'volume' issue, equating to high levels of consumption of health goods and services, not as a result of prices of health^{135, 136}. A larger amount of healthcare is being consumed because of increases in the use of and expenditure on medical services including diagnostic services; supplier induced demand; increased use of untested and expensive technologies; and to a lesser extent, an ageing population^{135, 136}. Healthcare is also a handicraft industry with low productivity growth in personal healthcare services^{137, 138}. In Australia, health services are being asked to deliver more, or at least the same

volume of health services with non-increasing budgets each year. This means that there is likely a reduction in health services' annual budgets in real terms.

Scarcity of resources is at the core of economics^{8, 9}. A decision to use resources in one way such as through a universal antibiotic prophylaxis policy causes a loss elsewhere in the health sector. The loss arises because resources are no longer available for an alternative use. Funding for an obstetric screening and decolonisation program may be foregone for the antibiotic prophylaxis policy. The benefits lost of not implementing the screening program represent the opportunity costs of the antibiotic prophylaxis policy^{8, 9}.

Questions of what strategies should be pursued in order to achieve desired outcomes are the realm of normative economics. Normative economics pursues how things should or ought to be, how to value them and identifying which things are good or bad, right or wrong. This is in contrast to 'positive economics' that deal with how the world of economics functions in practice¹³⁹. The study of normative issues that bear on economics is based on welfare economics.

Welfarism is a branch of economics that focuses on the optimal allocation of resources and goods and how this affects social welfare. Welfarists believe that the benefits of a healthcare intervention should be valued by individual consumers in the same way that any other goods or services are valued. This implies that a consumer will choose the types of healthcare, alongside other goods and services like education and transport that provide the maximum personal benefit. This way of thinking arises from the notion of competitive markets in microeconomics¹³⁹. Welfare economics assumes that social welfare is a function of individual satisfaction or happiness (utility) and extra-welfarism relaxes this assumption.

In the extra-welfarist approach, the desired outcome is health rather than personal utility. Extra-welfarists believe that resources should be allocated to pursue the social objective set by the social decision maker. In a healthcare context, the primary objective of the social decision maker is to maximise the total health of the population. The approach is paternalistic, tasking government, and other external groups to make decisions about what healthcare people need, how it should be produced and who receives it. The justification is that in a democratic society, the decision maker occupies the position due to a socially-acceptable political process¹³⁹.

These two broad schools of thought have competing approaches in economic evaluation. A failure to discriminate between welfarism and extra-welfarism could lead to mistakes in the choice of evaluation method used, a failure to apply the method properly and a failure to correctly interpret and report findings¹³⁹.

3.2 ECONOMIC EVALUATION

Cost-benefit analysis lies in the domain of welfarism, whereas extra-welfarists apply cost-effectiveness and cost-utility analysis. Cost-benefit analysis determines the net benefit to society of a program where all benefits, including health outcomes are monetarised¹³⁹. Decision making in infection prevention is focused on health outcomes which makes cost-effectiveness and cost-utility analysis the relevant methods¹⁴⁰.

Cost-effectiveness analysis determines an incremental cost-effectiveness ratio (ICER), comparing an intervention (i) to an alternative or the status quo (a). The ICER is given by:

$$ICER = \frac{C_i - C_a}{E_i - E_a} = \frac{\Delta C}{\Delta E}$$

where C is the cost, and E is the effectiveness⁹. Effectiveness can be measured a number of different ways, hence the ICER results could be expressed as cost per case of disease prevented, cost per life saved, or cost per life-year gained⁹. Cost-effectiveness analysis is useful in comparing alternative programs to treat the one condition, but it cannot be used to assess disparate alternatives such as comparing costs per infection avoided due to new surgical techniques, with costs per case of gestational diabetes averted from a healthy weight program.

Cost-utility analysis is a special form of cost-effectiveness analysis. It focuses on the utility gained by people exposed to the intervention measured through quality-adjusted life-years (QALYs). Policy alternatives can be ranked according to their cost per QALY gained (see Section 3.2.2)⁹. This approach makes comparisons across different interventions such as new surgical techniques and healthy weight programs and different health outcomes such as infection and gestational diabetes possible. Cost-utility analysis is appropriate when quality of life is an important outcome and when the program being evaluated affects both morbidity and mortality.

An evaluation of changes to caesarean section practice requires an understanding of the economic costs of implementing the new changes and possible cost-savings of reduced SSI incidence. More importantly, the evaluation would also require an understanding of changes to quality of life as well as any mortality, using health outcomes framed as a QALY. Hence, an extra-welfarist approach will be taken in this research, enabling maternity and patient safety decision makers to weigh the cost-utility of better adherence to evidence-based SSI risk-reducing strategies against competing health interventions. In the sections that follow, a framework for cost-utility analysis is described, emphasising their relevance to this research.

3.2.1 Valuing costs

It is important to not focus on the accounting costs of an intervention which only involves a financial analysis of operating costs¹⁴¹. Accounting costs may be an overestimation of some costs, or too conservative for others¹⁴². Economic approaches examine the opportunities lost by spending money one way at the expense of the alternative.

Gold¹⁴³ and Drummond¹⁴⁴ identified three stages of performing a cost analysis: identify resources, measures the resources and valuing them. However, an even more relevant approach has been developed by Page et al.¹⁴⁵ who outlined 7 comprehensive steps for evaluating infection control programmes. It is important to be clear on the aim and scope of the intervention, and perspective of the evaluation so that the change being implemented, what outcomes of interest and who is being impacted are explicit. An inventory of resources affected by the intervention enables researchers to identify the items that have large volume and unit costs, and need more precise cost estimates. An inventory is a planning process before the cost data is collected. After cost data is collected, the uncertainty surrounding the cost estimates needs to be acknowledged and quantified, as precise costs are unlikely to be available. Some resources may be used for health services other than the intervention being evaluated such as staff time or equipment and these need to be partitioned. The value of the cost data in terms of a dollar figure, based on the volume and units used in the intervention, is determined in the last step¹⁴⁵.

There are different types of costs to include in a cost analysis. Examples include variable hospital costs such as hospital supplies, equipment, medications. These are the types of costs that might change with the implementation of a new intervention.

Fixed costs such as hospital building maintenance, electricity and water supplies are unlikely to be affected by a new intervention and are therefore excluded from a cost analysis.

A cost that is important to value when evaluating infection prevention interventions is a bed day. The cost of occupied hospital beds is likely to be one of the larger costs identified in the resource inventory requiring a precise estimate in the evaluation. Using an accounting cost –how much it costs the hospital to run bed - may overestimate the opportunity cost of occupying a hospital bed due to an SSI^{133, 146}. The economic value of the bed, known as the opportunity cost, does not include the fixed and sunk costs and considers how much the freeing the bed achieves what the hospital desires such as capacity to treat more patients¹⁴⁶.

3.2.2 Valuing health outcomes

It is also important to distinguish between measurement and valuation of health outcomes, as is done with costs described above. Medical symptoms, disease progression or quality-of-life are often measured in health, and the instruments used to do this are referred to by economists as non-preference-based measures^{9, 147}. Non-preference-based health status measures are often not suitable in economic evaluation because they can't be compared to other options in health service delivery and often do not include measures of survival⁹.

Economists are typically interested in moving beyond measurement to assess what value individuals place on symptoms or quality-of-life states. Preference-based measures combine quantity and quality of life, incorporating the valuations that individuals place on particular states of health. An outcome metric currently favoured as meeting these requirements and facilitating the widest possible comparison between alternate uses of health resources is the QALY.

The QALY is a composite valuation of quality and quantity of life^{9, 148, 149}. It assumes that different states of ill health can be assessed in terms of the utility they provide relative to perfect health over a period of one year^{148, 150}. Perfect health is given a value of one, and zero corresponds to a health state equivalent to dead. For example, having a serious infection following caesarean section will be unpleasant, and might reduce the women's quality of life considered over a whole year by 15%. If this is the only disability or illness the woman experiences over a year, then the woman's QALY

over the year would be 0.85. Therefore, an intervention that prevented the infection, such as a new infection prevention and control bundle would save 0.15 QALYS. If it has saved 5000 women from the same infection, it would amount to 750 QALYs per year. If the intervention also saved 10 lives, total savings would be 760 QALYs per year.

Figure 3.1⁹ provides a graphical representation of the QALY approach, in which the life courses of two individuals are plotted, with quality of life on the y-axis and time or survival on the x-axis. Both people have started with similar levels of quality of life but after some time, one person had a number of recurrent infections (C1, C2, C3 and C4) that reduce their quality of life, and the final complication is fatal. The second person also experiences some ill health over the course of life (C5, C6 and C7)⁹. In terms of examining the differences of an infection prevention strategy, suppose person two was exposed to a policy that reduced the risk of her acquiring an SSI that person one, who did not receive the intervention, experienced. It can be seen from Figure 3.1 that the area under each of the two curves captures survival as well as the timing and number of non-fatal events and their health impact. Therefore, the difference represented by the shaded area is a measure of the QALYs gained by the intervention experienced by person two.

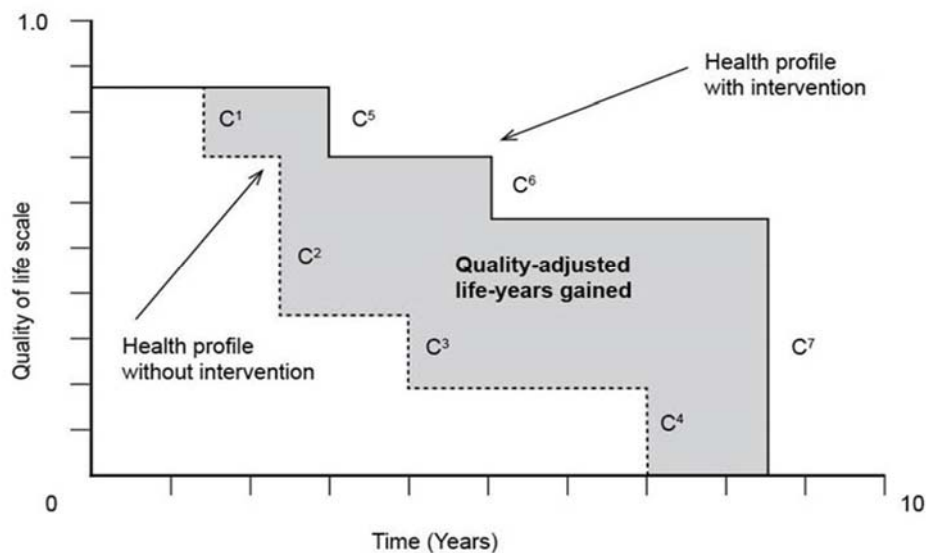


Figure 3.1.
Health profile of two individuals in quality and quantity of life dimensions⁹

QALYs are measured using a validated questionnaire designed to elicit people's well-being in a variety of health conditions relative to perfect health. Three methods can be used to obtain cardinal measures of health state preferences: visual analogue scales; time trade-off; and standard gamble.

Visual analogue scales are represented by a line similar to a thermometer. Respondents are given a scenario or asked to consider their own health and indicate on the line where they would locate the health state (from zero to one, 10 or 100)⁹. The EuroQol Group have developed a visual analogue scale⁹.

The standard gamble method has the strongest theoretical foundations of choice-based valuation methods. Respondents are presented with alternative pathways that lead to various different health states, usually dead, full health and a state of partial health. The health states are the possible consequences of a healthcare decision. It is the state of partial health that a utility value is sought for. An example arrangement of the gamble is that one pathway might lead to a P probability of ending up in full health and a 1-P probability of being dead. The second pathway will lead to a state of partial health. Varying probabilities are presented to the respondent and they are asked whether they prefer the pathway with a possibility of death or full health, or the pathway of guaranteed partial health. When they become indifferent between the two pathways, the value placed on state of partial health can be determined⁹.

The time trade-off method is a simpler alternative to the standard gamble and also involves finding a point of indifference between alternatives. Respondents are often asked to compare a situation between being in one health state for a period of time and being in worse health state for a longer period of time. The more time the respondent is willing to give up to be out of the worse health state, the worse it must be⁹.

A challenge in using visual analogue scales, standard gamble and time trade off methods is that it is difficult to devise a description for the particular health state being valued. This challenge can be overcome with multi-attribute utility systems such as the EQ-5D⁹.

The EQ-5D was developed by the EuroQol Group where health states can be evaluated across 5 dimensions⁹. It adopts a two-step valuation method where 243 possible health states have been described by patients using the EQ-5D and secondly,

those health states have already been valued by a large population sample of British adults using a time trade off and visual analogue scale⁹.

3.2.3 Discounting costs and health outcomes

Costs and utilities are often discounted to adjust for differential timing¹⁴⁷. For health utilities, discounting is a way of acknowledging the higher value people place on health at the current time than health outcomes in the future. For costs, discounting accounts for inflation over time and people's preference to incur costs in the future⁹. Discount rates are commonly applied somewhere between 3 and 5% and there is debate in the literature as to whether costs should be discounted at the same rate as health outcomes¹⁴⁷. Consequently, Briggs¹⁴⁷ advises that sensitivity analysis be conducted with a number of discount rates for both costs and health outcomes to explore the potential importance of differential discounting. Discounting costs and health outcomes is relevant when the scope of the intervention evaluation is beyond one year.

3.3 MODEL-BASED ECONOMIC EVALUATION

Decision analytic modelling plays an important role in cost-effectiveness analyses¹⁵¹⁻¹⁵³. The method compares at least two alternatives available to a decision maker and systematically compares them using information to describe how a patient moves through the model's alternative pathways. Models represent a simplified version of reality. They are used in situations where 'real life' cannot be exactly replicated, but information is required to answer decision problems¹⁵².

Decision analytic modelling is more appropriate than trial-based economic evaluations in healthcare decision making^{151, 152}. Randomised-controlled trials might not compare the relevant alternatives that a decision maker is considering. Trials often compare an intervention to a placebo or only one alternative. In real life, there may be multiple alternatives that a decision maker is interested in evaluating and a model is flexible to do this through a data synthesis process¹⁵². A single trial is unlikely to provide all the information required for decision making such as mortality, morbidity, health outcomes and quality of life beyond the clinical setting over an appropriate time horizon for the disease of interest^{151, 152}. Measuring single clinical outcomes such as volumes of blood loss to evaluate a change in caesarean section surgical practice is only justifiable where there is good reason to believe that the change will not also have

long term effects on quality of life and decision makers are not interested in other relevant intervention outcomes¹⁵². It is unlikely that a straightforward linear relationship exists between the immediate clinical outcome and long term health outcomes. Poor haemostasis does not automatically result in SSI and poor quality of life; it is dependent on other factors. A model can be structured to account for the non-linear long term prognosis¹⁵². Short term clinical outcomes are also not useful when decision problems involve broad choices across the whole of healthcare and this is where the QALY becomes an important measure of long-term health¹⁵². Finally, models have an advantage over clinical trial-based economic evaluations in that they can be generalised to other settings such as regular practice and other geographical locations. The data can be adjusted to reflect for example, that adherence with the intervention may not be as high as was seen in the trial, or adjusted to reflect the costs in different countries¹⁵².

The criticism of modelling studies has revealed a clash of empirical paradigms: biomedicine that values high internal validity of research and social science where high external validity is important¹⁵². Modelling for economic evaluations is focussed on guiding the decision making process around whether an intervention is cost-effective¹⁵⁴. Strict inclusion criteria of evidence based on an arbitrary 0.05 significance level is not applied in modelling because few or no data may become available for the model. It is not useful for the decision making process to then say that little or nothing is known in the area of research. Rather, all the best available evidence is used in the model, adjusted for quality if required, and the variance and uncertainty around each parameter value is stated¹⁵⁴.

3.3.1 Modelling methods

There are two main types of decision analytic models: decision trees and Markov models. Other models include systems dynamic models, discrete event simulation, and individual sampling models. The key uses and limitations of decision trees and Markov models are discussed here.

Using a decision tree for decision analytic modelling requires a branch-like structure to be developed, where each branch represents a clinical event that might take place in the future. The alternatives, sequences and links between events are important steps in constructing a decision tree⁹. The probabilities of moving from one event to the sequential and mutually exclusive alternative events are represented along

the tree branches. Cost and health consequences, also known as ‘payoffs’ are given to the final branch, and each clinical pathway along the tree leading to the final branch⁹. Decision trees are useful where recursive events do not need to be modelled and timeframes are short⁹. An example of recursive event is when a patient acquires a second HAI following initial treatment. Although decision trees can be designed to deal with diseases that have long clinical pathways and repeated or uncertain timing of events, Markov models deal best with these scenarios^{9, 155}.

Markov models are a multi-state modelling approach and assume that each patient in a hypothetical cohort is in one of a finite number of states of health referred to as Markov states. An example of a basic Markov model structure is provided in Figure 3.2. The states represent clinically and economically important events in the disease process that is to be modelled. Each state is assigned a health utility value and a cost value. Like decision trees, transition probabilities must be mutually exclusive and represent the likelihood of transitioning from one health state to another and are assigned to the arrows indicating possible transitions (Figure 3.2)^{147, 155}.

To evaluate infection prevention strategies, a structure is drawn that represents the patients’ prognoses. In the example model structure (*Figure 3.2*), women who have a caesarean section either become infected or not, and move to these respective health states. Infected women receive treatment and after a number of cycles all patients are no longer infected. Following the development of the model structure, it is populated with three types of data so the cost-effectiveness can be calculated: the probability of moving from one event to another, the costs, and health consequences of being in each health state¹⁴⁰.

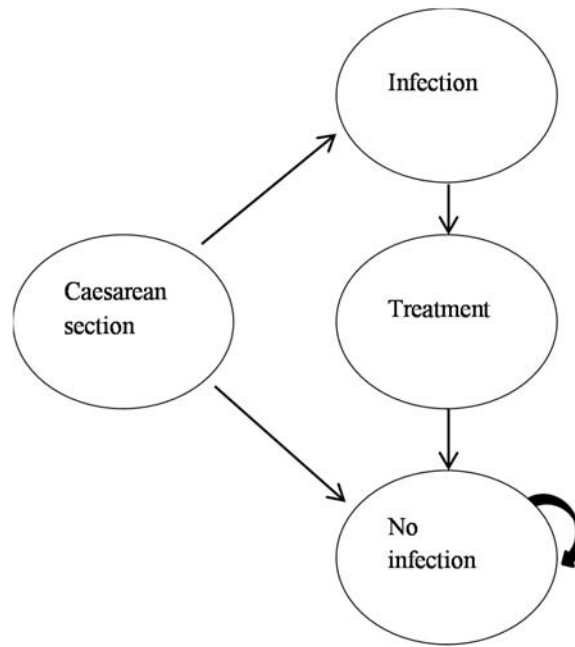


Figure 3.2.
Basic Markov model structure

Data used to inform a Markov model is sourced from the best quality evidence according to a hierarchy^{144, 156} where meta-analyses of randomised-controlled trials is considered high quality through to observational studies and expert opinion considered the lowest quality sources of data for a model. Databases and primary data collection is also used to inform the model⁸. Leal et al.¹⁵⁷ have established an individual elicitation method for sourcing data on expert opinion that is appropriate for economic evaluation models where no better quality data is available.

The time horizon reflects the scope of the evaluation, and is expressed in increments of time called ‘cycles’, that sum to the total length of time the evaluation will measure cost and health outcomes for. Cycle length may be one day or week for acute health issues, one month or year for long term, slow progressing diseases. During each cycle, the patient will either make a transition from one state to another or remain in a health state. It is assumed that a patient in a given state can make only a single state transition during each cycle and therefore cycle length must be able to capture real life movements along a clinical pathway^{147, 155}.

It is important to be aware of the ‘Markovian assumption’ which may limit the use of a Markov model. The assumption is that the probability of moving out of a state

is not dependent on the states a patient may have experienced before entering that state. This limitation may be overcome by using a combination of distinct states to model patient histories that influence prognosis (called ‘tunnel states’) and time-dependent transition probabilities^{147, 155}.

Evaluating a Markov model uses the average amount of time a person spends in each health state. The expected health utility and costs for a patient moving through the model are given by

$$\text{Expected utility} = \sum_{s=1}^n t_s \times u_s$$

and

$$\text{Expected cost} = \sum_{s=1}^n t_s \times c_s$$

where t_s is the time spent in state s , u_s is the health utility associated with that health state, and c_s is the cost associated with that health state. Summing utility values across all cycles will result in overall expected health utility for the strategy; summing costs across all cycles will result in overall expected costs^{147, 155}. The Markov model process ends when all patients are in a health state that they cannot leave, called an ‘absorbing state’, often ‘death’ or in the Markov model example ‘no infection’^{147, 155} (Figure 3.2).

3.4 INTERPRETING THE RESULTS OF ECONOMIC EVALUATIONS

Economic evaluations use a cost-effectiveness plane with a cost-effectiveness threshold plotted on the plane to present results to decision makers (see Figure 3.3). The cost-effectiveness plane represents the change in costs (ΔC) from an intervention on the y-axis, and change to health outcomes or effect (ΔE) on the x-axis, with the origin representing current practice or a status quo scenario. A cost-effectiveness threshold represents the maximum amount a decision maker is willing to pay for more health outcomes. Depending on the resources available to the decision maker, a cost-effectiveness threshold of between \$30 000 and \$60 000 per QALY gained is acceptable in Australia¹⁵⁸. The change in costs from 5 intervention options (A, B, C, D, and E), compared to the status quo, is along the y-axis, and the change in effectiveness (QALYs) is along the x-axis. Point A is cost-effective because the intervention is more effective, but cheaper to run. Intervention B is potentially cost-effective because it lies below the cost-effectiveness threshold; it is more costly, but

more effective. Lying above the threshold is intervention C – potentially too expensive even though it results in better health outcomes. Intervention D is unethical to implement as it makes people sicker and is more costly, and intervention E needs discussion amongst decision makers because it is cheaper to run (which may be very important), but results in worse health outcomes.

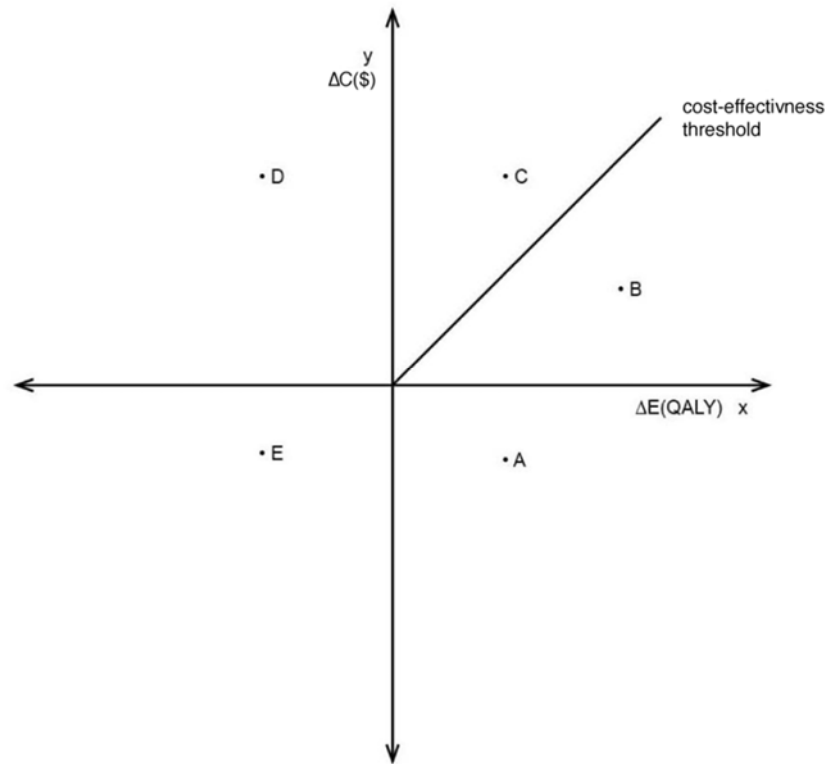


Figure 3.3.
Example cost-effectiveness plane

3.4.1 Quantifying uncertainty

Uncertainty in the model structure and parameters are important to consider in a decision analytic model. Identifying where there is large uncertainty and the value of conducting more research to strengthen the certainty is important when informing decision making through cost-effectiveness analysis.

Uncertainty regarding the model refers to its structure and assumptions the model is based on. Model uncertainty can be dealt with through scenario and subgroup analysis¹⁵⁹. In scenario analyses, the model assumptions and different scenarios

are varied and the model is evaluated with the new changes, to assess the importance of the model structure on the results. The results from different assumptions and scenarios are compared, and the most relevant model is selected for reporting to decision makers¹⁵⁹. Sub-group analysis explores situations in cost-effectiveness analysis where patients may vary regarding the benefit received, or other factors such as whether the type of hospital influences the benefits seen from a new intervention. Decision makers might be interested in whether an intervention benefits a population sub-group where the benefit is not seen across the general population on average or vice versa¹⁶⁰. Forms of sub-groups and patient heterogeneity might be related to: the treatment, such as the need to increase antibiotic dosage for patients with a high BMI; factors that are related to the progression of the disease like BMI; and factors that are unrelated to the disease, for example whether the procedure is performed in a public or private hospital¹⁶⁰. A sub-group should be identified based on its usefulness for decision making. The provision of an intervention to a sub-group should be able to be operationalised in practice. Further, selecting sub-groups for analysis needs to be based on a clear rationale¹⁶⁰. Examining sub-groups in decision problems has the potential to increase population health gains by focussing the use of an intervention in patients for whom the health gain is greatest. Scenario and sub-group analyses are performed as part of probabilistic sensitivity analysis described below.

Model parameters where uncertainty might exist are the transition probabilities, costs and health outcomes. Parameters are informed by the best-available data used to populate a model, and are usually only estimates; their true value is unknown. As such, the parameters have uncertainty surrounding them and this can be quantified through probabilistic sensitivity analysis¹⁵⁹. Probabilistic sensitivity analysis characterises parameter estimates as distributions rather than discrete values. Parameter values for a model are provided in cost-effectiveness analysis, but they are accompanied by distributions because for example, the cost of treatment for some patients will be high and for others will be low. The appropriate choice of distribution will be closely related to the nature of the parameter. Where a probability parameter is estimated from a proportion, the beta distribution, which is bounded by zero and one is used. An appropriate distribution for cost data may be the gamma distribution which is bounded by zero to infinity. A beta distribution is also usually appropriate for health utilities that range from zero to one. The analysis is conducted by randomly picking a value

thousands of times from the distribution for each parameter in the model using Monte Carlo simulation^{154, 159, 161}.

The simulation results can be represented as a scatter plot on the cost-effectiveness plane. Results are interpreted in terms of the proportion of results that fall below the cost-effectiveness threshold. A rationale decision maker will adopt the intervention if more than 50% of the scatter plot lies below the cost-effectiveness threshold – a more than 50% probability of the intervention being cost-effective¹⁵⁴. Probabilistic sensitivity analysis enables the uncertainty around the costs and health outcomes of an intervention to be described and relative contribution to all uncertainty arising from each parameter to be estimated¹⁶¹. The approach better informs a decision of whether to adopt a new intervention compared to point estimates of the ICER described in Section 3.2.

Results can also be presented as a cost-effectiveness acceptability curve when it is not clear exactly where the decision maker's cost-effectiveness threshold lies, or as a net monetary benefit (NMB)⁹. Cost-effectiveness acceptability curves illustrate the probability of an intervention being cost-effective given different thresholds. Curves for multiple interventions can be plotted on the same graph allowing comparison for decision making⁹. NMB is an alternative way of reporting probabilistic sensitivity analysis results⁹ and assumes decision makers use a decision rule whereby interventions with an ICER below the chosen cost-effectiveness threshold are cost-effective. The NMB is calculated by subtracting the costs from the product of QALYs and the chosen cost-effectiveness threshold ($[\text{QALYS} \times \text{CE threshold}] - \text{costs}$). The approach is useful when interventions result in ambiguous positive or negative ICERs. Negative ICERs could be cost-saving, with a negative change in costs between the comparator and the new intervention, and health gains observed; negative ICERs could also be a result of a more expensive intervention and negative health gains. In contrast, larger NMBs are unambiguously better⁹.

Probabilistic sensitivity analysis also answers the question of whether further research to inform the decision is needed or justified. Estimated value of perfect information analysis (EVPI) is an extension to probabilistic sensitivity analysis. The inverse of the probability that the intervention is cost-effective, which is the probability that the decision is wrong, as well as the consequences of a wrong decision are considered. If the decision made based on existing information is eventually

discovered to be a wrong decision, there are costs in terms of health benefits and resources foregone. These are the expected costs of uncertainty and can also be framed as the opportunity cost of the decision made with existing information. The opportunity costs of the decision is expressed as the EVPI¹⁶². A non-parametric approach is used to estimate EVPI, as benefits are unlikely to be normally distributed. EVPI is the difference between the expected NMB with perfect and existing information. However, the expected benefit with perfect information is unknown. Therefore, the expected value of a decision taken with perfect information is the mean of the maximum net benefits from each iteration of the probabilistic sensitivity analysis simulation¹⁶².

EVPI can be expressed both as per patient and for the population to whom the decision applies. For example, in the case of this research the population is approximately 20 000 women who have a caesarean section each year in Queensland. EVPI is a function of how much decision makers are willing to pay for a QALY, converted to NMB. Therefore, the values for the population EVPI at each possible value of the cost-effectiveness threshold are plotted. At a relevant cost-effectiveness threshold, the plot informs decision makers at what point spending more money on improving the precision of the model parameters is no longer cost-effective. Alternatively, if decision makers have for example \$1 million to spend on further research, the relationship between the population EVPI and the cost-effectiveness threshold can estimate whether spending the \$1 million is cost-effective¹⁶². EVPI is dependent on the uncertainty surrounding the model parameter estimates and how cost-effective the intervention is expected to be, given the size of the population that could benefit from more research. It is an important analysis to conduct, because it informs investment in further research where a decision to adopt an intervention is not clear.

3.5 CRITIQUE OF EXISTING COST-EFFECTIVENESS STUDIES

No known cost-effectiveness studies similar to the research undertaken in this thesis exist internationally. Databases were searched for published and unpublished health services research focussing on caesarean section and including a cost-analysis of an intervention. Five studies were found, and are summarised in Table 3.1 and

critiqued further in this section. Three studies are outdated and only one study evaluated a bundle of interventions¹⁶³.

In 2011 Lee et al. conducted a study based on United States data¹⁶⁴. They assessed the cost-effectiveness of pre-caesarean *Staphylococcus aureus* screening and decolonisation compared to no screening and concluded that the strategy was unlikely to be cost-effective under most scenarios tested because there are other causative organisms for SSI following caesarean, and the cost of screening in the United States was prohibitive¹⁶⁴. The two major limitations of the study are that costs were not appropriately estimated and the uncertain quality of information used to inform model parameters.

Lee et al. took the perspective of the health financier, only accounting for the direct costs of illness such as hospitalisation, and the cost of patient supplies for homecare and home visitation by a health professional. This perspective may underestimate the full economic cost of both current practice and the new screening program. It is recommended that the costs and benefits of competing infection control strategies should be viewed from the patient and family perspective as well as those incurred by the health system^{2, 165}. This approach is useful because costs to the patient and family are added to the health system costs. These will increase as the rates of infection increase, and effective infection control strategies will generate cost savings over and above those enjoyed by the hospital sector². Costs such as patients' private out of pocket expenditure on pharmaceuticals or time patients spend accessing health services would also be included. However, Graves et al.^{1, 2} found that a post-discharge SSI diagnosis was not associated with a large increase in the private cost or production loss. Post-discharge costs, even to the health system appear to be small compared to in-hospital costs for SSI in general^{1, 2, 166} and SSIs following caesarean section⁵². It is also debated as to whether production losses for the patient and informal carer should even be included because they may over-state the true cost of the healthcare program¹⁶⁷. However, costly new technologies such as negative pressure wound therapy (NPWT) are increasingly being used post-discharge for prevention and treatment of cesarean section SSI¹⁶⁸, and the out of pocket costs for primary healthcare are increasing in Australia¹⁶⁹. Therefore post-discharge costs, taking a societal perspective may be important to include in an economic evaluation.

Table 3.1

Economic evaluations of post-caesarean SSI prevention strategies

| Authors | Year | Evaluation perspective | Method | Comparators | Policy recommendations |
|--------------------------------|-------------|-------------------------------------|--------------------------------------|---|---|
| Arshi ¹⁶³ | 2012 | Norwegian health system and society | CEA/CBA trial | New infection prevention bundle | Implementing full bundle was cost-saving |
| Lee et.al. ¹⁶⁴ | 2011 | US health financier | CEA modelling | <i>Staphylococcus aureus</i> screening/decolonisation | Screening/decolonisation not cost-effective |
| Mallaret et.al. ¹⁷⁰ | 1990 | French hospital | Partial economic evaluation of trial | Antibiotic prophylaxis | Antibiotic prophylaxis reduces length of stay |
| Mugford et.al. ¹⁷¹ | 1989 | UK hospital | CEA trial | Antibiotic prophylaxis | Antibiotic prophylaxis was cost-saving |
| Ford et.al. ¹⁷² | 1987 | US hospital | CEA trial | <i>Piperacillin</i> vs 4 antibiotic alternatives | <i>Piperacillin</i> was cost-saving |

In-hospital costs may have also been overestimated in the study by Lee et al.. Costs of an infection prevention program are strongly dependent on the change in length of stay in hospital⁶. This study appears to not have considered the time-dependent bias of healthcare associated infections^{6, 173}. This bias is minimised when researchers use a multistate model with three states - admission, infection and discharge/death, to include information about when the infection began¹⁷³.

Lee et al. made assumptions in the model parameters drawn from experience at Magee-Women's Hospital, Pennsylvania in the United States and did not capture the uncertainty surrounding these model parameters. Eleven of the 35 model data inputs were assumptions, and without further evaluation of these parameters through scenario, subgroup or EVPI analysis, readers may be unsure of the consequences of these assumptions on the final results or the appropriateness for a different decision-making setting⁹.

The health utility values used in the study by Lee et al. are questionable. The utilities for an infected caesarean wound were sourced from a 1997 evaluation of the cost-effectiveness of different treatments for infected appendectomy wounds^{164, 174}. The authors of the appendectomy study arbitrarily decided on the utility values themselves – 0.6 for an inpatient treatment of a SSI and 0.7 for an outpatient treatment of SSI¹⁷⁴. NICE has attributed no QALY loss to the case of an infection following caesarean section in their economic evaluation of planned vaginal birth versus caesarean delivery on maternal request¹⁰⁹. NICE's position is that although there may be an important health state utility loss associated with an infection outcome, the duration of that loss is likely to be short and therefore only a small QALY loss over the course of a year¹⁰⁹. A QALY loss of zero may be an underestimation, and the utilities used by Lee¹⁶⁴ may overestimate the utility lost in obstetric infections. A more appropriate health utility value for infection following caesarean section may lie somewhere between 0.6 and one.

An unpublished Masters thesis evaluated the costs and health benefits of an infection prevention bundle aimed to reduced post-caesarean SSI in a Norwegian hospital between 2006 and 2010¹⁶³. The interventions evaluated are reported in Table 2.4¹³¹. Arshi¹⁶³ concluded that the intervention bundle was both cost-effective and demonstrated net benefits to society. The ICER comparing previous practice with the new bundle was 599 Norwegian Kroner per SSI avoided¹⁶³ equivalent to

approximately AU\$103. Only methods described in the abstract are available because the full thesis is not accessible by the public¹³¹.

In 1987 and 1990, partial economic evaluations of antibiotic prophylaxis for caesarean section were conducted in two studies^{170, 172}. Ford et.al.¹⁷² compared the antibiotic regime *Piperacillin* versus four other antibiotic alternatives in a cohort of patients at the University of California hospital. The second study¹⁷⁰ assessed the effectiveness of antibiotic prophylaxis at cord clamping versus a placebo. The economics of this strategy were evaluated by examining the differences between the two groups in length of stay and cost of administering a course of post-operative antibiotics after onset of infection. Using Drummond's checklist for economic evaluations¹⁶⁵, it can be seen that neither study outlined the economic importance of the research question with their primary aim to examine the clinical efficacy of different interventions; the rationale for alternative interventions was not clear, the form of evaluation was not stated, the methods used to assess effectiveness were questionable, costs were insufficiently considered in terms of perspective and discounting, and results were not presented alongside a sensitivity analysis.

A more thorough study from 1989 also aimed to estimate the cost-effectiveness of administering routine antibiotic prophylaxis compared to no antibiotics to reduce the incidence of infection following caesarean section¹⁷¹. Effects of routine prophylaxis with antibiotics were assessed by analysing the results of 58 controlled trials. Costs data was from two hospitals in the United Kingdom based on length of stay, overheads, costs of drugs and laboratory tests. The costs for women with and without wound infection were compared¹⁷¹. Mugford et.al. concluded that when using *Ampicillin*, the average costs of postnatal care would be reduced by GB£ 3938 per 100 caesarean sections.

These 5 studies that included some form of cost analysis have minimal relevance for the Australian health sector. The data is outdated and interventions compared are not helpful for decision makers. In summary, the limitations of existing studies are:

- appropriate costs were not included;
- uncertain quality of the information used to estimate effectiveness and costs from the intervention;

- the interventions evaluated are not relevant and out-dated for Australian decision makers; and
- there is no information about how cost-effectiveness might vary for sub-groups.

3.6 CHAPTER SUMMARY

In this chapter an economic framework that informs a decision to change caesarean section practice was been presented. Before an investment in new strategies to prevent SSI following caesarean section are made, the economic costs and health outcomes should be valued for the baseline and new scenarios. Uncertainty surrounding the cost-effectiveness modelling is also important to present to decision makers. There is no publically available literature that uses such an economic framework to evaluate a decision to adopt strategies that prevent SSI following caesarean section. The economic framework will be used in this research and as such, inform decision makers of the economics of preventing SSI following caesarean section. In the next chapter, evidence-based SSI prevention strategies will be identified and then evaluated in Chapter 7 using an economic model.

Chapter 4: Better Infection Control Practice

In order to model the changes to total economic costs and health benefits of better adherence to evidence-based strategies, baseline and comparator scenarios need to be established. In this research, relevant baseline scenarios could be no or current peri-operative and surgical infection control. The comparator is peri-operative and surgical infection control strategies that health services should aspire to implement for caesarean section: better infection control practice. The volume and quality of evidence around the SSI risk-reducing strategies that are relevant to decision makers will be identified in this chapter. The methods used for the evidence synthesis are described in Section 4.2, and better practice is identified in Section 4.3. The results are interpreted in the discussion of the thesis (Chapter 8).

4.1 INTRODUCTION

There are infection control practices, peri-operative strategies and surgical techniques that will reduce SSI risk association with caesarean sections. However, evidence for strategies and techniques has not been adequately synthesised for nurses, midwives and physicians (hereafter referred to as ‘clinicians’). The evidence may also not always be accessible, as evidenced by large variation in peri-operative practice and surgical technique amongst clinicians¹⁷⁵⁻¹⁷⁷.

Available evidence mostly reports effectiveness of individual risk-reducing strategies which means up to date evidence for all potential strategies is not in a single document. Furthermore, SSI is not always a primary outcome and publications need to be read in depth to identify the impact of each strategy on infection. A systematic review published in 2013 that examined a range of strategies and interventions for caesarean section¹⁰⁵ quickly became out of date due to new evidence^{67, 85, 97, 114, 178-186} potentially making its recommendations also out of date. In a more recent systematic review¹⁸⁷ the authors did not make clear recommendations for clinical practice, while the quality of a third review¹⁸⁸ is questionable because its methods are not clear.

A transparent and structured synthesis of systematic reviews, meta-analyses and other types of reviews has value in informing clinical decision makers of best-practice

and where gaps remain^{189, 190}. The large number of caesarean section review studies on individual strategies and techniques are difficult for decision makers to decipher, however many of them are meta-analyses which is a highly-ranked form of evidence¹⁵⁶. Evidence syntheses cut through the wealth of evidence while assessing consistency and quality, and providing definitive summaries to inform clinical practice^{189, 190}. The Cochrane Collaboration acknowledged that this is the case across many health areas and introduced the overview of Cochrane reviews method in their handbook¹⁹¹.

The objective of this study was to identify a suite of peri-operative strategies and surgical techniques that reduce SSI risk following caesarean section based on the latest published evidence. An evidence synthesis of key strategies unique and important to caesarean section will inform decision makers what better adherence to evidence-base practice looks like.

4.2 METHODS

A systematic review of literature reviews, systematic reviews and meta-analyses was conducted using the PRISMA guidelines¹⁹² to identify the most effective peri-operative strategies and surgical techniques for reducing the risk of SSI following caesarean section. A protocol was written¹⁹³ (Appendix B) and the review registered with Prospero (number CRD42016041366)¹⁹⁴.

4.2.1 Search strategy

Two researchers, independently searched electronic databases PubMed, CINAHL, Cochrane Library, Science Direct, Scopus and Embase for review studies published in the English language between January 2006 and June 2016. Only review studies were chosen, and no clinical trials, as this study sought to synthesise the key strategies with as large a volume of effectiveness evidence as possible. The 10-year timeframe corresponds to the extensive research activity that commenced after the rate of caesarean sections began to increase in the late 1990's.

The search strategy sought studies that synthesised SSI outcomes for women who had an emergency or elective caesarean section and were any age, parity and risk category. Any type of peri-operative or surgical intervention and appropriate comparator relevant to caesarean section was of interest. The primary outcome was SSI, defined according to the United States CDC classifications of superficial or deep

incisional and organ/space infection, including endometritis⁷⁹. The term “wound infection” was accepted as an alternative outcome but aggregate measures of infection such as “total infectious morbidity” was not used. Table 4.1 shows the PubMed search strategy for this review which can be replicated to verify or update the results.

Table 4.1

PubMed search strategy

```
(((((endometritis[MeSH Terms]) OR endometritis[Title/Abstract])) OR
((((("infection/surgery"[MeSH Terms]) OR surgical site infection[Title/Abstract]) OR
"surgical wound infection"[MeSH Terms]) OR surgical wound infection[Title/Abstract]) OR
wound infection[MeSH Terms]) OR wound infection[Title/Abstract]) OR obstetric
infection[Title/Abstract])) AND ((cesarean delivery[Title/Abstract] OR "cesarean
section"[MeSH Terms]) OR cesarean section[Title/Abstract]) AND ((Meta-Analysis[ptyp] OR
Review[ptyp] OR systematic[sb]) AND "last 10 years"[PDat]) AND (English[lang])
```

*Search terms are bolded

This synthesis of evidence was specifically designed to inform providers of maternity care and not broader hospital practice. The evidence has already been established for the importance of infection prevention strategies common to most surgeries at a general healthcare and surgical healthcare level. As such, inclusion and exclusion criteria were developed to reflect the focus of this review and shown in Table 4.2. Titles, then abstracts were independently scanned and full text studies were retrieved if the inclusion/exclusion criteria were met.

Table 4.2

Inclusion and exclusion criteria

| Included | Excluded |
|---|--|
| <ul style="list-style-type: none"> Studies aiming to evaluate effectiveness of caesarean section strategies that might reduce SSI risk Studies aiming to evaluate effectiveness of general surgical strategies that might reduce SSI risk when applied to caesarean section | <ul style="list-style-type: none"> No quantitative measure of effect Infection prevention strategies common to most surgeries e.g. hypothermia prevention, maintaining haemostasis; hand hygiene |

4.2.2 Data extraction

Data was extracted and bias within each review assessed independently by two researchers. Data identifying the review, key study characteristics and effectiveness of peri-operative strategies and surgical techniques on SSI was entered into a data extraction template. Bias was examined using a modified A Measurement Tool to Assess Systematic Reviews (AMSTAR) checklist and categorisation method developed by McKibben and colleagues¹⁸⁷. The quality of individual studies was reported as ‘good’, ‘fair’ or ‘poor’ using the McKibben method¹⁸⁷. To qualify as a ‘good’ quality study, two or more of the four major criteria must have been met, as well as four or more of the 23 minor assessment quality criteria. The method for assigning a quality rank to individual studies is summarized in Table 4.3 and more detail regarding the quality assessment method is in the original paper¹⁸⁷.

Table 4.3

Definitions of quality ranks developed McKibben and colleagues¹⁸⁷

| Quality assessment | Definition |
|--------------------|--|
| Good | ≥ 2 major criteria <i>and</i> ≥ 4 minor criteria |
| Fair | < 2 major criteria <i>and</i> > 3 minor criteria or > 1 major criteria <i>and</i> < 4 minor criteria |
| Poor | < 2 major criteria <i>and</i> < 4 minor criteria |

4.2.3 Evidence synthesis

A list of peri-operative strategies and surgical techniques, and their effectiveness in reducing SSI risk was created. Recommendations were made for each strategy using the GRADE approach of assessing the four determinants of the strength of a recommendation: effect; quality of evidence; value and preferences; and costs¹⁹⁵. Effectiveness data from the most recent ‘good’ quality studies was examined to avoid overstating the strength of the recommendation for each strategy however, the effect size was checked against other studies for consistency. This meant randomised controlled trials included in multiple meta-analyses were not counted twice, but important and relevant evidence was still captured. Quality of evidence as determined

by the original authors of the most recent good quality study selected for each strategy or surgical technique in this synthesis, was used to inform the strength of each recommendation. A suite of infection prevention and control strategies was chosen from those with strong recommendations and the highest evidence quality.

Other adverse outcomes reported in the included studies such as blood loss, unintended uterine extensions and including wasted health service resources were noted in the data extraction process. It was important to identify strategies that had potential maternal or perinatal morbidity despite them being effective in reducing SSI risk. The relative importance of non-infection outcomes was considered against SSI outcomes when developing the suite of infection prevention and control strategies.

4.3 RESULTS

4.3.1 Search results

In the evidence synthesis and development of the suite of infection prevention and control strategies, 67 full text studies were assessed for eligibility. From these, 44 studies were included in the full-text synthesis (*Figure 4.1*). Thirty-two studies were meta-analyses, one was a systematic review and 11 were non-systematic literature reviews. Excluded studies following abstract screening and full-text assessment for eligibility with reasons are in Appendix C.

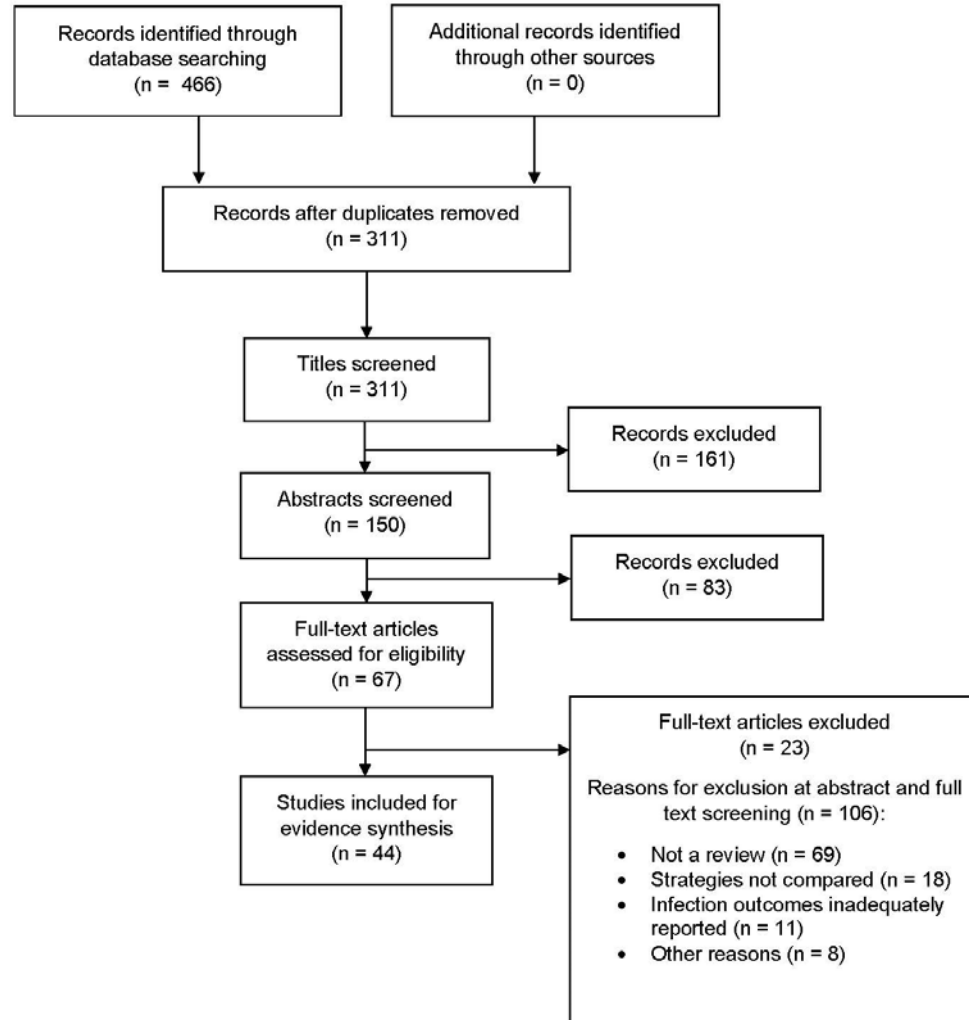


Figure 4.1.
Flowchart showing selection of studies

4.3.2 Data quality

Amongst the systematic reviews and meta-analyses, 33 were categorised as good quality and one study was given a ‘fair’ quality rating (Appendix D). The ‘fair’ quality study only met one of the four major quality assessment criteria and did not conduct duplicate data extraction, only searched one database and did not rate and document the quality of included studies. Non-systematic reviews were all assessed as ‘poor’ quality as they did not provide enough information on the criteria required in the McKibben assessment method¹⁸⁷.

4.3.3 Evidence for best-practice

Seventeen different types of peri-operative strategies and surgical techniques for caesarean section were identified as having been evaluated for their effectiveness in reducing the risk of SSI (Table 4.4). The groups of strategies with the largest number of studies assessing effectiveness were antibiotic prophylaxis and skin closure.

There was much variation regarding the specific interventions and comparators examined within each type of strategy. Seventeen studies evaluated three different aspects of antibiotic prophylaxis: timing, antibiotic class and route of administration. The effectiveness of 22 different combinations of antibiotic classes was reported across one meta-analysis¹⁸⁴ and one systematic review¹⁹⁶. Similarly, multiple intervention-comparator pairs were also evaluated for skin incision, uterine closure, peritoneum closure, wound drainage and skin closure. In total, 82 intervention-comparator pairs were identified in this study as having been evaluated for their effectiveness in reducing the risk of caesarean section SSI (Appendix E). All included studies that informed the list of peri-operative strategies and surgical techniques are provided in Table 4.4, while the single most recent good quality studies that influenced the recommendations are in the text below.

The effectiveness of the 82 intervention-comparator pairs was examined. From these, three peri-operative strategies and surgical techniques with strong evidence for reducing the risk of SSI following caesarean section were identified for the suite of infection prevention and control strategies. The strategies were: administer prophylactic antibiotics 15 to 60 minutes before incision; prepare the vagina with iodine-povidone solution; and remove the placenta spontaneously with gentle cord traction (Table 4.4). Pre-incision antibiotic prophylaxis reduced the risk of endometritis by 46% and wound infection by 41%¹⁸². Vaginal preparation reduced the risk of endometritis by 55%, but did not have an effect on wound infection⁶⁷. The risk of endometritis was increased by 64% with manual removal of the placenta⁸⁹. The three strategies had clear evidence of reducing the risk of caesarean section SSI and the associated recommendations were all strong, based on an assessment of the four determinants of recommendation strength used in the GRADE approach (Table 4.4). The suite of strategies are hereafter referred to as the infection prevention bundle as when implemented together, the bundle is likely to reduce SSI risk more than adhoc implementation of the individual elements.

Table 4.4

Types of strategies and techniques evaluated in included studies, and recommendations to reduce caesarean section SSI risk

| Strategy group (Recommendation) | Strength of recommendation | Quality of evidence ^a | Comments ^b | References |
|--|----------------------------|---|---|-------------------------------------|
| Infection prevention bundle | | | | |
| 1. Antibiotic prophylaxis (Yes) | Strong | Moderate ⁸⁵ | Benefits of prevention likely outweigh risk | 85, 197-199 |
| 2. Antibiotic timing (Pre-incision) | Strong | High ¹⁸² | Benefits of prevention likely outweigh risk | 23, 55, 105, 182, 196, 197, 199-205 |
| 3. Vaginal preparation (Yes) | Strong | Low ⁶⁷ | Large effect size | 67, 105 |
| 4. Placenta removal (Spontaneous) | Strong | Only risk of bias assessed | Large effect size | 89 |
| Strategies that provide other benefits | | | | |
| 5. Uterine entry (Blunt, cephalad-caudad) | Strong ^c | Only risk of bias assessed ¹⁸³ | Other benefits outweigh nil infection outcome | 183, 185, 206 |
| 6. Skin closure (Sutures) | Strong ^c | Moderate ^{d 180} | Other benefits outweigh nil infection outcome | 115, 116, 180, 181, 207 |
| Strategies likely to be wasteful | | | | |
| 7. High concentration supplemental oxygen (No) | Strong ^c | Moderate ²⁰⁸ | Unnecessary intervention | 208, 209 |
| 8. Cervical dilatation (No) | Strong ^c | Only risk of bias assessed | Unnecessary intervention | 210 |
| 9. Subcutaneous drain (No) | Strong ^c | Moderate or 'unclear' ²¹¹ | Unnecessary intervention | 105, 197, 198, 211-213 |
| Strategies likely to cause harm | | | | |
| 10. Intra-abdominal saline irrigation (No) | Strong ^c | Only risk of bias assessed | Likely harmful | 179 |

| | | | | |
|---|------|--------------------------------|--------------------|----------|
| Inconclusive evidence | | | | |
| 11. Skin preparation (Either iodine based / chlorhexidine based / parachlorometaxlenol / antibiotic-impregnated drapes) | Weak | Low to very low ⁹⁷ | Outcomes uncertain | 97, 214 |
| 12. Antibiotic class (First generation cephalosporin) | Weak | Moderate to low ¹⁸⁴ | Outcomes uncertain | 184, 196 |
| 13. Route of antibiotic administration (Either intravenous / irrigating intra-abdominal cavity) | Weak | Low to very low ¹⁷⁸ | Outcomes uncertain | 178 |
| 14. Skin incision and entry (Either Joel-Cohen / Pfannenstiel / Maylard) | Weak | ‘Variable’ ^{d 108} | Outcomes uncertain | 108, 215 |
| 15. Uterine repair (Either exteriorization / in situ) | Weak | Only risk of bias assessed | Outcomes uncertain | 216 |
| 16. Uterine closure (One layer) | Weak | ‘Variable’ ^{d 185} | Outcomes uncertain | 185, 217 |
| 17. Peritoneum closure (Close parietal peritoneum only) | Weak | ‘Variable’ ^{d 186} | Outcomes uncertain | 186 |

^aAssessed by authors of original selected article

^bFollowing assessment of GRADE four determinants of recommendation strength

^cRecommendation drawn from evidence of non-infection surgical outcomes

^dGRADE approach not used by original authors

Two strategies received strong recommendations for providing other surgical benefits despite there being little evidence for their effect in reducing SSI risk (Table 4.4). Significantly fewer unintended uterine extensions and a trend towards less blood loss was observed with blunt cephalad-caudad uterine expansion¹⁸³. Closing the skin with subcuticular sutures has a significantly lower risk of wound complication such as wound dehiscence¹⁸⁰.

Three strategies were strongly not recommended for implementation, because of the potential to waste scarce healthcare resources (Table 4.4). Supplemental oxygen²⁰⁸, mechanical dilatation of the cervix²¹⁰, and using a subcutaneous drain (even in obese women or women with subcutaneous tissue greater than 2cm)²¹¹ resulted in no beneficial health outcomes and unnecessarily lengthened surgery time occupying theatres that could be freed for another use.

Intra-abdominal irrigation received a strong recommendation to not implement because no additional health benefit was reported and it is significantly associated with intraoperative nausea¹⁷⁹ (Table 4.4).

4.4 COMPLIMENTARY STRATEGIES

Additional and potentially important strategies not evaluated in systematic reviews or meta-analyses were identified when reviewing the literature for this research (Chapter 2). The NICE and CDC prevention of SSI guidelines^{49, 50, 93} recommend clipping and not shaving hair that may interfere with the incision site immediately before entering theatre. This strategy was selected as relevant for caesarean section and complementary to the infection prevention bundle. 65-70% of women of child bearing age engage in at least monthly pubic hair removal^{218, 219} and may shave pre-operatively, increasing their risk of SSI. It may be appropriate to compliment the infection prevention bundle and recommend that clinicians advise women to not remove any pubic or abdominal hair by shaving, waxing or using depilatory cream within one month of the estimated date of delivery²²⁰. A surgical safety checklist as recommended by the WHO and the American Congress of Obstetricians and Gynecologists^{106, 107} would be a useful mechanism to aid translation of the infection prevention bundle into practice. Implementing the pre-incision time-out step within checklists will support both pre-incision antibiotic prophylaxis and vaginal preparation implementation.

4.5 ACKNOWLEDGEMENTS

Louise Barnsebee from the Australian Centre for Health Services Innovation (AusHSI) was the second researcher who assisted with the evidence synthesis. Louise's role in duplicating the search, data extraction and quality assessment was funded by AusHSI.

4.6 CHAPTER SUMMARY

Three peri-operative caesarean section strategies and surgical techniques to reduce SSI risk have been identified as having strong evidence for universal implementation: pre-incision antibiotic prophylaxis, vaginal preparation with an iodine-povidone solution and spontaneous placenta removal. Together, these can be considered hereafter as an infection prevention bundle as it meets the Institute for Healthcare Improvement definition¹¹⁹, and consists of three evidence-based interventions specifically for caesarean section. When implemented together, the bundle is likely to reduce SSI risk more than adhoc implementation of the individual elements. Changes to total economic costs and health benefits with a decision to adopt better adherence to the infection prevention bundle will modelled in Chapter 7. In the next chapter, the extent to which current practice varies from better practice will be identified.

Chapter 5: Current Infection Prevention Practice

A baseline scenario that the infection prevention bundle is compared to is needed for this cost-effectiveness research. Potential SSI risk-reducing strategies have been debated in the literature for many years (Section 2.3) and it is not sensible to assume that ‘no prevention’ forms the baseline scenario. Therefore understanding what current practice is, and how much it varies from best-practice is important. SSI risk-reducing peri-operative strategies and surgical techniques Australian Obstetricians employ at caesarean section are described in this chapter. The introduction outlines issues of unwarranted variation in practice (Section 5.1); the methods used for the cross-sectional survey are in Section 5.2, and the results (Section 5.3) provide an indication of current practice.

5.1 INTRODUCTION

Removing unwarranted variation and adhering to evidence-based practice should be a policy goal of maternity health services^{221, 222}. Some variation in caesarean section peri-operative and surgical practice is justifiable and desirable when individual patient’s health needs or health preferences are being met²²³. However, clinical practice that varies from the evidence is unwarranted as it may lead to poor health outcomes²²².

Evidence-based peri-operative and surgical practice for caesarean section has been identified in this thesis. An infection prevention bundle for caesarean section has been developed: administer antibiotic prophylaxis 15 to 60 minutes before skin incision; prepare the vagina with iodine povidone solution; and spontaneously remove the placenta with gentle cord traction. Chapter 4 also describes 82 competing intervention-comparator pairs for other strategies and techniques that have been evaluated for their effect on reducing the risk of SSI following caesarean section. Best-practice has been identified in this research, but nothing is known about how much current caesarean section practice varies from the evidence in Australia.

There is variation in practice internationally, and evidence of best-practice not being applied. Pre-incision antibiotic prophylaxis was reportedly administered in 98% of United States academic centres¹⁷⁶, and in three of 8 obstetric centres in an international study¹⁷⁷. Amongst maternal-fetal medicine physicians in the United States, 84.6% and 99.4%¹⁷⁵ reported administering pre-incision antibiotic prophylaxis in two separate studies. Vaginal preparation is a much less common infection prevention strategy, with implementation by only 4.8% of United States maternal-fetal medicine physicians¹⁷⁵, and 12.7% of United States academic centres¹⁷⁶. Spontaneous rather than manual placenta removal was reported amongst 76.6% of United States maternal-fetal medicine physicians¹⁷⁵, and amongst 72.9% and 71.8% of United Kingdom Obstetricians for elective and emergency caesarean sections respectively²²⁴. There is evidence of variation in practice for other strategies and techniques such as uterine closure²²⁵ and use of chlorhexidine-based abdominal skin antisepsis¹⁷⁶. There is likely to be unwarranted clinical variation amongst Australian Obstetricians as well.

The aim of this thesis is to model the cost-effectiveness of better adherence to evidence-based practice. To do this, it is critical to identify what current practice is in Australia and how much it varies from evidence-based practice. Identifying current practice will inform a baseline comparator for a proposed improvement in adherence with the infection prevention bundle (Chapter 4).

A survey was developed to identify current practice. The three aims of the study were: identify the peri-operative strategies and surgical techniques currently used for caesarean section in Australia; estimate the proportion of Obstetricians implementing the proposed infection prevention bundle and Queensland regions with good adherence; and identify the types of Obstetricians least likely to implement any of the infection prevention bundle.

5.2 METHODS

5.2.1 Survey development

A survey was developed to identify which SSI risk-reducing peri-operative strategies and surgical techniques are implemented by Australian Obstetricians for caesarean section (Appendix F). The survey consisted of 5 demographic questions and 34 clinical practice questions.

The clinical practice questions asked about usual implementation (Yes, No, or Unsure) of peri-operative strategies and surgical techniques that have been evaluated for their effect on reducing the risk of SSI following caesarean section. All types of peri-operative strategies and surgical techniques were selected for the survey from those identified in the systematic review conducted as part of this research and reported in Section 4.3. Additionally, strategies and techniques identified in randomised controlled trials, observational and experimental studies described in Section 2.2.4 were also selected to understand the scope of variation in practice at caesarean section. The strategies: pre-incision antibiotic prophylaxis, vaginal preparation and spontaneous placenta removal, which make up the infection prevention bundle and described in Section 4.3 were included in the 34 clinical practice questions, but not identified as best-practice to avoid social desirability response bias²²⁶. The survey was built in Key Survey software²²⁷ and was piloted with 12 Obstetricians from Mater Health Services, Queensland. The final version of the survey took respondents approximately three minutes to complete.

A weblink to the survey was emailed to 3749 Australian Fellows, Members and Diplomates of the Royal Australian College of Obstetricians and Gynaecologists (RANZCOG) in February 2016. Respondents were screened before completing the survey questions and must have performed at least one caesarean section in the last 12 months to complete the survey. Reminder emails were sent two and 6 weeks following the original email to potential respondents and the survey weblink was accessible for 8 weeks in total.

5.2.2 Descriptive methods

The demographics of respondents were compared to available RANZCOG membership information to assess the representativeness of the respondent group. A web-based tool²²⁸ was used to match postcodes of respondents' hospitals to the Accessibility and Remoteness Index for Australia (ARIA) categories: Major City, Inner Regional, Outer Regional, Remote, Very Remote.

Descriptive statistics on respondents' implementation of the three infection prevention bundle elements and adherence with the bundle according to four adherence categories were reported. Definitions of “zero”, “poor”, “adequate”, and “good” adherence are in Table 5.1.

Table 5.1

Definitions of categories of adherence with infection prevention bundle implementation

| Adherence category | Definition |
|---------------------------|---|
| Zero adherence | Respondents reported usually implementing zero elements of the infection prevention bundle |
| Poor adherence | Respondents reported usually implementing only one element of the infection prevention bundle |
| Adequate adherence | Respondents reported usually implementing two elements of the infection prevention bundle |
| Good adherence | Respondents reported usually implementing all three elements of the infection prevention bundle |

5.2.3 Statistical methods

A multivariable modelling approach, using binary logistic regression was chosen to find evidence for independent and statistically significant predictors of bundle implementation. The primary outcome variable was zero adherence with the infection prevention bundle implementation (Yes or No). Alternative adherence categories were not appropriate outcome variables because analysis with “zero adherence” can inform infection control interventions targeting clinicians most in need of education, and only very small numbers of respondents reported 100% adherence with the bundle which is challenging for analysis. One base model was fitted with only the intercept to represent the null hypothesis that there is no difference in bundle implementation across the types of clinicians who responded. Demographic variables and the behavioural variable ‘Usually implements surgical/patient safety checklist’ for the respondents were added to this base model. Initially, univariate analysis was conducted for each individual explanatory variable, followed by multivariable modelling with a full set of explanatory variables (Table 5.2). Residuals and standard errors were examined for multi-collinearity between variables: ‘RANZOCOG membership status’ and ‘Number of caesarean sections performed annually’; ‘Number of caesarean sections performed annually’ and ‘Number of years practicing obstetrics’; and ‘Number of caesarean sections performed annually’ and ‘Type of hospital usually practicing in’.

Table 5.2

Explanatory variables used for analysis

| Question type | Explanatory variable |
|----------------------------|--|
| Demographic | RANZCOG membership status |
| Demographic | Number of years practicing obstetrics |
| Demographic | Number of caesareans performed annually |
| Demographic | Type of hospital usually practicing in |
| Demographic | State of hospital usually practicing in (determined by postcode) |
| Demographic | ARIA classification of hospital usually practicing in (determined by postcode) |
| Clinical practice question | Surgical safety checklist implementation |

Explanatory variables with the largest p-values and least clinical value for informing infection control interventions were removed one by one through multivariable modelling using manual backwards stepwise selection. The most parsimonious model that practically informed infection control interventions and where most remaining variables were significant was chosen. Contribution to variation in bundle implementation of the explanatory variables was described using change in the Nagelkerke's pseudo- R^2 statistic between the models. This statistic was also used to inform selection of the most parsimonious model.

Results were expressed as crude and adjusted odds ratios (OR) of usually implementing none of the bundle with associated 95% confidence intervals (CI). Statistical significance was determined at the level of 5% (two-tailed hypothesis tests).

The RANZCOG Continuing Professional Development and Revalidation Committee approved the research and granted respondents one professional development point for completing the survey. Ethics approval for the research was provided by the Queensland University of Technology University Research Ethics Committee in November 2014 - approval number 1400000868 (Appendix G).

5.3 RESULTS

5.3.1 Survey response rate

The response rate was 22.4% with 839 Australians Obstetricians completing the survey. Of the 3749 Obstetricians who received the survey weblink, the number eligible to complete the survey, defined as those performing at least one caesarean section per year, is unknown. Ten of the 839 respondents were excluded from the

analysis because they did not answer any questions and one was excluded because their RANZCOG membership status was ‘other’, leaving 828 responses for analysis.

5.3.2 Descriptive results

Demographic characteristics of respondents are presented in Table 5.3. The representativeness of the sample was able to be assessed for the variables ‘RANZCOG membership status’, ‘State or territory of hospital usually practicing in’ and “ARIA classification of hospital usually practicing in’ as 2015 RANZCOG census data was available.

Table 5.3

Demographic characteristics of respondents

| Demographic variable | Number | Percentage | Percentage in RANZCOG membership |
|--|--------|------------|----------------------------------|
| RANZCOG membership status | | | |
| Fellow or Member | 643 | 77.7 | 62.9 |
| Diplomate | 185 | 22.3 | 37.1 |
| Number of years practicing obstetrics | | | |
| 1-10 years | 207 | 28 | NA |
| 11-20 years | 247 | 33.4 | NA |
| 21-30 years | 178 | 24.1 | NA |
| ≥ 31 years | 108 | 14.6 | NA |
| Number of caesarean sections performed annually | | | |
| 1-10 | 79 | 9.6 | NA |
| 11-50 | 341 | 41.3 | NA |
| 51-150 | 350 | 42.4 | NA |
| ≥ 151 | 56 | 6.8 | NA |
| Type of hospital where caesarean sections mainly performed | | | |
| Public | 477 | 57.9 | NA |
| Private | 187 | 22.7 | NA |
| Both public and private | 160 | 19.4 | NA |
| State or territory of hospital usually practicing in | | | |
| New South Wales | 227 | 28.7 | 25.4 |
| Victoria | 189 | 23.9 | 32.2 |
| Queensland | 182 | 23 | 17.9 |
| Western Australia | 89 | 11.3 | 10.5 |
| South Australia | 70 | 8.8 | 8.1 |
| Tasmania | 17 | 2.1 | 2.1 |
| Northern Territory | 17 | 2.1 | 2.1 |
| Australian Capital Territory | 0 | 0 | 1.7 |
| ARIA classification of hospital usually practicing in | | | |
| Major city | 507 | 64.1 | 68.4 |
| Inner regional | 156 | 19.7 | 19.7 |
| Outer regional | 95 | 12 | 9 |
| Remote | 23 | 2.9 | 1.9 |
| Very remote | 10 | 1.3 | 1 |

NA: Data not available

The survey respondents were mostly Fellows or Members (77.7%) with the remaining being Diplomates who are usually obstetrics-trained General Practitioners (22.3%). A larger proportion of Fellows and Members responded to the survey than the proportion making up the 2015 Australian RANZCOG census. Victorian Obstetricians were under-represented in the survey while Queensland Obstetricians were over-represented. No Obstetricians from the Australian Capital Territory responded to the survey. A smaller proportion of Obstetricians from major cities responded to the survey than there were in the RANZCOG census. However, a larger proportion of Obstetricians from outer regional, remote and very remote areas of Australia responded compared to the proportion within RANZCOG practicing in these areas. Overall, the respondent group were experienced Obstetricians with a mean of 19 years practicing obstetrics (standard deviation 10.97) and 42.4% performing between 51 and 150 caesarean sections each year (Table 5.3).

Thirty-seven respondents (4.5%) usually implemented all three elements of the infection prevention bundle at caesarean section, while 80 (9.7%) usually implemented none, 329 (39.7%) usually implemented one element and 382 (46.1%) usually implemented two elements of the infection prevention bundle (*Figure 5.1*). Usual implementation of the bundle's individual elements is presented in Table 5.4. Administering prophylactic antibiotics 15 to 60 minutes before skin incision rather than not at all or post cord-clamping was usually implemented amongst 57.4% of respondents. Vaginal preparation with antiseptic solution was implemented amongst 9% of respondents. The placenta was not usually removed manually, with spontaneous gentle cord traction used in preference amongst 80% of respondents. Usual implementation of strategies that may complement the bundle, strategies that provide other surgical benefits despite no effect on SSI risk, strategies likely to be wasteful or cause harm as described in Section 4.3.3 of this thesis are presented in Table 5.4.

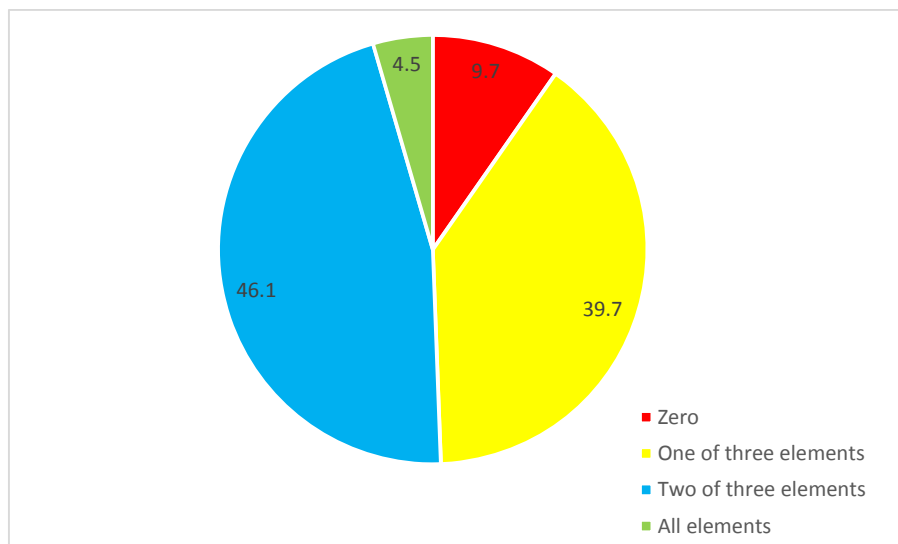


Figure 5.1.
Percentage of respondents who usually implement zero, one, two and all three infection prevention bundle elements

Table 5.4

*Number and percentage of respondents implementing key peri-operative strategies and surgical techniques**

| Strategy or Technique | Number | Percentage |
|---|------------|-------------|
| Infection prevention bundle | | |
| Administer prophylactic antibiotics 15 to 60 minutes before skin incision | | |
| Yes | 472 | 57.4 |
| No | 342 | 41.6 |
| Unsure | 9 | 1.1 |
| Prepare the vagina with antiseptic solution | | |
| Yes | 74 | 9 |
| No | 744 | 90.5 |
| Unsure | 4 | 0.5 |
| Remove the placenta manually | | |
| No | 658 | 80 |
| Yes | 160 | 19.4 |
| Unsure | 5 | 0.6 |
| Complementary strategies | | |
| Instruct women to not remove pubic hair | | |
| Yes | 53 | 6.4 |
| No | 748 | 90.4 |
| Unsure | 26 | 3.1 |
| Clip pubic hair that may interfere with incision to 1-2mm | | |
| Yes | 540 | 65.5 |
| No | 273 | 33.1 |
| Unsure | 11 | 1.3 |
| Use a surgical or patient safety checklist | | |
| Yes | 566 | 68.5 |
| No | 244 | 29.5 |
| Unsure | 16 | 1.9 |

| Strategy or Technique | Number | Percentage |
|--|------------|-------------|
| Strategies that provide other benefits | | |
| Uterine entry with blunt, cephalad-caudad technique | | |
| Yes | 470 | 57 |
| No | 329 | 39.8 |
| Unsure | 26 | 3.2 |
| Use sutures rather than staples to close skin incision | | |
| Yes | 626 | 75.6 |
| No | 202 | 24.4 |
| Unsure | 0 | 0 |
| Strategies likely to be wasteful | | |
| Use perioperative supplemental oxygen | | |
| No | 527 | 63.9 |
| Yes | 210 | 25.5 |
| Unsure | 88 | 10.7 |
| Dilate the cervix after removing the placenta | | |
| No | 636 | 77.8 |
| Yes | 173 | 21.1 |
| Unsure | 9 | 1.1 |
| Use a superficial wound drain | | |
| No | 759 | 93.9 |
| Yes | 79 | 6.1 |
| Unsure | 0 | 0 |
| Strategies likely to cause harm | | |
| Irrigate intra-abdominally with saline solution | | |
| No | 788 | 96 |
| Yes | 31 | 3.8 |
| Unsure | 2 | 0.2 |

*Recommended strategies or techniques are highlighted in bold

The proportion of respondents in Queensland Health Hospital and Health Services reporting zero, poor, adequate and good adherence with the infection prevention bundle are shown in Table 5.5. Postcodes of hospitals Obstetricians usually practiced in were used to allocate respondent data to a Hospital and Health Service. Not all Queensland maternity hospitals were represented by survey respondents, and some respondents practice in private hospitals not associated with the Queensland Hospital and Health Services. Hospital and Health Service areas are therefore only used as a general guide to regional adherence. Furthermore, data from multiple postcodes is reported in aggregate to avoid potential identification of Obstetricians. Table 5.5 should not be interpreted as performance of Queensland Health Obstetricians.

Table 5.5

Percentage of respondents in Queensland Health Hospital and Health Services (allocated by postcode) reporting zero, poor, adequate and good adherence with infection prevention bundle

| Hospital and Health Service | Number of respondents | Adherence | | | |
|---|-----------------------|-----------|--------|------------|--------|
| | | % Zero | % Poor | % Adequate | % Good |
| Metro North* | 33 | 6.06 | 51.52 | 30.30 | 12.12 |
| Metro South** | 38 | 2.63 | 26.32 | 63.16 | 7.89 |
| Gold Coast [#] | 17 | 5.88 | 47.06 | 41.18 | 5.88 |
| West Moreton ^{##} | 7 | 0.00 | 28.57 | 57.14 | 14.29 |
| Darling Downs [^] | 27 | 3.70 | 55.56 | 37.04 | 3.70 |
| Sunshine Coast ^{^^} | 10 | 10.00 | 30.00 | 40.00 | 20.00 |
| Wide Bay ^{<} | 6 | 0.00 | 50.00 | 50.00 | 0.00 |
| Central Queensland, and Central West ^{<<} | 13 | 7.69 | 23.08 | 61.54 | 7.69 |
| Mackay ^{>} | 7 | 14.29 | 28.57 | 57.14 | 0.00 |
| Townsville ^{>>} | 9 | 11.11 | 33.33 | 55.56 | 0.00 |
| Cairns and Hinterland, North West, and Torres and Cape ⁺ | 15 | 0.00 | 13.33 | 80.00 | 6.67 |

*Respondents' postcode areas allocated to Metro North: Albion, Auchenflower, Brisbane City, Caboolture, Everton Park, Fortitude Valley, Inala, Indooroopilly, Redcliffe, Royal Brisbane and Women's Hospital.

**Respondents' postcode areas allocated to Metro South: Beaudesert, Greenslopes, Holland Park, Meadowbrook, South Brisbane, Moorooka, Mount Gravatt, Park Ridge, Redland, Sunnybank, Yarrabilba.

[#]Respondents' postcode areas allocated to Gold Coast: Molendinar, Southport, Runaway Bay, Benowa, Tugun.

^{##}Respondents' postcode areas allocated to West Moreton: Ipswich

[^]Respondents' postcode areas allocated to Darling Downs: Chinchilla, Dalby, Goondiwindi, Kingaroy, Roma, St George, Stanthorpe, Toowoomba, Warwick.

^{^^}Respondents' postcode areas allocated to Sunshine Coast: Buderim, Gympie, Nambour.

[<]Respondents' postcode areas allocated to Wide Bay: Bundaberg, Hervey Bay.

^{<<}Respondents' postcode areas allocated to Central Queensland and Central West: Emerald, Gladstone, Longreach, Rockhampton.

[>]Respondents' postcode areas allocated to Mackay: Mackay, Proserpine.

^{>>}Respondents' postcode areas allocated to Townsville: Douglas, Home Hill, Pimlico, Townsville.

⁺ Respondents' postcode areas allocated to Cairns and Hinterland, North West, and Torres and Cape: Atherton, Cairns, Cooktown, Innisfail, Mount Isa, Thursday Island, Yungaburra.

Data from each Queensland maternity hospital represented by Obstetricians who responded to the current practice survey, and report adequate or good adherence will inform the economic modelling methods outlined in Chapter 6.

5.3.3 Logistic regression results

The assumptions of logistic regression were met by the data because error terms were independent, and there was no evidence of multi-collinearity between dependent variables (Appendix I).

In the multivariable logistic regression model that included all independent variables, respondents who usually practice in private hospitals (Adjusted OR 4.39, 95% CI 1.98-9.72) and those who do not usually use a surgical or patient safety checklist (Adjusted OR 3.48, 95% CI 1.96-6.18 for no checklist use) were significantly more likely to not implement the infection prevention bundle.

Table 5.6

Univariate and multivariable models identifying predictors of not implementing infection prevention bundle

| Variable | Number of respondents | Percentage of sub-group not implementing bundle | Unadjusted OR | Adjusted OR (95% confidence interval) | Adjusted p-value |
|---|-----------------------|---|---------------|---------------------------------------|------------------|
| RANZCOG membership status | | | | | |
| Fellow or Member | 643 | 9.5 | 1 | 1 | referent |
| Diplomate | 185 | 10.3 | 1.09 | 1.86 (0.73-4.76) | 0.2 |
| Number of years practicing obstetrics | | | | | |
| 11-20 years | 247 | 7.3 | 1 | 1 | referent |
| 1-10 years | 207 | 6.3 | 0.85 | 1.03 (0.45-2.36) | 0.95 |
| 21-30 years | 178 | 13.5 | 1.983* | 1.67 (0.81-3.41) | 0.16 |
| ≥ 31 years | 108 | 14.8 | 2.21* | 1.9 (0.83-4.33) | 0.13 |
| Number of caesareans performed annually | | | | | |
| 51 to 150 | 350 | 8.9 | 1 | 1 | referent |
| 11 to 50 | 341 | 8.8 | 0.99 | 0.95 (0.49-1.82) | 0.87 |
| 1 to 10 | 79 | 17.7 | 2.22* | 2.12 (0.81-5.58) | 0.13 |
| ≥ 151 | 56 | 8.9 | 1.01 | 1.32 (0.39-4.48) | 0.65 |
| Type of hospital usually practicing in | | | | | |
| Public | 477 | 7.1 | 1 | 1 | referent |
| Private | 187 | 16.6 | 2.59* | 4.39* (1.98-9.72) | <0.001 |
| Both public and private | 160 | 9.4 | 1.35 | 2.22 (0.99-4-5.00) | 0.053 |
| State of hospital usually practicing in | | | | | |
| New South Wales | 227 | 8.8 | 1 | 1 | referent |
| Victoria | 189 | 13.2 | 1.58 | 1.3 (0.65-2.59) | 0.46 |
| Queensland | 182 | 4.9 | 0.54 | 0.47 (0.18-1.19) | 0.11 |
| Western Australia | 89 | 12.4 | 1.46 | 1.47 (0.60-3.61) | 0.41 |
| South Australia | 70 | 10 | 1.15 | 0.66 (0.21-2.03) | 0.47 |
| Northern Territory | 17 | 11.8 | 1.38 | 1.04 (0.13-8.19) | 0.97 |
| Tasmania | 17 | 0 | # | # | # |

| Variable | Number of respondents | Percentage of sub-group not implementing bundle | Unadjusted OR | Adjusted OR (95% confidence interval) | Adjusted p-value |
|---|-----------------------|---|---------------|---------------------------------------|------------------|
| ARIA classification of hospital usually practicing in | | | | | |
| Major city | 507 | 10.1 | 1 | 1 | referent |
| Inner regional | 156 | 6.4 | 0.61 | 0.99 (0.41-2.41) | 0.98 |
| Outer regional | 95 | 11.6 | 1.17 | 2.16 (0.77-6.08) | 0.15 |
| Remote | 23 | 4.3 | 0.41 | 0.71 (0.07-7.04) | 0.77 |
| Very remote | 10 | 10 | 0.99 | 1.62 (0.12-21.39) | 0.71 |
| Surgical safety checklist | | | | | |
| Usually implements checklist | 566 | 5.5 | 1 | 1 | referent |
| Does not usually implement checklist | 244 | 19.3 | 4.12* | 3.48* (1.96-6.18) | <0.001 |
| Unsure | 16 | 12.5 | 2.47 | 2.2 (0.40-12.19) | 0.37 |

ARIA: Accessibility and Remoteness Index for Australia

*Significant at the 5% level of significance

#Not calculable because number not implement bundle = 0

After backward stepwise selection of explanatory variables for the most parsimonious model, Diplomates (Adjusted OR 2.58, 95% CI 1.25-5.34), private hospital Obstetricians (Adjusted OR 3.34, 95% CI 1.68-6.65), Obstetricians practicing in both private and public hospitals (Adjusted OR 2.23, 95% CI 1.05-4.73), and those who do not usually use a surgical or patient safety checklist (Adjusted OR 3.77, 95% CI 2.21-6.42) were significant independent predictors of zero adherence with the infection prevention bundle (see Table 5.7). The Nagelkerke's pseudo-R² statistic for model fit to the data was highest at 0.151 suggesting that this model explained 15.1% of the variance in infection prevention bundle implementation.

Table 5.7

Most parsimonious model identifying independent significant predictors of not implementing infection prevention bundle

| Variable | Adjusted OR (95% confidence interval) | Adjusted p-value |
|--|---------------------------------------|------------------|
| RANZCOG membership status | | |
| Fellow or Member | 1 | referent |
| Diplomate | 2.58 (1.25-5.34) | 0.01* |
| Number of years practicing obstetrics | | |
| 11-20 years | 1 | referent |
| 1-10 years | 0.89 (0.40-1.96) | 0.77 |
| 21-30 years | 1.72 (0.88-3.36) | 0.12 |
| ≥ 31 years | 2.13 (0.99-4.56) | 0.05 |
| Type of hospital usually practicing in | | |
| Public | 1 | referent |
| Private | 3.34 (1.68-6.65) | 0.01* |
| Both public and private | 2.23 (1.05-4.73) | 0.04* |
| Surgical Safety Checklist | | |
| Usually implements checklist | 1 | referent |
| Does not usually implement checklist | 3.77 (2.21-6.42) | <0.001* |
| Unsure | 2.67 (0.54-13.18) | 0.23 |

*Significant at the 5% level of significance

5.4 CHAPTER SUMMARY

Clinical variation in practice exists as a normal part of health services, however sometimes it is unwarranted and for caesarean section, it may increase the risk of SSI. In this study, the range of clinical variation in peri-operative and surgical practice at caesarean section through a cross-sectional survey of Australian Obstetricians was identified. Very few (4.5%) respondents reported full adherence with the infection prevention bundle described in Chapter 4. The types of Obstetricians that were most

likely to report zero adherence were Diplomates, those practicing in private hospitals, or both public and private hospitals, and those who do not usually implement a surgical or patient safety checklist. The results of this study inform data analysis for the cost-effectiveness of adopting the infection prevention bundle described in Chapters 6 and 7, and are discussed in Chapter 8. In the chapter that follows, the economic model used for the cost-effectiveness analysis and methods of model evaluation will be outlined.

Chapter 6: An Economic Model to Evaluate Caesarean Section SSI Prevention

The methods used to develop, parameterise and evaluate an economic model that assessed the cost-effectiveness of universally adopting an infection prevention bundle for caesarean section are described in this chapter. The context of the economic decision is defined in Section 6.1, followed by a description of the Markov economic model used to evaluate the intervention (Section 6.2), model parameter estimation (Section 6.3) and assumptions of the model (Section 6.4). The methods used to evaluate the economic model are described in Section 6.5, with a summary of the chapter in Section 6.6.

6.1 THE ECONOMIC DECISION

Caesarean section peri-operative strategies and surgical techniques that reduce the risk of SSI were the focus of this research, as described in Section 2.2.4. A cost-effectiveness modelling study was conducted, evaluating a proposed change from current peri-operative and surgical practice to universally implementing the infection prevention bundle for caesarean section. The results of this study will inform the economic decision faced by payers of health services: should caesarean section practice change in maternity hospitals in Queensland, Australia to reduce the risk of SSI?

6.1.1 Decision context

The stakeholders within Queensland affected by the consequences of a decision to change caesarean section peri-operative and surgical practice are public and private maternity hospitals, the lead Obstetrician surgeon, Anaesthetist, Surgical Nurses, Midwives, and Infection Control Practitioners. These are all responsible for identifying and implementing SSI prevention strategies within the bounds of their professional roles. The direct costs of implementing strategies are borne by the hospitals, which means the decision to make a change to peri-operative and surgical technique is the responsibility of both clinicians and hospital administrators who allocate the maternity service budget. It is critical to acknowledge that the

consequences of SSI prevention decisions affect stakeholders outside the hospitals. Costs of SSI are incurred for the women and their families, primary healthcare providers and the federal health system through Pharmaceutical Benefits Scheme and Medicare Benefits Schedule reimbursement. The clinical team and hospitals administrators are not responsible for the private costs incurred for a woman and her family during SSI treatment post-discharge. The economic model evaluated in this thesis for Queensland therefore takes a societal perspective, acknowledging health outcomes and costs incurred during a caesarean section admission, post-discharge and possible readmission.

Queensland maternity hospitals are diverse in terms of size, remoteness of location, birthing procedures performed and types of women cared for. Table 6.1 shows characteristics of Queensland maternity hospitals in 2013-14, classified according to their ARIA category. Public and private maternity hospitals in diverse locations across Queensland are capable of performing both emergency and elective caesarean sections. These hospitals can also care for women with co-morbidities that may increase a woman's NNIS risk index. The evaluation included a sub-group analysis examining whether the cost-effectiveness of a change to caesarean section practice varies for hospital or patient type.

Table 6.1

Characteristics of Queensland maternity hospitals 2013-14[^]

| Hospital name | Funding[#] | Number of beds[#] | Peer group[#] | Number of stays for caesarean section[#] | Number of stays for childbirth[#] |
|---|----------------------------|-----------------------------------|-----------------------------------|--|---|
| Major city hospitals* | | | | | |
| Gold Coast University Hospital | Public | >500 | Principal referral | 674 | 2566 |
| Ipswich Hospital | Public | 200-500 | Principal referral | 499 | 1661 |
| Logan Hospital | Public | 200-500 | Principal referral | 724 | 2301 |
| Mater Mother's Hospital | Public | 100-199 | Specialist women's and children's | 982 | 3801 |
| Redcliffe Hospital | Public | 200-500 | Principal referral | 367 | 1126 |
| Redland Hospital | Public | 100-199 | Large major cities | 478 | 1327 |
| Royal Brisbane And Women's Hospital | Public | >500 | Principal referral | 898 | 2588 |
| Greenslopes Private Hospital | Private | >500 | na | na | na |
| John Flynn Private Hospital | Private | 200-500 | na | na | na |
| Mater Mother's Private Hospital, South Brisbane and Redland | Private | 100-199 | na | na | na |
| North West Private Hospital | Private | 100-199 | na | na | na |
| Pindara Private Hospital | Private | 200-500 | na | na | na |
| St Andrew's Ipswich Private Hospital | Private | 100-199 | na | na | na |
| Sunnybank Private Hospital | Private | 100-199 | na | na | na |
| The Wesley Hospital | Private | >500 | na | na | na |
| Inner Regional Hospitals* | | | | | |
| Beautesert Hospital | Public | <50 | Small regional acute | na | na |

| Hospital name | Funding[#] | Number of beds[#] | Peer group[#] | Number of stays for caesarean section[#] | Number of stays for childbirth[#] |
|--|----------------------------|-----------------------------------|-------------------------------|--|---|
| Bundaberg Base Hospital | Public | 200-500 | Large regional and remote | 268 | 748 |
| Caboolture Hospital | Public | 200-500 | Principal referral | 455 | 1256 |
| Dalby Hospital | Public | <50 | Medium | 67 | 183 |
| Gladstone Hospital | Public | 50-99 | Medium | 93 | 358 |
| Gympie Hospital | Public | 50-99 | Medium | 65 | 219 |
| Hervey Bay Hospital | Public | 100-199 | Large regional and remote | 195 | 421 |
| Kingaroy Hospital | Public | <50 | Medium | 101 | 251 |
| Nambour General Hospital | Public | 200-500 | Principal referral | 387 | 1533 |
| Rockhampton Hospital | Public | 200-500 | Principal referral | 263 | 918 |
| Toowoomba Hospital | Public | 200-500 | Principal referral | 413 | 749 |
| Warwick Hospital | Public | 50-99 | Medium | 44 | 143 |
| Mater Misericordiae Hospital Gladstone | Private | <50 | na | na | na |
| Mater Misericordiae Hospital Rockhampton | Private | 100-199 | na | na | na |
| Nambour Selangor Private Hospital | Private | 50-99 | na | na | na |
| St Vincent's Private Hospital Toowoomba | Private | 100-199 | na | na | na |
| The Sunshine Coast Private Hospital | Private | 100-199 | na | na | na |
| Outer Regional Hospitals* | | | | | |
| Atherton Hospital | Public | <50 | Medium | 55 | 114 |
| Ayr Hospital | Public | <50 | Medium | 36 | 74 |
| Biloela Hospital | Public | <50 | Small regional acute | 16 | 33 |
| Cairns Hospital | Public | 200-500 | Principal referral | 554 | 1614 |

| Hospital name | Funding[#] | Number of beds[#] | Peer group[#] | Number of stays for caesarean section[#] | Number of stays for childbirth[#] |
|--|----------------------------|-----------------------------------|-------------------------------|--|---|
| Chinchilla Hospital | Public | <50 | Small non-acute | 9 | 20 |
| Emerald Hospital | Public | <50 | Small regional acute | 53 | 214 |
| Goondiwindi Hospital | Public | <50 | Small non-acute | 18 | 62 |
| Innisfail Hospital | Public | 50-99 | Medium | 38 | 109 |
| Mackay Base Hospital | Public | 100-199 | Principal referral | 267 | 756 |
| Mareeba Hospital | Public | <50 | Medium | 24 | 87 |
| Proserpine Hospital | Public | <50 | Medium | 50 | 168 |
| Roma Hospital | Public | 50-99 | Small regional acute | 49 | 109 |
| Stanthorpe Hospital | Public | <50 | Small non-acute | 24 | 78 |
| The Townsville Hospital | Public | >500 | Principal referral | 527 | 1582 |
| Cairns Private Hospital | Private | 100-199 | na | na | na |
| Mater Misericordiae Hospital Mackay | Private | <50 | na | na | na |
| Mater Women's and Children's Hospital Townsville | Private | 50-99 | na | na | na |
| Remote Hospitals* | | | | | |
| Charleville Hospital | Public | <50 | Small remote acute | 9 | 23 |
| Mount Isa Base Hospital | Public | 50-99 | Large regional and remote | 116 | 332 |
| St George Hospital | Public | <50 | Small non-acute | 9 | 25 |
| Very Remote Hospitals* | | | | | |
| Longreach Hospital | Public | <50 | Small remote acute | 16 | 60 |
| Thursday Island Hospital | Public | <50 | Small remote acute | 12 | 58 |

^Most recent data available; *ARIA classification; #Source: www.myhospitals.gov.au

6.2 ECONOMIC MODEL

6.2.1 Development of economic model structure

The structure of the economic decision analytic model was determined by identifying relevant events following caesarean section for women who do and do not acquire an SSI (Table 6.2). Peer-reviewed literature was used (Section 2.2.2) to guide the selection of events, clinical pathway between the relevant events and the time horizon for the evaluation. Events that added complexity to the model or were unlikely to inform the economic decision such as: defining emergency or elective caesarean; SSI due to drug resistant organisms; and death were excluded from the model. The time horizon for the model was 12 months. This was informed by peer-reviewed literature estimating that the average length of stay for caesarean section was four days, an SSI is usually diagnosed between two and 10 days following caesarean section⁵¹⁻⁵³, treatment for SSI without complications is 5 days minimum²²⁹, and post-infection recovery representing discomfort, dysfunction and mental health issues may occur for 6 months²³⁰. The clinical and economic importance of the events for a Queensland context was assessed before penultimate health states were selected. A Queensland Obstetrician and Health Consumer Representative from the organisation Maternity Choices were consulted on the economic model structure. The Obstetrician recommended including the event where a woman is provided with hospital in the home care while the infected wound is healing with the assistance of NPWT. This event was included because NPWT is increasingly used by maternity hospitals, is expensive, and may have different health utility values than other events in the economic model. The Health Consumer Representative confirmed it was important to include an event representing post-infection recovery, as women may take weeks or months to return to a health state that represents normal recovery following caesarean section. An analysis of the literature, as well as clinician and consumer expertise verified the face validity of the model structure.

Table 6.2

Initial clinical events considered for inclusion in the economic model

| Event | Included? | Rationale |
|--|------------------|---|
| Emergency/elective caesarean section | No | Intervention is universally applied, adds unnecessary complexity to model |
| Caesarean section | Yes | |
| Normal recovery at home from caesarean section | Yes | Becomes absorbing state |
| General SSI event | No | Large variation in costs and health outcomes across treatment pathways |
| Infection at home | Yes | Captures post-discharge SSI treated in primary care setting |
| Infection in hospital | Yes | |
| Infection in hospital with incision and drainage | Yes | Second stage of treatment for complex SSI |
| MRSA or MDRO SSI | No | Very few expected diagnoses in Queensland |
| Post-infection recovery | Yes | Captures lower health utilities following SSI diagnosis |
| Death | No | No expected deaths attributed to SSI in Queensland |

6.2.2 Economic model structure

A Markov model was chosen to represent the selected health events, the clinical pathway between events and its timeframes (*Figure 6.1*). A Markov model was superior to a decision tree as the timing of important events could be included and transitions between health states that may occur more than once could also be easily included.

There are 7 Markov health states and the model is structured so that all women start in the “Caesarean section inpatient” health state. This health state captures the pre-operative preparation, caesarean section surgery, post-operative recovery and the hospital stay following birth. “Caesarean section inpatient” (“caesarean section”) is where the infection prevention bundle is implemented. The health state “normal recovery at home” occurs following discharge where no SSI has been diagnosed and usual pain and dysfunction following caesarean section is experienced. “Infection at home” is a health state where SSI diagnosis has occurred, treatment is in a primary healthcare setting with two visits to a General Practitioner, oral antibiotics prescribed and usual postnatal care is provided. “Infection in hospital” reflects a longer hospital stay or readmission due to SSI diagnosis with intravenous antibiotic treatment, wound swabs sent to pathology and minor wound care. “Infection in hospital with incision and drainage” (“infection with surgery”) is a secondary stage of treatment during admission for SSI involving surgical incision and drainage of the infected tissue, possible debridement and more complex wound care. “Infection at home with NPWT”

(“infection with NPWT”) represents discharge from hospital following NPWT application to either an open or closed infected wound. NPWT continues at home with daily visits from a nurse, oral antibiotics prescribed and one non-admitted attendance at hospital for wound care or removal of the NPWT device. “Post-infection recovery” is a health state representing no SSI, but residual wound pain, dysfunction and/or diagnosis of a mental health condition associated with the SSI.

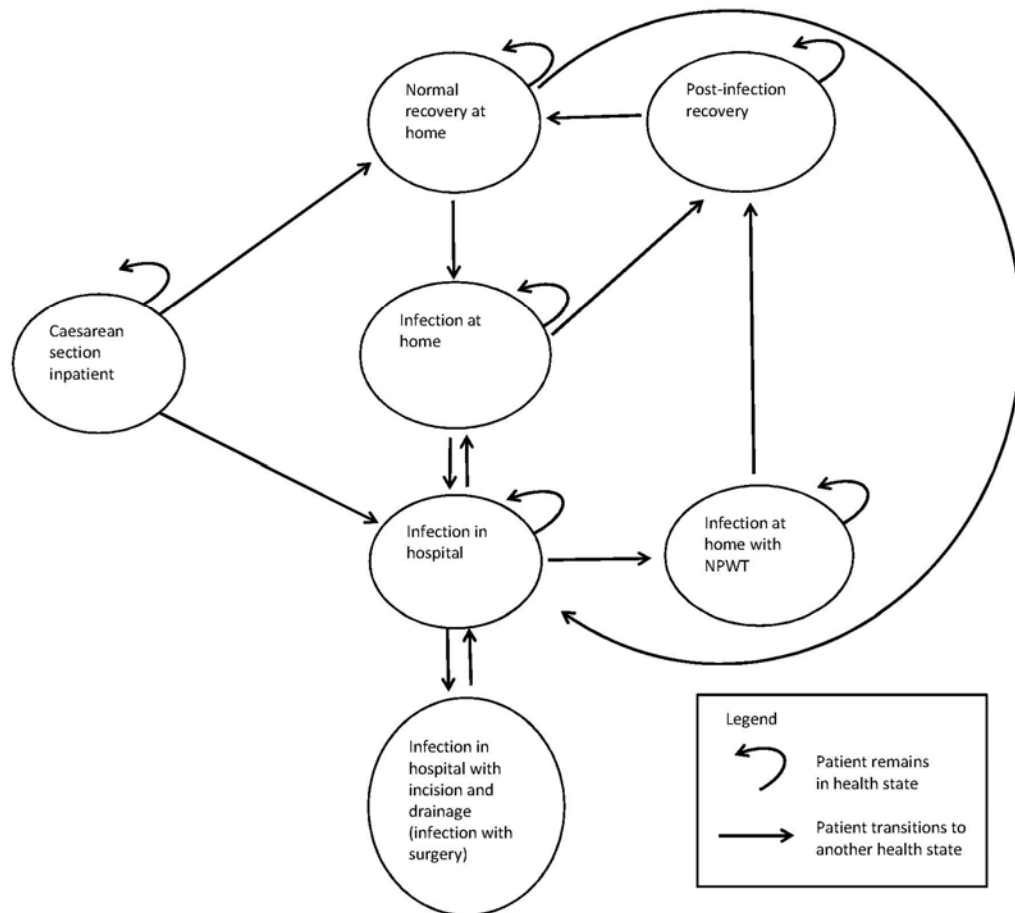


Figure 6.1.
Structure of the Markov economic model

Allowable transitions between the health states are shown by arrows in *Figure 6.1*. Women stay in the “caesarean section inpatient” health state until discharge to normal recovery at home, or they remain in hospital, but move to “infection in hospital” due to an SSI diagnosis. “Normal recovery at home” is the absorbing health state that women either remain in, or return to following SSI diagnosis, treatment and

post-infection recovery. From “normal recovery at home”, women diagnosed with an SSI can transition to “infection at home” or “infection in hospital”. From “infection at home”, women can transition to “infection in hospital” or to “post-infection recovery”, or remain at home with an infection until the infection is cleared. From “infection in hospital”, women can transition to “infection with surgery”, “infection at home” or “infection with NPWT”, or remain in hospital until the infection is cleared. From “infection with surgery”, women can only transition to “infection in hospital”. From “infection with NPWT”, women can transition to “post-infection recovery”, or remain in “infection with NPWT” until the infection is cleared. Women diagnosed with an SSI will always return to “normal recovery at home” via “post-infection recovery” and prior to that, treatment with oral antibiotics in “infection at home” or “infection with NPWT”. From “post-infection recovery”, women can remain there until their health utility is equivalent to a normal recovery following caesarean section, at which stage they will transition to “normal recovery at home”. Although the Markov economic model structure represents “normal recovery at home” as a non-absorbing health state, the model reaches a point of equilibrium by the completion of cycles, where the entire cohort of women stay in “normal recovery at home”. This is possible because the time-dependent probabilities of transitioning to either “infection at home” or “infection in hospital”, described in Section 6.3.3, become zero over time. This means the cohort is forced to enter and remain in “normal recovery at home” by the end of the model. Overall, the Markov decision model structure reflects the clinical pathway and epidemiology of SSI and no SSI following caesarean section.

Cycle length for the Markov economic model is daily for 42 days, then weekly for two weeks, and monthly for 10 months, with a 12 month time horizon. The daily cycles capture the quick transitions between health states, while beyond the six week timeframe the model reflects the potentially slow recovery from SSI. There is no discounting of costs or health utilities in the model due to the 12 month time horizon.

6.3 ESTIMATION OF MODEL PARAMETERS

The Markov economic model described in Section 6.2 was populated with transition probabilities allocated to each arrow in *Figure 6.1*, and costs and health utilities associated with each health state. Together these three types of parameters inform the evaluation of the economic model.

6.3.1 Queensland hospital data

The hierarchy of preferred data sources used in economic models is outlined in Section 3.3.1. As such, primary data collected routinely by Queensland's Department of Health (Queensland Health) in the 2014-15 financial year was used to estimate transition probabilities and inform the costs associated with each health state. Only Queensland hospital data was used rather than also sourcing data from other states or territories in Australia. Requesting hospital data from one state is administratively burdensome and takes at least 6 months from commencing the ethics application and engaging private hospitals, to receiving the data. The quality of the Queensland hospital data was also deemed adequate compared to an unknown level of quality from other states or territories. Replicating the data request process with other states or territories in Australia was not achievable within the timeframe of this research.

The types of Queensland hospital data required to inform the economic model were patient admission data, post-caesarean SSI data and patient risk factor data. Administrative infection data using diagnosis codes was not used for this study. Instead, only SSI data was used where it had been collected by a hospital infection prevention and control unit with Infection Control Practitioners conducting either active or passive surveillance on caesarean section patients and SSIs were defined according to the CDC definitions. The process of accessing the Queensland hospital data is detailed below.

It was critical to source data from private Queensland maternity hospitals so the evaluation represented the 38.7% of caesarean sections in Queensland that were performed in private hospitals in 2015²⁶. Queensland private hospitals already provide patient admission and risk factor data to Queensland Health, however infection data is not released. Parent organisations that administered groups of private maternity hospitals were contacted to request infection data so that an application for ethics approval process could commence for each group. Of 16 private maternity hospitals administered by 7 parent organisations, 8 agreed to participate and provide infection data for the study (Table 6.3).

Applications for ethics and research governance approvals to access data were submitted to a university research ethics committee representing the Queensland public hospitals, and 5 human research ethics committees representing the parent organisations of the private hospitals. Applications for ethics approval went to full

committee meetings as a ‘waiver of consent’ was required. This process acknowledged that women had not given their consent for the hospital to provide admission, risk factor or infection data to a third party. Ethics and research governance approvals are provided in Appendix G.

The availability of datasets and variables was determined concurrently with the ethics approval process. The Queensland Health Admitted Patient Data Collection (QHAPDC) was used to source admission data and the Queensland Perinatal Data Collection (PDC) was used to source risk factor data. The Queensland Health Communicable Diseases Unit (CDU) collates post-caesarean SSI data that is voluntarily provided by public hospitals. This data was requested, and SSI data from private hospitals that agreed to participate in the study was also requested (Table 6.3). Relevant variables in each dataset were selected from the dataset manuals, relevant International Statistical Classification of Disease and Related Health Problems, Tenth Revision, Australian Modification, 7th edition (ICD-10-AM) codes, and the Australian Classification of Health Interventions, 7th edition (ACHI) codes in consultation with data custodians. The aim of the data request was to understand the epidemiology of acquiring an SSI and no SSI following caesarean section, and treatment pathways with the intention of calculating transition probabilities between health states in the economic model. The ICD-10-AM and ACHI codes selected for the data request are described in Table 6.4, while the full list of variables requested from each dataset is in Appendix H.

A Public Health Act application for the data was prepared (Appendix H). The application needed approval from Queensland Health’s Director General once ethical approval was granted. The application also requested that Queensland Health’s Data Linkage Unit link the three datasets in order to provide a single dataset that could inform the economic model. Private hospitals provided their infection data with identifiable patient information to the Data Linkage Unit, who then created the de-identified dataset following data linkage. As reported in Table 6.3 and denoted with an asterisk, 6 private hospitals provided data only for women who were diagnosed with an SSI. This meant that during data linkage, women admitted to these private hospitals for caesarean section who were not reported as acquiring an SSI were assigned a ‘no infection’ status. The linked dataset provided important admission, risk factor and some infection data for every public patient and private patient from participating

hospitals who had a caesarean section (n = 17 291) in the most recent year for which data was available (2014-15).

Table 6.3

Data provided by Queensland maternity hospitals

| | QHAPDC data | PDC data | Infection data |
|--------------------------------|-------------|----------|----------------|
| Public Hospitals | | | |
| Atherton Hospital | ✓ | ✓ | × |
| Ayr Hospital | ✓ | ✓ | × |
| Beaudesert Hospital | ✓ | ✓ | ✓ |
| Biloela Hospital | ✓ | ✓ | × |
| Bundaberg Base Hospital | ✓ | ✓ | ✓ |
| Caboolture Hospital | ✓ | ✓ | ✓ |
| Cairns Base Hospital | ✓ | ✓ | × |
| Charleville Hospital | ✓ | ✓ | × |
| Chinchilla Hospital | ✓ | ✓ | × |
| Dalby Hospital | ✓ | ✓ | × |
| Emerald Hospital | ✓ | ✓ | × |
| Gladstone Hospital | ✓ | ✓ | ✓ |
| Gold Coast Hospital | ✓ | ✓ | ✓ |
| Goondiwindi Hospital | ✓ | ✓ | × |
| Gympie Hospital | ✓ | ✓ | × |
| Hervey Bay Hospital | ✓ | ✓ | ✓ |
| Innisfail Hospital | ✓ | ✓ | × |
| Ipswich Hospital | ✓ | ✓ | × |
| Kingaroy Hospital | ✓ | ✓ | × |
| Logan Hospital | ✓ | ✓ | ✓ |
| Longreach Hospital | ✓ | ✓ | × |
| Mackay Base Hospital | ✓ | ✓ | ✓ |
| Mareeba Hospital | ✓ | ✓ | × |
| Maryborough Hospital | ✓ | ✓ | × |
| Mater Mothers' Public Hospital | ✓ | ✓ | ✓ |
| Mount Isa Hospital | ✓ | ✓ | ✓ |
| Nambour Hospital | ✓ | ✓ | × |
| Proserpine Hospital | ✓ | ✓ | × |
| Redcliffe Hospital | ✓ | ✓ | ✓ |
| Redland Hospital | ✓ | ✓ | ✓ |

| | QHAPDC data | PDC data | Infection data |
|--|-------------|------------------|----------------|
| Rockhampton Base Hospital | ✓ | ✓ | ✓ |
| Roma Hospital | ✓ | ✓ | × |
| Royal Brisbane & Women's Hospital | ✓ | ✓ | ✓ |
| St George Hospital | ✓ | ✓ | × |
| Stanthorpe Hospital | ✓ | ✓ | × |
| Thursday Island Hospital | ✓ | ✓ | × |
| Toowoomba Hospital | ✓ | ✓ | ✓ |
| Townsville Hospital | ✓ | ✓ | × |
| Warwick Hospital | ✓ | ✓ | × |
| Private Hospitals (grouped by parent organisation) | | | |
| Healthscope | | | |
| Sunnybank Private Hospital | | No data provided | |
| Mater Misericordiae Ltd. | | | |
| Mater Mothers' Private South Brisbane and Redland | ✓ | ✓ | ✓ |
| Mercy Health and Aged Care Central Queensland Ltd. | | | |
| Mater Misericordiae Hospital Gladstone | ✓ | ✓ | ✓* |
| Mater Misericordiae Hospital Mackay | ✓ | ✓ | ✓* |
| Mater Misericordiae Hospital Rockhampton | ✓ | ✓ | ✓* |
| Mater Health Services North Queensland | | | |
| Mater Women's And Children's Hospital Townsville | ✓ | ✓ | ✓ |
| St Vincent’s Health Australia | | | |
| St Vincent's Private Hospital Toowoomba | ✓ | ✓ | ✓* |
| Ramsay Health Care | | | |
| Cairns Private Hospital | | No data provided | |
| Greenslopes Private Hospital | | | |
| John Flynn Private Hospital | | | |
| North West Private Hospital | | | |
| Pindara Private Hospital | | | |
| Selangor Private Hospital | | | |
| St Andrew's Ipswich Private Hospital | | | |
| Uniting Care Health | | | |
| Sunshine Coast Private Hospital | ✓ | ✓ | ✓* |
| Wesley Private Hospital | ✓ | ✓ | ✓* |

*Incomplete infection dataset provided for data linkage

Table 6.4

Diagnosis and procedure codes selected for data request, and code allocation to economic model health states

| Health state | Code selected | Description |
|--|-----------------|---|
| Caesarean section inpatient | ICD-10-AM codes | |
| | O82 | Single delivery by caesarean section |
| | O84.2 | Multiple delivery, all by caesarean section |
| | ACHI codes | |
| | Block [1340] | |
| | 16520-00 | Elective classical caesarean section |
| | 16520-02 | Elective lower segment caesarean section |
| | 16520-01 | Emergency classical caesarean section |
| | 16520-03 | Emergency lower segment caesarean section |
| Infection at home | ICD-10-AM codes | |
| | O85 | Puerperal sepsis |
| | O86.0 | Infection of obstetric surgical wound |
| | N71.XX | Endometritis |
| | ACHI code | |
| Infection in hospital | Block [1920] | |
| | 96203-02 | Oral administration of anti-infective agent |
| | ICD-10-AM codes | |
| | O85 | Puerperal sepsis |
| | O86.0 | Infection of obstetric surgical wound |
| | N71.XX | Endometritis |
| | ACHI codes | |
| | Block [1920] | |
| | 96199-02 | Intravenous administration of anti-infective agent |
| | 96200-02 | Subcutaneous administration of anti-infective agent |
| | 96202-02 | Enteral administration of anti-infective agent |
| Infection in hospital with incision and drainage | ICD-10-AM codes | |
| | O85 | Puerperal sepsis |
| | O86.0 | Infection of obstetric surgical wound |
| | N71.XX | Endometritis |
| | ACHI codes | |
| | Block [0987] | |
| | 30224-01 | Percutaneous drainage of intra-abdominal abscess, haematoma or cyst |
| | 30224-02 | Percutaneous drainage of retroperitoneal abscess |
| | 30394-00 | Drainage of intra-abdominal abscess, haematoma or cyst |
| | 30394-01 | Laparoscopic drainage of intra-abdominal abscess, haematoma or cyst |
| | 30402-00 | Drainage of retroperitoneal abscess |
| | 90952-00 | Incision of abdominal wall |
| | Block [1628] | |
| | 90665-00 | Excisional debridement of skin and subcutaneous tissue |
| Infection at home with NPWT | ICD-10-AM codes | |
| | O90.0 | Complications of the puerperium not elsewhere classified |
| | ACHI codes | |
| | Block [1628] | |
| | 90686-01 | Non-excisional debridement of skin and subcutaneous tissue |

6.3.2 Allocation of hospital data to baseline and comparator groups

The linked dataset was used to inform the economic model that was designed to compare two groups of caesarean section patients:

1. women admitted to “current practice” hospitals; and
2. women admitted to “better practice” hospitals.

The results of the current practice survey were used to define each group (Section 5.3). In “better practice” hospitals, at least 75% of current practice survey respondents from each postcode implemented either adequate or good adherence; for example, at least three of the four respondents from hospital X. Additionally, in “better practice” hospitals no respondents reported zero adherence, and the respondent group from each hospital postcode was representative of Obstetricians in that hospital (Table 6.5). Hospitals would not provide data on employed and contracted Obstetricians for their service. Therefore, the number of caesarean sections performed annually was used as an indicator of volume of activity and number of Obstetricians who were expected to work in each hospital. A ratio of at least one survey respondent to 90 caesarean sections performed annually per hospital was used as criteria to suggest that the data was representative of Obstetricians performing caesarean sections in each hospital. Hospitals in the remaining postcodes were defined as “current practice” hospitals. These hospitals had a large proportion of respondents reporting zero adherence with the infection prevention bundle, or adherence was uncertain due to the poor response rate from the hospital’s postcode.

Table 6.5

Inclusion criteria for hospital postcode allocation to “better practice” group

| Inclusion criteria element | Criteria |
|---|--|
| Adequate adherence with infection prevention bundle | 1. At least 75% of respondents from each postcode reported either adequate or good adherence |
| No zero adherence with infection prevention bundle | 2. All respondents from each postcode reported at least poor adherence |
| Representativeness of hospital practice | 3. At least 1:90 ratio of survey respondents to caesarean sections performed annually in hospital postcode |

The Queensland hospital data was divided into hospitals in postcodes that met the “better practice” criteria and those that did not meet the criteria; they were allocated

to the “current practice” group. The hospitals allocated to each group and included in further analysis are shown in Table 6.6. Private hospitals were de-identified at their request. Hospitals that did not provide infection data, for example Cairns Hospital, were excluded from the dataset at this point as the full clinical pathway for women diagnosed with SSI was not available and a decision was made to not use administrative infection data. The number of women in the “current practice” and “better practice” groups was 6636 and 4853 respectively, representing 54% of caesarean sections in Queensland in 2014-15²⁶.

Table 6.6

“Current practice” and “better practice” hospitals included in economic evaluation

| “Current practice” hospitals (postcode) | “Better practice” hospitals (postcode) |
|---|---|
| Beautesert Hospital (4285) | Caboolture Hospital (4510) |
| Bundaberg Base Hospital (4670) | Gladstone Hospital (4680) |
| Emerald Hospital (4720) | Mater Mother’s Hospital (4101) |
| Gold Coast University Hospital (4215) | Toowoomba Hospital (4350) |
| Hervey Bay Hospital (4655) | Private Hospitals Q and H |
| Logan Hospital (4131) | |
| Mackay Base Hospital (4740) | |
| Mount Isa Base Hospital (4825) | |
| Redcliffe Hospital (4020) | |
| Rockhampton Hospital (4700) | |
| Royal Brisbane and Women’s Hospital (4006 and 4029) | |
| Private Hospitals A, C, D, E, G, J and K | |

The unadjusted cumulative incidence of SSI following caesarean section in the 2014-15 financial year for the “current practice” and “better practice” groups was 1.22% and 1.09% respectively.

The two datasets were examined for confounding variables that might influence the SSI incidence other than Obstetrician adherence with the infection prevention bundle. The following SSI risk factors were selected as potential confounders and univariate binary logistic regression analysis was conducted with each variable: type of caesarean section, hospital funding type; NNIS risk index; BMI; and Aboriginal and Torres Strait Islander status. Results are presented in Table 6.7. The “better practice” hospitals had significantly greater odds of representing private patients and women with an NNIS risk index of 1. These hospitals also significantly under represented overweight and obese women and Aboriginal and/or Torres Strait Islander women. This meant that the women in the baseline “current practice” and comparator “better

practice” groups were not homogenous and transition probabilities that were adjusted for these confounders needed to be estimated for the economic model.

Correlations between the SSI risk factors were tested to select the most appropriate covariates for the regression model which estimated adjusted “current practice” and “better practice” transition probabilities. There were significant correlations at the 1% level of significance between hospital funding type and Aboriginal and Torres Strait Islander status; and BMI and Aboriginal and Torres Strait Islander status. It was thus determined that the regression model estimating the transition probabilities would exclude Aboriginal and Torres Strait Islander status. Including this covariate in the model may have resulted estimations that could not be trusted due to multi-collinearity.

Table 6.7

Univariate associations between women's allocation to the "better practice" hospital group and SSI risk factors

| Variable | Number of women | Percentage of women in "better practice" group | Unadjusted OR (95% confidence interval) |
|--|------------------------|---|--|
| Type of caesarean section | | | |
| Elective | 6565 | 57.3 | 1 |
| Emergency | 4924 | 42.7 | 0.987 (0.916 – 1.064) |
| Hospital funding type | | | |
| Public | 6964 | 38.0 | 1 |
| Private | 4525 | 48.8 | 1.562 (1.45-1.68)* |
| NNIS risk index | | | |
| 0 | 3975 | 22.2 | 1 |
| 1 | 1880 | 30.1 | 1.51 (1.335-1.71)* |
| 2 | 127 | 26.0 | 1.23 (0.82-1.84) |
| BMI | | | |
| Healthy weight | 5492 | 46.8 | 1 |
| Underweight | 483 | 47.0 | 1.01 (0.84-1.22) |
| Overweight | 2672 | 40.6 | 0.78 (0.71-0.85)* |
| Obese | 2838 | 34.3 | 0.60 (0.54-0.65)* |
| Aboriginal and Torres Strait Islander status | | | |
| Non-Indigenous | 10864 | 43.3 | 1 |
| Aboriginal and/or Torres Strait Islander | 411 | 34.5 | 0.69 (0.56-0.85)* |
| Not stated | 214 | 4.2 | 0.06 (0.03-0.11)* |

*Significant at the 5% level of significance

6.3.3 Estimating transition probabilities

The daily probability of transitioning from each health state was required to inform the economic model. Daily hospital data on women's admission, length of stay, SSI diagnosis, procedure and readmission were organised into a dataset to be used for all analyses estimating adjusted transition probabilities. A daily time trend was included in the dataset as a function of the number of cycles elapsed since the start of the economic model; that is the number of days, weeks or months since caesarean section. All transition probabilities were time dependent which meant they varied from cycle to cycle. It was possible to model the cohort in this manner because all women were simulated to give birth on day one. The time dependent nature of transition probabilities was important to reflect in the economic model because the hospital data and other research⁵¹⁻⁵³ showed that events such as SSI are more likely to occur at certain times following caesarean section than other times.

A nominal logistic model with longitudinal structure²³¹ was used to estimate the effect of time on transitioning out of each health state, adjusting for hospital funding type, NNIS risk index and BMI. That is, the logistic coefficients for the intercept and time trend were used to estimate transition probabilities for each cycle in the economic model. The exponential of the coefficients gave the adjusted odds ratio state for a one-day increase in time since caesarean section for a transition to another health state. A multinomial logistic regression model was applied to transitions where there was more than one transition out to other health states in the economic model (*Figure 6.1*). For example, a multinomial distribution was appropriate for transition probabilities from "infection in hospital" to "infection at home", "infection with surgery" and "infection with NPWT" and remaining in "infection in hospital". Binary logistic regression models were used for transitions with only one alternative to remaining in the health state.

Regression models with linear and quadratic time trends were fitted using the same risk factor variables listed above. The regression model can be represented by the equations:

$$p(t) = \frac{\exp\{y(t)\}}{1 + \exp\{y(t)\}};$$
$$y(t) = \alpha + \beta_0 x_0 + \beta_1 t + \beta_2 t^2$$

where $y(t)$ is the linear predictor for the probability of transitioning from one health state to another at time t , $p(t)$ is the actual probability of transitioning, α is the time-constant intercept, β_0 is the coefficient for hospital behaviour, β_1 is the coefficient for the linear time trend and β_2 is the coefficient for the quadratic time trend. x_0 can take a value of 0 or 1, where 0 represented better practice hospitals and 1 represented current practice hospitals.

The best-fitting model was selected using Akaike's Information Criterion (AIC)²³², where the model with the smaller AIC value was deemed a better fit. An AIC difference of 10 represents substantial statistical evidence in favour of the model with the smaller AIC²³³. Clinical knowledge of women's transitions between health states was also used for regression model selection if daily transition probabilities of the best-fitting model differed from clinical expectation.

The hospital-focused nature of the data set meant that SSIs identified and treated in the primary healthcare setting alone were not recorded. Hence, the estimated probabilities for the transition from "normal recovery at home" to "infection at home" using this dataset would underestimate the true incidence. Instead, only the transition probability from "normal recovery at home" to "infection in hospital" was estimated from the data using a binary logistic regression model. Approximately 80% of post-caesarean SSI identified post-discharge are diagnosed and treated solely in the primary healthcare setting^{7, 46}. Therefore, the predicted probabilities of transitioning from normal recovery at home to infection at home were manually set at a conservative three times the probability of transitioning from "normal recovery at home" to "infection in hospital", reflecting a more accurate estimation of the incidence of infections that hospitals never become aware of.

Time-dependent predicted probabilities for transitions from "caesarean section", "normal recovery at home", "infection at home", "infection in hospital", "infection with surgery" and "infection with NPWT" are plotted in *Figures 6.2 to 6.16*, while the predicted probabilities values used in the economic model are tabulated in Appendix J. The covariate values from the regression output are also tabulated in Appendix J. *Figures 6.2 to 6.16* show the transition probabilities for each cycle in the economic model up to the time point where hospital data was no longer available. Transition probabilities for the remaining cycles in the economic model were informed by the

real hospital data which showed all women transitioning to the next stage of recovery with a probability of zero for transition to other treatment health states (Appendix J).

The predicted probabilities for remaining in the “caesarean section” and transitioning from “caesarean section” to “normal recovery at home” health states are similar for women from current and better practice hospitals (*Figure 6.2* and *Figure 6.3*). The transition probability patterns follow a usual clinical pathway and reflects the original Queensland hospital data where most women are discharged to home between days one and 7. Women remaining in hospital following caesarean section after day 7 are likely to stay admitted because of non-SSI related complications following the procedure which may predispose them to an SSI at a later time in the model. This was observed in the original Queensland hospital data where a small number of women remained in hospital more than 15 days and then were diagnosed with an SSI. SSI complications for women remaining in hospital are represented by *Figure 6.4*. Women from better practice hospitals are less likely than women from current practice hospitals to have an SSI diagnosed while still in hospital following caesarean section. The probabilities of transitioning from “caesarean section” to “infection in hospital” are very small at less than 0.0008 (*Figure 6.4*).

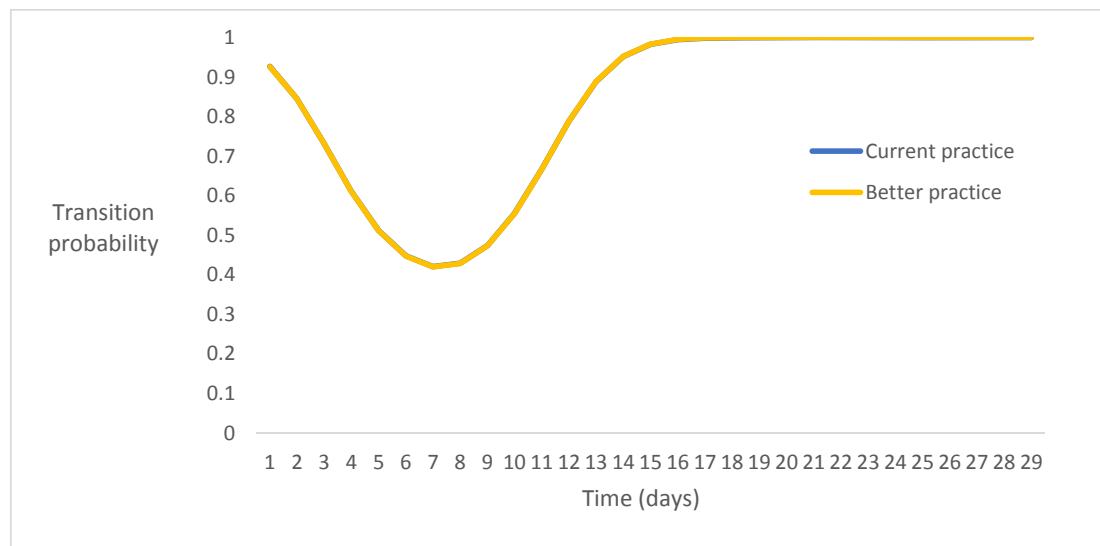


Figure 6.2.
Daily predicted probabilities for remaining in caesarean section health state,
quadratic model

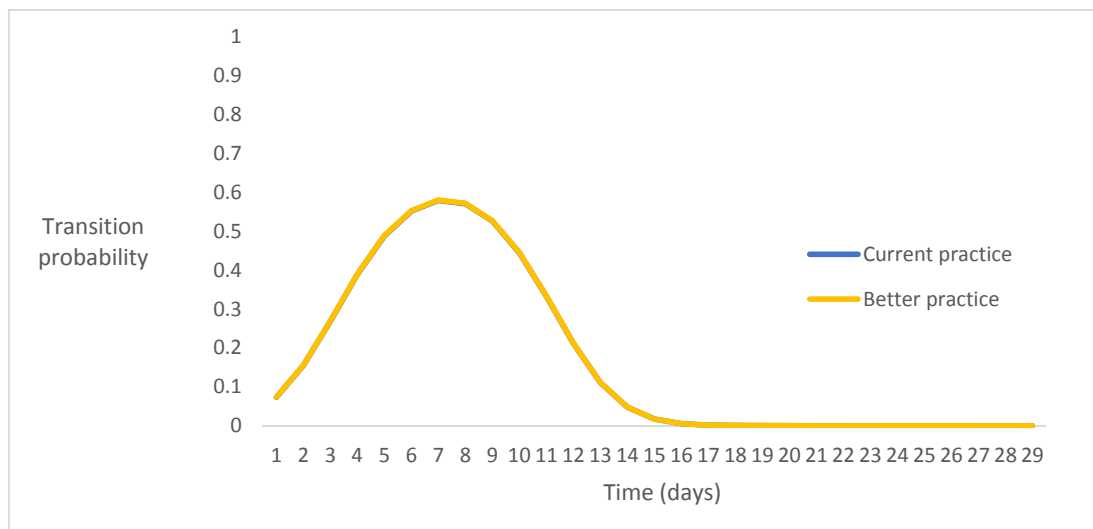


Figure 6.3.
Daily predicted probabilities for transitioning from caesarean section to normal recovery health state, quadratic model

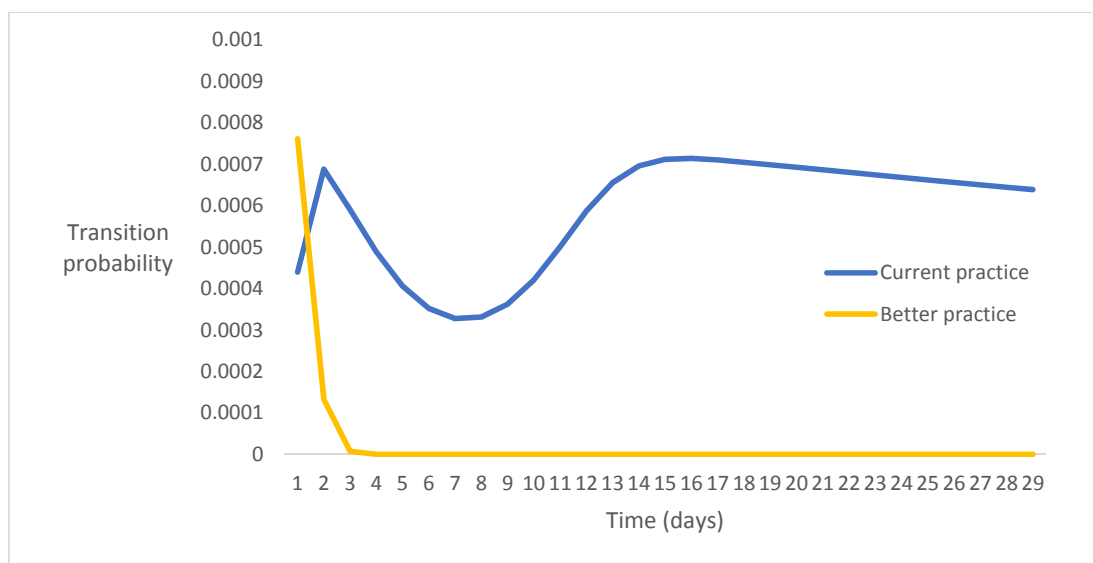


Figure 6.4.
Daily predicted probabilities for transitioning from caesarean section to infection in hospital health state, quadratic model

The predicted probabilities for remaining in the “normal recovery” health state vary from 0.991 to 0.999 for women from both current and better practice hospitals (*Figure 6.5*). Women from better practice hospitals have a higher probability of acquiring an SSI post-discharge and being treated in the primary healthcare setting and

also being readmitted to hospital (*Figure 6.6* and *Figure 6.7*). As the original Queensland hospital data had a lower SSI incidence overall, results where better practice hospitals have a higher SSI risk is most likely due to the adjustment for fewer high risk patients in better practice hospitals that was conducted in the logistic regression modelling.

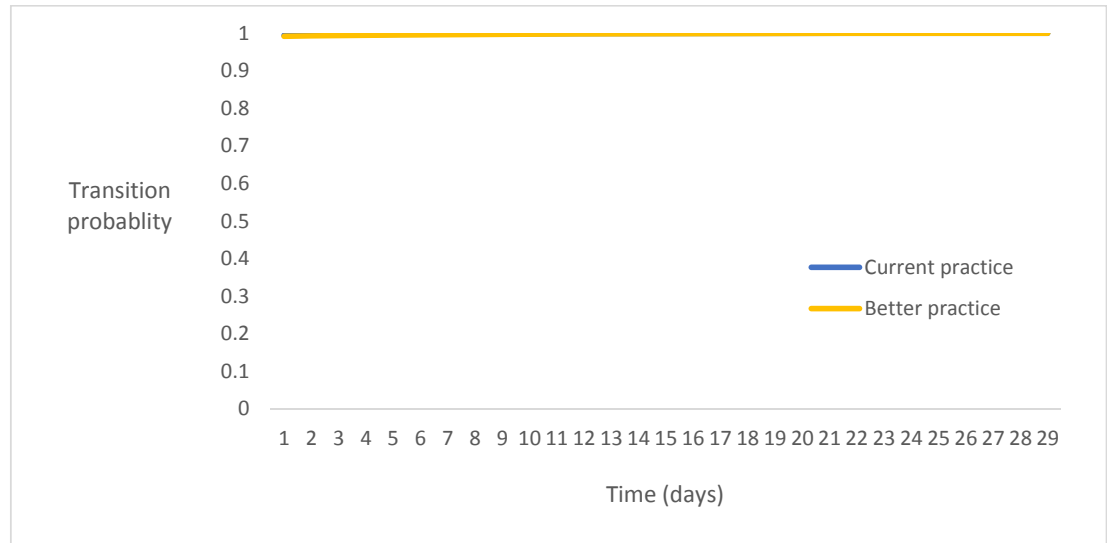


Figure 6.5.
Daily predicted probabilities for remaining in normal recovery health state, linear model

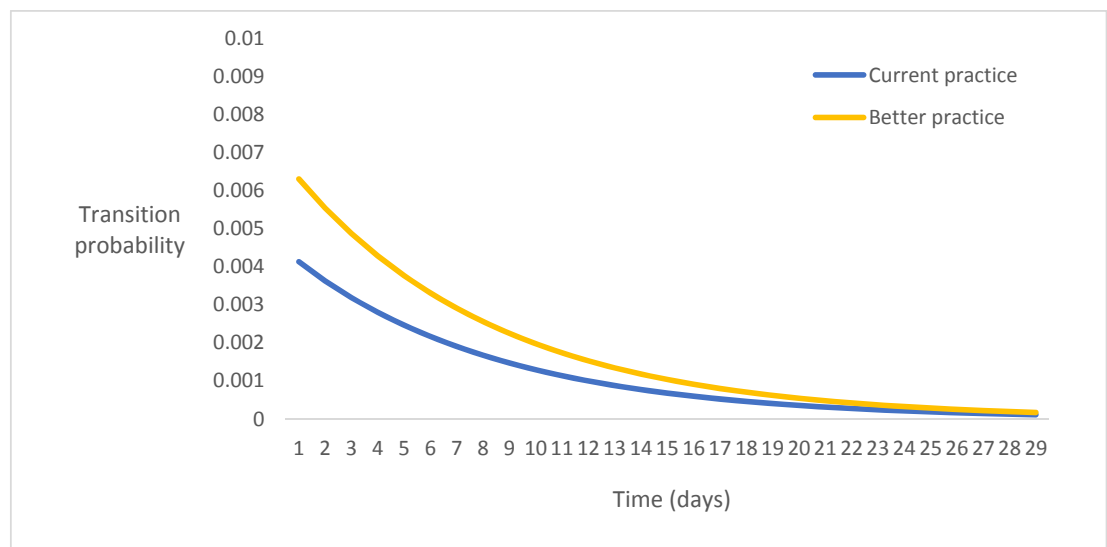


Figure 6.6.
Daily predicted probabilities for transitioning from normal recovery to infection at home health state, linear model

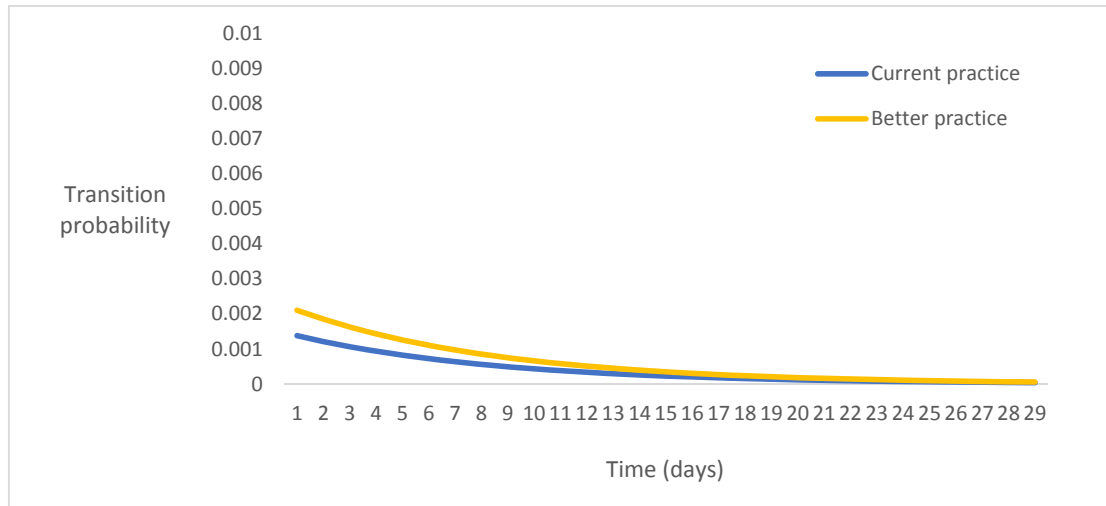


Figure 6.7.
Daily predicted probabilities for transitioning from normal recovery at home to infection in hospital health state, linear model

Women from current practice hospitals are more likely to remain in the “infection at home” health state than women from better practice hospitals (*Figure 6.8*). The slight rise in probability of remaining in the infection at home health state between days 31 and 37 is reflective of the original Queensland hospital data where women return to home for further SSI treatment following hospital treatment. Women from better practice hospitals transition to the “post-infection recovery” health state sooner than women from current practice hospitals (*Figure 6.9*). Women from current practice hospitals have a slightly higher probability of transitioning from the “infection at home” and the “infection in hospital” health state than women from better practice hospitals (*Figure 6.10*).

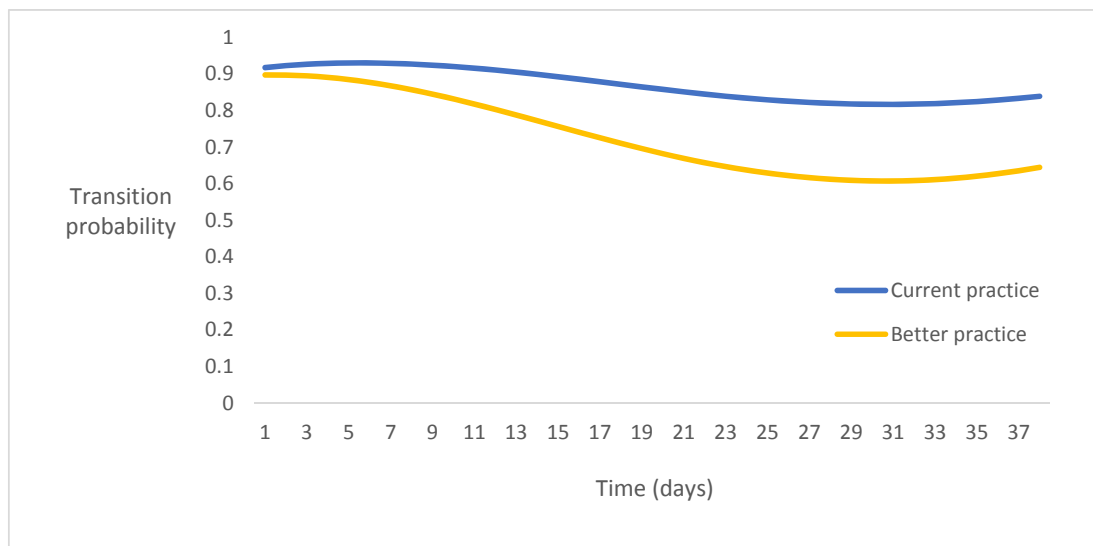


Figure 6.8.
Daily predicted probabilities for remaining in infection at home health state,
quadratic model

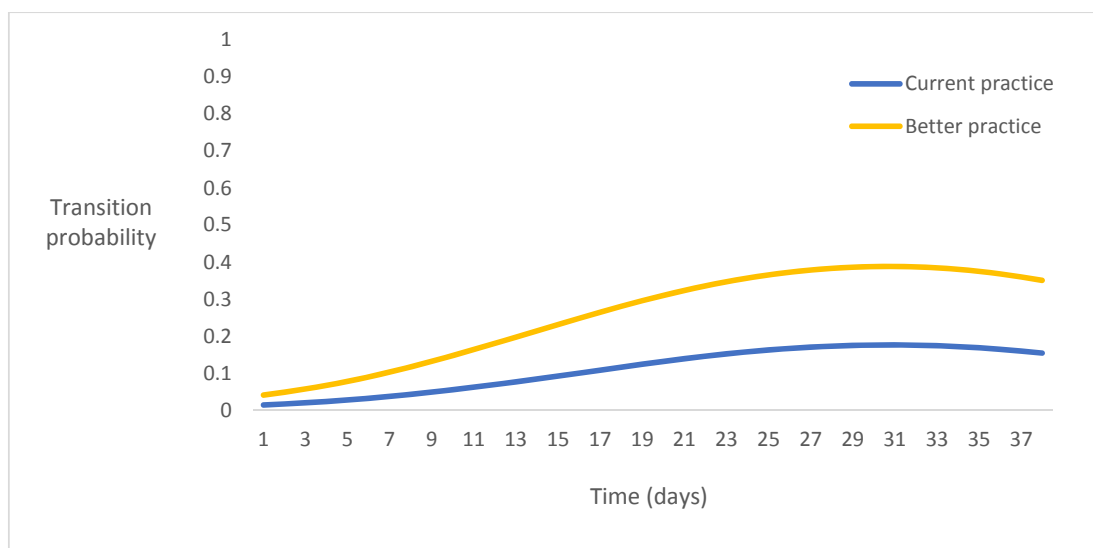


Figure 6.9.
Daily predicted probabilities for transitioning from infection at home to post-
infection recovery health state, quadratic model

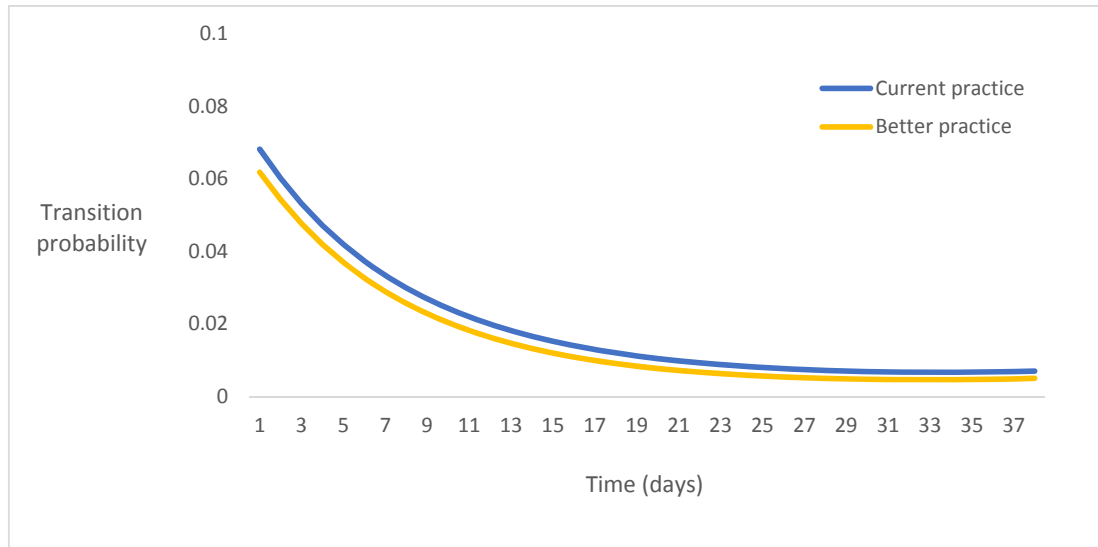


Figure 6.10.
Daily predicted probabilities for transitioning from infection at home to infection in hospital health state, quadratic model

Women from current practice hospitals have a slightly higher probability of remaining in the “infection in hospital” health state than women from better practice hospitals (*Figure 6.11*). The probability of transitioning from “infection in hospital” to “infection at home” health state is similar for women from both current practice and better practice hospitals (*Figure 6.12*). Very few women transition from “infection in hospital” to “infection with surgery”, with a slightly higher probability estimated for women from better practice hospitals (*Figure 6.13*). More women from better practice hospitals transition from “infection in hospital” to “infection with NPWT” (*Figure 6.14*). Approximately the same number of women in the current and better practice hospitals had NPWT applied in the original Queensland hospital data. The estimated transition probabilities from “infection in hospital” to “infection with surgery” and “infection with NPWT” are also most likely a result of the adjustment conducted in the logistic regression previously explained.

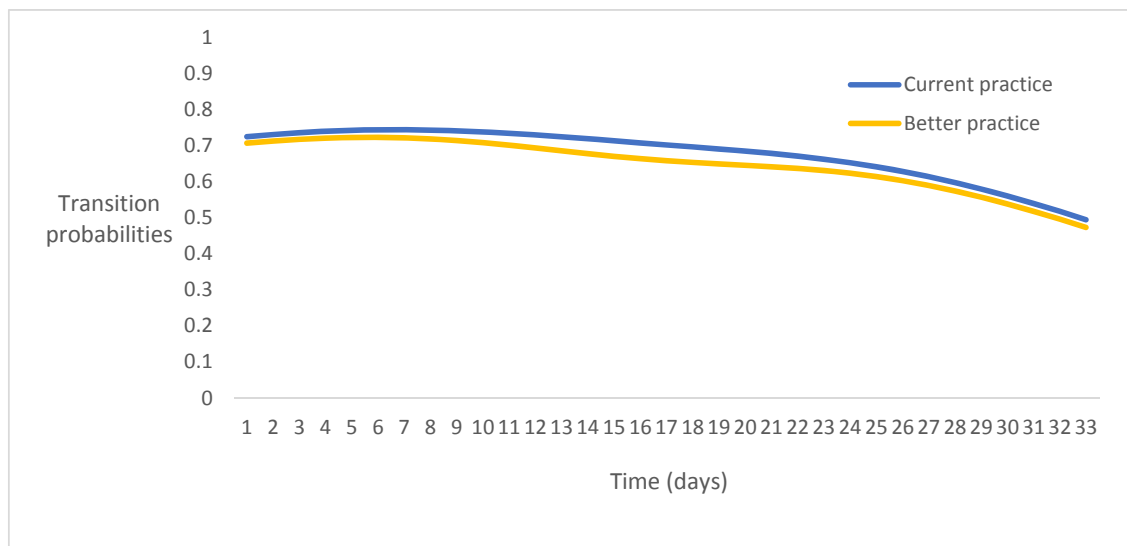


Figure 6.11.
Daily predicted probabilities for remaining in infection in hospital health state,
quadratic model

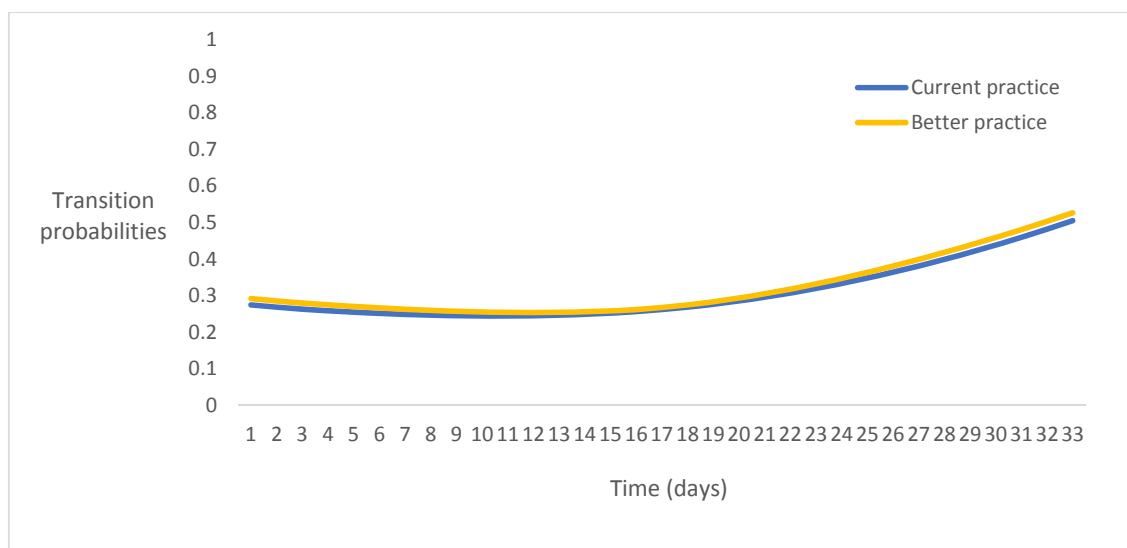


Figure 6.12.
Daily predicted probabilities for transitioning from infection in hospital to infection
at home health state, quadratic model

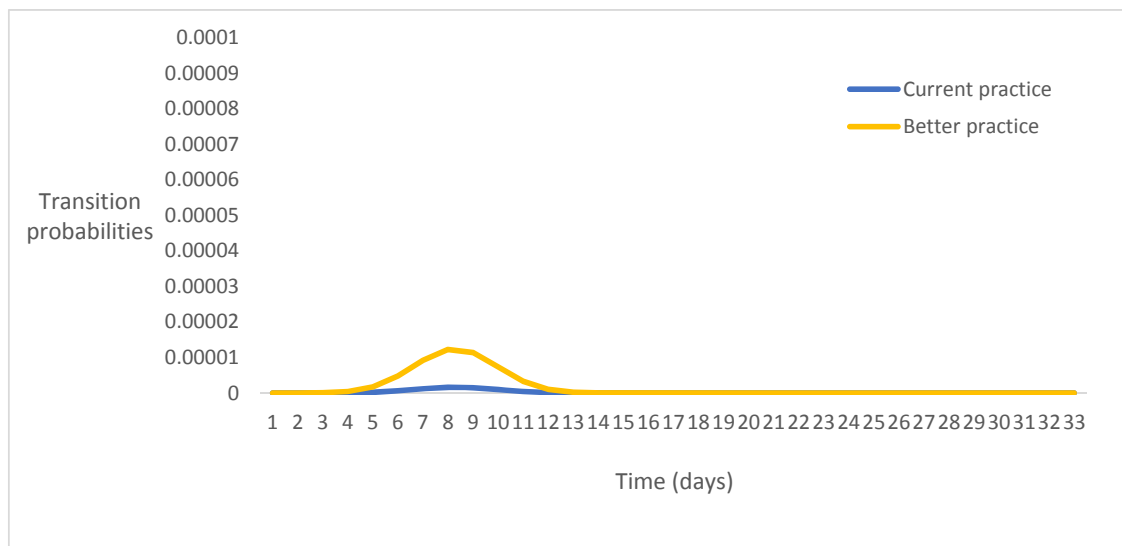


Figure 6.13.
Daily predicted probabilities for transitioning from infection in hospital to infection with surgery health state, quadratic model

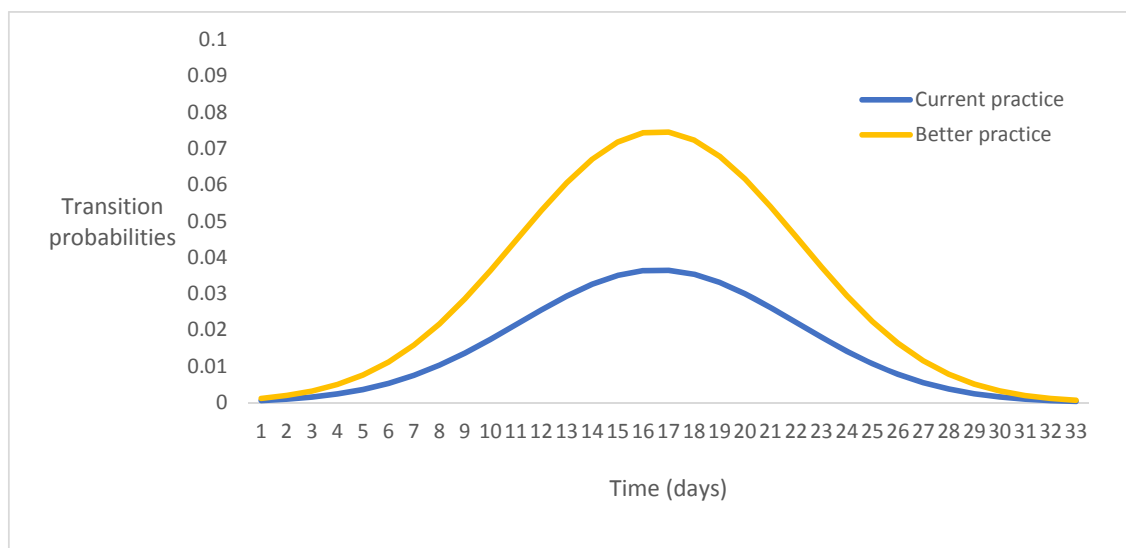


Figure 6.14.
Daily predicted probabilities for transitioning from infection in hospital to infection with NPWT health state, quadratic model

Women from better practice hospitals have a higher probability of remaining in the “infection with NPWT” health state and treatment is longer (*Figure 6.15*). The inverse is observed for the transition from “infection with NPWT” to “post-infection recovery” (*Figure 6.16*).

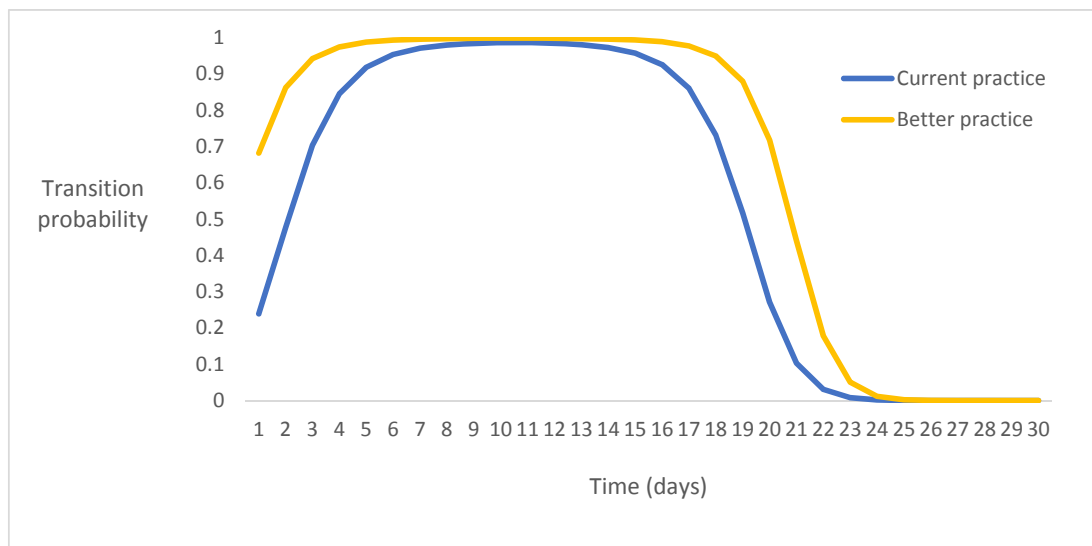


Figure 6.15.
Daily predicted probabilities for remaining in infection with NPWT health state, quadratic model

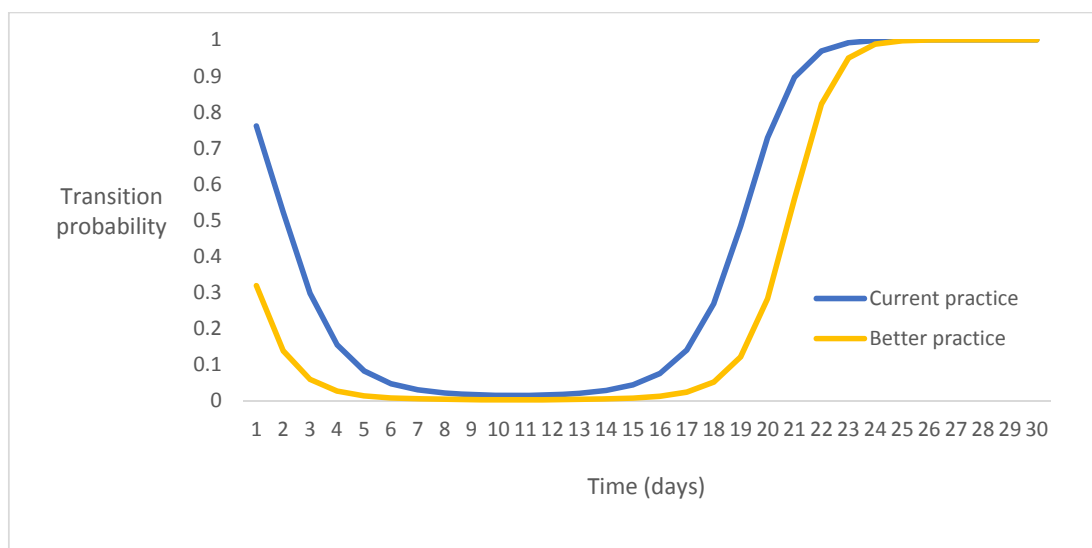


Figure 6.16.
Daily predicted probabilities for transitioning from infection with NPWT to post-infection recovery health state, quadratic model

For all transitions except the transition from “post-infection recovery”, daily probabilistic values were fitted using the standard errors and normal distributions of the intercept and time-trend coefficients estimated in the nominal logistic regression

models. Transition probabilities beyond the time hospital data was available were not probabilistic (Appendix J).

Data was not available for probability of transitioning from “post-infection recovery”. The most likely value of the transition probability for each cycle was elicited from an expert²³⁴. Uncertainty surrounding the estimate was also elicited from the expert in four complimentary intervals¹⁵⁷, and alpha and beta values for a smoothed beta distribution were approximated²³⁵ (Appendix J).

6.3.4 Costs

Costs to society were estimated for two categories: costs of implementing the infection prevention bundle and costs of treating SSI. Private costs, costs to the broader health system and costs to the hospital were included. Costs of SSI to the infant were excluded as they were assumed to be zero. As the economic model was intended to inform a change to practice, costs that were not affected by an SSI diagnosis were also excluded, for example the cost of caesarean section surgery and recovery at home with usual post-natal care. For the two cost categories, a resource inventory was created, data was collected with information about uncertainty in the estimates, and the resources were valued¹⁴⁵.

Resources required for implementing the infection prevention bundle, costs and uncertainty are presented in Table 6.8. Time taken to implement the three bundle elements was estimated with an Obstetrician using an expert elicitation method with four complimentary intervals to provide uncertainty around the elicited value¹⁵⁷. Pre-incision administration of antibiotic prophylaxis may require additional staff time if administered pre-operatively or in a ward. There is large uncertainty regarding the additional time taken to administer pre-incision antibiotics because there is likely to be variation across hospitals regarding when this occurs in the peri-operative process. The least-costly scenario with zero additional time is where antibiotic administration is integrated into the anaesthetic protocols in theatre. An assumption was made that all hospitals administer antibiotic prophylaxis at some point, therefore no additional equipment was included in the inventory. Vaginal preparation may require additional time in theatre if the process is not integrated with catheter insertion. The most costly scenario was where the Obstetrician prepares the vagina separate to catheter insertion and then scrubs for surgery. In this case, theatre is used for an additional three minutes while staff wait for the Obstetrician to prepare the vagina and scrub. It was assumed

that vaginal preparation requires no additional equipment because generous supplies of surgical swabs and povidone-iodine solution are already provided in theatre. Spontaneous removal of the placenta with gentle cord traction used a mean half minute additional time in theatre (Table 6.8). The total additional cost of implementing the infection prevention bundle was AUD\$110.00 per procedure in 2017. The intervention cost was applied in the economic model as a one-time cost in cycle one for all women in the simulated “better practice” cohort. The daily cost of being in the caesarean section health state was \$2389.40. Accounting costs using daily National Efficient Price for a hospital stay following caesarean section with intermediate complexity²³⁶, rather than the economic value of a bed day¹⁴⁶ were included in the model so that costing methods were applied consistently. Only the economic value for a bed day, and not use of theatre or other treatments were available for this research. Probabilistic values for the intervention and daily caesarean section health state costs were also fitted to the model using Gamma distributions.

Table 6.8

Resources used and costs of caesarean section health state

| Resource | Cost (uncertainty) | Distribution | Source |
|---|--------------------|--------------|---|
| One-time cost of infection prevention bundle | | | |
| Pre-incision antibiotic prophylaxis | | Gamma | Expert opinion ²³⁴ and Queensland Health award salaries after tax ²³⁷ |
| Less than half a minute for two nursing staff | \$0.50 | | |
| Vaginal preparation | | Gamma | Expert opinion ²³⁴ and 2016-17 NEP for caesarean section ²³⁶ |
| One minutes for theatre use | \$73 | | |
| Spontaneous placenta removal | | Gamma | Expert opinion ²³⁴ and 2016-17 NEP for caesarean section ²³⁶ |
| Half a minute for theatre use | \$36.50 | | |
| Total cost | \$110 (se 50.1) | Gamma | |
| Daily cost of CS health state | | | |
| Bed day | \$2389.40 | Fixed | Daily NEP for caesarean section intermediate complexity ²³⁶ |

NEP: National Efficient Price; se: Standard Error

Costs of SSI treatment for each health state in the economic model are presented in Table 6.9. An SSI diagnosed and treated in the primary healthcare setting (“infection at home” health state in *Figure 6.1*) incurs private costs and costs to the health system totalling \$59.80 per day. Private costs were incurred due to out of pocket costs for two

visits to the General Practitioner¹⁶⁹, antibiotics*, wound dressings* and informal carer production losses which include the time lost by a partner in caring for the sick woman¹. Health system costs were due to the General Practitioner Medicare rebate²³⁸, and the Pharmaceutical Benefits Scheme benefit²³⁹. The daily cost an SSI treated in hospital (“infection in hospital” health state) was \$1203.40, comprising private informal carer production losses¹ and the daily National Efficient Price for a minor postpartum procedure²³⁰. The daily cost of an SSI in hospital with incision and drainage (“infection in surgery” health state) was the daily National Efficient Price for a minor postpartum procedure requiring theatre²³⁰ plus a one-time cost of surgery for each woman who entered this health state. The cost of surgery was \$2305.50²³⁶. In hospital costs include proportionate fixed costs. The daily cost of an SSI treated at home with NPWT (“infection with NPWT” health state) was \$240.60. Private costs were due to antibiotics[†] and informal carer production losses¹. Hospitals incurred costs for daily home visits for wound management²³⁶. The health system cost was the Pharmaceutical Benefits Scheme benefit²³⁹. A one-time equipment cost of \$184.26¹⁶⁸ was also attributed to each woman who entered the “infection with NPWT” health state. Probabilistic values were fitted to uncertain parameters in the model using gamma distributions, while costs drawn solely from the National Efficient Price values were fixed (Table 6.9).

Table 6.9

SSI treatment and recovery costs for each health state in economic model

| Health state | Daily cost (se) | Distribution | Sources |
|--|-----------------|--------------|------------------|
| Normal recovery at home | \$0 | na | na |
| Infection at home | \$59.80 (6.8) | Gamma | 1, 169, 238, 239 |
| Infection in hospital | \$1203.40 | Fixed | 1, 146, 236 |
| Infection in hospital with incision and drainage | \$2209.75 | Fixed | 146, 236 |
| One-time cost | \$2305.50 | Fixed | 236 |
| Infection at home with NPWT | \$240.60 (6.8) | Gamma | 1, 236, 239 |
| One-time cost | \$184.26 | Fixed | 168 |
| Post-infection recovery | \$0 | na | na |

se: standard error; na: not applicable

* Market price, April 2017

6.3.5 Health outcomes

To calculate QALYs, health utility weights were assigned to cycles spent in each health state in the economic model (Table 6.10). Health utilities were sourced from the best available estimates in the literature for all health states except “post-infection recovery”, which used expert opinion²³⁰ to inform the utility value. Only maternal health utilities were included in the economic model, as evaluating infant health outcomes was beyond the scope of this study. “Normal recovery at home” was assigned a health utility of 0.91 rather than perfect health because the lower utility is the mean EQ-5D index score for Australian women of child-bearing age²⁴⁰. Health utility values for “caesarean section”, “infection at home” and “infection in hospital” were selected from a study that used expert opinion to estimate values for economic evaluations^{241, 242}, as no values have been derived from appropriate instruments such as the EQ-5D or SF-36. Tan and colleagues conducted a cost-effectiveness analysis which included utilities for caesarean section and post-caesarean adverse outcome health states (0.78 and 0.76 respectively)²⁴¹. These health utilities were selected for the economic model and supported by another study which derived SSI utilities from experts using a visual analogue scale²⁴². The health utilities for SSI requiring readmission and SSI requiring incision and drainage following breast reconstruction from this study were also used in the economic model²⁴². It was assumed that the health utility for an SSI treated at home with NPWT was equivalent to that for an SSI at home and in hospital. Probabilistic values were fitted to the economic model using beta distributions. Where uncertainty surrounding estimates was not available, a plus/minus 25% range was allocated to the mean utility value and the standard error was estimated from the interquartile range (Table 6.10).

Table 6.10

Health utilities assigned to each health state in economic model

| Health state | Daily utility (se) | Distribution | Sources |
|--|--------------------|--------------|---------------|
| Caesarean section inpatient | 0.78 (0.15) | Beta | 241, 243, 244 |
| Normal recovery at home | 0.91 (0.01) | Beta | 240 |
| Infection at home | 0.76 (0.03) | Beta | 174, 241, 242 |
| Infection in hospital | 0.76 (0.6) | Beta | 174, 241, 242 |
| Infection in hospital with incision and drainage | 0.73 (0.13) | Beta | 241 |
| Infection at home with NPWT | 0.76 (0.14) | Beta | 180,181 |
| Post-infection recovery | 0.85 (0.16) | Beta | 230 |

se: standard error

6.4 MODEL ASSUMPTIONS

Assumptions were made during the development of the economic model regarding the baseline and comparator scenarios, treatment for SSI, transition probabilities and health outcomes.

The hospitals implementing “current practice” demonstrated variation in caesarean peri-operative practice and surgical technique, with most Obstetricians practicing in those hospitals reporting poor adherence with the infection prevention bundle (Chapter 5). In contrast, it was assumed that due to the representativeness of Obstetricians from the “better practice” hospitals, these hospitals implement the infection prevention bundle much better overall than “current practice” hospitals. It was assumed that standard infection prevention and control practice is consistently applied inconsistently across all “current practice” and “better practice” hospitals, and that aspects of infection control such as policy, surveillance, environmental cleaning and aseptic technique did not drive the differences in risk of SSI between the two groups. It was also expected that there was no cost-difference for antibiotic prophylaxis between the “current practice” and “better practice” groups because they both implement prophylaxis, and a consistent range of regimens and dosages were likely to be administered for caesarean section.

Oral and intravenous treatment for SSI with antibiotics was assumed to be 5 days with Flucloxacillin, unless recorded otherwise in the hospital data. Treatment for SSI at home with NPWT was for 7 days, unless recorded otherwise in the hospital data.

Very small transition probabilities appeared in the probabilistic model creating an ‘overflow’ error in the economic model. The value of the mean transition probability for the equivalent cycle in the deterministic model was applied to the cycle where the economic model could not provide a value.

Mortality and multi-drug resistant organism SSI were excluded from the model as these health outcomes were not reported in the hospital dataset. Maternal health outcomes were assumed to be more significant than infant health outcomes. Evidence does not exist to quantify the impact of a maternal SSI on the infant.

The economic model represented a simplification of what could be a more complex diagnosis, treatment and recovery clinical pathway. Relaxing the assumptions would require additional primary data to be collected to more clearly distinguish

between the baseline and comparator groups, and inform the model parameters. Despite some low quality evidence used to inform model parameters, the approach is transparent and uncertainty included. Use of real hospital data applied to a cohort captured the breadth of the uncertainty in diagnosis and treatment for SSI. Overall, the implications of the model assumptions are that the results may favour remaining with “current practice” as health outcome estimates were conservative, and the hospital dataset may not represent the real-life differences between “current practice” and “better practice” hospitals.

6.5 EVALUATION OF MODEL

The economic model was built and evaluated in Excel, structured as a series of linked spreadsheets with macros embedded to perform simulations. Evaluation of the cost-effectiveness of “better practice” was conducted in four stages: deterministic evaluation estimating the incremental change in costs and QALYs using a single value for each model parameter; probabilistic sensitivity analysis to capture the uncertainty in model parameters, estimating the expected value of perfect information; and subgroup analysis to estimate variation in cost-effectiveness across types of hospitals and women.

6.5.1 Deterministic evaluation

Deterministic evaluation of the economic model was conducted using single values for each model parameter. The incremental change in costs and QALYs was estimated and the ICER was calculated. Moving to “better practice” with better adoption of the infection prevention bundle was considered cost-saving if greater health benefits and reduced costs were achieved compared to “current practice”. A cost-effectiveness threshold of AUD\$42 000 per QALY was used to determine if moving to “better practice” was cost-effective. This threshold was used because it aligns with the Australian Government’s increased likelihood of funding pharmaceuticals that have an ICER of less than \$42 000 per QALY gained¹⁵⁸. A cohort of 20 000 women was modelled deterministically using the transition probabilities estimated in Section 6.3.3, the costs estimated in Section 6.3.4, and the health utilities estimated in Section 6.3.5.

6.5.2 Probabilistic evaluation

Probabilistic sensitivity analysis was used to capture uncertainty in the model parameters. Appropriate probability distributions with the standard error for each parameter estimate were used to represent the parameter uncertainty. The standard errors of the intercept and time-trend coefficients in the regression model (Section 6.3.3) were used to represent uncertainty in the predicted transition probabilities. Normal distributions were allocated to the coefficients, and new values were drawn from the distributions. Predicted probabilities were calculated as described in Section 6.3.3 from the random draws of coefficient values. Transition probabilities of zero or one that were informed directly by the real hospital data were not probabilistic. For costs, gamma distributions using standard errors of the cost estimates were chosen, except for fixed costs. Uniform distributions were chosen for these costs. The uncertainty surrounding health outcomes were represented by beta distributions.

The economic model was evaluated 5 times, with 1000, 5000, 10 000, 15 000 and 20 000 Monte Carlo⁹ simulations each time, to determine the number of simulations that produced the most stable results. The model produced stable results with minimal variation when 10 000 Monte Carlo simulations were run. At each simulation, a new value was drawn from each parameter from within the specified distribution. Probabilistic sensitivity analysis results were reported as mean values of the 10 000 simulations for the outcomes: SSIs, total costs and QALYs per 20 000 procedures performed.

The results of each simulation were also presented as the incremental NMB observed from a move to “better practice”. To calculate the NMB, the incremental QALYs gained by adopting “better practice” were valued at \$42 000 each, which is the cost-effectiveness threshold (Section 3.4.1). The average NMB across the 10 000 simulations was calculated for the “current practice” and “better practice” groups and an incremental NMB was estimated with 95% uncertainty intervals. The optimal economic decision was defined as the caesarean section practice with the highest average NMB. The probability that each type of caesarean section practice was cost-effective and the probability that it was cost-saving and health-improving were calculated. The chance of error in concluding that the type of caesarean section practice with the highest average NMB is where caesarean section peri-operative and surgical practice should move to, was calculated using the formula: probability of error in

conclusion = 1 – probability of being cost-effective. This chance was presented in a cost-effectiveness acceptability curve.

6.5.3 Expected value of perfect information

The expected cost of the uncertainty in the decision was estimated by analysing the expected value of perfect information (EVPI). The results of the 10 000 simulations run in the probabilistic sensitivity analysis were used to calculate the improvement in NMB that would be obtained under perfect information relative to those obtained under uncertainty assuming a cost-effectiveness threshold of \$42 000. The Queensland population EVPI for the decision was estimated by multiplying the improvement in NMB by 20 000, which is the approximate number of caesarean sections performed in Queensland each year²⁶. The life of this information was assumed to be one year, after which new technologies or changed clinical circumstances may alter the decision.

6.5.3.1 Sub-group analyses

Sub-group analyses¹⁶⁰ were conducted to determine if the economic decision applied to types of hospitals or hospitals that had large numbers of a particular types of women. New daily “current practice” and “better practice” transition probabilities were estimated from the hospital data for 5 sub-groups: emergency caesarean sections, elective caesarean sections, obese women, private hospitals and public hospitals. There were too few women with an NNIS risk index equal to 2 or higher (127 women) and too few Aboriginal and/or Torres Strait Islander women (411 women) to conduct analyses for these sub-groups. The selected sub-groups are likely to be operationalised in routine practice and the economic decision can be emphasised in these types of hospitals and sub-groups of women. Most selected sub-groups have evidence of being risk factors for SSI following caesarean section (Section 2.2.4), except for private/public hospitals which was chosen because of the high number of private hospitals offering caesarean section in Queensland and relevance of the economic decision for these hospitals. The cost and utility values were unchanged for the sub-group analysis. Uncertainty surrounding each parameter in the economic model was reflected in the probabilistic sensitivity analysis of each sub-group.

6.6 CHAPTER SUMMARY

A Markov economic model was developed to inform the decision to change peri-operative and surgical practice for caesarean section. The economic model was

designed for a cost-effectiveness analysis of an infection prevention bundle, which was described in this research as “better practice” compared to “current practice”. The economic model represented the clinical pathway of women who did, and did not acquire an SSI following caesarean section. Routinely collected hospital data was used to estimate the transition probabilities for the model, while the literature and expert opinion informed the cost and health utility parameters. The economic model was designed to capture parameter estimate uncertainty through probabilistic sensitivity analysis and determine cost-effectiveness for a range of sub-groups.

Chapter 7: Results - Cost-Effectiveness of Preventing Caesarean Section SSI

In this chapter the changes to total economic costs and health benefits of better adherence to the infection prevention bundle identified in Chapter 4 will be modelled. Better practice will be compared to current peri-operative and surgical practice for caesarean section, described in Chapter 5. The effect of uncertainty in the model is quantified in this chapter through an emphasis on the probabilistic sensitivity analysis results. The cost-effectiveness of the economic decision to adopt better practice for all caesarean sections in Queensland is reported in Section 7.1. The cost-effectiveness of the decision for 5 sub-groups of hospital and patient types is reported in Section 7.2. A summary of results is presented in Section 7.3.

7.1 COST-EFFECTIVENESS OF BETTER PRACTICE

The results of the deterministic analysis that did not consider uncertainty showed that better adherence to the infection prevention bundle is cost-effective (*Figure 7.1*-1000 simulations are shown). The point estimate in *Figure 7.1* indicates the ICER for better practice at \$18 597 per QALY gained. This point estimate lies below the \$42 000 cost-effectiveness threshold drawn in *Figure 7.1*.

The probabilistic sensitivity analysis quantifies the effect of uncertainty surrounding the decision to adopt better practice, and is shown by the scatter plot in *Figure 7.1*. The scatterplot of simulation results crosses all four quadrants of the cost-effectiveness plane and at a cost-effectiveness threshold of \$42 000, there is a 44% probability that better practice is cost-effective. There is also a 30% probability that better practice is cost-saving and health-improving with 3000 of the 10 000 simulations falling in the south-east quadrant. These results demonstrate that there is large uncertainty surrounding the deterministic point-estimate as the 1000 simulations plotted in *Figure 7.1* are widespread and 56% of them show better practice is not cost-effective.

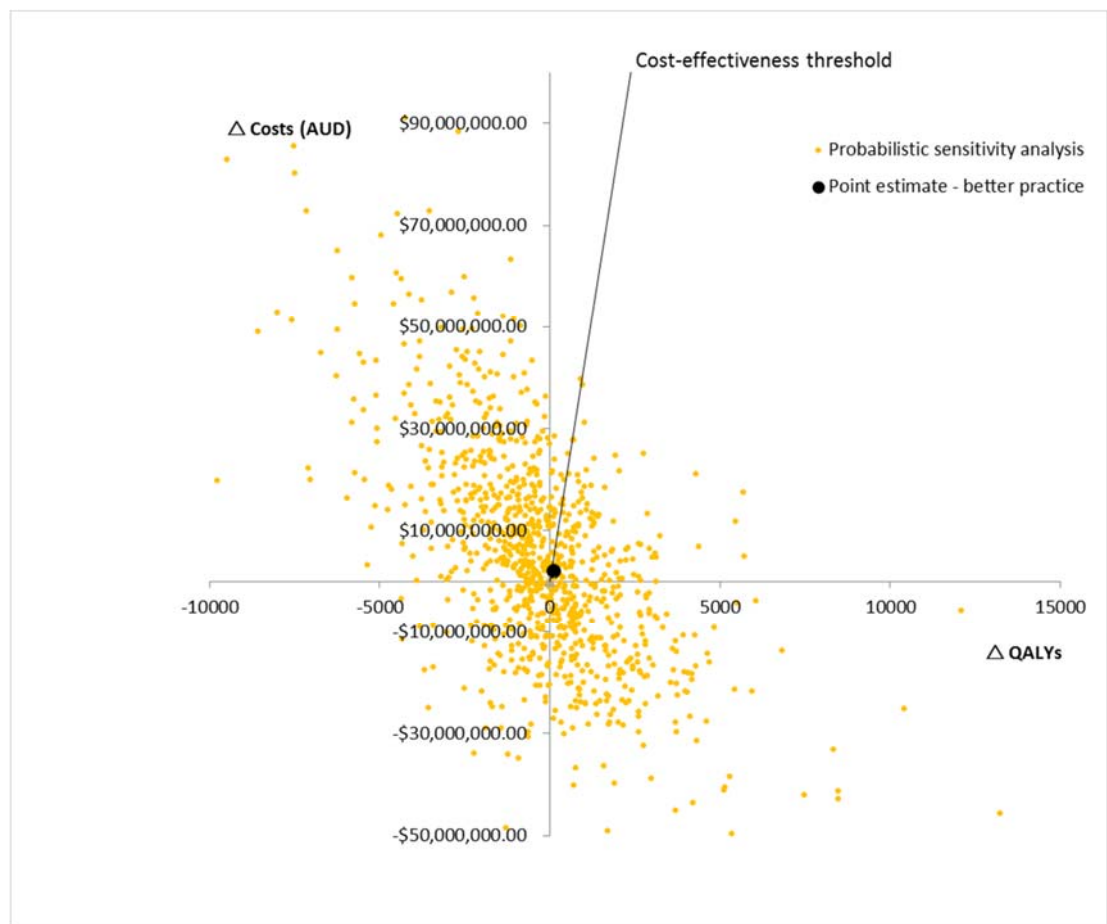


Figure 7.1.
Incremental cost-effectiveness of “better practice” (results per 20 000 procedures)

The mean outcomes from 10 000 simulations of the probabilistic economic model are reported in Table 7.1. A mean of 734 SSIs per 20 000 caesarean section procedures are estimated to be diagnosed amongst women from current practice hospitals. A mean of 1011 SSIs per 20 000 procedures are estimated amongst women from better practice hospitals. Better practice is more expensive, and fewer QALYs are gained, resulting in a probabilistic ICER of -\$29 530 per QALY gained.

Table 7.1

Probabilistic SSI, cost and health outcomes associated with each type of caesarean section practice

| Practice type | SSIs | Probabilistic outcomes (per 20 000 procedures) | | |
|------------------|------|--|---------|------------|
| | | Costs | QALYs | ICER |
| Current practice | 734 | \$198 876 906 | 988 948 | comparator |
| Better practice | 1011 | \$201 764 462 | 988 850 | dominated |

7.1.1 Net monetary benefit

As the ICER is negative, examining the incremental NMB and its uncertainty intervals, assists interpretation of the results. The incremental NMB is negative at approximately -\$7 million at a cost-effectiveness threshold of \$42 000 per QALY, which confirms that better practice is unlikely to be cost-effective (Table 7.2).

Table 7.2

Probabilistic incremental NMB associated with each type of caesarean section practice

| Practice type | Mean | Incremental NMB |
|------------------|--------------|--------------------------------|
| | | 95% uncertainty interval |
| Current practice | | comparator |
| Better practice | -\$6 994 079 | -\$249 804 004 – \$258 056 825 |

This result is supported by the distribution of incremental NMBs plotted in *Figure 7.2* because slightly more of the distribution of NMB is negative. The red line indicates zero incremental NMB, and the peak of the distribution is at -\$6.9 million.

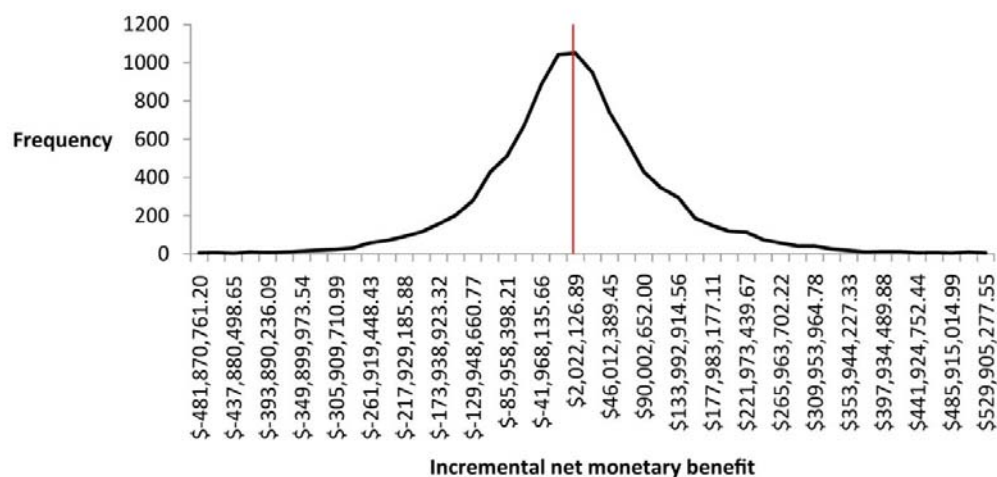


Figure 7.2.

Distribution of NMB at a \$42 000 cost-effectiveness threshold

A cost-effectiveness acceptability curve represents the proportion of probabilistic sensitivity analysis simulations that result in a greater NMB for better practice plotted against a range of cost-effectiveness thresholds (*Figure 7.3*). Current practice has a consistently higher probability of being cost-effective compared to better practice.

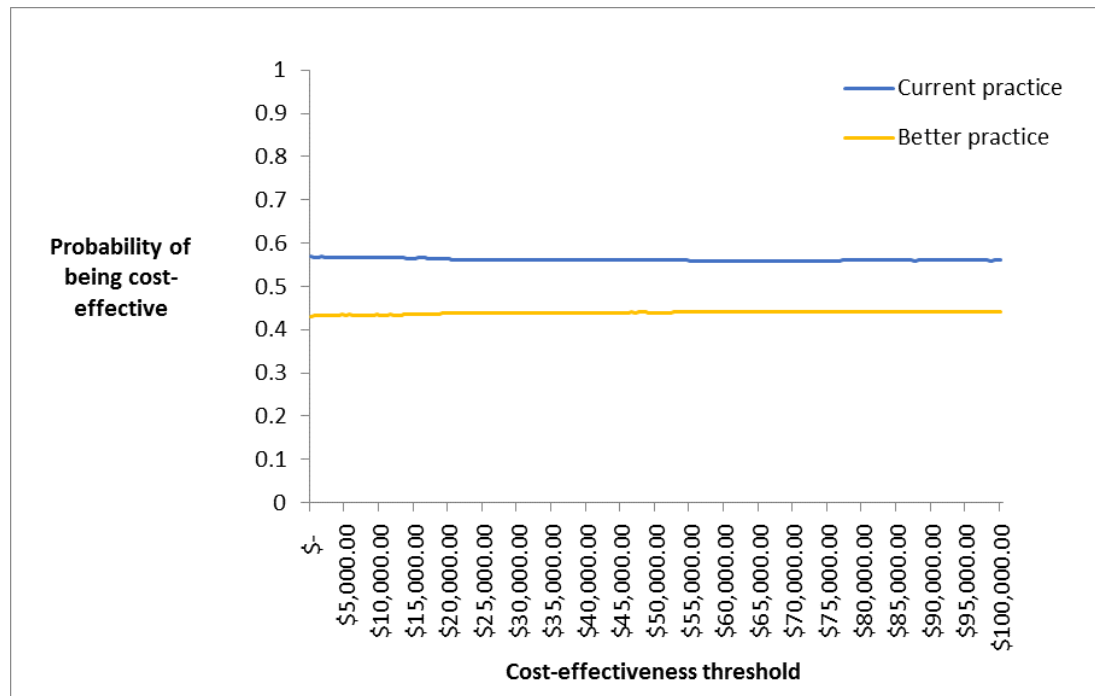


Figure 7.3.
Cost-effectiveness acceptability curve

7.1.2 Markov traces

The cohort of 20 000 women moving through the economic model can be traced to investigate which health states and transitions are driving the cost-effectiveness results. Known as Markov traces⁹, the plots of women's movements throughout the model timeframe explain where costs are incurred and health utilities lost. It is important to note that women can re-enter some health states and therefore the total number of women who are in each health state reported below includes multiple entries over time. The sum of entries to a health state indicates costs and health outcomes associated with that health state. Markov traces for women remaining in each health state in the economic model structure (*Figure 6.1*) are reported below and their meaning is discussed in Chapter 8.

Women leave the “caesarean section” health state and enter “normal recovery at home” at approximately the same rates (*Figure 7.4*). This means there are no large differences in costs incurred and health outcomes gained between women from current and better practice hospitals.

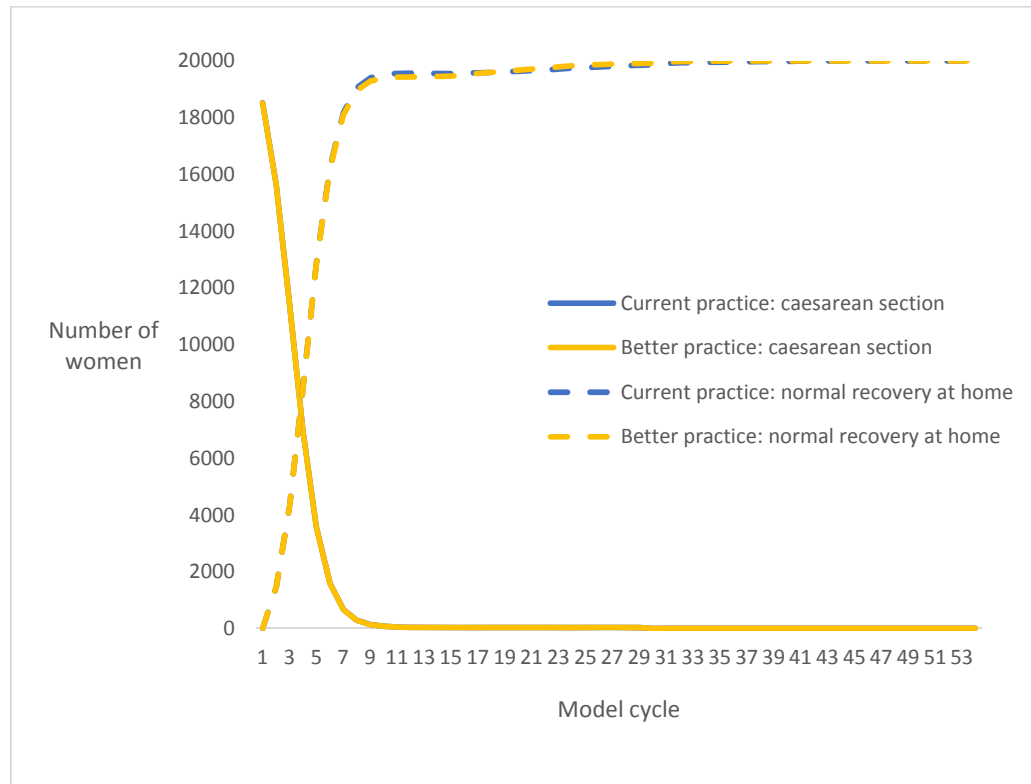


Figure 7.4.
Number of women in caesarean section and normal recovery at home health states

Of the 20 000 cohort, 5110 women from current practice hospitals are in the “infection at home” health state compared to 3766 women from better practice hospitals between days one and 39. This difference is shown in *Figure 7.5* where there is a smaller area under the better practice curve compared to the current practice curve.

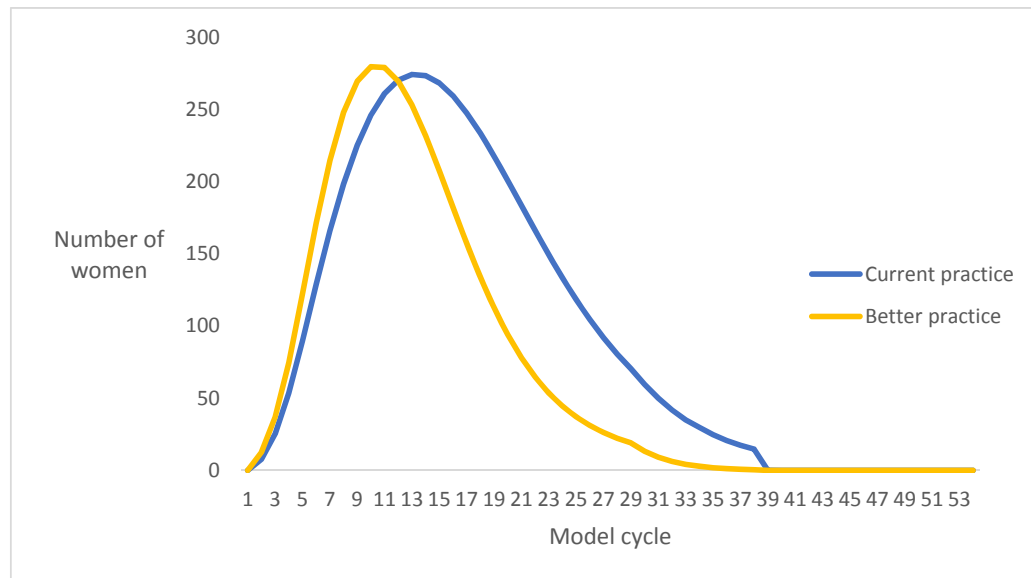


Figure 7.5.
Number of women in infection at home health state

Of the 20 000 cohort, 890 women from current practice hospitals and 893 women from better practice hospitals are in the “infection in hospital” health state over 34 days. This difference is represented by the area under the curves in *Figure 7.6*. More women from better practice hospitals remain in the “infection in hospital” health state between days 6 and 17, and fewer women remain in the health state between days three and 5, and between days 18 and 34.

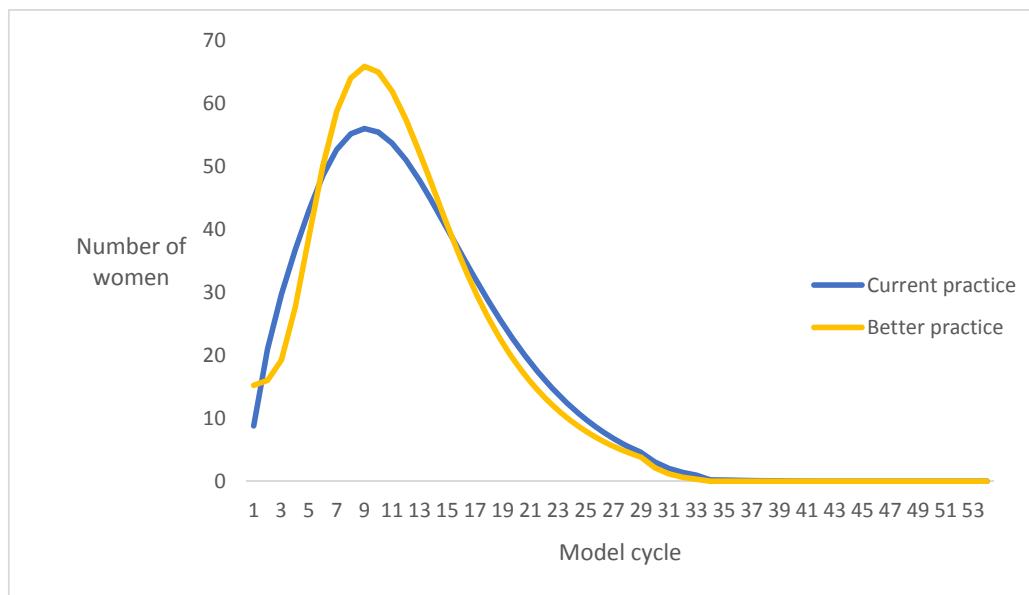


Figure 7.6.
Number of women in infection in hospital health state

Of the 20 000 cohort, 80 women from current practice hospitals and 245 women from better practice hospitals are in the “infection with NPWT” health state between days 6 and 23 (*Figure 7.7*).

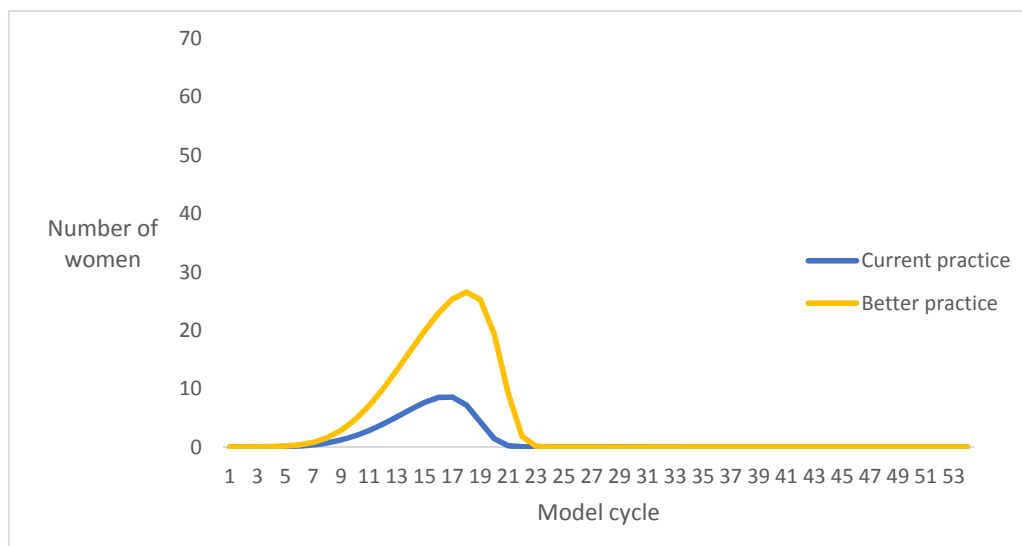


Figure 7.7.
Number of women in infection with NPWT health state

The estimated transition probabilities of moving into the “infection with surgery” health state were very low for both better and current practice hospitals (Appendix J). This means that zero women enter this health state from the cohort and no costs or health utilities are incurred.

Of the 20 000 cohort, 1184 women from current practice are in the “post-infection recovery” health state between days 5 and 40, compared to 1867 women from better practice hospitals between days 4 and 36 (*Figure 7.8*). Women from better practice hospitals transition to the “post-infection recovery” health state sooner compared to women from current practice hospitals. Women from better practice hospitals also return to the “normal recovery at home” health state from “post-infection recovery” earlier than women from current practice hospitals.

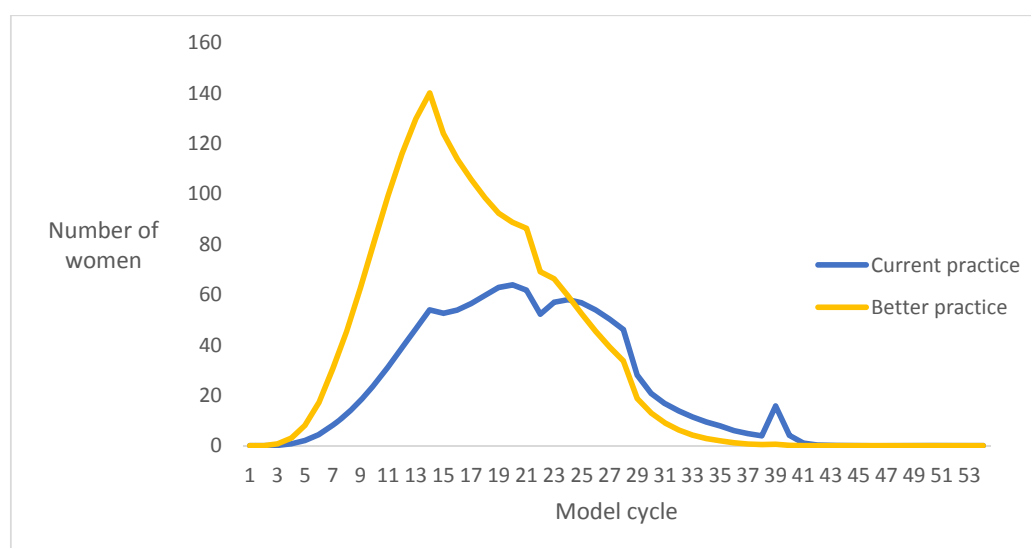


Figure 7.8.
Number of women in post-infection recovery health state

Implementing the infection prevention bundle with mostly adequate and good adherence (Table 6.5) is unlikely to be cost-effective when implemented universally in Queensland. From the cohort of 20 000, more women from better practice hospitals are estimated to acquire SSIs. The higher risk of SSI amongst women from better practice hospitals is a consequence of adjusting the Queensland hospital data for hospital funding type, NNIS risk index and BMI when estimating the transition probabilities (Section 6.3.3). After examining treatment patterns further through the Markov traces, it can be seen that women from current practice hospitals remain in the

“infection at home” health state longer than women from better practice hospitals. The number of women who are in the “infection in hospital” health state is similar for both better and current practice hospitals, while more women from better practice hospitals are in the “infection with NPWT” health state than women from current practice hospitals. Despite the shorter treatment time at home for women from better practice hospitals, the larger number of women diagnosed with SSI and treated with NPWT means that better adherence to the infection prevention bundle incurs more costs and fewer health outcomes.

7.1.3 Expected value of perfect information

The EVPI is \$40 284 960 at a cost-effectiveness threshold of \$42 000 (*Figure 7.9*). When decision makers are not willing to pay any amount for perfect information, which is a zero dollar cost-effectiveness threshold, the value of the research is \$7 105 119.

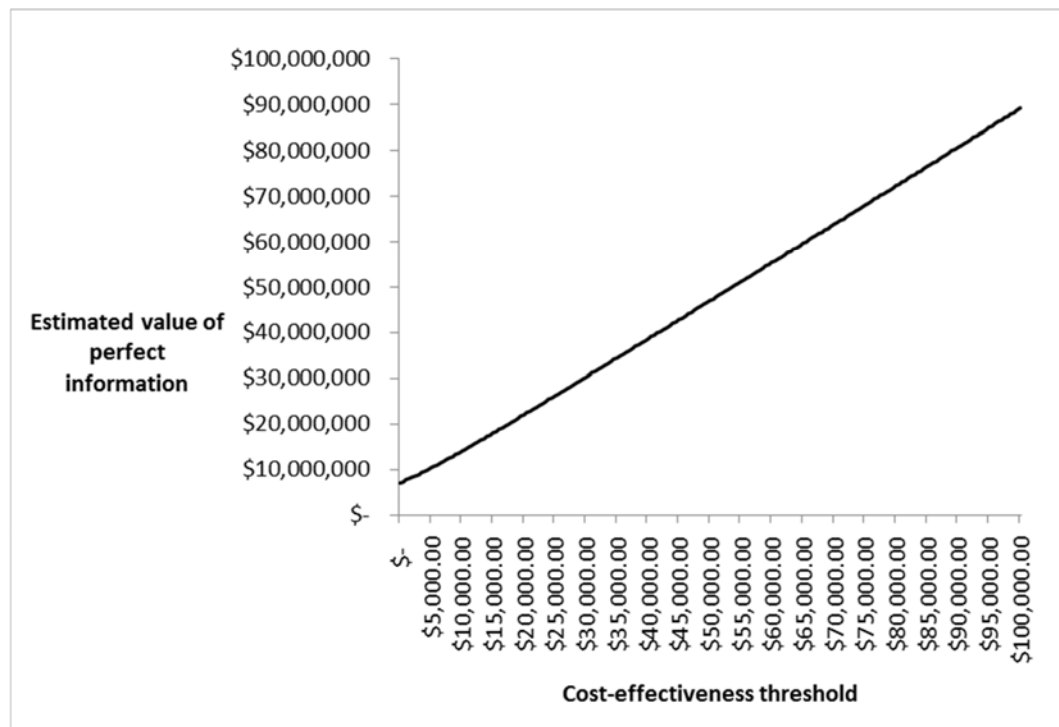


Figure 7.9.
EVPI at a range of cost-effectiveness thresholds

7.2 SUB-GROUP ANALYSES

In this section, the cost-effectiveness of a decision to adopt better adherence to the infection prevention bundle will be examined for the sub-groups: emergency caesarean sections, elective caesarean sections, obese women, private hospitals and public hospitals. The sub-group analysis results need to be interpreted with caution because when the small number of SSIs observed in the original Queensland hospital dataset were divided further into sub-groups, this meant there was even less data available for analysis. Therefore, some regression models excluded covariates to simplify the analysis, and the probability estimates from the original economic model were used for transitions where there were too few women for analysis (Appendices K to O). There was also high uncertainty in the transition probability estimates, represented by large standard errors of the coefficients that informed the estimates. For each sub-group, cost-effectiveness results are presented in terms of costs and health outcomes, as well as NMB. Relevant results of the transition probability estimations and Markov traces are also presented here to assist in the explanation of results provided in Chapter 8.

7.2.1 Emergency caesarean section

For women having an emergency caesarean section, better adherence to the infection prevention bundle is cost-effective. The point estimate from the deterministic analysis plotted in *Figure 7.10* shows the ICER of -\$24 326 per QALY gained, which lies below the cost-effectiveness threshold. There is a 68% probability that better practice is cost-effective, and a 57% probability that better practice is cost-saving and health-improving. The results of the probabilistic sensitivity analysis are represented in the scatterplot of simulation results (*Figure 7.10* - only 1000 simulations shown).

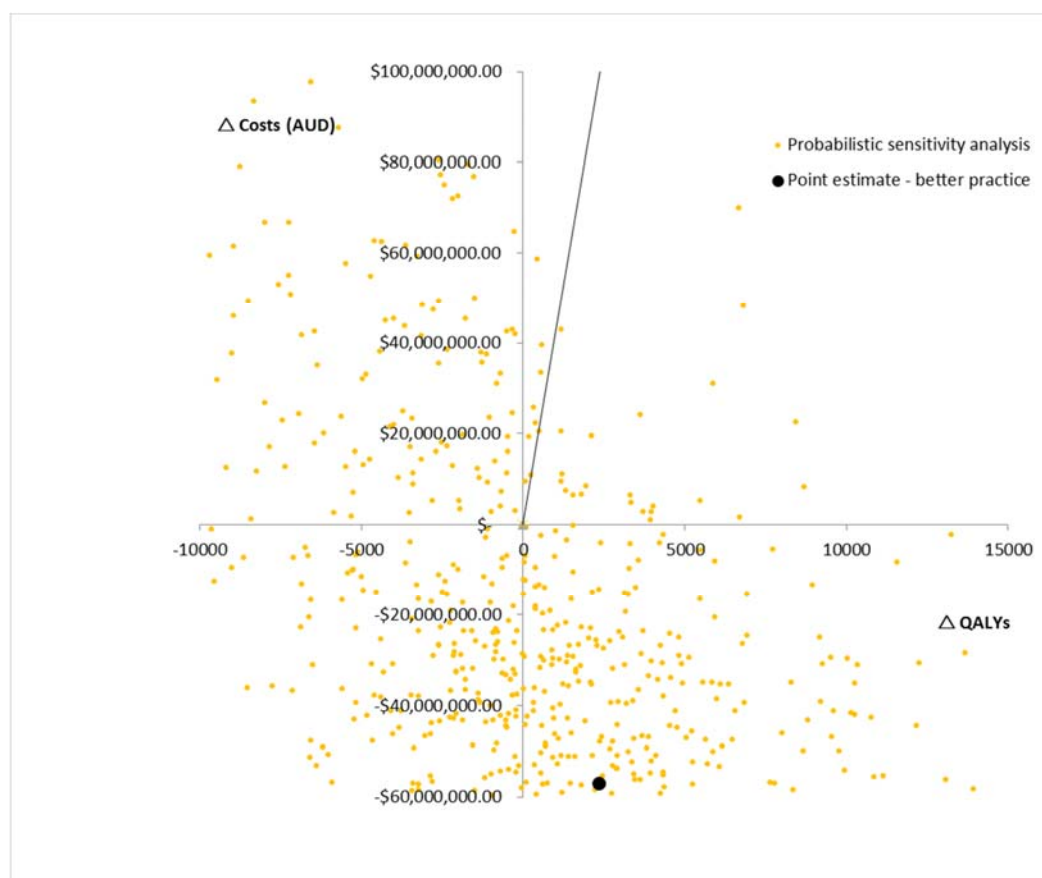


Figure 7.10.
Incremental cost-effectiveness of “better practice”, emergency caesarean section sub-group (results per 20 000 procedures)

The mean outcomes from the 10 000 simulations of the probabilistic economic model are reported in Table 7.3. More SSIs per 20 000 procedures are estimated to be diagnosed amongst women from better practice hospitals. Better adherence to the infection prevention bundle is less costly and more QALYs are gained from the intervention.

Table 7.3

Probabilistic SSI, cost and health outcomes associated with each type of caesarean section practice, emergency caesarean section sub-group

| Practice type | SSIs | Probabilistic outcomes (per 20 000 procedures) | | |
|------------------|------|--|---------|------------|
| | | Costs | QALYs | ICER |
| Current practice | 1597 | \$282 253 765 | 983 521 | comparator |
| Better practice | 2030 | \$224 919 294 | 985 919 | dominant |

The incremental NMB is approximately \$158 million at a cost-effectiveness threshold of \$42 000 per QALY gained, which confirms that adopting better practice amongst women having an emergency caesarean section is likely to be cost-effective (Table 7.4).

Table 7.4

Probabilistic incremental NMB associated with each type of caesarean section practice, emergency caesarean section sub-group

| Practice type | Mean | Incremental NMB |
|------------------|---------------|----------------------------------|
| | | 95% uncertainty interval |
| Current practice | | comparator |
| Better practice | \$158 030 161 | -\$519 345 692 – \$1 025 047 106 |

To understand the cost-effectiveness analysis of the emergency caesarean section sub-group further, brief results of the transition probabilities and Markov traces are presented in the following paragraphs. Transition probabilities used for the emergency caesarean section sub-group model are presented in Appendix K.

Women from current practice hospitals who have an emergency caesarean section stay longer immediately following birth and have a higher probability of transitioning to the infection in hospital health state directly from the “caesarean section” health state (Appendix K). This is reflected in the Markov trace with women from better practice hospitals transitioning from “caesarean section” to “normal recovery at home” sooner than women from current practice hospitals (*Figure 7.11*). As the scale of *Figure 7.11* is in the tens of thousands, the difference in numbers of women from current practice hospitals incurring costs by remaining in “caesarean section” is very large. For example, on day four, 11 010 women from current practice hospitals remain in the caesarean section health state, while only 6281 women from better practice hospitals remain.

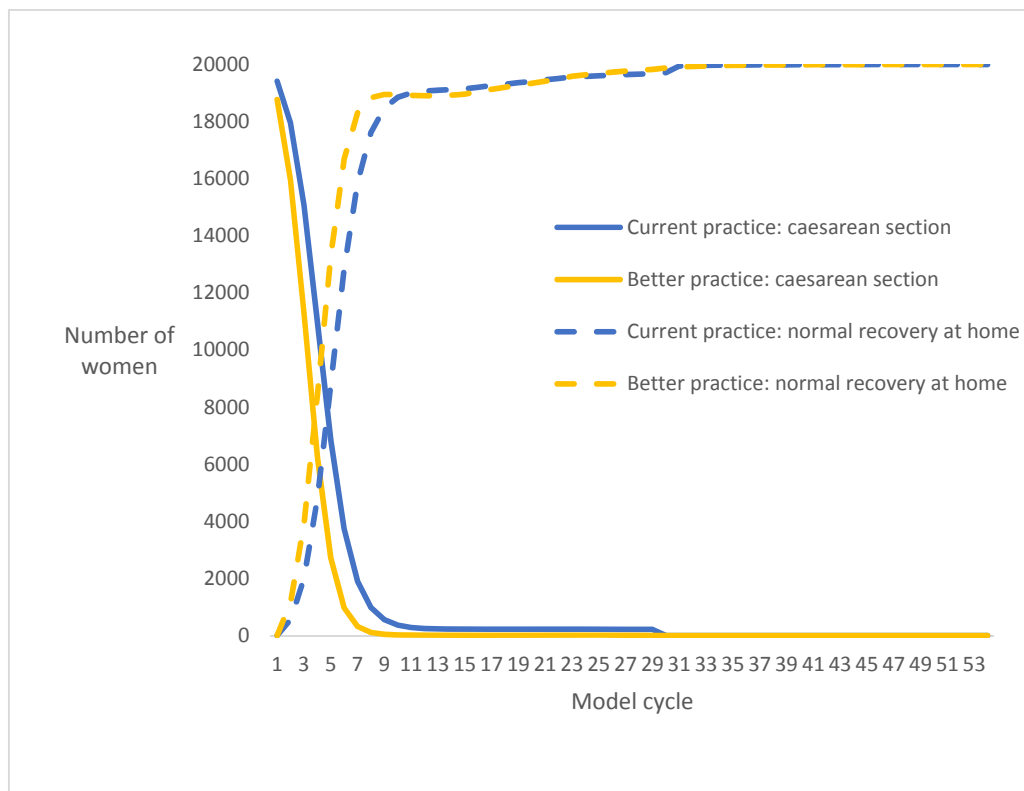


Figure 7.11.
Number of women in caesarean section and normal recovery at home health states, emergency caesarean section sub-group

For women from current and better practice hospitals, there is a higher probability of transitioning from “normal recovery at home” to both the “infection at home” and “infection in hospital” health states than the estimated probabilities in the original economic model. However, consistent with the original economic model, women from better practice hospitals have a slightly higher probability of transitioning to both “infection at home” and “infection in hospital” than women from current practice hospitals (Appendices J and K).

There are three large differences in the transition probability patterns from the “infection at home” health state compared to the probabilities estimated in the original economic model. Firstly, the probability of remaining in “infection at home” is similar for women from current and better practice hospitals, whereas women from current practice hospitals remain in the health state for longer and transition later to the “post-infection recovery” health state in the original economic model. The second difference for the emergency caesarean section sub-group is that women from better practice

hospitals are slightly less likely to transition to “post-infection recovery” than women from current practice hospitals, which is the reverse pattern observed in the original economic model. The third difference from the original economic model is that women from better practice hospitals were more likely to transition from “infection at home” to “infection in hospital” than women from current practice hospitals, which is also the reverse to what was observed in the original economic model (Appendices J and K). Overall, the time spent in the “infection in hospital” health state is similar for women from current and better practice hospitals, with treatment occurring between days one and 33 (*Figure 7.12*).

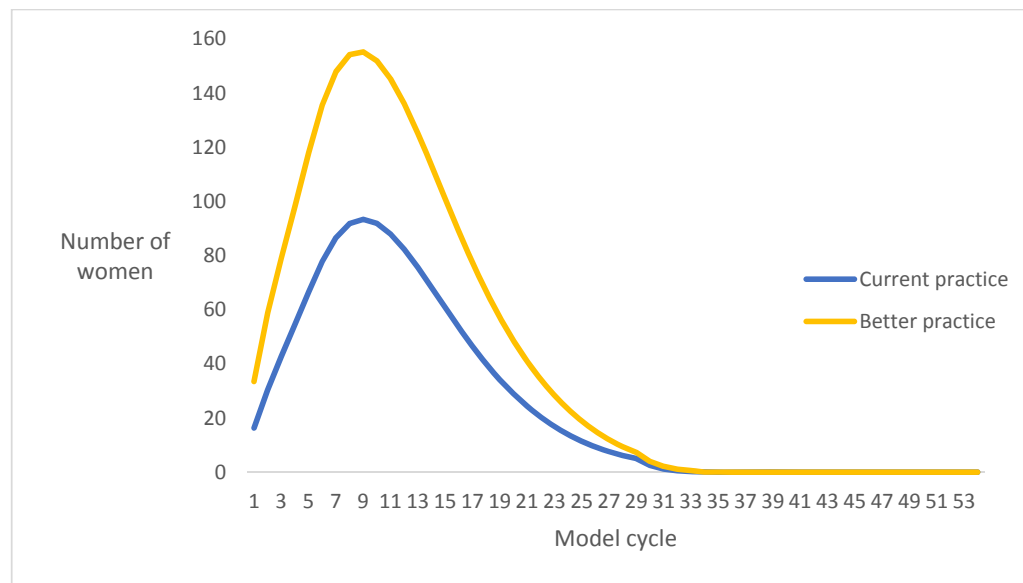


Figure 7.12.
Number of women in infection in hospital health state, emergency caesarean section sub-group

In the original economic model, only women who have an emergency caesarean section enter the “infection with NPWT” health state. Therefore the original estimated probabilities for transitioning out of the “infection with NPWT” health state were used in the emergency caesarean section sub-group model.

In all sub-group analyses, the transition probabilities from the “post-infection recovery” health state were the same as those used in the original economic model as they were not expected to vary by sub-group (Appendix J).

The health gains observed with better adherence to the infection prevention bundle for women who have had an emergency caesarean section sub-group model, are a result of women from better practice hospitals transitioning from “caesarean section” to the “normal recovery at home” health state sooner. In this sub-group, there are more women from current practice hospitals being treated compared to the original economic model. Length of treatment is similar between the two hospital types for both “infection at home” and “infection in hospital” health states, with women from current practice being admitted directly following caesarean section and women from better practice hospitals readmitted post-discharge. This means that more costs are associated with current practice in the sub-group analysis and the differences between the two interventions are smaller.

7.2.2 Elective caesarean section

For women having an elective caesarean section, better adherence to the infection prevention bundle is not likely to be cost-effective. The point estimate from the deterministic analysis plotted in *Figure 7.13* shows the ICER of -\$7 144 per QALY gained, which lies in the north-west quadrant above the cost-effectiveness threshold. There is a 38% probability that better practice is cost-effective, and a 25% probability that better practice is cost-saving and health improving. The results of the probabilistic sensitivity analysis are represented in the scatter plot of simulation results (*Figure 7.13* - only 1000 simulations are shown).

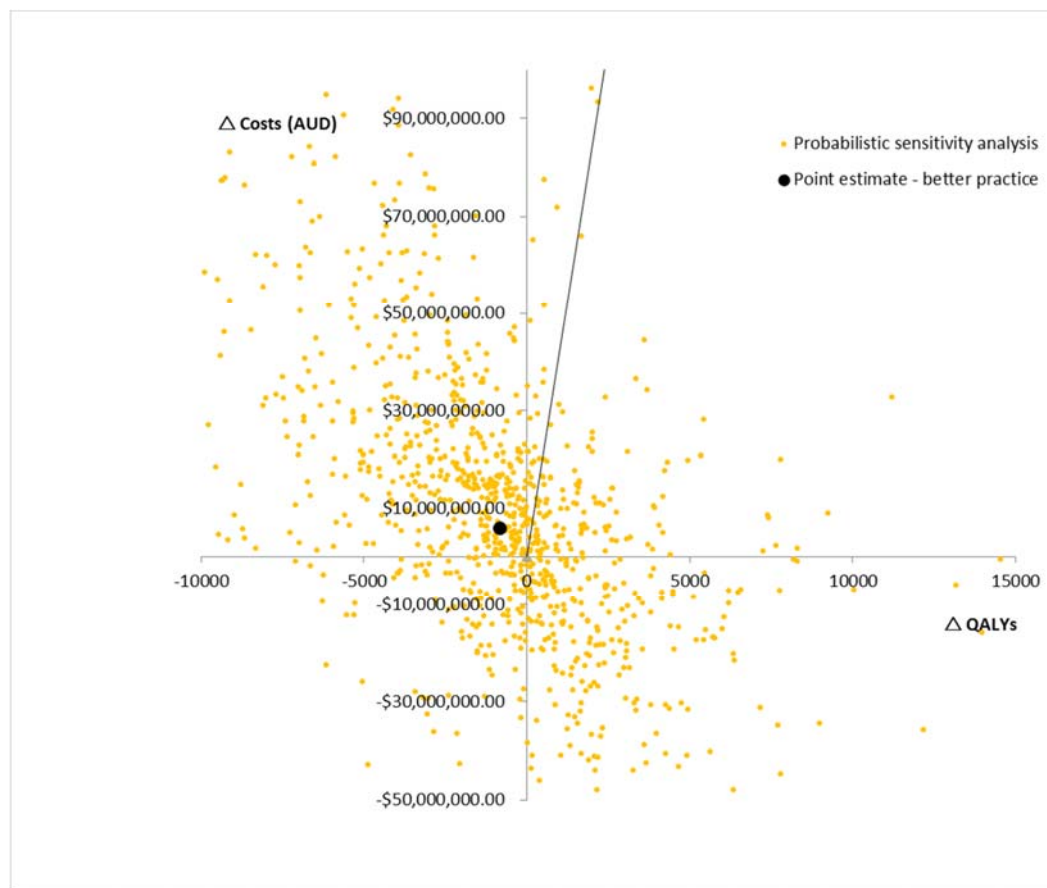


Figure 7.13.
Incremental cost-effectiveness of “better practice”, elective caesarean section sub-group (results per 20 000 procedures)

The mean outcomes from the 10 000 simulations of the probabilistic economic model are reported in Table 7.5. The key difference with the elective caesarean section sub-group is that better adherence to the infection prevention bundle costs much more, with more QALYs lost with adoption of better practice compared to the original economic model.

Table 7.5

Probabilistic SSI, cost and health outcomes associated with each type of caesarean section practice, elective caesarean section sub-group

| Practice type | SSIs | Probabilistic outcomes (per 20 000 procedures) | | |
|------------------|------|--|---------|------------|
| | | Costs | QALYs | ICER |
| Current practice | 1414 | \$187 332 473 | 988 610 | comparator |
| Better practice | 1876 | \$195 800 139 | 987 782 | dominated |

The incremental NMB is negative (-\$43.3 million) at a cost-effectiveness threshold of \$42 000 per QALY gained, which confirms that adopting better practice amongst women having an elective caesarean section is not likely to be cost-effective (Table 7.6).

Table 7.6

Probabilistic incremental NMB associated with each type of caesarean section practice, elective caesarean section sub-group

| Practice type | Mean | Incremental NMB |
|------------------|---------------|--------------------------------|
| | | 95% uncertainty interval |
| Current practice | | comparator |
| Better practice | -\$43 276 899 | -\$506 413 852 – \$452 526 989 |

The key results from the estimation of transition probabilities further explain the results of the cost-effectiveness analysis (Appendix L). Women who have an elective caesarean section at better practice hospitals are more likely to transition directly from the “caesarean section” health state to the “infection in hospital” health state than women from current practice hospitals. Women from better practice hospitals also have a higher probability of transitioning from “normal recovery at home” to “infection in hospital” than women from current practice hospitals, and also compared to the original economic model. Women who have an elective caesarean section at better practice hospitals are slightly more likely to transition from “infection at home” to “infection in hospital” compared to current practice hospitals. This is inverse to the trend in the estimated probabilities used in the original economic model where more women from current practice hospitals transition from “infection at home” to “infection in hospital” (Appendices J and L).

The probabilities of transitioning from “infection in hospital” were not able to be estimated, and the estimates from the original economic model were used for the elective caesarean section sub-group model. However, in the original Queensland hospital dataset, no women who had an elective caesarean section were treated with NPWT. Therefore, the transition probabilities were data-driven and the probability of women from both current and better practice hospitals transitioning from “infection in hospital” to “infection with NPWT” was set at zero. Consequently, no women

transition from “infection with NPWT” to “post-infection recovery” in the elective caesarean section sub-group (Appendix L).

Better adherence to the infection prevention bundle for elective caesarean section is unlikely to be cost-effective because many more women from better practice hospitals acquire a SSI and more are admitted to hospital for treatment than women from current practice hospitals, and also compared to those in the original economic model.

7.2.3 Obese women

Better adherence to the infection prevention bundle is unlikely to be cost-effective for obese women (*Figure 7.14* – 1000 simulations are shown).

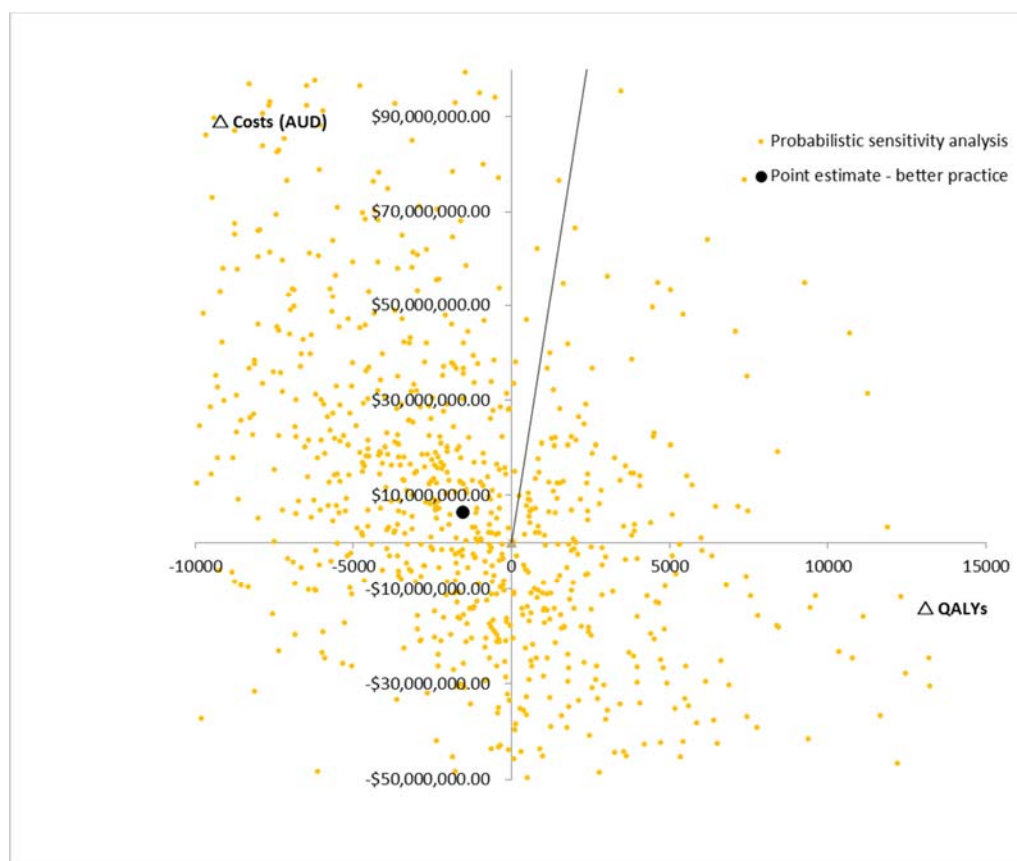


Figure 7.14.
Incremental cost-effectiveness of “better practice”, obese women sub-group (results per 20 000 procedures)

The point estimate in *Figure 7.14* indicates the ICER for better practice at -\$4260 per QALY gained, which lies in the north-west quadrant and above the cost-effectiveness threshold. Better practice has a 37% probability of being cost-effective, with a 26% probability of being cost-saving and health-improving as shown by the scatterplot of simulation results in *Figure 7.14*.

A probabilistic mean of 2768 SSIs are estimated amongst obese women from current practice hospitals, with 3775 SSIs amongst obese women from better practice hospitals (Table 7.7). Costs are higher, and fewer health outcomes are achieved with better adherence to the infection prevention bundle (Table 7.7).

Table 7.7

Probabilistic SSI, cost and health outcomes associated with each type of caesarean section practice, obese women sub-group

| Practice type | SSIs | Probabilistic outcomes (per 20 000 procedures) | | |
|------------------|------|--|---------|------------|
| | | Costs | QALYs | ICER |
| Current practice | 2768 | \$210 248 861 | 985 946 | comparator |
| Better practice | 3775 | \$221 732 773 | 984 407 | dominated |

The incremental NMB is negative at approximately -\$76.1 million at a cost-effectiveness threshold of \$42 000 per QALY, which confirms that better practice is not cost-effective for obese women (Table 7.8).

Table 7.8

Probabilistic incremental NMB associated with each type of caesarean section practice, obese women sub-group

| Practice type | Mean | Incremental NMB |
|------------------|---------------|--------------------------------|
| | | 95% uncertainty interval |
| Current practice | | comparator |
| Better practice | -\$76 144 423 | -\$871 169 235 – \$733 140 663 |

The results of the transition probability estimations and Markov traces will be examined briefly in the following paragraphs to further understand the sub-group model results.

Obese women from current practice hospitals have a much higher probability of transitioning directly from “caesarean section” to “infection in hospital” health state

than women in the original economic model and women from better practice hospitals in the sub-group model. Obese women from better practice hospitals have an almost zero probability of transitioning directly to “infection in hospital” (Appendix M).

Obese women from current and better practice hospitals have a similar probability of transitioning from the “infection at home” to “post-infection recovery” health state. This is in contrast to the original economic model where women from better practice hospitals transition to “post-infection recovery” sooner. Obese women from both current and better practice hospitals had a higher probability of transitioning to the “infection in hospital” health state than women in the original economic model. However, in the obese women sub-group model, those from better practice hospitals have a higher probability of transitioning to “infection in hospital” than women from current practice hospitals (Appendix FF).

The probabilities of transitioning from “infection in hospital” were not able to be estimated, and so the estimates from the original economic model were used for the obese women sub-group model (Appendix J).

As per the original probability estimates, obese women from better practice hospitals have a higher probability of entering the “infection with NPWT” health state than women from better practice hospitals. The higher probability is reflected in the Markov trace where 223 women from current practice hospitals are in the “infection with NPWT” health state between days 7 and 23 compared to 1291 women from better practice hospitals over a slightly longer treatment time (*Figure 7.15*).

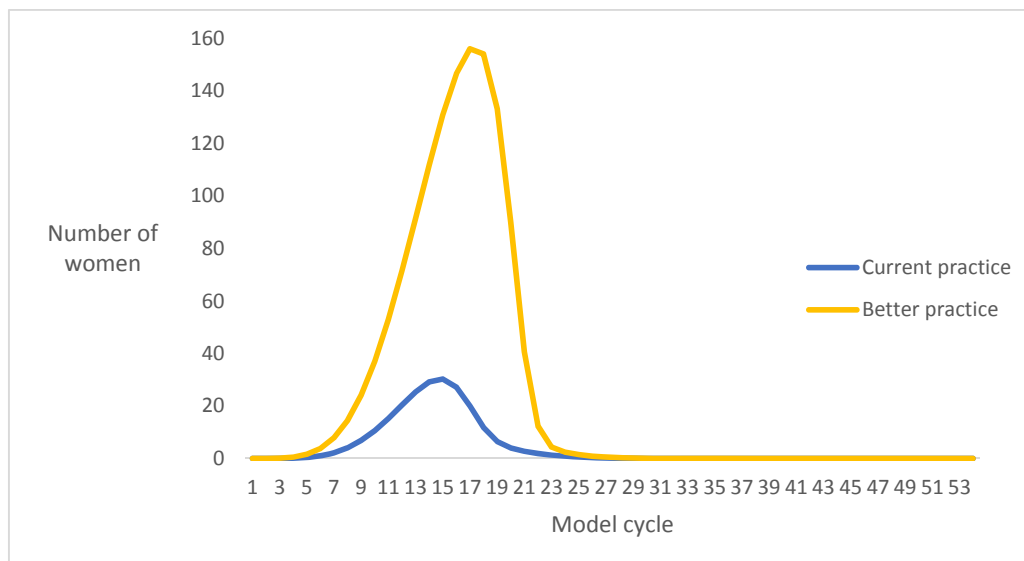


Figure 7.15.
Number of women in infection with NPWT health state, obese women sub-group

Higher costs are associated with more women from better practice hospitals being treated with NPWT, and health outcomes are lost with more women diagnosed and treated for an SSI than women from current practice hospitals. This results in better adherence to the infection prevention bundle unlikely to be cost-effective. Whether the decision to use the original probabilities of transitioning from infection in hospital in the obese women sub-group model has affected these results in either direction is unknown.

7.2.4 Private hospitals

For women birthing in private hospitals, better adherence to the infection prevention bundle is unlikely to be cost-effective. The point estimate from the deterministic analysis plotted in *Figure 7.16* shows the ICER of -\$19 125 per QALY gained, which lies above the cost-effectiveness threshold. There is a 22% probability that better practice is cost-effective, and a 12% probability that better practice is cost-saving and health-improving. The results of the probabilistic sensitivity analysis are represented in the scatterplot of simulation results (*Figure 7.16* - only 1000 simulations shown).

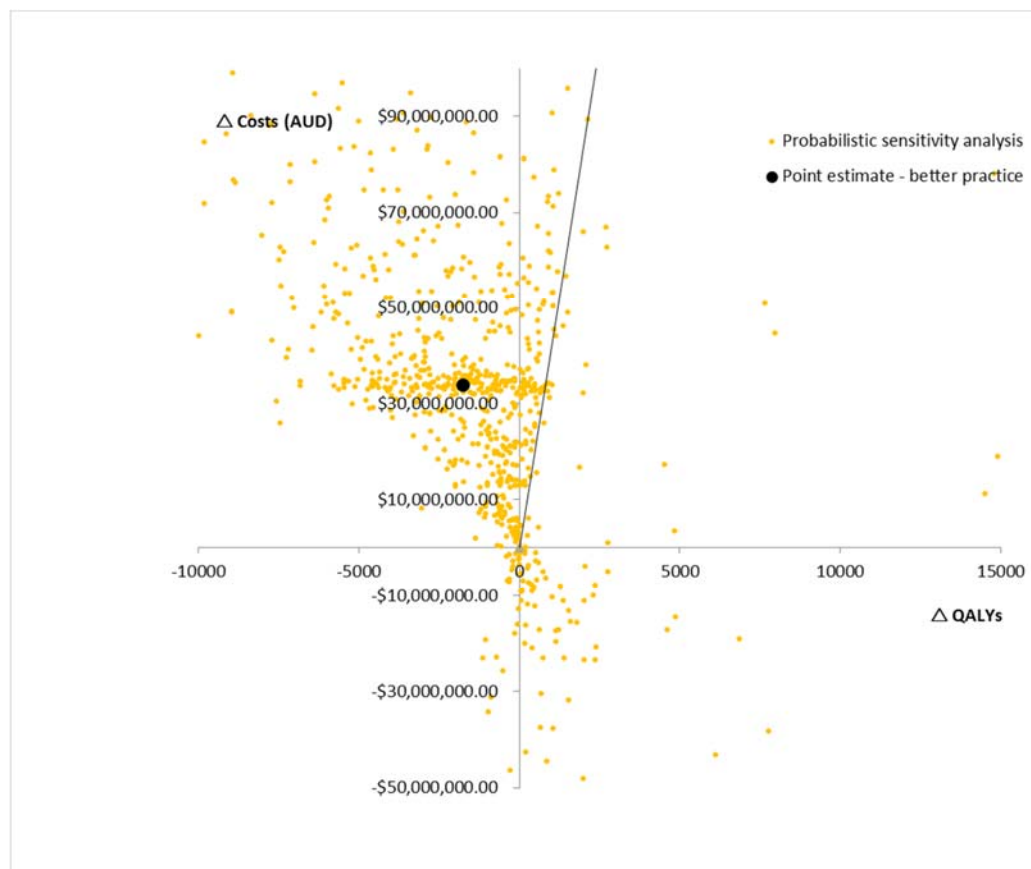


Figure 7.16.
Incremental cost-effectiveness of “better practice”, private hospitals sub-group
(results per 20 000 procedures)

The mean outcomes from the 10 000 simulations of the probabilistic economic model are reported in Table 7.9. More SSIs per 20 000 procedures are estimated to be diagnosed amongst women from better practice private hospitals. Better adherence to the infection prevention bundle is more expensive and fewer QALYs are gained from the intervention in private hospitals.

Table 7.9

Probabilistic SSI, cost and health outcomes associated with each type of caesarean section practice, private hospitals sub-group

| Practice type | SSIs | Probabilistic outcomes (per 20 000 procedures) | | |
|------------------|------|--|---------|------------|
| | | Costs | QALYs | ICER |
| Current practice | 1468 | \$214 340 572 | 986 480 | comparator |
| Better practice | 1696 | \$263 624 150 | 984 134 | dominated |

The incremental NMB is negative, at approximately -\$147.8 million at a cost-effectiveness threshold of \$42 000 per QALY gained, which confirms that adopting better practice in private hospitals is not likely to be cost-effective (Table 7.10).

Table 7.10

Probabilistic incremental NMB associated with each type of caesarean section practice, private hospitals sub-group

| Practice type | Mean | Incremental NMB |
|------------------|----------------|-----------------------------------|
| | | 95% uncertainty interval |
| Current practice | | comparator |
| Better practice | -\$147 805 718 | -\$2 526 694 183– \$2 277 126 807 |

When examining the estimated transition probabilities and Markov traces, the sub-group model results can be understood further.

Women from better practice private hospitals have a higher probability of staying in the “caesarean section” health state than women from current practice private hospitals (Appendix N), which is also reflected in the Markov trace (*Figure 7.17*).

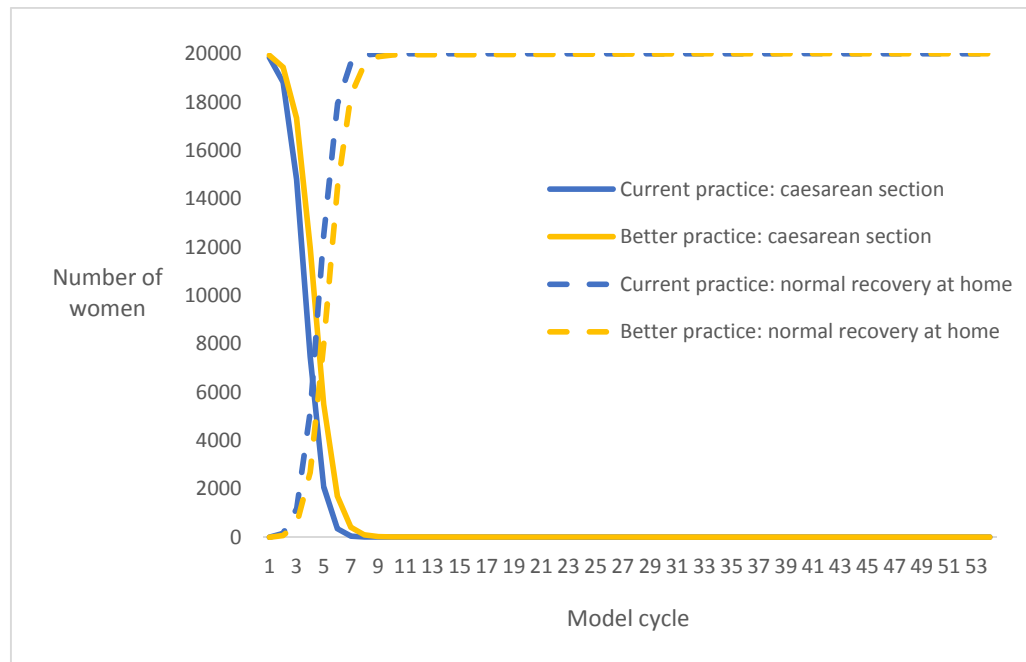


Figure 7.17.
Number of women in caesarean section normal and recovery at home health states,
private hospital sub-group

In the original Queensland hospital dataset, one woman from current practice private hospitals transitioned from “normal recovery at home” to “infection in hospital”, and zero women transitioned to “infection at home”. The binomial regression outputs were therefore spurious and multiplying the probability of transitioning to “infection in hospital” by three to estimate a more realistic probability of transitioning to “infection at home” (Section 6.3.3) resulted in nonsensical estimates. A multinomial regression model was used for estimating the transition probabilities from “normal recovery at home” to both “infection in hospital” and “infection at home” for women from private hospitals instead. The transition probabilities for women from current practice were also data-driven with the probability of transitioning to “infection at home” set to zero. The result of this changed method is that the transition probabilities better reflect the original Queensland hospital data, with very low probabilities of transitioning to the “infection at home” health state, but are unlikely to be representative of real life post-discharge SSI incidence for women from private hospitals (Appendix N).

For the transition from “infection at home”, women from current practice private hospitals have a zero probability of transitioning to infection in hospital, with a much higher probability for women from better practice hospitals (Appendix N).

The probabilities of transitioning from both “infection in hospital” and “infection with NPWT” were not able to be estimated, and so the estimates from the original economic model were used for the private hospital sub-group model (Appendix N).

Better adherence to the infection prevention bundle is unlikely to be cost-effective for private hospitals because of the much larger number of women from better practice hospitals being treated in hospital for an SSI. However, the estimated transition probabilities do not reflect a real life model of private hospitals adopting the infection prevention bundle because the estimates from the original economic model are used for two transitions, and the estimates for the transition from “normal recovery at home” are conservative.

7.2.5 Public hospitals

Better adherence to the infection prevention bundle is unlikely to be cost-effective for women birthing in public hospitals (*Figure 7.18* – 1000 simulations are shown).

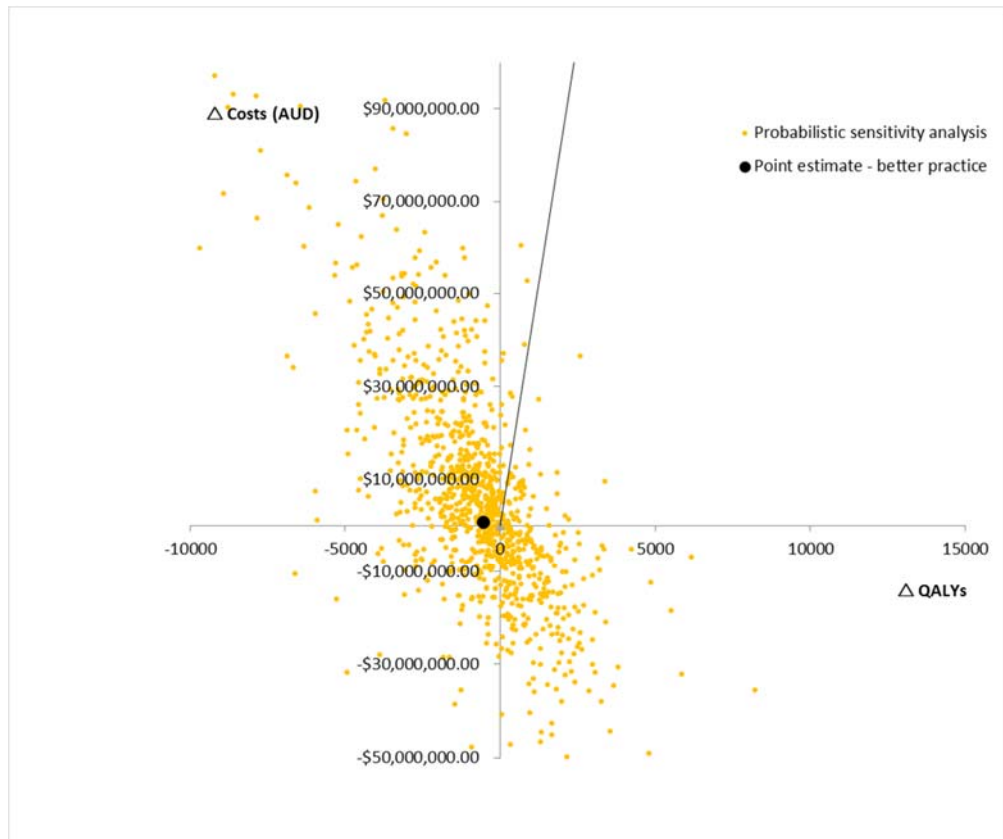


Figure 7.18.
Incremental cost-effectiveness of “better practice”, public hospitals sub-group
(results per 20 000 procedures)

The point estimate in *Figure 7.18* indicates the ICER for better practice at - \$1384, which lies in the north west quadrant and above the cost-effectiveness threshold. Better practice has a 35% probability of being cost-effective, and a 26% probability of being cost-saving and health-improving (*Figure 7.18*).

A probabilistic mean of 817 SSIs are estimated amongst women from current practice public hospitals, with 1304 SSIs amongst women from better practice public hospitals (Table 7.11). Costs are higher, and fewer health outcomes are achieved with better adherence to the infection prevention bundle (Table 7.11).

Table 7.11

Probabilistic SSI, cost and health outcomes associated with each type of caesarean section practice, public hospitals sub-group

| Practice type | SSIs | Probabilistic outcomes (per 20 000 procedures) | | |
|------------------|------|--|---------|----------------------|
| | | Costs | QALYs | ICER |
| Current practice | 817 | \$165 591 752 | 991 258 | comparator dominated |
| Better practice | 1304 | \$170 188 709 | 990 585 | |

The incremental NMB is negative at approximately -\$32.9 million at a cost-effectiveness threshold of \$42 000 per QALY, which confirms that better practice is not cost-effective for public hospitals (Table 7.12).

Table 7.12

Probabilistic incremental NMB associated with each type of caesarean section practice, public hospitals sub-group

| Practice type | Mean | Incremental NMB |
|------------------|---------------|--------------------------------|
| | | 95% uncertainty interval |
| Current practice | | comparator |
| Better practice | -\$32 862 908 | -\$271 175 918 – \$178 276 345 |

When examining the estimated transition probabilities and Markov traces, the sub-group model results can be understood further.

Similar to obese women, women from current practice public hospitals have a much higher probability of transitioning directly from the “caesarean section” to “infection in hospital” health state between days 15 and 29 than women from better practice hospitals, and all women in the original economic model. Women from better practice public hospitals have an almost zero probability of transitioning directly to “infection in hospital” (Appendix O).

Women from better practice public hospitals have a higher probability of remaining in the “infection at home” health state compared to the original economic model. These women transition to “post-infection recovery” at approximately the same rate as women from current practice hospitals. This results in women from better practice hospitals having a lower probability of transitioning from “infection at home” to “infection in hospital” between days 7 and 37 compared to women from current practice hospitals (Appendix O). One thousand, two hundred and seventy-six women

from current practice public hospitals are treated in hospital compared to 1726 women from better practice hospitals (*Figure 7.17*). The effect of the lower probability of transitioning to “infection in hospital” for women from better practice hospitals is seen by the large reduction in number of women in the health state between days 11 and 19 (*Figure 7.17*).

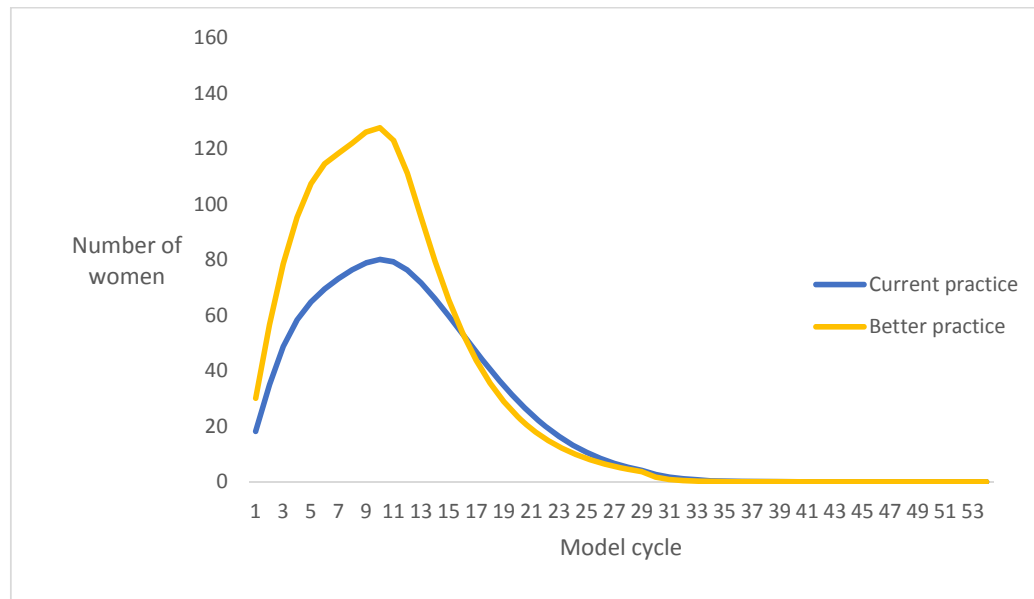


Figure 7.19.
Number of women in infection in hospital health state, public hospitals sub-group

Women from better practice public hospitals have a much higher probability of transitioning from the “infection in hospital” to the “infection with surgery” health state than women from current practice public hospitals, and also compared to the original economic model. This is reflected in the Markov trace (*Figure 7.20*) where 11 women from current practice hospitals are in the “infection with surgery” health state compared to 90 women from better practice hospitals. More women from better practice public hospitals also transition to “infection with NPWT” (*Figure 7.21*) (Appendix O).

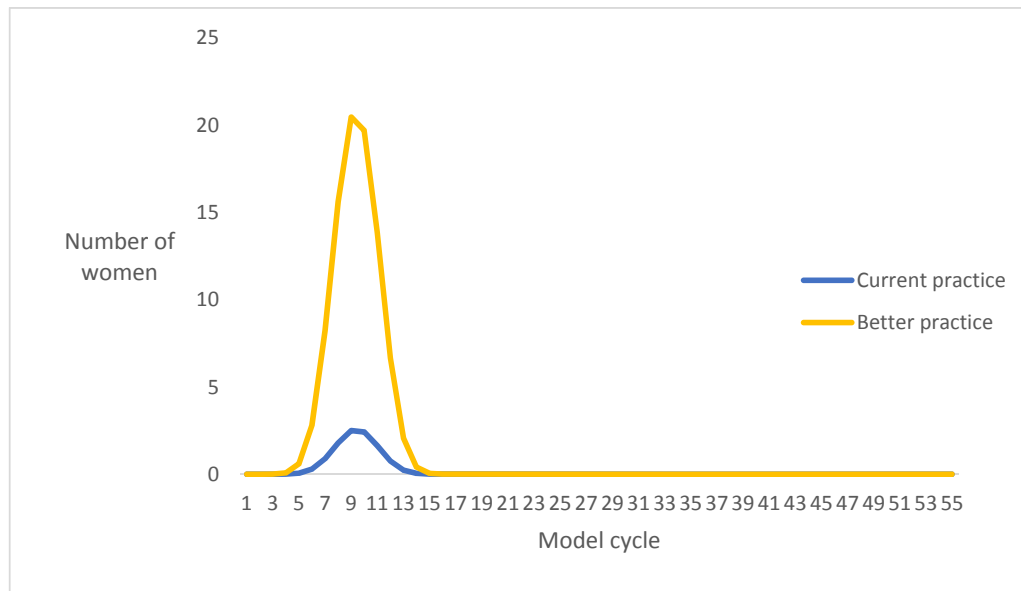


Figure 7.20.
Number of women in infection with surgery health state, public hospitals sub-group

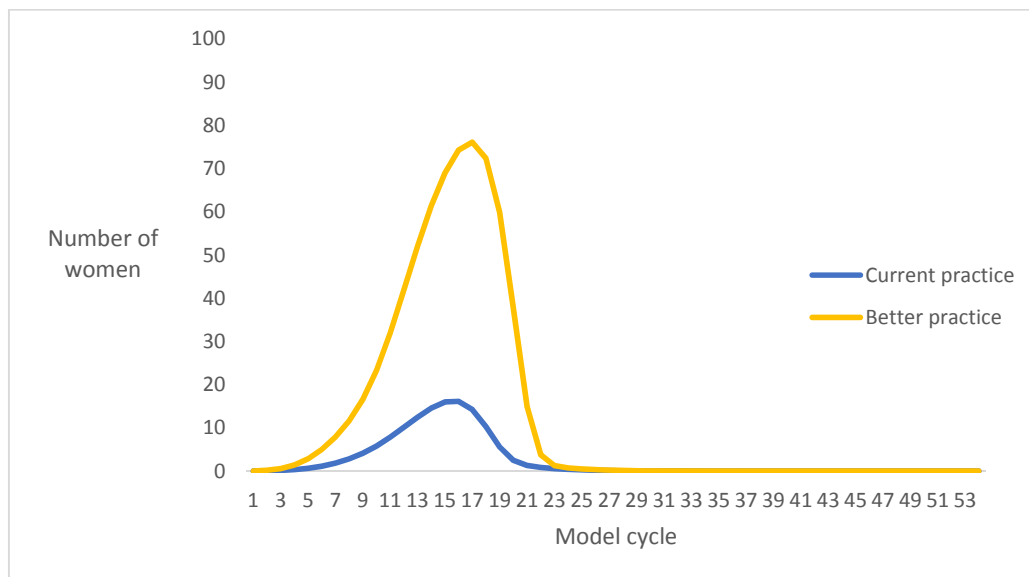


Figure 7.21.
Number of women in infection with NPWT health state, public hospitals sub-group

Better adherence to the infection prevention bundle is unlikely to be cost-effective for public hospitals because more women from better practice hospitals are diagnosed with an SSI and are treated in health states with higher associated costs: “infection in hospital”, “infection with surgery” and “infection with NPWT”.

7.3 CHAPTER SUMMARY

Overall, better adherence to the infection prevention bundle is not cost effective at a cost-effectiveness threshold of \$42 000 per QALY gained, given that women from better practice hospitals consistently have a higher risk of SSI than women from current practice hospitals. The exception to this result is the emergency caesarean section sub-group that has a 68% probability of being cost-effective. However the uncertainty is high in the decision to reject the infection prevention bundle for most caesarean sections. For the original economic model, the uncertainty is quantified by the probabilistic results contrasting the deterministic point-estimate, and the wide distribution of incremental NMB across both negative and positive benefits. There is also large uncertainty in the estimates of the transition probabilities for the sub-group analyses, especially those for private hospitals, due to the smaller sample sizes used in the regression models for transitions from infection health states. The estimated transition probabilities and Markov traces for the original economic model indicate there are differences in treatment and discharge patterns between women from current and better practice hospitals. Most notably, NPWT is used more often in better practice hospitals to treat women with an SSI. Variation in treatment and discharge patterns for women with SSI persisted across the different sub-groups. The reasons for women from better practice hospitals having a higher risk of SSI and whether variation in treatment of SSI following caesarean section is a driver of higher costs will be discussed in the next chapter.

Chapter 8: Discussion

The results of the evidence synthesis, survey of current infection prevention practice and economic modelling are discussed in this chapter. The meaning of the results for decision makers are interpreted in Section 8.1. Limitations and strengths of each study are also acknowledged in detail throughout Section 8.1, and they are summarised in Sections 8.2 and 8.3. Whether the economic modelling results can be generalised to all Queensland or Australian maternity hospitals is discussed in Section 8.4. The implications of the results for maternity and patient safety decision makers, including recommendations are outlined in Sections 8.5 and 8.6, and a conclusion to the thesis is presented in Section 8.7.

8.1 SUMMARY AND INTERPRETATION OF RESULTS

8.1.1 Synthesis of evidence for better infection control practice

In Chapter 4 the volume and quality of evidence around the competing risk reduction strategies that are relevant to decision makers for the prevention of post-caesarean SSI was identified and assessed. Key evidence was synthesised and an infection prevention bundle unique to caesarean section was developed. The infection prevention bundle was defined as “better practice” for the purposes of evaluating a decision to adopt the bundle (Chapter 4).

Three peri-operative strategies and surgical techniques with strong evidence for reducing the risk of SSI following caesarean section were selected for the infection prevention bundle. Pre-incision antibiotic prophylaxis is consistently demonstrated to reduce the risk of SSI by approximately 45%¹⁸². An even larger effect size is observed for vaginal preparation, particularly when used for emergency caesarean sections, but it applies only to endometritis and not wound infection⁶⁷. Spontaneous removal of the placenta protects against the higher risk of SSI associated with manual removal. As the effect sizes are large, and associated recommendations in Chapter 4 are based on the GRADE approach, there is confidence in the efficacy of the infection prevention bundle as the better practice for reducing SSI risk at caesarean section.

The results of the evidence synthesis are generally paralleled in other studies. Eighty-two peri-operative strategies and surgical techniques that have been evaluated for their impact on reducing surgical site infection risk were identified, while 77 strategies were found in the McKibben study¹⁸⁷. There is agreement between the evidence synthesis and the McKibben study for 17 out of 18 quality ratings given to each of the included studies using the modified AMSTAR method¹⁸⁷. The strategies recommended in the evidence synthesis also align with some of those identified in the McKibben paper¹⁸⁷. However, there is disagreement that the Joel-Cohen skin incision and that suturing thick ($\geq 2\text{cm}$) subcutaneous tissue are definitively superior to the alternatives in reducing SSI risk. For skin incision¹⁰⁸, only wound infection outcomes were examined, and it appears McKibben used a broader infection outcome¹⁸⁷. For suturing of subcutaneous tissue, an updated study was selected for inclusion²¹¹ which was different to that used by McKibben¹⁸⁷. Updated evidence for vaginal preparation has been synthesised in Chapter 4, allowing a stronger recommendation to be made since a study by Dahlke and colleagues was published¹⁰⁵. However as the quality of studies included in a meta-analysis selected for the evidence synthesis was assessed as low⁶⁷, more research for vaginal preparation is warranted, particularly as the effect sizes may not be seen across all sub-populations such as elective caesarean section. The results of the evidence synthesis otherwise corroborate with the Dahlke study.

The strength of the evidence synthesis is the focus on key caesarean section peri-operative strategies and surgical techniques that have been rigorously examined for their impact on surgical site infection. The GRADE approach used to develop the infection prevention bundle has resulted in better practice being clearly defined for decision makers.

In Chapter 4, evidence was synthesised from reviews, systematic reviews and meta-analyses given the prominence placed on the type of evidence generated by the latter two for clinical end users. As such, a limitation is that there may be strategies that have been trialled and demonstrate an effect in reducing SSI risk such as CHG for skin preparation⁹⁵ and NPWT¹⁶⁸, but not captured in the evidence synthesis because the small volume of evidence has not warranted a review by other researchers. There is potential for bias in the evidence synthesis approach used if other researchers were unable to publish or have not conducted systematic reviews of strategies and techniques that may reduce SSI risk and further inform this study.

Demonstrated efficacy of the individual bundle elements is different from demonstrated effectiveness of the bundle's implementation in theatre. The three identified strategies are therefore proposed as a theoretical infection prevention bundle, yet to be trialled in practice.

The success of infection prevention bundles is attributed to the higher health service standards that are set with an 'all or nothing' approach^{125, 245-247}. Implementing all elements of a bundle is more difficult than implementing a single process. However, effectiveness of an infection prevention bundle in practice is dependent on other factors as well bundle adherence. Best-practice in SSI prevention requires a multi-modal approach^{125, 245, 246} and therefore the infection prevention bundle is only one part of effective patient care. Other important aspects of SSI prevention are identifying patients' risk for SSI, general infection prevention and control strategies, environmental cleaning and surgeon's skill and techniques (Section 2.2.4). Best-practice surgical processes that were implemented as a bundle through the Surgical Care Improvement Project were effective in reducing SSI outcomes despite unknown adherence with other important aspects of SSI prevention^{125, 248, 249}. When at least two of the 6 individual surgical processes were consistently adhered to as a bundle, the odds of SSI reduced significantly by 15%. Adhoc implementation of the 6 individual practices did not significantly reduce the odds of SSI¹²⁵. A bundled or multi-modal approach has also shown to be effective in reducing the risk of SSI following caesarean section (Table 2.4)^{7, 38, 77, 127-131}, but less emphasis can be given to these studies because confounding variables were not considered unlike the evaluations of the Surgical Care Improvement Project. Even without perfect adherence, the proposed infection prevention bundle for caesarean section is likely to be effective in practice.

8.1.2 Current infection prevention practice

In Chapter 5, current adherence to evidence-based infection prevention practice was examined. Australian Obstetricians were asked to report their usual implementation of the three individual elements of the infection prevention bundle and implementation of other peri-operative strategies and techniques that have been evaluated for their effect in reducing SSI risk. The purpose of identifying current adherence to the infection prevention bundle was to establish current practice as the baseline comparator for a proposed improvement in peri-operative and surgical practice.

There was poor adherence to the infection prevention bundle with 4.5% of respondents usually implementing all three elements. Most respondents (85.8%) usually implemented either one or two elements of the bundle. Despite strong evidence in favour of pre-incision antibiotic prophylaxis existing for caesarean section since at least 2010¹⁸², it occurred for just over half of procedures. Spontaneous removal of the placenta occurred more often, with 80% of respondents usually implementing this technique. Vaginal preparation was very rarely implemented, which is not surprising as the evidence in favour of this strategy is more recent⁶⁷.

Australian Obstetricians have much lower adherence to pre-incision prophylactic antibiotics administration compared to maternal-fetal medicine physicians in the United States who report between 85% and 99% adherence^{175, 250}. Vaginal preparation has less than 10% adherence for both Australian and United States physicians. Adherence to spontaneous placenta removal is similarly high for both Australian and United States physicians, ranging between 70 and 80%. United States physicians' adherence to pre-incision antibiotic prophylaxis for caesarean section^{175, 250} is consistent with good adherence following implementation of the Surgical Care Improvement Project in the United States²⁴⁹. Low adherence amongst Australian Obstetricians is consistent with overall low adherence for pre-incision antibiotic prophylaxis in Australia²⁵¹. Low adherence to pre-incision antibiotic prophylaxis for caesarean section in Australia may be because RANZCOG updated their antibiotic guidelines to best-practice pre-incision prophylaxis in 2016, much later than obstetric recommendations in the United Kingdom^{252, 253}, United States²⁵⁴ and Canada²⁵⁵. There is also often a time-lag between guideline release and uptake in clinical practice, and Australian clinicians only had a few months to respond to the new RANZCOG guidelines from the time of their release to the survey of current infection prevention practice.

The strength of the study is that few, if any studies examining adherence to best-practice for caesarean section have reported predictors of adherence. This study used a multivariable modelling method with manual backwards stepwise selection of covariates to estimate the most significant, independent predictors of zero adherence with the infection prevention bundle. This approach informs decision makers of where infection prevention and control programs should be targeted to improve adherence.

Obstetricians who do not usually implement a surgical or patient safety checklist are least likely to implement the infection prevention bundle (Table 5.7). Surgical safety checklists are a process recommended by the WHO and the American Congress of Obstetricians and Gynecologists that support implementation of strategies such as pre-incision administration of antibiotic prophylaxis^{106, 107}. The results of the current practice survey support other research²⁵⁶⁻²⁵⁸ emphasising the importance of systems and structures in supporting implementation of patient safety processes. With over 30% of Australian Obstetricians never using a surgical or patient safety checklist (Table 5.4), allocating resources to encourage adoption of such a system may be worthwhile.

Infection prevention and control efforts may also need to be directed to Australian Obstetricians practicing in private hospitals. Private practitioners had 3.34 greater odds of never implementing the infection prevention bundle compared to Obstetricians only practicing in public hospitals (Table 5.7). There is no publically-available evidence of sub-optimal quality of care in private hospitals. However, amongst Australian women with low risk pregnancies between 1996 and 1997, those who attended private hospitals received more unnecessary interventions during labour management and birth than women who were public patients²⁵⁹. For these women, there was no obvious clinical reason for a deviation from best-practice, and the research suggests that non-adherence to evidence-based practice may occur more in private hospitals. Reasons for unnecessary interventions in obstetrics have been attributed to fear of litigation, health system financial incentives, time pressures and widespread use of electronic foetal monitoring and epidurals^{33, 259}. Of these reasons, only time pressures in private hospitals may explain poor-adherence to the infection prevention bundle.

Unwarranted variation in healthcare delivery is receiving much attention in Australia and also globally. The Australian Commission on Safety and Quality in Healthcare has produced an Atlas of Healthcare Variation which reports differences in rates of health services across geographical regions²²². Selected surgical interventions are reported, but not caesarean section. The OECD does report variation in caesarean section rates globally and Australia contributes data to the OECD for their monitoring of healthcare variation²²¹. What is not reported is variations in surgical processes as described in Chapter 4. This is understandable, given that patient outcomes such as

caesarean section and SSI incidence are appropriate indicators of health service quality. While routine monitoring of unwarranted variation in surgical processes is not necessarily required, understanding that unwarranted variation in processes may be driving unwarranted variation in outcomes is important. This research raised the profile of unwarranted variation in peri-operative and surgical practice for caesarean section and established the baseline scenario for the economic evaluation.

8.1.3 Cost-effectiveness of better practice

Unwarranted variation in peri-operative and surgical practice for caesarean section is a problem for health services and patients. Therefore, the changes to total economic costs and health benefits with a decision to adopt better adherence to the infection prevention bundle were modelled in a cost-effectiveness study. The effect of uncertainty in the model was quantified using probabilistic sensitivity analysis. A sub-group analysis was also undertaken to investigate whether cost-effectiveness varies by type of hospital or patient. An interpretation and explanation of the results of the probabilistic sensitivity analysis for the costs and health outcomes will be provided in this section. The original economic model and sub-group models will be discussed together.

Better adherence to the infection prevention bundle was not cost-effective for the original economic model and for all sub-groups except emergency caesarean section. At face value, the results can be explained by a higher risk of SSI amongst women from better practice hospitals, although it is unlikely that the infection prevention bundle causes harm (Section 8.1.1). The appropriateness of the chosen cost-effectiveness threshold can also be questioned as the decision-making context of maternity health services is different to that of funding pharmaceuticals within the Australian Government. The bundle might be more expensive to implement in hospitals that do not integrate antibiotic administration with the anaesthetic protocol and integrate vaginal preparation with catheter insertion. To understand why better adherence to the infection prevention bundle is not universally cost-effective in this economic model, three issues are discussed in the following sections. Firstly, the limitations of how women in the Queensland hospital dataset were allocated to the current and better practice groups will be acknowledged. Secondly, differences in treatment patterns between current and better practice hospitals will be discussed. Thirdly, a hypothesis will be proposed regarding better practice hospitals' better SSI

surveillance. Examined together, these issues might explain why better adherence to the infection prevention bundle is mostly cost-ineffective.

Allocation of hospital data

The behaviour of Obstetricians practicing in hospitals who responded to the survey of current infection prevention practice survey was used as the indicator of hospital adherence with the infection prevention bundle. Obstetricians, rather than hospitals were surveyed because there is evidence that hospital policy on obstetric peri-operative and surgical processes does not reflect actual practice¹⁷⁶. However, not all Obstetricians from the hospitals that were analysed for estimation of SSI infection risk responded to the current practice survey. It is unknown how representative the responding Obstetricians are of all Obstetricians in each hospital because hospitals were unwilling or unable to provide information on employed or contracted Obstetricians in their health service. Numbers of caesarean sections performed each year was used as a proxy indicator of number of Obstetricians and size of health service. There is therefore much uncertainty regarding what happens at these hospitals on an everyday basis, particularly regarding how different from better practice the current practice hospitals actually are. In this research, current practice hospitals were defined as those with wide variation in practice with evidence of mostly poor and zero bundle implementation. There might be Obstetricians and surgical teams in current practice hospitals who did not respond to the survey that have good adherence with the infection prevention bundle. The reverse might also be the case for better practice hospitals. These scenarios will result in current practice only varying from better practice to a small extent. Only 4.5% of respondents to the current practice survey reported 100% adherence with the infection prevention bundle. Hence most of the practice in better practice hospitals will be defined as adequate, which decreases the extent to which better practice is better than current practice. It is important to emphasise that better practice hospitals have been labelled such because they are ‘better’, and not ‘best’. Despite imperfect compliance being sufficient to improve SSI outcomes in other research^{125, 248}, it is possible that better practice does not reduce SSI risk in this modelling study because adherence is not high enough, and the variation in current practice hospitals is too uncertain.

The definition of better practice hospitals could have been stricter to more strongly discriminate from current practice hospitals. Using information available

from the current practice survey (Chapter 5), a stricter definition of better practice would have been to add a criteria whereby at least one respondent from the hospital's postcode had full adherence with the infection prevention bundle. Three public hospitals and no private hospitals met this stricter criteria. Over 85% of Obstetricians from these hospitals had adequate adherence with the infection prevention bundle and no hospitals had better adherence than this. However, these three hospitals provided data on only 914 women for analysis to estimate the transition probabilities (Section 6.3.3), with 54 women acquiring an SSI. This stricter definition of better practice was not used in this research for four reasons: 1) the smaller number of women in this group is not representative of Queensland women; 2) the three hospitals do not represent private hospitals who make up almost half of the maternity services decision makers in Queensland; 3) most transition probabilities could not be estimated due to the small numbers of women entering the SSI health states in the economic model each cycle; and 4) sub-group analysis could not be conducted which is also useful information for decision makers. A larger caesarean section SSI surveillance data set would enable the economic modelling to compare current practice to a stricter definition of better practice.

Differences in treatment

The differences in treatment patterns between current and better practice hospitals need to be examined before the conclusion is drawn that better adherence to the infection prevention bundle will only be cost-effective with full adherence. Different uptakes of expensive treatment approaches between the two types of hospitals will affect costs and ultimately the cost-effectiveness results. Three differences in treatment patterns between current and better practice hospitals are observed from the economic modelling. Firstly, women who have an emergency caesarean section in better practice hospitals have a shorter length of initial stay which means that fewer costs and more health gains are incurred with women returning home for a normal recovery sooner. Secondly, women from better practice hospitals in the original economic model have a shorter treatment time at home and in hospital than women from current practice hospitals. Better adherence to the infection prevention bundle is still not cost-effective in this economic model despite the shorter treatment time because of the much higher risk of SSI amongst women from better practice hospitals. Thirdly, women from better practice hospitals are much more likely to be

treated with costly NPWT than women from current practice hospitals. The implications of these three differences in treatment patterns are discussed in more detail below.

As women who had an emergency caesarean section in better practice hospitals are discharged sooner than women from current practice hospitals, questions arise of whether this approach is good or bad and what it means for post-discharge risk of SSI. Early discharge between 24 and 96 hours following caesarean section is appropriate provided criteria such as maternal pain management and wound healing are met, and the neonate is thriving^{252, 253, 260}. There has been a decline in average length of stay for caesarean section in countries with developed health services. Researchers and clinicians have debated how the same quality of health services can be delivered in a shorter time period^{69, 70}. Whether a shorter length of stay following caesarean section results in worse maternal outcomes or increased risk of readmission is uncertain. In a Canadian study²⁶¹, a length of stay of four days or less following caesarean section was associated with a significantly higher risk of maternal readmission, with readmissions occurring mostly in the first week post-discharge. In Australia, a shorter length of stay following caesarean section was not associated with increased readmission rates for SSI and general readmission rates are unknown⁷⁰. Average length of stay for emergency caesarean section is similar to elective caesarean section²⁶². It may therefore be entirely appropriate for women from better practice hospitals to have a higher probability of discharge following emergency caesarean section than women from current practice hospitals. Women from current practice hospitals may keep their patients admitted because they are more unwell and at higher risk of SSI than women from better practice hospitals whose carers have better adherence to the infection prevention bundle. The estimated transition probabilities support this theory, with women from current practice hospitals who had an emergency caesarean section much more likely than women from better practice hospitals to be treated in hospital for an SSI prior to discharge (Appendix K).

Questions of whether better adherence to the infection prevention bundle prevents SSIs or reduces SSI severity for women who have an emergency caesarean section cannot be answered with this research. Women from better practice hospitals were more likely to be readmitted to hospital post-discharge than women from current practice hospitals (Appendix J) and this may be due to the shorter length of initial stay

following emergency caesarean section. All women who acquired an SSI following emergency caesarean section were treated for approximately the same length of time in hospital and at home. The economic modelling simply demonstrates that large costs are saved with a shorter length of stay for women who had an emergency caesarean section in better practice hospitals. However, these costs saved are not offset by a much higher and potentially more expensive risk of readmission for women from better practice hospitals. Better adherence to the infection prevention bundle is unlikely to have a 57% probability of being cost-saving and health-improving (Section 7.2.1) if larger costs were incurred due to more hospital readmissions for women from better practice hospitals. Therefore, there is a possibility that better adherence to the infection prevention bundle reduces the severity of SSI for women who had an emergency caesarean section.

There is more evidence from the original economic model to suggest that SSIs amongst women from better practice hospitals are less severe because of differences in treatment patterns. Firstly, it appears that women from better practice hospitals have a slightly shorter length of stay than women from current practice hospitals (*Figure 6.11* and *Figure 7.6*) and are treated for a much shorter time at home than women from current practice hospitals (*Figure 7.5*). Whether this is due to less severe SSIs is uncertain. There may be fewer women from better practice hospitals being treated at home with a simple antibiotic prescription because they are more likely to be treated with NPWT instead (*Figure 6.14*). Secondly, there is also evidence to suggest women from current practice hospitals are more likely to return to hospital for treatment for a second readmission after initial discharge and treatment at home with oral antibiotics. The probability of readmission after treatment at home for an SSI is consistently higher for women from current practice hospitals (*Figure 6.10*). In addition, only 574 women from current practice hospitals are diagnosed with an SSI in the deterministic analysis, but there are 890 readmissions to hospital over 34 days. For women from better practice hospitals, 830 women were diagnosed with an SSI and 893 were treated in hospital over the same time period (*Figure 7.6*) which suggests far fewer re-entries to the infection in hospital health state.

There is some evidence in the original economic model that treatment for SSI amongst women from better practice hospitals is shorter. A shorter treatment time suggests that SSIs may be less severe with better adherence to the infection prevention

bundle. In the emergency caesarean section sub-group model, a shorter length of initial stay does not appear to increase the treatment time at home or in hospital for women from better practice hospitals. Whether shorter treatment times are due to less severe SSIs, or better treatment approaches is unknown. Given that women from better practice hospitals had a 73% increased risk of SSI in the economic model, it would be expected that better adherence to the infection prevention bundle would have a much higher probability than 56% of being cost-ineffective if the infection prevention bundle was harmful and not at all effective in preventing SSI. It is inappropriate to conclude that better adherence to the infection prevention bundle reduces the severity of SSI without understanding differences in treatment approaches between current and better practice hospitals, and also the reasons for a shorter length of original stay amongst women who had an emergency caesarean section in better practice hospitals.

NPWT is used to treat SSI amongst women from better practice hospitals far more than women from current practice hospitals. It is a world-wide established method for the treatment of chronic wounds and wounds that are difficult to heal²⁶³. NPWT is used for both prevention and treatment of SSIs following caesarean section. However for this research, treatment, and not prevention using NPWT was modelled because the costs consequences of a higher SSI risk were of interest, and the cost of preventing SSI using the only infection prevention bundle were required (Table 6.8 and Table 6.9).

NPWT is an expensive treatment^{168, 264}, estimated in this research to have a societal cost of \$241 per day plus a one-time cost of \$184.26 for the equipment (Table 6.9). However, health outcomes are estimated to be better with a shorter time to complete wound healing²⁶⁵. Prevention of SSI using NPWT following caesarean section is cost-effective for high risk women^{168, 264}, and therefore it may be assumed that treatment is also cost-effective, as treatment in the context of this research is essentially the prevention of recurrent infection. In this research, NPWT is used more in better practice hospitals and across both types of hospitals for obese women. Obese women have a higher risk of SSI and NPWT is recommended for this group²⁶³. Therefore, assuming NPWT is used for mostly high risk women, which is the case in the economic model, it is an appropriate secondary treatment for SSI. It can be concluded that better practice hospitals are implementing good treatment practices with the use of NPWT more often than current practice hospitals.

Quality of SSI surveillance data

The purpose of SSI surveillance is to inform decision making around the investment of resources in infection prevention and control. Health services that have SSI incidence data can identify patients most at risk of SSI. SSI surveillance stimulates change in processes when clusters, outbreaks, or no change in SSI rates are observed over time. SSI surveillance also enables health services to assess the effect of their processes such as peri-operative and surgical practices on SSI outcomes. For surveillance to be informative in these ways, it needs to be accurate.

Accurate surveillance of SSI following caesarean section is difficult and costly¹⁵ because such a large proportion of SSIs are diagnosed and treated in the primary healthcare setting^{7, 46}. In this research, data on women who did and did not acquire a SSI was sourced in two ways. Fifteen of the 39 public maternity hospitals in Queensland voluntarily provided SSI data to Queensland Health's CDU in 2014-15 and this was collated into a central database which was acquired for this research. Requests for SSI data were made to 16 Queensland private maternity hospitals, and 8 hospitals provided their data for this research. A limitation of this approach to sourcing data is that bias would have been introduced due the types of hospitals that actually collect SSI data. A strength of the data is that variables and definitions in the public hospitals dataset are consistent across hospitals as data is collated centrally. In addition, private hospitals aligned their variables, definitions and dataset structure with the public hospital dataset. The key limitations of the data are that mostly passive surveillance was used at all hospitals and no hospitals strove to include in their datasets the post-discharge SSIs that did not result in readmission. An absence of active in-hospital surveillance means not all women who had a caesarean section were assessed, and not all women who were diagnosed with an SSI were assessed by a qualified Infection Control Practitioner or Infectious Diseases Physician. Therefore the CDC definitions of SSI may not have been used, and over- or underestimation of SSI incidence may have occurred. No active post-discharge surveillance usually means that a caesarean section SSI incidence is grossly underestimated^{7, 46}. The Queensland hospitals dataset indicates that some women were diagnosed with an infection by hospital staff, but not admitted to hospital. For example, the woman had contact with a midwife post-discharge, and the SSI diagnosis was captured by the hospitals' SSI passive surveillance. Beyond these rare post-discharge diagnoses, the Queensland

hospitals dataset does not provide any data on SSI diagnosed and treated in the primary healthcare setting. It is for this reason that the probabilities of post-discharge SSIs treated at home were estimated by multiplying by three the probabilities of post-discharge SSIs treated in hospital. The other limitations of the Queensland hospital dataset could not be addressed in this research however.

Better practice hospitals may have a higher risk of SSI because they may be better at SSI surveillance than current practice hospitals. More or better quality surveillance in better practice hospitals will result in a higher SSI incidence because when hospitals do not conduct surveillance, there is no evidence of an SSI problem. Using a multiple of three to estimate the post-discharge SSIs treated at home might further inflate the incidence of less complex SSIs amongst women from better practice hospitals. The incidence of SSIs treated in hospital may already be higher, but more accurate than the incidence of SSIs treated in current practice hospitals. There is no empirical evidence in this research of better surveillance amongst better practice hospitals. By using intuition, a hypothesis can be developed. Hospitals are known to measure adherence with processes without necessarily measuring outcomes such as SSI incidence. It would be surprising though to find an innovative hospital that decides to adopt a new process and have good process adherence, but has no intention of measuring outcomes. How does the hospital know that better adherence to best-practice was a good decision without measuring outcomes? The hypothesis emerging from this research is that better practice hospitals monitor SSI following caesarean section better than current practice hospitals.

Better surveillance might consist of either more active surveillance or more accurate diagnoses, or both. The public hospital SSI data used for this research does not provide any clues regarding how often the data is voluntarily provided to the CDU in Queensland Health, or dataset completeness. However during this research it was observed that private hospitals allocated to the better practice group were more forthcoming with data, datasets were more complete and Infection Control Practitioners were more engaged in the research than current practice private hospitals. The hypothesis that better practice hospitals are also better at SSI surveillance explains the higher risk of SSI amongst women from these hospitals. However, the hypothesis has been developed using anecdote and intuition rather than empirical evidence.

The allocation of hospitals to the intervention and comparator groups, the differences in SSI treatment and SSI surveillance data used are the three key issues that explain why better adherence to the infection prevention bundle is not universally cost-effective in this economic model.

Health utilities

There was large variance surrounding the health utilities selected for this research. Furthermore, there are no valuations of health states from women who have had caesarean sections in the literature to better-inform the economic model. The health utility selected for the caesarean section health state lay between a low value of 0.59²⁴³ to 0.99 in the literature²⁴⁴, but was determined as the best estimate because it was sourced from a relevant existing cost-effectiveness study²³⁵ and was supported by another study which derived SSI utilities from experts using a visual analogue scale²⁴². For normal recovery following caesarean section, other cost-effectiveness studies have used a utility value of close to one^{266, 267} which was determined to be too high for this research. Consequently, a lower utility for Australian women of child-bearing age²⁴⁰ was used for the health utility associated with normal recovery at home. This value may also be too high, as women of childbearing age have not necessarily experienced recovery from caesarean section. The health utility values for the infection health states were also based on the best available evidence, although the appropriateness of values following breast reconstruction²⁴² can be questioned. It is also unlikely that treatment for SSI with NPWT has an equivalent health utility to an SSI treated in hospital because of the added difficulty of caring for a new baby. However, there was no evidence available to inform whether the utility value should be higher or lower. An expert elicitation method could have been applied, although conducting an EQ-5D survey with women to derive utility estimates for all health states would be preferred. Neither methods were achievable due to time and resource constraints.

The uncertain health utility estimates have implications for the results. If the infection prevention bundle does in fact prevent severe SSIs, lower utility values for the infection health states would result in the intervention more likely to be cost-effective. However, a lower utility value associated with the normal recovery at home health state would reduce the health benefits seen by more women from better practice hospitals entering this health state sooner than women from current practice hospitals.

Overall, there would be benefit in collecting better health utility data to inform the economic modelling.

Sub-group analysis

Decision makers may see value in more sub-group analyses to inform health services that are challenged by multi-drug resistant organisms or methicillin-resistant *Staphylococcus aureus*. Treating both healthcare-associated and community-acquired multi-drug resistant organisms is an emerging and widespread challenge across eastern Australia, particularly the tropical north^{60, 61} and amongst Aboriginal and Torres Strait Islander people⁶². A larger hospitals data set would be required to capture the smaller number of women birthing via caesarean section in warmer climates, remote/very remote ARIA category hospitals or Aboriginal and Torres Strait Islander women. A sub-group analysis for ARIA categories was not conducted for two reasons: 1) the results of the survey of Obstetricians suggested that adherence to the infection prevention bundle did not vary by ARIA category and therefore there would not be enough discrimination between the intervention and comparator groups for the economic modelling; and 2) there was insufficient data on women in remote and very remote hospitals to estimate the transition probabilities. With more data, these additional sub-group analyses would be important to conduct to inform a decision to change caesarean section practice.

8.1.4 Expected value of perfect information

The EVPI results for the Queensland population suggest that investing between \$7.1 million and \$40.2 million in research to gain more information to inform the economic decision further is a cost-effective decision. The investment in research is of high value because of the large numbers of women having a caesarean section each year in Queensland, and large uncertainty associated with the economic modelling results. The opportunity costs of not adopting better adherence to the infection prevention bundle are therefore high because the expected costs of uncertainty are high.

8.2 SUMMARY OF LIMITATIONS

In the evidence synthesis, other SSI risk-reducing strategies such as CHG with alcohol for skin preparation and NPWT used as primary prevention were not eligible for inclusion in the bundle as no systematic review or meta-analysis collating the

evidence exists for these strategies. A large volume of evidence supporting these strategies as effective in reducing the risk of SSI following caesarean section does not exist like it does for the strategies chosen for the infection prevention bundle. Other strategies may actually be very effective at reducing SSI risk, and current practice hospitals may be implementing these strategies consistently which would reduce the risk of SSI in current practice hospitals.

The uncertain extent of bundle implementation in both current and better practice hospitals is a limitation in this research. As discussed in Section 8.1.3, the method used to allocate hospitals to the current and better practice groups means that it is not clear how much better, if at all, better practice hospitals are than current practice hospitals.

The sub-optimal quality of the SSI surveillance data used to estimate transition probabilities limits the confidence that can be placed in the results of this research. In Section 8.1.3, whether all SSIs are captured by the mostly passive surveillance methods is discussed. Also discussed is the limitation of not knowing whether there are differences between current and better practice hospitals' surveillance quality. Furthermore, it is unknown whether the method used to estimate the probabilities of being treated at home with an SSI post-discharge means that post-discharge incidence is better represented in this model.

There was large uncertainty surrounding the health utilities selected for the economic model. The best available evidence was used to inform the health utilities. However, a direct or indirect valuation of health utilities for different clinical scenarios following caesarean section is needed to better-inform the economic model.

It was not within the scope of this study to conduct a scenario analysis and this is a limitation of the study. Varying scenarios, particularly increasing the risk of SSI for women from current practice hospitals and lowering the cost of NPWT would be valuable. Having this information would inform decision makers of how much scenarios need to change before the results are different. For example, questions of how much smaller the SSI risk difference between current and better practice hospitals needs to be, or how much cheaper NPWT needs to be before better adherence to the infection prevention bundle is cost effective can be answered.

8.3 SUMMARY OF STRENGTHS

The rigorous and transparent methods used in the evidence synthesis is a strength of this research. A large body of literature was synthesised using the GRADE approach. Outlining the infection prevention bundle and other complementary strategies is useful for clinical end-users. No other evidence synthesis of caesarean section SSI risk-reducing strategies have used such transparent methods and focussed the purpose of the study toward decision makers.

The reported results of the current practice survey is the first time in Australia, and possibly internationally, that predictors of adherence to best-practice have been identified. The method is useful for informing where infection prevention and control programs should be targeted to improve adherence.

The method used to estimate transition probabilities for the economic model is a strength of the research. A nominal logistic model with longitudinal structure enabled time-dependent probabilities to be estimated. Including time-dependent probabilities in the economic model better reflected how they change over time in real life. In the regression model, risk of transitioning to health states was adjusted for key differences between the two datasets: hospital funding type, NNIS risk index and BMI. This was an important method. By doing so it could be seen that the original unadjusted lower risk of SSI amongst women from better practice hospitals was most likely a result of fewer women with a high BMI birthing in these hospitals. The estimated probabilities of treatment for SSI in hospital reflect Australian literature⁷ and government reports⁷¹, therefore the method used is appropriate.

Representing uncertainty in the model is more informative for decision makers than a single deterministic point-estimate of the incremental-cost-effectiveness ratio. The value of representing uncertainty in the model is demonstrated with the results of the original economic model. The deterministic results were that better adherence to the infection prevention bundle is cost-effective, but the probabilistic results were that this is likely only 44% of the time. Where large uncertainty surrounds model parameter estimates, such as health utilities, transition probabilities of moving from “post-infection recovery” to “normal recovery”, and transition probabilities for the subgroup models, priorities for further research can be easily identified. Quantifying the effect of uncertainty in the model is a strength of this study.

8.4 GENERALISABILITY OF THE RESULTS

The economic model results are generalizable to most Australian maternity hospitals. There is no reason to believe that the sample of Queensland women in the hospital data used to estimate the transition probabilities is different to other Australian women. It is acknowledged though, that demographic characteristics of the Queensland women were not compared to Australian census data. More than half of women having a caesarean section in Queensland were represented in the data used for estimation of transition probabilities. Hospitals of varying sizes, geographic location and funding type were included.

The same proportion of Aboriginal and Torres Strait Islander women were represented in the sample of Queensland hospital data as there are in the general Queensland population (3.6%)²⁶⁸. A sub-group analysis was not able to be conducted with the small numbers of Aboriginal and Torres Strait Islander women who were included in the final dataset used for the estimation of transition probabilities though. This means that the economic model results are likely to apply both non-Indigenous and Aboriginal and Torres Strait Islander women, but it is unknown if better practice is more or less cost-ineffective with this sub-group.

The results are generalizable to other types of patients and hospitals as a sub-group analysis was conducted. These sub-groups were chosen because a decision to change caesarean section practice can be operationalised in practice and are important sub-groups for Australian health services.

The economic model structure represents a usual clinical pathway for women who have had a caesarean section in Australia and the costs and health utilities assigned to each health state are applicable nation-wide. The economic model results may not be generalizable to maternity hospitals that care for caesarean section patients infected with multi-drug resistant organisms or even methicillin-resistant *Staphylococcus aureus* such as those in the Northern Territory and potentially northern Australia more broadly^{7, 60, 61}. A health state was not included in the economic model to capture costs and health outcomes associated with treatment of SSIs due to multi-drug resistant organisms.

8.5 INFORMING MATERNITY AND PATIENT SAFETY HEALTH SERVICES

The results of this research inform the allocation of maternity and patient safety resources in Queensland maternity hospitals. Through this research, it has been demonstrated that SSI following caesarean section is not only a health problem, but also an economic problem for women and health services. SSIs following caesarean section cost the Queensland health system and society in terms of hospital bed days lost, General Practitioner time used and private costs incurred. These are scarce healthcare resources that could be spent elsewhere. From this research, three recommendations can be made to stakeholders in maternity and patient safety health services in Queensland. Future challenges that might change the recommendations are also considered.

8.5.1 Recommendations

It is recommended that maternity hospitals in Queensland who do not yet implement the infection prevention bundle invest resources to adopt the new process for emergency caesarean section. In the evidence syntheses in Chapter 4 the importance of implementing the three bundle elements for emergency caesarean section was outlined. Emergency caesarean sections have a greater risk of SSI and this is reduced markedly with pre-incision antibiotic prophylaxis¹⁸² and vaginal preparation in particular⁶⁷. It is possible that it is not the infection prevention bundle, but the shorter length of initial hospital stay for women from better practice hospitals that is driving the cost-effectiveness results for the emergency caesarean section subgroup, and this needs to be investigated further. A rational decision maker would adopt the infection prevention bundle for emergency caesarean section because the results estimate there is a 57% probability of the intervention being cost-saving and health-improving. The alternative decision of not implementing the bundle is likely to be harmful and has only a 32% probability of being cost-effective.

For elective caesarean section, it is also recommended that the infection prevention bundle be adopted. Delaying adoption of pre-incision antibiotic prophylaxis and spontaneous placenta removal may be unethical given the significant increased risk of SSI associated with the alternatives. However, health services need to be aware that they take an economic risk in implementing the bundle due to the large uncertainty surrounding the cost-effectiveness results and data quality. There

may be a large opportunity cost of universal adoption of the bundle and another service may be foregone due to the decision.

Queensland and Australian maternity hospitals who already have partial or full adherence with the infection prevention bundle for all caesarean section procedures should not be concerned with the results of this study. It is recommended that these hospitals continue better adherence with the infection prevention bundle. Where the infection prevention bundle is being integrated into existing process in theatre, costs of implementation should be insignificant even when applied over 20 000 or more caesarean sections in Queensland each year. The efficacy of the infection prevention bundle in reducing the risk of SSI is convincing, and it is extremely unlikely the infection prevention bundle causes harm in practice.

It is recommended that Queensland maternity hospitals commence post-discharge surveillance of SSI following caesarean section and consider assessing the sensitivity of current passive surveillance methods. Post-discharge surveillance of caesarean section SSI will provide data to better inform allocation of maternity and patient safety resources. The data is needed because Queensland maternity hospitals have been recommended to adopt a process that has demonstrated efficacy, but the recommendation is given with caution partially due to concerns with SSI data quality. Women who have a caesarean section in Queensland hospitals that delay adoption of the bundle may not receive the best care for preventing SSI due to the uncertainty of the results of this study. The uncertainty should be reduced with better quality SSI data and more research in other areas discussed in Section 8.6. Post-discharge SSI surveillance following caesarean section is important because despite the efforts of this research, it is still unclear how large a problem SSI following caesarean section is in Queensland or Australia. Furthermore, an estimated 19% of caesarean sections are life-saving procedures³⁰ and the caesarean section rate is unlikely to ever fall below this in Australia. Hence, large numbers of caesarean sections will always be conducted in Australia and SSI will remain a risk of the procedure. Women and health services need an accurate understanding of how big a risk SSI following caesarean section is. Such data informs decision-making and SSI prevention efforts.

8.5.2 Stakeholders

These recommendations are made to all maternity health services in Queensland, Obstetricians and obstetric surgical teams as well as key stakeholders in the implementation of the recommendations.

The Queensland Health Statewide Maternity and Neonatal Clinical Network plays a key role in standardising and improving maternity care through development of clinical guidelines. Nationally, the RANZCOG also has the potential to play this role in its training of Obstetricians. The recommendation to adopt the infection prevention bundle for emergency caesarean section and the uncertainty surrounding the results needs to be communicated to these groups.

The Queensland Maternal and Perinatal Quality Council Maternal and Queensland Health Patient Safety and Quality Improvement Service are responsible for collecting and analysing data regarding maternal morbidity in Queensland. These units within Queensland Health will need to be engaged regarding the funding and method of post-discharge surveillance in Queensland public maternity hospitals following caesarean section.

Health consumers should also be involved in the design of post-discharge surveillance methods. Health Consumers Queensland and Maternity Choices are appropriate organisations to represent women have caesarean sections in Queensland.

Private hospitals in Queensland can be engaged regarding post-discharge surveillance through the Australian Private Hospitals Association and Women's Healthcare Australasia. These groups are the peak representation bodies for private hospitals and maternity hospitals in Australia. There may be resistance from private maternity hospitals to invest more resources in surveillance as they are more profit driven than service-driven public hospitals.

8.5.3 Future issues

Two key issues might change the recommendations of this research. Firstly, caesarean rates might fall to a more optimal rate which may reduce the burden of SSI following caesarean section on health services. Caesarean section delivery rates continue to be an OECD health systems quality indicator for member countries¹¹, despite clinicians debating its appropriateness^{269, 270}. The OECD monitors caesarean section rates with the intention of stimulating action to reducing them¹¹, and local

health service efforts have been successful²⁷¹. In Australia, the Independent Hospital Pricing Authority intends to introduce a bundled pricing approach for low risk maternity care in July 2018²⁷². A bundled pricing approach gives hospital managers greater room to develop innovative models of care for groups of patients, rather than bound by prices for discrete episodes of care. Bundled pricing for maternity services is also a financial incentive to reduce the rates of costly caesarean section²⁷³⁻²⁷⁵, although this is not an explicitly stated purpose of the Independent Hospital Pricing Authority's proposal. There is also an opportunity through Australia's Choosing Wisely program²⁷⁶ for RANZCOG to encourage their members have conversations with their patients about the risks of caesarean deliveries on maternal request which are not medically indicated. The program has the potential to facilitate a reduction in the caesarean section rate nationally, as the obstetric recommendations have not yet been released²⁷⁶. A reduction in caesarean rates would likely be due to fewer caesarean deliveries on maternal request and the procedure would remain appropriate for high risk pregnancies. It is high risk pregnancies though, such as women with a high BMI or those resulting in emergency caesarean sections that remain at high risk of SSI. Therefore, a reduction in the caesarean section rate may not see a reduced burden of SSI on health services. It is possible to examine different rates of emergency and elective caesarean sections in future applications of the model in a scenario analysis.

The second issue that might change the recommendations of this research is an emergence of multi-drug resistant organisms in obstetrics. If multi-drug resistant organisms become a problem, the economic model will no longer be valid for three reasons: treatment health states in the model structure will need to change; the risk of SSI may increase with caesarean section; and prophylaxis with currently available antibiotics may no longer be a primary SSI prevention strategy^{277, 278}. Decision makers may need to consider an economic decision to adopt additional strategies to the infection prevention bundle in the absence of effective antibiotic prophylaxis.

8.6 FUTURE RESEARCH

This research is characterised by large uncertainty, arising from both the quality and quantity of the data available. A prospective research program is worth pursuing due to the high costs of uncertainty in the economic model results shown in the EVPI analysis. To better inform decision-making around the reduction of SSI risk following

caesarean section, further data are required regarding competing treatments for SSI, more accurate SSI surveillance data that informs the model's transition probabilities would be valuable, and reducing the uncertainty for other model parameters would be useful. Estimated Value of Perfect Parameter Information analysis should be conducted to identify which parameters should be focussed on to narrow the uncertainty.

It appears that women from better practice hospitals are generally treated faster for SSI than women from better practice hospitals. Quantitative and qualitative research should be conducted to assess the variation in length and type of treatment, and understand why these variations exists. This research would clarify whether a shorter treatment time amongst better practice hospitals is attributable to better adherence to the infection control bundle or other reasons.

For this research, it was estimated that maternity hospitals never become aware of 75% of post-discharge SSI following caesarean section. Therefore, it is proposed that there is value in investigating post-discharge SSI incidence for a small but representative number of maternity hospitals in Australia. Post-discharge SSI surveillance is resource intensive and appropriate methods have not yet been established for caesarean section^{15, 279}. The purpose of having more accurate post-discharge SSI data is to trial the most appropriate method for post-discharge SSI surveillance in Australia, estimate the burden of SSI following caesarean section on primary healthcare services and identify if the method to estimate the probability of post-discharge SSI treated at home used in this research was appropriate.

Research investigating the hypothesis that better practice hospitals are better at SSI surveillance needs to be conducted. Qualitative interviews of Infection Control Practitioners that provide a deeper understanding of individual Queensland hospitals' surveillance methods could be used.

Both quantitative and qualitative research needs to be conducted to better describe with more certainty the costs and health outcomes associated with recovery from SSI following caesarean section. Expert opinion was used to estimate the health utility associated with the "post-infection recovery" health state in the economic model and no costs were attributed to the health state. Expert opinion was also used for the estimated transition probabilities of remaining in the health state. These estimates may not accurately reflect the experiences of women recovering from an SSI. Qualitative

studies exist describing patient's experiences of general SSIs⁶⁸ and recovery after caesarean section⁵. There is not a good understanding women's experiences recovering from SSI following caesarean section and this has increased the uncertainty in the economic model.

Health utilities for caesarean section, recovery from caesarean section and SSI following caesarean section in the literature vary widely. NICE does not attribute any disutility to SSI following caesarean section¹⁰⁹, while other studies attribute a health utility as low as 0.6¹⁶⁴. The uncertainty regarding health utilities associated with each health state in the economic model needs to be reduced. To do this, research that conducts surveys of Australian women using the EQ-5D health related quality of life instrument should be conducted.

Finally, the economic model developed for this research could be updated with less variable information for selected model parameters. In the absence of better caesarean section SSI surveillance data, the existing systematic reviews that estimate the effectiveness of the three individual bundle elements should be used to estimate the joint effectiveness of the infection prevention bundle in future cost-effectiveness research.

8.7 CONCLUSIONS

The research described in this thesis informs maternity and patient safety health services in a number of ways. The synthesis of evidence identified not only best-practice peri-operative strategies and surgical techniques for caesarean section, but also strategies that are complimentary to the infection prevention bundle, and strategies that are potentially wasteful and harmful. The unwarranted variation in caesarean section practice was highlighted in this research through the survey of Australian Obstetricians. A change in caesarean section practice from unwarranted variation to better adherence to the infection prevention bundle was evaluated in a cost-effectiveness modelling study.

Despite the efficacy of the infection prevention bundle, the economic modelling results showed that it apparently increased the risk of SSI following caesarean section and was not universally cost-effective to implement in Queensland. Maternity and patient safety health services should not be concerned by the results, as the infection prevention bundle is unlikely to cause harm and can be applied to emergency caesarean

section. The economic modelling results can be explained by a likely small difference between current and better practice hospitals regarding the infection prevention bundle implementation in practice and differences in length of hospital stay and use of NPWT between the two groups of hospitals. Hospitals that have better adherence to the infection prevention bundle may also have more complete data on SSIs following caesarean section, which explains the increased risk of SSI amongst women from these hospitals. Better adherence to the infection prevention bundle may actually reduce the severity of SSI as length of treatment is shorter.

The implications of this research are that the infection prevention bundle cannot yet be universally recommended as a cost-effective strategy to prevent post-caesarean SSI. There is value in pursuing a research program that reduces the uncertainty in the model's parameters. In particular, a better understanding of the reasons for the differences in risk of SSI between current and better practice hospitals is needed.

This thesis contributes to the maternity and patient safety health services body of literature by raising the profile of SSI following caesarean section and identifying prevention strategies. An economic framework and the methods applied in this research will assist decision makers to evaluate maternity services in the future. Maternity health services research including economic evaluations of interventions is important for finding the best ways of delivering services during a critical time of the lifecycle. Maternity care will always be a high volume service in Australia and achieving optimal maternal and neonatal health outcomes with scarce resources should be a priority for the Australian health system.

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Appendices

Appendix A **Strategic Policy Context for Economics of Infection Prevention**

This research is part of the National Health and Medical Research-funded Centre of Research Excellence in Reducing Healthcare Associated Infections (<http://cre-rhai.org.au/>). The Centre of Research Excellence operates within the Australian Centre for Health Services Innovation (AusHSI) (<http://aushsi.org.au/>) which aims to address challenges of new technologies, rising costs and improving quality with collaborative research across clinical and academic organisations.

Improvements in HAI rates have been driven by the quality and safety in healthcare movement as they are seen as a problem for patient safety⁴³. The Australian Commission on Safety and Quality in Health Care and the National Health and Medical Research Council are responsible for the national coordination and leadership of HAI surveillance, and making recommendations and producing guidelines for infection prevention and control^{40, 280}. In Queensland the Communicable Diseases Unit conducts surveillance of HAI based on state-wide priorities and often leads the implementation of new interventions and education in health districts as do similar organisations in other states and territories of Australia⁴³. The research programs of the Centre of Research Excellence and AusHSI are coordinated with these national and state bodies.

This research aligns with the Centre of Research Excellence's research priorities of 'Evaluating Evidence and Knowledge' as it will evaluate the various approaches Australian hospitals could take to reduce the infection rate, improve health outcomes and reduce the costs associated with a post-caesarean SSI. The research is about finding ways to use healthcare resources as efficiently as possible.

Appendix B

Evidence Synthesis Protocol

Peri-operative strategies for reducing the risk of surgical site infection following caesarean delivery: a systematic review protocol

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Introduction

SSIs are a significant cause of morbidity following caesarean delivery¹ and women who have a caesarean delivery are 5 times more likely to acquire an infection than those who deliver vaginally². A large number of randomized controlled trials, cohort and quasi-experimental studies have identified individual best-practice caesarean delivery strategies that reduce the risk of SSI and these studies have been summarised in literature reviews, systematic reviews and meta-analyses³⁻¹¹. Risk-reducing strategies include pre-incision antibiotic prophylaxis, vaginal preparation with iodine-povidone solution, and gentle cord traction for placenta removal, however there is large variability in their uptake by clinicians¹²⁻¹⁵. Barriers to uptake may be because in syntheses of best-practice caesarean delivery techniques, SSI is not always a primary outcome and it can be challenging to identify the specific impact a strategy has on infection incidence. Furthermore, these individual strategies have yet to be collated and ranked, enabling resource-scarce hospitals to select strategies that have a large amount of evidence supporting their implementation. This systematic review will synthesise all the evidence presented in previous reviews, systematic reviews and meta-analyses so that important peri-operative strategies are identified in the one study and be accessible to clinicians.

This new systematic review serves to inform the development of an infection prevention bundle, useful for clinical teams needing to minimise the risk of SSI following caesarean delivery. The infection prevention bundle will be mapped against clinical guidelines for caesarean delivery and identify which guidelines need to be updated, further informing clinical practice.

Aim of the review

The purpose of this systematic review is to identify the most effective peri-operative strategies for reducing the risk of SSI following caesarean delivery.

Design

The systematic review will be conducted using the PRISMA guidelines¹⁶ and has been registered with Prospero (number CRD42016041366)¹⁷.

Types of studies – The review will include all literature reviews, systematic reviews and meta-analyses published in the English language between January 2006

and June 2016. This timeframe corresponds to the extensive research activity following the increase in rate of caesarean deliveries from the late 1990's.

Types of participants – Studies will describe women of any age, parity and risk category who had an emergency or elective caesarean delivery globally.

Types of interventions and comparisons- All strategies evaluated in previous reviews, systematic reviews and meta-analyses for reducing the risk of SSI following caesarean section will be included. Strategies can be pre-operative (e.g. antibiotic prophylaxis), intra-operative (e.g. skin incision type) and post-operative (e.g. wound dressing). Included studies may focus on a range of peri-operative procedures, with no specific comparators of interest, but must report SSI outcomes for caesarean delivery.

Types of outcome measures – The primary outcome measure of this review is rate of SSI, defined according to the US Centres for Disease Control and Prevention (CDC) classifications of superficial or deep incisional and organ/space infection, including endometritis¹⁸. This review will accept “wound infection” as an alternative outcome measure to the CDC classifications but will not include aggregate measures of infection outcomes such as “total infectious morbidity”.

Search methods for identifying studies – Two researchers will independently and electronically search for eligible review studies and any conflict will be resolved by a third researcher. Reference lists of the final studies selected by electronic searching will be searched by hand.

Electronic searches - Studies will be identified by searching the electronic databases PubMed, CINAHL, Cochrane Library, Science Direct, Scopus and Embase. The search strategy will identify all potentially relevant studies which will be examined using the inclusion and exclusion criteria described in this protocol. Box 1 shows the PubMed search strategy using the terms ‘cesarean’ AND (‘infection’ OR ‘endometritis’).

Box 1: PubMed search strategy

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(((((endometritis[MeSH Terms]) OR endometritis[Title/Abstract])) OR
((((("infection/surgery"[MeSH Terms]) OR surgical site infection[Title/Abstract]) OR
"surgical wound infection"[MeSH Terms]) OR surgical wound infection[Title/Abstract]) OR
wound infection[MeSH Terms]) OR wound infection[Title/Abstract]) OR obstetric
infection[Title/Abstract])) AND ((cesarean delivery[Title/Abstract] OR "cesarean
section"[MeSH Terms]) OR cesarean section[Title/Abstract]) AND ((Meta-Analysis[ptyp] OR
Review[ptyp] OR systematic[sb]) AND "last 10 years"[PDat]) AND (English[lang])
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Inclusion/exclusion criteria - Studies will be included if the purpose of the review is to evaluate the effectiveness of caesarean delivery or general surgical strategies, interventions or peri-operative techniques in reducing post-caesarean SSI risk. Studies that qualitatively describe best-practice without providing quantitative measures of effect will be excluded. Infection prevention strategies common to most surgeries such as hypothermia prevention measures, maintaining haemostasis and hand hygiene will also be excluded, even if they have been examined in the literature for caesarean delivery specifically since the evidence has already been established for these infection control strategies at a healthcare and general surgical procedure level. This new systematic review aims to inform obstetric healthcare specifically and not the broader hospital-wide level of healthcare.

Study selection – Titles, then abstracts will be scanned independently by two researchers using the inclusion/exclusion criteria and any studies that meet the inclusion criteria will be retrieved for full text examination. Excluded studies and reasons for exclusion will be listed in the table of excluded studies in the final publication.

Data extraction – Data extraction will be conducted independently by two researchers. Details of selected studies will be extracted simultaneously by the two researchers and in turn collated using a data extraction template. Data items extracted will be:

Information to identify the review including title, authors and year of publication;

Review method including study design, search years, risk of bias within studies;

Population of interest for each review and countries primary research was conducted in; and

Strategies examined, primary and secondary outcomes.

Assessment of risk of bias – Bias within each review selected for inclusion will be assessed as part of the quality assessment using a modified A Measurement Tool to Assess Systematic Reviews (AMSTAR) checklist and categorisation method developed by McKibben and colleagues (4). Study quality will be reported in the data collection table as ‘good’ or ‘fair’ in the final publication. Both good and fair studies will be included in the synthesis.

Synthesis – The results of included reviews will be synthesised narratively. Meta-analysis will not be conducted because many meta-analyses already exist for key strategies and the purpose of this review is to collate the individual strategy syntheses into one narrative study. All strategies reviewed in included studies will be summarised in a table in the final publication. Effectiveness data available from each review such as changes in SSI rates, relative risks or odds ratios associated with the strategies investigated as well as corresponding statistical significance will be reported for each strategy. The strength of evidence for each strategy will be assessed using the U.S. Preventive Services Task Force (USPSTF) terminology for developing evidence-based clinical practice recommendations¹⁹ so this review aligns with other studies examining caesarean delivery techniques. Strategies will be ranked according to strength of evidence using the USPSTF method and quality of evidence source using the AMSTAR checklist so as to establish the most effective peri-operative strategies for reducing the risk of SSI following caesarean delivery.

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Appendix C

Excluded Studies from Evidence Synthesis

| First Author | Year | Title | Journal | Reason for exclusion |
|-----------------|------|--|-------------------------------------|--|
| Wilson A | 2011 | A comparison of clinical officers with medical doctors on outcomes of caesarean section in the developing world: meta-analysis of controlled studies | BMJ | Not relevant for a developed healthcare system context |
| Morrill M Y | 2013 | Antibiotic prophylaxis for selected gynecologic surgeries | Int J Gynaecol Obstet | Caesarean section outcomes not reported |
| Stannard J P | 2012 | Use of negative pressure wound therapy over clean, closed surgical incisions | Int Wound J | Caesarean section outcomes not reported |
| Bratzler D W | 2013 | Clinical practice guidelines for antimicrobial prophylaxis in surgery | Surg Infect | Clinical guideline |
| van Schalkwyk J | 2010 | Antibiotic Prophylaxis in Obstetric Procedures | J Obstet Gynaecol Can | Clinical guideline |
| Liu J | 2013 | Prophylactic administration of cefazolin prior to skin incision versus antibiotics at cord clamping in preventing post-caesarean infectious morbidity: A systematic review and meta-analysis of randomized controlled trials | Gynecol Obstet Invest | Duplicate of Sun |
| McKibben R A | 2015 | Practices to Reduce Surgical Site Infections Among Women Undergoing Cesarean Section: A Review | Infect Control Hosp Epidemiol | Infection outcomes inadequately reported |
| Pandit S N | 2013 | Surgical techniques for performing caesarean section including CS at full dilatation | Best Pract Res Clin Obstet Gynaecol | Infection outcomes inadequately reported |
| Anderson V | 2013 | The relationship between obesity and surgical site infections in women undergoing caesarean sections: An integrative review | Midwifery | Infection outcomes inadequately reported |
| Kennedy D | 2013 | Techniques for caesarean section - A re-appraisal | Obstetrics and Gynaecology Forum | Infection outcomes inadequately reported |
| Meyhoff C S | 2012 | Rational use of oxygen in medical disease and anesthesia | Curr Opin Anesthesiol | Infection outcomes inadequately reported |
| Carpenter L | 2012 | Maintaining perioperative normothermia in the patient undergoing cesarean delivery | Obstet Gynecol Surv | Infection outcomes inadequately reported |
| Clay F S | 2011 | Staples vs subcuticular sutures for skin closure at cesarean delivery: a meta-analysis of randomized controlled trials | Am J Obstet and Gynecol | Infection outcomes inadequately reported |

| First Author | Year | Title | Journal | Reason for exclusion |
|-----------------|------|---|---|--|
| Mahajan N N | 2009 | Justifying formation of bladder flap at cesarean section? | Arch Gynecol Obstet | Infection outcomes inadequately reported |
| Hofmeyr J G | 2009 | Techniques for cesarean section | Am J Obstet Gynecol | Infection outcomes inadequately reported |
| Simm A | 2008 | Caesarean section: techniques and complications | Obstetrics, Gynaecology and Reproductive Medicine | Infection outcomes inadequately reported |
| Harper A | 2015 | Reducing morbidity and mortality among pregnant obese | Best Pract Res: Clin Obstet and Gynaecol | No comparison of interventions |
| Pergialiotis V | 2014 | First versus second stage C/S maternal and neonatal morbidity: A systematic review and meta-analysis | Eur J Obstet Gynecol Reprod Biol | No comparison of interventions |
| Calvert C | 2013 | HIV and the Risk of Direct Obstetric Complications: A Systematic Review and Meta-Analysis | PLoS ONE | No comparison of interventions |
| Karsnitz D B | 2013 | Puerperal infections of the genital tract: a clinical review | J Midwifery Womens Health | No comparison of interventions |
| Lapinsky S E | 2013 | Obstetric infections | Crit Care Clin | No comparison of interventions |
| Madsen K | 2013 | Educational strategies in performing cesarean section | Acta Obstetrica et Gynecologica Scandinavica | No comparison of interventions |
| Jaiyeoba O | 2012 | Postoperative infections in obstetrics and gynecology | Clin Obstet Gynecol | No comparison of interventions |
| Lyell D J | 2011 | Adhesions and perioperative complications of repeat cesarean delivery | Am J Obstet Gynecol | No comparison of interventions |
| Sung E | 2011 | Sepsis in pregnancy | Fetal Matern Med Rev | No comparison of interventions |
| Lakhan D | 2010 | A systematic review of maternal intrinsic risk factors associated with surgical site infection following Caesarean sections | Healthcare Infection | No comparison of interventions |
| Nissotakis C | 2010 | Abdominal Wall Endometrioma: A Case Report and Review of the Literature | AORN Journal | No comparison of interventions |
| O'Callaghan K J | 2009 | How do we reduce maternal deaths due to puerperal sepsis in South Africa? | Obstetrics and Gynaecology Forum | No comparison of interventions |

| First Author | Year | Title | Journal | Reason for exclusion |
|-------------------|------|---|---|--|
| Baldo M H | 2008 | Caesarean section in countries of the Eastern Mediterranean Region | East Mediterr Health J | No comparison of interventions |
| Yiannakopoulou E | 2008 | Cephalosporin induced haemolytic anaemia in surgical patients: Systematic review | Review of Clinical Pharmacology and Pharmacokinetics, International Edition | No comparison of interventions |
| Gould D | 2007 | Caesarean section, surgical site infection and wound management | Nurs Stand | No comparison of interventions |
| Maharaj D | 2007 | Puerperal pyrexia: a review. Part I | Obstet Gynecol Surv | No comparison of interventions |
| Irvine L | 2006 | The impact of obesity on obstetric outcomes | Current Obstet Gynaecol | No comparison of interventions |
| Gurusamy K S | 2014 | Subcutaneous closure versus no subcutaneous closure after non-caesarean surgical procedures | Cochrane Database of Syst Rev | Non-caesarean surgical procedures only |
| Anderson E | 2004 | Techniques and materials for closure of the abdominal wall in caesarean section | Cochrane Database of Syst Rev | Not in year range |
| Chelmow D | 2004 | Suture closure of subcutaneous fat and wound disruption after cesarean delivery: a meta-analysis | Obstet Gynecol | Not in year range |
| Assawapalangool S | 2016 | Risk factors for cesarean surgical site infections at a Thai-Myanmar border hospital | Am J Infect Control | Not review |
| Bogges K | 2016 | 192: Clinical risk factors for post-caesarean surgical site infection despite pre-incision azithromycin-based extended spectrum antibiotic prophylaxis | Am J Obstet Gynecol | Not review |
| Heard C | 2016 | Cost-effectiveness analysis alongside a pilot study of prophylactic negative pressure wound therapy | J Tissue Viability | Not review |
| Hinkson L | 2016 | Surgical site infection in cesarean sections with the use of a plastic sheath wound retractor compared to the traditional self-retaining metal retractor | Eur J Obstet Gynecol Reprod Biol | Not review |
| Hsu C D | 2016 | 191: Reduction and sustainability of surgical site infections (SSI) after cesarean delivery (CD): seven years of experience | Am J Obstet Gynecol | Not review |
| Kieffer P | 2016 | And Baby Makes Three: Utilizing Outbreak Investigation Methodology to Address Concerns of Increasing Surgical Site Infections Following Cesarean Sections | Am J Infect Control | Not review |

| First Author | Year | Title | Journal | Reason for exclusion |
|-----------------|------|--|-----------------------------------|----------------------|
| Srinivas S | 2016 | 513: A multidisciplinary approach to reducing post cesarean delivery surgical site infections | Am J Obstet Gynecol | Not review |
| Tuuli M G | 2016 | Comparison of suture materials for subcuticular skin closure at cesarean delivery | Am J Obstet Gynecol | Not review |
| Westcott J M | 2016 | 519: Effect of skin coverage method following subcuticular suturing on wound infection rates at cesarean section | Am J Obstet Gynecol | Not review |
| Bharatam K K | 2015 | The tip of the iceberg: Post caesarean wound dehiscence presenting as abdominal wound sepsis | Int J Surg Case Rep | Not review |
| Chang H C | 2015 | Cesarean section surgical site infection caused by Mycobacterium massiliense | J Microbiol Immunol Infect | Not review |
| Haidar Z | 2015 | Cesarean delivery surgical site infection: what are expected rates and modifiable risk factors? | Am J Obstet Gynecol | Not review |
| Ng W | 2015 | A multifaceted prevention program to reduce infection after cesarean section: Interventions assessed using an intensive post-discharge surveillance system | Am J Infect Control | Not review |
| Palatnik A | 2015 | The association of skin-incision type at cesarean with maternal and neonatal morbidity for women with multiple prior cesarean deliveries | Euro J Obstet Gynecol Reprod Biol | Not review |
| Skjeldestad F E | 2015 | The effect of antibiotic prophylaxis guidelines on surgical-site infections associated with cesarean delivery | Int J Gynecol Obstet | Not review |
| Spruill C | 2015 | Improving Antibiotic Prophylaxis Prior to Cesarean Birth | J Obstet Gynecol Neonatal Nurs | Not review |
| Sutton A L | 2015 | Perinatal pharmacokinetics of azithromycin for cesarean prophylaxis | Am J Obstet Gynecol | Not review |
| Tuffaha H W | 2015 | Cost-utility analysis of negative pressure wound therapy in high-risk cesarean section wounds | J Surg Res | Not review |
| No author | 2015 | Antibiotic prophylaxis versus no prophylaxis for preventing infection after cesarean section | Essentially MIDIRS | Not review |
| Antonello V S | 2014 | Post-cesarean surgical site infection due to Buttiauxella agrestis | Int J Infect Dis | Not review |
| Lucas L S | 2014 | A Potential Method to Lower Risk for Surgical Site Infection During Cesarean Birth | Nurs Womens Health | Not review |

| First Author | Year | Title | Journal | Reason for exclusion |
|--------------|------|--|--------------------------------|----------------------|
| Rodewald K | 2014 | 653: Cesarean surgical site infection (SSI) in the obese mother: association and contributing factors | Am J Obstet Gynecol | Not review |
| Tuuli M G | 2014 | Infectious morbidity is higher after second-stage compared with first-stage cesareans | Am J Obstet Gynecol | Not review |
| Walker R | 2014 | Improved Birth Outcomes With Implementation of a Perinatal Quality and Patient Safety Collaborative | J Obstet Gynecol Neonatal Nurs | Not review |
| Witter F R | 2014 | Decreasing cesarean section surgical site infection: An ongoing comprehensive quality improvement program | Am J Infect Control | Not review |
| Xiao C W | 2014 | The Effect on Perioperative Bleeding of Placental Extraction From an Exteriorized Uterus During Cesarean Section | J Obstet Gynaecol Can | Not review |
| Lamont R F | 2014 | Prophylactic antibiotics for caesarean section administered preoperatively rather than post cord clamping significantly reduces the rate of endometritis | Evid Based Med | Not review |
| Brown J | 2013 | Pre-incision antibiotic prophylaxis reduces the incidence of post-caesarean surgical site infection | J Hosp Infect | Not review |
| Corcoran S | 2013 | Surgical site infection after cesarean section: Implementing 3 changes to improve the quality of patient care | Am J Infect Control | Not review |
| Newsom C T | 2013 | Skin preparation for Caesarean section | Nurs Times | Not review |
| Bastani P | 2012 | Comparison of neonatal and maternal outcomes associated with head-pushing and head-pulling methods for impacted fetal head extraction during cesarean delivery | Int J Gynecol & Obstet | Not review |
| Gries J | 2012 | Implementing a New Initiative to Reduce Surgical Site Infections in Cesarean Birth Patients | J Obstet Gynecol Neonatal Nurs | Not review |
| Kittur N D | 2012 | Long-term effect of infection prevention practices and case mix on cesarean surgical site infections | Obstet Gynecol | Not review |
| Mauzey S | 2012 | A Multifaceted Approach Reduces Surgical Site Infection Rates, Incidents, and Associated Costs for Abdominal Hysterectomy and Cesarean Section Patients | Am J Infect Control | Not review |
| McIlmoyle K | 2012 | Antibiotic timing at caesarean section | Int J Obstet Anesth | Not review |
| Parsons M | 2012 | Hot Mommas! Pre-warming of Maternity Patients Undergoing Cesareans | J Obstet Gynecol Neonatal Nurs | Not review |
| Eriksen H M | 2011 | Antibiotics prophylaxis in connection with caesarean section--guidelines at Norwegian maternity departments | Tidsskr Nor Lægeforen | Not review |

| | First Author | Year | Title | Journal | Reason for exclusion |
|-----|-------------------|------|---|----------------------------------|----------------------|
| | Fesseha N | 2011 | A national review of cesarean delivery in Ethiopia | Int J Gynecol & Obstet | Not review |
| | Kelt L | 2011 | Cesarean Section Surgical Site Infections 2008–2010: “If First You Don't Succeed Try, Try Again!” | Am J Infect Control | Not review |
| | Salim R | 2011 | Effect of interventions in reducing the rate of infection after cesarean delivery | Am J Infect Control | Not review |
| | Walsh C | 2011 | Maternity services for obese women in Ireland | Ir Med J | Not review |
| | Alanis M C | 2010 | Complications of cesarean delivery in the massively obese parturient | Am J Obstet Gynecol | Not review |
| M C | Cardoso Del Monte | 2010 | Post-discharge surveillance following cesarean section: The incidence of surgical site infection and associated factors | Am J Infect Control | Not review |
| | Doğanay M | 2010 | Effects of method of uterine repair on surgical outcome of cesarean delivery | Int J Gynecol & Obstet | Not review |
| | Thurman A R | 2010 | Post-cesarean delivery infectious morbidity: Focus on preoperative antibiotics and methicillin-resistant <i>Staphylococcus aureus</i> | Am J Infect Control | Not review |
| | Virgincar N | 2010 | Surveillance of caesarean section surgical site infections to determine the extent of the problem and identify targets for intervention | J Hosp Infect | Not review |
| | No author | 2010 | In brief: recommendation for earlier antibiotic prophylaxis for cesarean delivery | Med Lett Drugs Ther | Not review |
| | No author | 2010 | Reduction of Low Transverse Cesarean Section-associated Surgical Site Infections | Am J Infect Control | Not review |
| | Astagneau P | 2009 | Reducing surgical site infection incidence through a network: results from the French ISO-RAISIN surveillance system | J Hosp Infect | Not review |
| | Dumas A M | 2009 | Maternal infection rates after cesarean delivery by Pfannenstiel or Joel–Cohen incision: A multicenter surveillance study | Eur J Obstet Gynecol Reprod Biol | Not review |
| | Owens S M | 2009 | Antimicrobial prophylaxis for cesarean delivery before skin incision | Obstet Gynecol | Not review |
| | No author | 2009 | Surgical Site Infections in Cesarean Section Patients Using the National Healthcare Safety Network Criteria | Am J Infect Control | Not review |
| | Heathcote R | 2008 | Caesarean section surgical site surveillance in a private healthcare setting: a collaboration with the Victorian Hospital | Healthcare Infection | Not review |

| First Author | Year | Title | Journal | Reason for exclusion |
|--------------|------|---|------------------------|----------------------|
| Kaimal A J | 2008 | Acquired Infection Surveillance System (VICNISS) Coordinating Centre Effect of a change in policy regarding the timing of prophylactic antibiotics on the rate of post-cesarean delivery surgical-site infections | Am J Obstet Gynecol | Not review |
| Tita A T N | 2008 | Impact of extended-spectrum antibiotic prophylaxis on incidence of post-cesarean surgical wound infection | Am J Obstet Gynecol | Not review |
| No author | 2008 | Chlorhexidine Gluconate Preoperative Skin Preparation in Obstetrical Cesarean Section Patients Results in 100% Prevention of Surgical Site Infections | Am J Infect Control | Not review |
| No author | 2008 | Post Cesarean Surgical Site Infections | Am J Infect Control | Not review |
| Kaimal A | 2007 | 59: Timing of prophylactic antibiotics and the rate of post-cesarean surgical site infections | Am J Obstet Gynecol | Not review |
| Merchavy S | 2007 | Method of placental removal during cesarean delivery and postpartum complications | Int J Gynecol & Obstet | Not review |
| Nafisi S | 2007 | Influence of uterine exteriorization versus in situ repair on post-cesarean maternal pain: a randomized trial | Int J Obstet Anesth | Not review |
| Sullivan S A | 2007 | Administration of cefazolin prior to skin incision is superior to cefazolin at cord clamping in preventing post-cesarean infectious morbidity: a randomized, controlled trial | Am J Obstet Gynecol | Not review |
| Tita A | 2007 | 228: Impact of extended-spectrum antibiotic prophylaxis on incidence of post-cesarean surgical wound infection | Am J Obstet Gynecol | Not review |
| Willemssen I | 2007 | A standardized protocol for perioperative antibiotic prophylaxis is associated with improvement of timing and reduction of costs | J Hosp Infect | Not review |
| Bärwolff S | 2006 | Reduction of surgical site infections after Caesarean delivery using surveillance | J Hosp Infect | Not review |
| Johnson A | 2006 | Caesarean section surgical site infection surveillance | J Hosp Infect | Not review |
| Song S H | 2006 | Finger-assisted stretching technique for cesarean section | Int J Gynecol & Obstet | Not review |
| | 2010 | Committee opinion no. 465: Antimicrobial prophylaxis for cesarean delivery: Timing of administration | Obstet Gynecol | Review - withdrawn |

Appendix D

Quality Assessment of Studies Included in Systematic Review

| First author | Year | Number of minor criteria met | Number of major criteria met | Quality rating |
|-------------------|------|------------------------------|------------------------------|----------------|
| Altman A D | 2009 | 0 | 0 | Poor |
| Anorlu Rose I | 2008 | 6 | 4 | Good |
| Ayres-de-Campos D | 2015 | 0 | 0 | Poor |
| Baaqeel H | 2013 | 7 | 4 | Good |
| Bamigboye A | 2014 | 6 | 4 | Good |
| Berhan Y | 2014 | 5 | 3 | Good |
| Clifford V | 2012 | 0 | 0 | Poor |
| Costantine M M | 2008 | 6 | 3 | Good |
| Dahlke J D | 2013 | 5 | 4 | Good |
| Dalton V | 2010 | 0 | 0 | Poor |
| Dodd J | 2014 | 6 | 4 | Good |
| Eke A C | 2016 | 6 | 3 | Good |
| Fitzwater J L | 2014 | 0 | 0 | Poor |
| Gates S | 2013 | 6 | 4 | Good |
| Gyte G | 2014 | 7 | 4 | Good |
| Haas D | 2014 | 7 | 4 | Good |
| Hadiati D | 2014 | 7 | 4 | Good |
| Heesen M | 2013 | 5 | 4 | Good |
| Hellums E K | 2007 | 5 | 2 | Good |
| Jeve Y B | 2016 | 5 | 4 | Good |
| Karanth K L | 2010 | 0 | 0 | Poor |
| Klingel M L | 2013 | 6 | 4 | Good |
| Kosins, A M | 2013 | 4 | 3 | Good |
| Lamont R F | 2011 | 0 | 0 | Poor |
| Liabsuetrakul T | 2011 | 6 | 4 | Good |
| Mackeen A D | 2014 | 7 | 4 | Good |
| MacKeen A D | 2015 | 5 | 3 | Good |
| Mackeen A D | 2012 | 6 | 4 | Good |
| Mathai M | 2013 | 6 | 4 | Good |
| Munoz-Price L S | 2013 | 0 | 0 | Poor |
| Nabhan A F | 2016 | 7 | 4 | Good |
| Roberge S | 2014 | 5 | 4 | Good |
| Saad A F | 2014 | 6 | 4 | Good |
| Smaill F | 2014 | 6 | 4 | Good |
| Sun J | 2013 | 5 | 3 | Good |
| Tharpe N | 2008 | 0 | 0 | Poor |
| Tipton A M | 2011 | 0 | 0 | Poor |
| Tita A T | 2009 | 3 | 1 | Fair |
| Tuuli M G | 2011 | 5 | 4 | Good |
| Wang H | 2016 | 6 | 4 | Good |
| Waterfall H | 2016 | 6 | 4 | Good |
| Xu L L | 2013 | 6 | 4 | Good |

| First author | Year | Number of minor criteria met | Number of major criteria met | Quality rating |
|---------------------|-------------|---|---|---------------------------|
| Zaphiratos V | 2015 | 5 | 3 | Good |
| Zhang C | 2015 | 5 | 3 | Good |

Appendix E
Effect of Peri-Operative Strategies and Surgical Interventions on Reducing Caesarean Section SSI Risk

| Strategy type | Strategy number | Population | Intervention | Comparator | Wound infection outcome | Endometritis outcome | Reference |
|------------------------|-----------------|---|--|----------------------------------|--|---|-----------|
| Skin preparation | 1 | Emergency or elective caesarean section | Chlorhexidine-alcohol skin preparation | Povidone-iodine skin preparation | Superficial and deep incisional surgical site infection reduced RR 0.59 (CI 0.41-0.85) | nil | 213 |
| | 2 | Emergency or elective caesarean section | Drape | No drape | Wound infection no significant difference RR 1.29 (CI 0.97-1.71) | nil | 97 |
| | 3 | Emergency or elective caesarean section | Alcohol scrub plus iodophor drape | Iodophor scrub | nil | Endometritis no significant difference RR 1.62 (CI 0.29-9.16) | 97 |
| | 4 | Emergency or elective caesarean section | Parachlorometaxylenol plus iodine | Iodine alone | Wound infection no significant difference RR 0.33 (CI 0.04-2.99) | Endometritis no significant difference RR 0.88 (CI 0.56-1.38) | 97 |
| | 5 | Emergency or elective caesarean section | Chlorhexidine gluconate | Povidone-iodine solution | Wound infection no significant difference RR 2.10 (CI 0.20-21.42) | nil | 97 |
| Antibiotic prophylaxis | 6 | Emergency or elective caesarean section | Antibiotic prophylaxis | No antibiotic prophylaxis | Wound infections significantly reduced RR 0.39 (CI 0.32-0.48) | Endometritis significantly reduced RR 0.38 (CI 0.34-0.42) | 197-199 |
| | | | | | nil | Endometritis significantly reduced RR 0.39 (CI 0.31-0.43) | 55 |
| | | | | | Wound infection significantly reduced RR 0.40 (CI 0.35-0.46) | Endometritis significantly reduced RR 0.38 (CI 0.34-0.42) | 85 |
| | 7 | Emergency or elective caesarean section | Antibiotic prophylaxis with natural penicillin | No antibiotic prophylaxis | Wound infection no significant difference RR 0.43 (CI 0.07-2.87) | Endometritis significantly reduced RR 0.19 (CI 0.05-0.65) | 85 |

| Strategy type | Strategy number | Population | Intervention | Comparator | Wound infection outcome | Endometritis outcome | Reference |
|---------------|-----------------|---|---|---------------------------|--|---|-----------|
| | 8 | Emergency or elective caesarean section | Antibiotic prophylaxis with aminopenicillins | No antibiotic prophylaxis | Wound infection RR 0.50 significantly reduced (CI 0.35-0.72) | Endometritis significantly reduced RR 0.24 (CI 0.16-0.38) | 85 |
| | 9 | Emergency or elective caesarean section | Antibiotic prophylaxis with extended spectrum penicillins | No antibiotic prophylaxis | Wound infection significantly reduced RR 0.18 (CI 0.09-0.39) | Endometritis significantly reduced RR 0.46 (CI 0.37-0.58) | 85 |
| | 10 | Emergency or elective caesarean section | Antibiotic prophylaxis with beta-lactamase inhibitor combination | No antibiotic prophylaxis | Wound infection significantly reduced RR 0.26 (CI 0.13-0.51) | Endometritis no significant difference RR 0.67 (CI 0.27-1.66) | 85 |
| | 11 | Emergency or elective caesarean section | Antibiotic prophylaxis with first generation cephalosporins | No antibiotic prophylaxis | Wound infection significantly reduced RR 0.38 (CI 0.28-0.53) | Endometritis significantly reduced RR 0.42 (CI 0.33-0.54) | 85 |
| | 12 | Emergency or elective caesarean section | Antibiotic prophylaxis with second generation cephalosporins | No antibiotic prophylaxis | Wound infection significantly reduced RR 0.38 (CI 0.19-0.75) | Endometritis significantly reduced RR 0.27 (CI 0.20-0.37) | 85 |
| | 13 | Emergency or elective caesarean section | Antibiotic prophylaxis with cefamycins | No antibiotic prophylaxis | Wound infection significantly reduced RR 0.45 (CI 0.33-0.60) | Endometritis significantly reduced RR 0.36 (CI 0.28-0.47) | 85 |
| | 14 | Emergency or elective caesarean section | Antibiotic prophylaxis with third generation cephalosporin | No antibiotic prophylaxis | Wound infection significantly reduced RR 0.44 (CI 0.26-0.73) | Endometritis significantly reduced RR 0.28 (CI 0.11-0.69) | 85 |
| | 15 | Emergency or elective caesarean section | Antibiotic prophylaxis with monobactams | No antibiotic prophylaxis | Wound infection no significant difference RR 0.25 (CI 0.03-2.44) | Endometritis no significant difference RR 0.63 (CI 0.25-1.54) | 85 |
| | 16 | Emergency or elective caesarean section | Antibiotic prophylaxis with nitroimidazoles | No antibiotic prophylaxis | Wound infection significantly decreases RR 0.49 (CI 0.34-0.69) | Endometritis significantly reduced RR 0.52 (CI 0.37-0.73) | 85 |
| | 17 | Emergency or elective caesarean section | Antibiotic prophylaxis with trimethoprim-sulfamethoxazole | No antibiotic prophylaxis | nil | Endometritis no significant difference RR 0.45 (CI 0.20-1.01) | 85 |
| | 18 | Emergency or elective caesarean section | Antibiotic prophylaxis with aminoglycoside-containing combination | No antibiotic prophylaxis | Wound infection significantly reduced RR 0.17 (CI 0.08-0.34) | Endometritis significantly reduced RR 0.29 (CI 0.19-0.45) | 85 |

| Strategy type | Strategy number | Population | Intervention | Comparator | Wound infection outcome | Endometritis outcome | Reference |
|-------------------|-----------------|---|--|--------------------------------|---|---|-------------------|
| Antibiotic timing | 19 | Emergency or elective caesarean section | Antibiotic prophylaxis with other antibiotic combination | No antibiotic prophylaxis | Wound infection no significant difference RR 0.60 (CI 0.36-1.02) | Endometritis significantly reduced RR 0.33 (CI 0.14-0.75) | 85 |
| | 20 | Emergency or elective caesarean section | Antibiotic prophylaxis with other regimen | No antibiotic prophylaxis | Wound infection no significant difference RR 0.58 (CI 0.15-2.30) | Endometritis no significant difference RR 0.42 (CI 0.17-1.03) | 85 |
| | 21 | Elective caesarean section | Antibiotic prophylaxis | No antibiotic prophylaxis | Wound infection significantly reduced RR 0.62 (CI 0.47-0.82) | Endometritis significantly reduced RR 0.38 (CI 0.24-0.61) | 85 |
| | 22 | Emergency caesarean section | Antibiotic prophylaxis | No antibiotic prophylaxis | Wound infection significantly reduced RR 0.39 (CI 0.27-0.58) | Endometritis significantly reduced RR 0.39 (CI 0.33-0.47) | 85 |
| | 23 | Emergency or elective caesarean section | Antibiotic prophylaxis administered before cord clamping | No antibiotic prophylaxis | Wound infection significantly reduced RR 0.39 (CI 0.32-0.47) | Endometritis significantly reduced RR 0.33 (CI 0.26-0.40) | 85 |
| | 24 | Emergency or elective caesarean section | Antibiotic prophylaxis administered after cord clamping | No antibiotic prophylaxis | Wound infection significantly reduced RR 0.41 (CI 0.34-0.50) | Endometritis significantly reduced RR 0.40 (CI 0.36-0.46) | 85 |
| | 25 | Emergency or elective caesarean section | Pre-incision prophylaxis | Post-cord clamping prophylaxis | Wound infections no significant difference RR 0.71 (CI 0.44-1.14) | Endometritis significantly reduced RR 0.59 (CI 0.37-0.94) | 197,200 |
| | | | | | Wound infection no significant difference RR 0.60 (CI 0.30-1.21) | Endometritis significantly reduced RR 0.47 (CI 0.26-0.85) | 4,105,196,199,202 |
| | | | | | Wound infection no significant difference RR 0.72 (CI 0.41-1.27) | Endometritis significantly reduced RR 0.48 (CI 0.27-0.87) | 203 |
| | | | | | Wound infection significantly reduced RR 0.59 (CI 0.44-0.81) | Endometritis significantly reduced RR 0.54 (CI 0.36-0.79) | 182 |
| | | | | | nil | Endometritis no significant difference RR 1.09 (CI 0.6-1.9) | 196 |

| Strategy type | Strategy number | Population | Intervention | Comparator | Wound infection outcome | Endometritis outcome | Reference |
|---------------|-----------------|-----------------------------|--|--------------------------------|---|--|-----------|
| | | | | | Wound infection significantly reduced RR 0.11 (CI 0.01-0.9) | Endometritis no significant difference RR 0.40 (CI 0.12-1.3) | 196 |
| | | | | | Wound infection no significant difference RR 0.42 (CI 0.04-4.5) | Endometritis no significant difference RR 0.84 (CI 0.05-13.00) | 196 |
| | | | | | Wound infection no significant difference RR 0.84 (CI 0.45-1.6) | Endometritis no significant difference RR 0.67 (CI 0.42-1.1) | 196 |
| | | | | | Wound infection no significant difference RR 0.52 (CI 0.18-1.5) | Endometritis significantly reduced RR 0.20 (CI 0.2-0.94) | 196 |
| | | | | | nil | Endometritis significantly reduced RR 0.34 (CI 0.13-0.92) | 196 |
| | | | | | Wound infection no significant difference RR 0.80 (CI 0.55-1.17) | Endometritis no significant difference RR 0.73 (CI 0.39-1.36) | 199 |
| | 26 | Emergency caesarean section | Pre-incision antibiotic prophylaxis with cefazolin | Post-cord clamping antibiotics | Wound infection incidence reduced with pre-incision prophylaxis 3.6% compared to 2.5% AOR 0.70 (CI 0.55-0.90) | Endometritis incidence reduced with pre-incision prophylaxis 3.9% compared to 2.2% AOR 0.61 (CI 0.47-0.79) | 23 |
| | | | | | Wound infection no significant difference in incidence 2.4% vs 3.4% RR 0.70 (CI 0.43-1.12) | Endometritis incidence significantly reduced from 2.3% to 4.0% RR 0.57 (CI 0.36-0.90) | 204 |

| Strategy type | Strategy number | Population | Intervention | Comparator | Wound infection outcome | Endometritis outcome | Reference |
|------------------|-----------------|---|--|--|--|--|-----------|
| | | | | | nil | Endometritis significantly reduced RR 0.20 (CI 0.15-0.94) | 55 |
| Antibiotic class | 27 | Emergency or elective caesarean section | Antibiotic prophylaxis with gentamycin | Antibiotic prophylaxis with gentamycin plus ampicillin | Wound infection no significant difference 0.98 (CI 0.06-15.0) | Endometritis significantly reduced RR 0.38 (CI 0.14-0.99) | 196 |
| | 28 | Emergency or elective caesarean section | Antibiotic prophylaxis with vaginal metronidazole | Antibiotic prophylaxis with vaginal metronidazole plus cefazolin | Wound infection no significant difference 1.67 (CI 0.41-6.81) | Endometritis significantly reduced RR 0.42 (CI 0.19-0.92) | 196 |
| | 29 | Emergency or elective caesarean section | Antibiotic prophylaxis with metronidazole | Antibiotic prophylaxis with metronidazole plus cefotetan | nil | Endometritis significantly reduced RR 0.43 (CI 0.23-0.82) | 196 |
| | 30 | Emergency or elective caesarean section | Antibiotic prophylaxis with ampicillin | Antibiotic prophylaxis with first generation cephalosporin | nil | Endometritis no significant difference OR 1.27 (CI 0.84-1.93) | 55 |
| | 31 | Emergency or elective caesarean section | Antibiotic prophylaxis with cefotetan at cord clamping | Antibiotic prophylaxis with cefotetan at cord clamping plus broad spectrum parenteral doxycycline and oral azithromycin 6-12 hours following caesarean section | nil | Endometritis incidence significantly reduced 24.7% vs 16.9% p = 0.02 | 55 |
| | 32 | Emergency or elective caesarean section | Antibiotic prophylaxis with azithromycin/doxycycline | Antibiotic prophylaxis with azithromycin/doxycycline plus cefotetan | Wound infection significantly reduced RR 0.22 (CI 0.05-0.99) | Endometritis significantly reduced RR 0.68 (CI 0.49-0.94) | 196 |
| | 33 | Emergency or elective caesarean section | Single cephalosporin | Single penicillin | Wound infection no significant difference RR 0.83 (CI 0.38-1.81) | Endometritis no significant difference RR 1.11 (CI 0.81-1.52) | 184 |

| Strategy type | Strategy number | Population | Intervention | Comparator | Wound infection outcome | Endometritis outcome | Reference |
|---------------|-----------------|---|---|--|--|--|-----------|
| | 34 | Emergency or elective caesarean section | Single cephalosporin | Penicillin combination | Wound infection no significant difference RR 0.72 (CI 0.40-1.30) | Endometritis no significant difference RR 0.90 (CI 0.60-1.35) | 184 |
| | 35 | Emergency or elective caesarean section | Cephalosporin combination | Single penicillin | Wound infection no significant difference RR 2.02 (CI 0.42-9.63) | Endometritis no significant difference RR 2.70 (CI 0.63-11.55) | 184 |
| | 36 | Emergency or elective caesarean section | Cephalosporin combination | Penicillin combination | Wound infection no significant difference RR 1.23 (CI 0.42-3.58) | Endometritis no significant difference RR 0.33 (CI 0.01-7.77) | 184 |
| | 37 | Emergency or elective caesarean section | Cephalosporin | Penicillin | nil | Endometritis no significant difference RR 1.11 (CI 0.90-1.37) | 184 |
| | 38 | Emergency caesarean section | Cephalosporin | Penicillin | nil | Endometritis significantly increased RR 1.33 (CI 1.01 - 1.75) | 184 |
| | 39 | Elective caesarean section | Cephalosporin | Penicillin | nil | Endometritis no significant difference RR 2.06 (CI 0.66-6.39) | 184 |
| | 40 | Emergency or elective caesarean section | Cephalosporin before cord clamping | Penicillin before cord clamping | nil | Endometritis no significant difference RR 0.42 (CI 0.02-8.20) | 184 |
| | 41 | Emergency or elective caesarean section | Cephalosporin after cord clamping | Penicillin after cord clamping | nil | Endometritis no significant difference RR 1.15 (CI 0.94-1.42) | 184 |
| | 42 | Emergency or elective caesarean section | Cephalosporin administered intravenously | Penicillin administered intravenously | nil | Endometritis no significant difference RR 1.18 (CI 0.94-1.49) | 184 |
| | 43 | Emergency or elective caesarean section | Cephalosporin administered with lavage/infiltration | Penicillin administered with lavage/infiltration | nil | Endometritis no significant difference RR 0.96 (CI 0.65-1.43) | 184 |
| | 44 | Emergency or elective caesarean section | First generation cephalosporin | Extended spectrum penicillins | Wound infection no significant difference RR 2.02 (CI 0.42-9.63) | Endometritis significantly increased RR 2.18 (CI 1.30-3.66) | 184 |

| Strategy type | Strategy number | Population | Intervention | Comparator | Wound infection outcome | Endometritis outcome | Reference |
|------------------------------------|-----------------|---|------------------------------------|-------------------------------|---|---|-----------|
| Route of antibiotic administration | 45 | Emergency or elective caesarean section | First generation cephalosporin | Aminopenicillins | Wound infection no significant difference RR 0.85 (0.36-2.01) | Endometritis no significant difference RR 1.09 (CI 0.69-1.71) | 184 |
| | 46 | Emergency or elective caesarean section | Second generation cephalosporins | Extended spectrum penicillins | Wound infection no significant difference RR 2.37 (CI 0.64-8.73) | Endometritis no significant difference RR 1.10 (0.78-1.54) | 184 |
| | 47 | Emergency or elective caesarean section | Second generation cephalosporins | Aminopenicillins | Wound infection no significant difference RR 1.14 (CI 0.47-2.78) | Endometritis no significant difference RR 1.01 (CI 0.75-1.35) | 184 |
| | 48 | Emergency or elective caesarean section | Third generation cephalosporins | Extended spectrum penicillins | nil | Endometritis no significant difference RR 2.14 (CI 1.14-4.00) | 184 |
| | 49 | Emergency or elective caesarean section | Third generation cephalosporins | Aminopenicillins | Wound infection significantly reduced RR 0.49 (CI 0.27-0.90) | Endometritis no significant difference RR 1.47 (CI 0.89-2.42) | 184 |
| | 50 | Emergency or elective caesarean section | Aminoglycoside plus nitroimidazole | Standard antibiotic cocktail | nil | Endometritis no significant difference RR 0.81 (CI 0.29-2.26) | 184 |
| Vaginal preparation | 51 | Emergency or elective caesarean section | Intravenous antibiotics | Irrigation with antibiotics | Wound infection no significant difference RR 0.49 (CI 0.17-1.43) | Endometritis no significant difference RR 0.95 (CI 0.70-1.29) | 172 |
| | 52 | Emergency or elective caesarean section | Preoperative vaginal preparation | No vaginal preparation | Appropriate composite infectious morbidity no significant difference RR 0.55 (CI 0.26-1.11) | Endometritis significantly decreased OR 0.44 (CI 0.19-0.99) | 105 |
| | | | | | nil | Endometritis significantly reduced RR 0.57 (CI 0.38-0.87) | 105 |

| Strategy type | Strategy number | Population | Intervention | Comparator | Wound infection outcome | Endometritis outcome | Reference |
|---------------|-----------------|--|----------------------------------|------------------------|--|---|-----------|
| | | | | | Wound infection no significant difference RR 0.86 (CI 0.54-1.36) | Endometritis significantly decreased RR 0.45(CI 0.25-0.81) | 67 |
| | 53 | Women undergoing caesarean section with ruptured membranes | Preoperative vaginal preparation | No vaginal preparation | nil | Endometritis significantly reduced RR 0.13 (CI 0.02-0.66) | 105 |
| | | | | | Wound infection no significant difference RR 1.22 (CI 0.46-3.20) | Endometritis significantly reduced RR 0.24 (CI 0.10-0.55) | 67 |
| | 54 | Women undergoing caesarean section with intact membranes | Preoperative vaginal preparation | No vaginal preparation | Wound infection no significant difference RR 0.72 (CI 0.35-1.52) | Endometritis no significant difference RR 0.62 (CI 0.36-1.06) | 67 |
| | 55 | Women undergoing caesarean section after being in labor | Preoperative vaginal preparation | No vaginal preparation | Wound infection no significant difference RR 0.72 (CI 0.24-2.21) | Endometritis significantly reduced RR 0.56 (CI 0.34-0.95) | 67 |
| | 56 | Women undergoing caesarean section never having labored | Preoperative vaginal preparation | No vaginal preparation | Wound infection no significant difference RR 0.64 (CI 0.27-1.56) | Endometritis no significant difference RR 0.89 (CI 0.52-1.54) | 67 |

| Strategy type | Strategy number | Population | Intervention | Comparator | Wound infection outcome | Endometritis outcome | Reference |
|---------------------|-----------------|---|---|-------------------------------------|---|----------------------|-----------|
| Supplemental oxygen | 57 | Emergency or elective caesarean section | High oxygen concentration FiO2 >60% | Low oxygen concentration FiO2 < 40% | Surgical site infection including endometritis no significant difference with high FiO2 infection incidence 10.6% compared to 9.5% RR 1.12 (CI 0.86 - 1.46) | nil | 208 |
| | | | | | Surgical site infection incidence not significant 13% with high O2 supplementation compared to 14.5% (p=0.82) | nil | 209 |
| | | | | | Surgical site infection incidence not significant 5.8% with high O2 supplementation compared to 5.5% (p=0.98) | nil | 209 |
| Skin incision | 58 | Elective caesarean section under regional anesthesia after onset of labor | Oxygen supplementation (high concentration) | Face mask (low concentration) | Surgical site infection incidence not significant 25% with high O2 supplementation compared to 14% (p=0.13) | nil | 209 |
| | 59 | Emergency or elective caesarean section | Maylard muscle cutting incision | Pfannenstiel incision | Wound infection no significant difference RR 1.26 (CI 0.27-5.91) | nil | 215 |
| | 60 | Emergency or elective caesarean section | Joel-Cohen incision | Pfannenstiel incision | Wound infection no significant difference RR 1.56 (CI 0.45-5.42) | nil | 108 |

| Strategy type | Strategy number | Population | Intervention | Comparator | Wound infection outcome | Endometritis outcome | Reference |
|-------------------|-----------------|---|---|----------------------------------|--|--|-----------|
| Uterine incision | 61 | Emergency or elective caesarean section | Muscle cutting/Maylard | Pfannenstiell incision | Wound infection no significant difference RR 1.26 (CI 0.27-5.91) | nil | 108 |
| | 62 | Emergency or elective caesarean section | Blunt uterine incision | Sharp uterine incision | nil | Endometritis no significant difference RR 0.915 (CI 0.757-1.105) | 183, 206 |
| | 63 | Emergency or elective caesarean section | Auto stapler | Conventional method | nil | Endometritis no significant difference RR 0.2 (CI 0.02-1.65) | 185 |
| Placenta removal | 64 | Emergency or elective caesarean section | Cord traction/expressions method for placenta removal | Manual removal of placenta | nil | Endometritis significantly increased RR 1.64 (CI 1.42-1.90) | 89 |
| Cervical dilation | 65 | Women undergoing caesarean section after no labor | Mechanical dilation of cervix | No mechanical dilation of cervix | Wound infection no significant difference RR 0.90 (CI 0.37-2.17) | Endometritis no significant difference RR 0.60 (CI 0.15-2.48) | 210 |
| Uterine repair | 66 | Emergency or elective caesarean section | Uterine exteriorization for repair | In situ uterine repair | Wound infection no significant difference Or 0.96 (CI 0.59-1.56) | Endometritis no significant difference OR 1.25 (CI 0.96-1.62) | 216 |
| Uterine closure | 67 | Emergency or elective caesarean section | Single layer uterine closure | Double layer uterine closure | Wound infection no significant difference RR 0.99 (CI 0.89-1.10) | nil | 185 |
| | | | | | Wound infection no significant difference RR 0.93 (CI 0.83-1.04) | Endometritis no significant difference RR 1.04 (CI 0.81-1.34) | 217 |
| | 68 | Emergency or elective caesarean section | Chromic catgut (single study) | Polygactin-910 | Wound infection no significant difference RR 0.99 (CI 0.82-1.19) | nil | 185 |

| Strategy type | Strategy number | Population | Intervention | Comparator | Wound infection outcome | Endometritis outcome | Reference |
|-----------------------------------|-----------------|--|---|--|--|--|-----------|
| Peritoneum closure | 69 | Emergency or elective caesarean section | Leaving both the visceral and parietal peritoneum unsutured | Continuous suture of both visceral and parietal peritoneum | Wound infection no significant difference RR 0.96 (CI 0.86-1.07) | Endometritis no significant difference RR 1.07 (CI 0.78-1.46) | 186 |
| | 70 | Emergency or elective caesarean section | Non-closure of the visceral peritoneum only | Continuous suture of both visceral and parietal peritoneum | Wound infection decreased RR 0.36 (CI 0.14-0.89) | Endometritis no significant difference RR 3.00 (CI 0.12-72.91) | 186 |
| | 71 | Emergency or elective caesarean section | Non-closure of parietal peritoneum only | Continuous suture of both visceral and parietal peritoneum | Wound infection no significant difference RR 0.95 (CI 0.14-6.66) | Endometritis no significant difference RR 0.88 (CI 0.53-1.46) | 186 |
| Intra-abdominal saline irrigation | 72 | Emergency or elective caesarean section | Intra-abdominal saline irrigation | No irrigation | Wound infection no significant difference RR 0.51 (CI 0.09-2.73) | Endometritis no significant difference RR 0.95 (CI 0.64-1.40) | 179 |
| Wound drainage | 73 | Emergency or elective caesarean section | Subcutaneous drain | No drain | Wound infection no significant difference OR 1.15 (CI 0.70-1.90) | nil | 212 |
| | | | | | Wound infection no significant difference OR 1.03 (CI 0.62-1.73) | nil | 219 |
| | | | | | Wound infection no significant difference RR 1.02 (CI 0.85-1.21) | Endometritis no significant difference RR 1.20 (CI 0.90-1.59) | 21 |
| | | | | | Wound infection no significant difference RR 0.90 (CI 0.58-1.38) | nil | 198 |
| | 74 | Obese women undergoing emergency or elective caesarean section | Subcutaneous drain | No drain | Wound infection no significant difference RR 0.86 (CI 0.50-1.51) | Nil | 211 |
| | 75 | Emergency or elective caesarean section | Subcutaneous drain | Sub-sheath drain | Wound infection significantly increased RR 5.42 (CI 1.28-22.98) | nil | 211 |

| Strategy type | Strategy number | Population | Intervention | Comparator | Wound infection outcome | Endometritis outcome | Reference |
|---------------|-----------------|---|---|---------------------------------------|--|----------------------|-----------|
| Skin closure | 76 | Emergency or elective caesarean section | Subcutaneous drain | Subcutaneous suture | Wound infection no significant difference RR 0.77 (CI 0.42-1.44) | nil | 211 |
| | 77 | Emergency or elective caesarean section | Subcutaneous drain | Subaponeurotic drain | Wound infection significantly increased RR 5.42 (CI 1.28-22.98) | nil | 197 |
| | 78 | Women undergoing caesarean section with tissue thickness greater than 4cm | Subcutaneous closure with drain | No drain | Wound morbidity no significant difference RR 1.3 (CI 0.8-2.1) | nil | 105 |
| | 79 | Emergency or elective caesarean section | Staples for skin closure | Subcuticular sutures for skin closure | Wound infection no significant difference OR 1.41 (CI 0.92-2.17) | nil | 115 |
| | | | | | Wound infection no significant difference RR 0.80 (CI 0.36-1.75) | nil | 181 |
| | | | | | Wound infection no significant difference RR 1.10 (CI 0.69-1.77) | nil | 180 |
| | | | | | Wound infection incidence 7.9% with subcuticular sutures compared to 13% for staples p=0.03. | nil | 207 |
| | 80 | Emergency or elective caesarean section | Non-absorbable staples | Absorbable suture | Wound infection no significant difference RR 0.85 (CI 0.43-1.71) | nil | 116 |
| | 81 | Emergency or elective caesarean section | Pfannenstiel method non-absorbable suture | Pfannenstiel method absorbable suture | Wound infection no significant difference RR 0.41 (CI 0.12-1.31) | nil | 116 |
| | 82 | Emergency or elective caesarean section | Barbed suture | PDS suture | Wound infection no significant difference RR 0.96 (CI 0.18-5.10) | nil | 116 |

Appendix F

Current Practice Survey

Caesarean Section - Current Practice Survey

The purpose of this survey is to identify current caesarean techniques to prevent surgical site infections and endometritis. The results of this study will be used to compare the cost-effectiveness of current practice and a gold-standard approach to caesarean section.

Participant Information QUT Ethics Approval Number 1400000868 This survey has been approved for distribution by the Royal Australian and New Zealand College of Obstetricians and Gynaecologists; however, this approval in no way constitutes ethics approval nor endorses the statements or opinions expressed in the survey or any publication arising from the survey's data or its interpretation. Research Team Principal Researcher: Elizabeth Martin, PhD Candidate, Queensland University of Technology (QUT) Principal Supervisor: Professor Nicholas Graves, Faculty of Health, QUT Associate Supervisor: Dr Michael Beckmann, Director of Obstetrics and Gynaecology, Mater Health Services Associate Supervisor: Dr Katharina Merollini, Faculty of Health, QUT Description of the research This research is being undertaken as part of a PhD for Elizabeth Martin. The purpose of this research is to find out if moving from current practice to gold standard infection prevention for caesarean sections is cost-effective for Australian hospitals. As part of the research, this survey aims to identify what strategies are currently being used to prevent caesarean infections. You are invited to participate in this project because you are likely to perform at least one caesarean per year and we are interested in your current caesarean techniques. Participation Participation will involve completing a 40 item anonymous questionnaire with mostly Yes/No/Unsure responses options that will take approximately 2 minutes of your time. Questions will be about your experience level and current practice including "Do you routinely use a Baer Hugger?" and "Do you routinely use the Joel-Cohen incision entry?". Your participation in this project is entirely voluntary. If you agree to participate you are not required to answer any question(s) you are uncomfortable answering. Your decision to participate or not participate will in no way impact upon your current or future relationship with QUT or with Mater Health Services. If you do agree to participate you can withdraw from the project without comment or penalty. However as the questionnaire is anonymous once it has been submitted it will not be possible to withdraw. Expected Benefits It is expected that this research may not directly benefit you. However, it may benefit departments in the hospital you work at. This research will identify an appropriate level of infection control, midwifery and obstetric investment for preventing post-caesarean infections, potentially freeing resources for other worthwhile activities at the hospital. Risks There are no risks beyond normal day-to-day living associated with your participation in this project. Privacy and Confidentiality All comments and responses are anonymous and will be treated confidentially unless required by law. The names of individual persons are not required in any of the responses. Any data collected as part of this project will be stored securely as per QUT's management of research data policy. Consent to Participate Submitting the completed online questionnaire is accepted as an indication of your consent to participate in this project. Questions/Further Information about the Research If have any questions or require further information please contact one of the research team members below. Elizabeth Martin - PhD Candidate Phone 0422809021 Email elizabethkate.martin@hdr.qut.edu.au Professor Nicholas Graves - Principal Research Fellow Phone 07 3138 6115 Email n.graves@qut.edu.au Concerns/Complaints Regarding the Conduct of the Project QUT is committed to research integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of

the project you may contact the QUT Research Ethics Unit on +61 7 3138 5123 or email ethicscontact@qut.edu.au . The QUT Research Ethics Unit is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

Background questions The following questions around about your level of experience and type of hospital you usually practice in.

Are you a:

- ☐ Fellow?
- ☐ Member?
- ☐ Diplomate?
- ☐ Other?

How many years have you been practicing in the field of obstetrics?

How many caesarean sections do you perform annually?

- ☐ 1 to 10
- ☐ 11 to 50
- ☐ 51 to 150
- ☐ Over 151

What type of hospital do you mainly perform caesarean sections in?

- ☐ Private hospital
- ☐ Public hospital
- ☐ Both public and private hospitals

What is the postcode of the hospital you mainly perform caesarean sections in?

Your current practice The following strategies have been evaluated in trials and observational studies regarding their effect on reducing surgical site infections and endometritis following caesarean section. The questions apply to both emergency and elective caesarean sections unless otherwise stated. Please answer the questions based on your current practice. There are no right or wrong answers.

Do you currently implement the following strategies in your obstetric practice:

Preparing for surgery

Routinely instruct women to not remove pubic hair one month before estimated date of delivery?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely clip pubic hair that may interfere with incision to 1-2mm before entering the operating theatre?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely provide a chlorhexidine-gluconate wash or sponge for women to use the night before an elective caesarean ?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely clean the abdominal skin with a chlorhexidine-gluconate no-rinse wipe before entering the operating theatre?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely use a surgical or patient safety checklist that includes confirmation of team members' roles and/or administration of prophylactic antibiotics 15 to 60 minutes before incision?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely administer prophylactic antibiotics (any type and dosage) 15 to 60 minutes before incision?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely use perioperative supplemental oxygen (any concentration)?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely use a Baer Hugger?

- ☐ Yes
- ☐ No
- ☐ Unsure

Skin preparation

Routinely prepare the vagina with antiseptic solution (e.g. povidone iodine)?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely prepare the abdominal skin with a chlorhexidine-gluconate- alcohol solution?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely prepare the abdominal skin with a chlorhexidine-gluconate solution?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely prepare the abdominal skin with a povidone-iodine- alcohol solution?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely prepare the abdominal skin with a povidone-iodine solution?

- ☐ Yes
- ☐ No
- ☐ Unsure

Surgical technique

Routinely use the Joel-Cohen entry?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely expand the uterine incision using a blunt, cephalad-caudad technique?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely use the same surgical knife to incise the skin and deeper tissues?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely use an Alexis self-retaining retractor?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely create a bladder flap?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely remove the placenta manually?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely dilate the cervix after removing the placenta?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely change gloves after placenta removal?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely exteriorise the uterus for repair?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely close the uterine incision using 2 layers?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely irrigate intra-abdominally with saline solution?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely close the parietal peritoneum?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely administer prophylactic antibiotics (any type and dosage) after cord-clamping?

- ☐ Yes
- ☐ No
- ☐ Unsure

Techniques for obese patients In the following questions, 'obese women' have a pre-pregnancy body mass index of $>30\text{kg/m}^2$.

Do you currently implement the following strategies in your obstetric practice:

Routinely irrigate the subcutaneous tissue in obese women?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely irrigate the subcutaneous tissue in non-obese women?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely close the subcutaneous tissue space in women with tissue thickness greater than 2cm?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely close the subcutaneous tissue space in women with tissue thickness less than 2cm?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely use a superficial wound drain in women with tissue thickness greater than 2cm?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely use a superficial wound drain in women with tissue thickness less than 2cm?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely use sutures (any type) rather than staples to close the wound in obese women?

- ☐ Yes
- ☐ No
- ☐ Unsure

Routinely use sutures (any type) rather than staples to close the wound in non-obese women?

- ☐ Yes
- ☐ No
- ☐ Unsure

Are there any other strategies you routinely use to prevent infections following caesarean section not mentioned in this survey?

.....

.....

.....

.....

END OF SURVEY

Appendix G

Ethics and Governance Approvals

Elizabeth Kate Martin

From: Elizabeth Martin <elizabethkate.martin@qut.edu.au>
Sent: Wednesday, 26 November 2014 8:40 PM
To: Elizabeth Kate Martin
Subject: FW: Ethics Application Approval-- 1400000868
Attachments: UHRECSTANDARDCONDITIONSOFAPROVAL-HUMANRESEARCH.DOC

Follow Up Flag: Flag for follow up
Flag Status: Flagged

From: QUT Research Ethics Unit
Sent: Thursday, 13 November 2014 11:22 AM
To: Nicholas Graves; Katharina Merollini; Elizabeth Kate Martin; Elizabeth Martin
Cc: Janette Lamb
Subject: Ethics Application Approval-- 1400000868

Dear Prof Nicholas Graves and Mrs Elizabeth Martin

Project Title: A cost-effectiveness modelling study of strategies to prevent post-caesarean surgical site infection

Ethics Category: Human - Low Risk
Approval Number: 1400000868
Approved Until: 2/02/2018
(subject to receipt of satisfactory progress reports)

We are pleased to advise that your application has been reviewed and confirmed as meeting the requirements of the National Statement on Ethical Conduct in Human Research.

I can therefore confirm that your application is APPROVED.
If you require a formal approval certificate please advise via reply email.

CONDITIONS OF APPROVAL

Please ensure you and all other team members read through and understand all UHREC conditions of approval prior to commencing any data collection:

- > Standard: Please see attached or go to
<http://www.orei.qut.edu.au/human/stdconditions.jsp>
- > Specific: Approval has only been provided for Stage 1 and 3.

Decisions related to low risk ethical review are subject to ratification at the next available UHREC meeting. You will only be contacted again in relation to this matter if UHREC raises any additional questions or concerns.

Whilst the data collection of your project has received QUT ethical clearance, the decision to commence and authority to commence may be dependent on factors beyond the remit of the QUT ethics review process. For example, your research may need ethics clearance from other organisations or permissions from other organisations to access staff. Therefore the proposed data collection should not commence until you have satisfied these requirements.

Please don't hesitate to contact us if you have any queries.

We wish you all the best with your research.

Kind regards

Janette Lamb on behalf of Chair UHREC
Office of Research Ethics & Integrity
Level 4 | 88 Musk Avenue | Kelvin Grove
p: +61 7 3138 5123
e: ethicscontact@qut.edu.au
w: <http://www.orei.qut.edu.au>

From: [QUT Research Ethics Advisory Team](#)
To: [Nicholas Graves](#); [Katharina Merollini](#); [Elizabeth Kate Martin](#)
Cc: [QUT Research Ethics Advisory Team](#)
Subject: Ethics application - approved - 1400000868
Date: Wednesday, 16 March 2016 2:09:13 PM

Dear Prof Nicholas Graves and Mrs Elizabeth Martin

Project Title: A cost-effectiveness modelling study of strategies to prevent post-caesarean surgical site infection

Ethics Category: Human - Committee
Approval Number: 1400000868
Approved Until: 2/02/2018
(subject to receipt of satisfactory progress reports)

We are pleased to advise that your application has been reviewed by the University Human Research Ethics Committee (UHREC) and confirmed as meeting the requirements of the National Statement on Ethical Conduct in Human Research.

I can therefore confirm that your application for waiver of consent is APPROVED.

If you require a formal approval certificate, please advise via reply email.

CONDITIONS OF APPROVAL

Please ensure you and other team members read through and understand all UHREC conditions of approval prior to commencing any data collection:

- Standard: Please see attached or <http://www.orei.qut.edu.au/human/stdconditions.jsp>
- Specific: None apply

Whilst the data collection of your project has received QUT ethical clearance, the decision to commence and authority to commence may be dependent on factors beyond the remit of the QUT ethics review process. For example, your research may need ethics clearance from other organisations or permissions from other organisations to access staff. Therefore the proposed data collection should not commence until you have satisfied these requirements.

Please don't hesitate to contact us if you have any queries.

We wish you all the best with your research.

Kind regards

Janette Lamb / Debbie Smith
on behalf of Chair UHREC
Office of Research Ethics & Integrity
Level 4 | 88 Musk Avenue | Kelvin Grove
p: +61 7 3138 5123 / 3138 4673
e: ethicscontact@qut.edu.au
w: <http://www.orei.qut.edu.au>

Elizabeth Kate Martin

From: Human Ethics Advisory Team
Sent: Monday, 21 November 2016 3:41 PM
To: Nicholas Graves; Elizabeth Kate Martin
Cc: Deborah Smith
Subject: Ethics variation 2 - approved - 1400000868

Dear Prof Nicholas Graves and Elizabeth Kate Martin

Approval #: 1400000868
End Date: 2/02/2018
Project Title: A cost-effectiveness modelling study of strategies to prevent post-caesarean surgical site infection

This email is to advise that your variation has been considered by the Chair, University Human Research Ethics Committee. This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2007).

Approval has been provided for:
< the alteration to application to QH for health data (received incorrect data, seeks de-id birth data)

PLEASE NOTE:
RESEARCH SAFETY -- Ensure any health and safety risks relating to this variation have been appropriately considered, particularly if your project required a Health and Safety Risk Assessment.

CONFLICTS OF INTEREST -- If this variation will introduce any additional perceived or actual conflicts of interest please advise the Research Ethics Advisory Team by return email.

Please don't hesitate to contact us if you have any questions.

Regards

Janette Lamb / Debbie Smith
on behalf of Chair UHREC
Office of Research Ethics & Integrity
Level 4 | 88 Musk Avenue | Kelvin Grove
+61 7 3138 5123
humanethics@qut.edu.au
<http://www.orei.qut.edu.au>



21 April 2016

Ms Elizabeth Martin
201 Kedron Brook Rd
Wilston 4051

Dear Ms Martin

Re: HREC Ref N°: HREC/16/MHS/20

Project title: A cost-effectiveness modelling study of strategies to prevent post-caesarean infection

Thank you for submitting the above research project for single ethical review. This project was considered by the Mater Health Services Human Research Ethics Committee (MHS HREC) (EC00332) at its meeting held on 19.04.16.

I am pleased to advise that the MHS Human Research Ethics Committee has granted ethical approval of this research project. The waiver of consent was approved in accordance with the National Statement on Ethical Conduct in Human Research 2007 (updated 2015) 2.3.10 and Section 95A of the Privacy Act D.5 a, b, c i, ii, iii, iv, v, d, g, h, j, k i, ii.

The nominated participating sites for this project are:

- Mater Misericordiae Health Services Brisbane Limited at Mater Mothers' Hospital, Mater Mothers' Private Brisbane, Mater Mothers' Private Redland
- Mater Misericordiae Hospital Rockhampton
- Mater Misericordiae Hospital Mackay
- Mater Misericordiae Hospital Gladstone

This letter constitutes ethical approval only. Please liaise with your Research Governance office in regard to any additional requirements. At Mater Health Services please contact the Research Governance Office on 07 3163 3769.

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2007), updated in 2015. The processes used by this HREC to review multi-centre research proposals have been certified by the National Health and Medical Research Council.

Mater Research HREC Office
Room 294 Level 2 Aubigny Place

Ph: 07 3163 1585 Fax: 07 3163 1588

Email: research.ethics@mmri.mater.org.au

Mater Misericordiae Health Services Brisbane Limited
ACN 096 708 922
Raymond Terrace,
South Brisbane,
Queensland 4101 Australia
Phone + 61 7 3163 8111
www.mater.org.au

F0621
11/07



The approved documents include:

| Document | Version | Date |
|---|--|-----------------------|
| Covering Letter | | 21 March 2016 |
| Application: Online Forms LNR Submission Code AU/10/C1F4211 | 1.0 (2011) | 22 March 2016 |
| Protocol | | February 2014 |
| Example linked data spreadsheet | | |
| Investigator CV: Elizabeth Martin | March 2016 | (valid to March 2018) |
| Investigator CV: Nicholas Graves | | March 2016 |
| Investigator CV: Michael Beckmann | submitted 22.03.16 (valid to 22.03.18) | |
| Investigator CV: Katharina Merollini | submitted 22.03.16 (valid to 22.03.18) | |
| Investigator CV: Kate Halton | submitted 22.03.16 (valid to 22.03.18) | |
| HREC approval letter: Ethics approval from Mater Health Services North Queensland (noted) | | 16 March 2016 |
| HREC approval letter: Queensland University of Technology UHEC approval | various QUT HREC documents | |

Approval of this project by the MHS HREC is valid from **19.04.16** to **19.04.19**, subject to the following conditions being met:

- The Principal Investigator will immediately report anything that might warrant review of ethical approval of the project.
- The Principal Investigator will notify the MHS HREC of any event that requires a modification to the protocol or other project documents and submit any required amendments.
- The Principal Investigator will submit any necessary reports related to the safety of research participants.
- In accordance with *Section 3.3.22(b)* of the National Statement the Principal Investigator will report to the MHS HREC annually, the first report is to be submitted by **19.04.17**. Template may be downloaded at: <http://www.mater.org.au/Home/Research/Human-Research-Ethics-Committee/HREC-and-RGO-Resources>
- The Principal Investigator will notify the MHS HREC if the project is discontinued before the expected completion date, with reasons provided.
- The Principal Investigator will notify the MHS HREC of any plan to extend the duration of the project past the approval period listed above and will submit any associated required documentation.
- A copy of this ethical approval letter together with completed Site Specific Assessment (SSA) and any other requirements must be submitted by all site Principal Investigators to the Research

Governance Office at each participating institution in a timely manner to enable the institution to authorise the commencement of the project at its site/s.

Please confirm the commencement date with the Research Ethics Office.

Should you have any queries about the MHS HREC's consideration of your project, please contact the HREC Coordinator on (07) 3163 1585. The MHS HREC Terms of Reference, membership and standard forms are available at <http://www.mater.org.au/Home/Research/Human-Research-Ethics-Committee/Human-Research-Ethics/HREC-Resources>

The MHS HREC wishes you every success in your research.

Yours sincerely



Dr Conor Brophy MBBS; MD; MBioethics; FRCP; AFRACMA
Chairperson
Mater Health Services Human Research Ethics Committee

From: [Schneider, Anne-Maree](#)
To: [Elizabeth Kate Martin](#)
Subject: FW: Query re process for approval to access de-identified patient data
Date: Thursday, 10 March 2016 3:02:54 PM

Hi Elizabeth

Please see email response from Allan Maraj.

Kind Regards

-
[Anne-Maree Schneider](#)
Privacy Coordinator
Information Privacy Office
Information & Technology Division

Mater Health Services || Raymond Terrace || South Brisbane || Qld 4101
t: (07) 3163 2666 e: Anne-Maree.Schneider@mater.org.au
f: (07) 3163 8104

From: Maraj, Allan
Sent: Thursday, 10 March 2016 2:50 PM
To: Schneider, Anne-Maree
Subject: RE: Query re process for approval to access de-identified patient data

Approved

Cheers
Allan

-
[Allan Maraj](#) B.Juris, LLB, MBA, M.IT
Manager, Risk & Compliance Services
Mater Health

Information & Technology Division || Ground Floor, Potter Building || Annerley Road || South Brisbane || Qld 4101
t: (07) 3163 2484 m: 0434 603 787 f: (07) 3163 1629
e: allan.maraj@mater.org.au

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Please consider the environment before printing this email

From: Schneider, Anne-Maree
Sent: Thursday, 10 March 2016 2:40 PM
To: Maraj, Allan
Subject: FW: Query re process for approval to access de-identified patient data

Hi Allan

Please see email below.

Kind Regards

-
Anne-Maree Schneider
Privacy Coordinator
Information Privacy Office
Information & Technology Division

Mater Health Services || Raymond Terrace || South Brisbane || Qld 4101
t: (07) 3163 2666 e: Anne-Maree.Schneider@mater.org.au
f: (07) 3163 8104

From: Elizabeth Kate Martin [<mailto:elizabethkate.martin@hdr.qut.edu.au>]
Sent: Thursday, 3 March 2016 2:19 PM
To: Privacy Office
Cc: Beckmann, Mike
Subject: FW: Query re process for approval to access de-identified patient data

Dear Anne-Maree,

As per our discussion yesterday, I write for two reasons:

I require an updated approval from Allan for access to the Mater data for my study with Dr Mike Beckmann; and

I would now like data from the Emergency Data Information System (EDIS).

Updated approval:

In 2013, I spoke with the Mater ethics office about my study with Mike investigating the cost-effectiveness of strategies to prevent infections in women who have had a caesarean section. The study was approved as an 'audit of practice' by the ethics office and the Privacy Office. Jodie Powell from infection control has been helping me with access to infection data from the Mater hospital since then.

The study is also being conducted across Queensland. Other private hospitals would like evidence of Mater's support for the study (in lieu of no ethics approval) that is no older than 6 months.

For your records, the study has ethics approval from the QUT UREC.

Could Alan please update the approval? I happy to provide more information if required.

Data from EDIS:

Our study now requires information about women who have presented to Emergency with caesarean wound complications. Can you please advise the process for accessing this data? The data will be forwarded to Queensland Health for linking to the Queensland Health Admitted Patient Data Collection (QHAPDC) and the Perinatal Data Collection (PDC). Identifying variables will be required for authorised Queensland Health staff (Health Statistics Branch) to conduct the data linkage. As the researcher, I am not required to see the patient-identifying EDIS database at this stage. After data linkage, Queensland Health will remove all identifying variables and securely send the dataset to me. Once again, I am happy to provide more information if required.

Many thanks for your help,

Elizabeth.

From: Maraj, Allan [<mailto:Allan.Maraj@mater.org.au>]
Sent: Tuesday, 26 November 2013 3:41 PM
To: Schneider, Anne-Maree
Cc: Elizabeth Martin
Subject: Re: Query re process for approval to access de-identified patient data

Approved

Cheers

Allan

Allan Maraj B.Juris, LLB, MBA, M.IT
Manager, Risk & Compliance Services
Mater Health Services

Information & Infrastructure Division || Ground Floor, Potter Building || Annerley Road ||
South Brisbane || Qld 4101
t: [\(07\) 3163 2484](tel:0731632484) m: [0434 603 787](tel:0434603787) f: [\(07\) 3163 1629](tel:0731631629)
e: allan.maraj@mater.org.au

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On 26 Nov 2013, at 12:15 pm, "Schneider, Anne-Maree" <Anne-Maree.Schneider@mater.org.au> wrote:

Good Morning

I have been advised by Dr Beckmann that he is the sponsor for this activity.

Kind Regards

Anne-Maree Schneider
Privacy Coordinator
Information Privacy Office
Mater Health Services

Mater Adult Hospital || Raymond Terrace|| South Brisbane|| Qld 4101
t: (07) 3163 2666 e: Anne-Maree.Schneider@mater.org.au
f: (07) 3163 8104

From: Maraj, Allan
Sent: Monday, 25 November 2013 3:26 PM
To: Schneider, Anne-Maree; elizabethkate.martin@qut.edu.au
Subject: RE: Query re process for approval to access de-identified patient data

I'm happy to approve this if Mike confirms that he is sponsor of the study.

Cheers

Allan

Allan Maraj B.Juris, LLB, MBA, M.IT
Manager, Risk & Compliance Services
Mater Health Services

Information & Infrastructure Division ||Ground Floor, Potter Building || Annerley Road || South
Brisbane || Qld 4101
t: (07) 3163 2484 m: 0434 603 787 f: (07) 3163 1629
e: allan.maraj@mater.org.au

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Please consider the environment before printing this email

From: Schneider, Anne-Maree
Sent: Monday, November 25, 2013 1:29 PM
To: Maraj, Allan
Subject: FW: Query re process for approval to access de-identified patient data

Hi Allan

Please see email below.

Kind Regards

Anne-Maree Schneider
Privacy Coordinator
Information Privacy Office
Mater Health Services

Mater Adult Hospital || Raymond Terrace|| South Brisbane|| Qld 4101
t: (07) 3163 2666 e: Anne-Maree.Schneider@mater.org.au
f: (07) 3163 8104

From: Elizabeth Martin [<mailto:elizabethkate.martin@qut.edu.au>]
Sent: Friday, 22 November 2013 10:08 AM
To: Privacy Office
Subject: Query re process for approval to access de-identified patient data

Dear Anne-maree,

Dr Michael Beckmann and I are planning to evaluate a quality improvement activity to prevent infections in women who are about to have an emergency caesarean.

As I am external to the Mater, what is the process for gaining approval for me to see de-identified patient data so I can help Michael measure changes in infection rates?

Odette from the ethics office suggested that we might get approval for this to be considered an 'audit of practice' but that the Privacy Office would need to be happy with me looking at the data with Michael.

Kind regards,

Elizabeth.

Elizabeth Martin
PhD Candidate
<[image005.png](#)>

Ph: +61 7 3138 0104
Mob: +61 422 809 021
<[image006.png](#)>@Elizabeth201kbr
<http://www.elizabethkatemartin.com>

| Office Use Only | |
|-----------------|--|
| Ref. No. | |
| Rec. Date | |
| Rec. By | |

Mater Health Services Site-Specific Assessment (SSA) Form

Site-Specific Assessment (SSA) is a key component of research governance and involves assessment of the suitability of the site and the Investigator(s) for the proposed research. The SSA is the mechanism for professional, legal and financial accountability and transparency and is consistent with the NHMRC's "Australian Code for the Responsible Conduct of Research" 2007 (the Code).

The SSA process considers the following elements of Research Governance:

- Ethical Approval
- Compliance with legislation, regulations, policies and codes of conduct relating to matters such as privacy, confidentiality, consent, biosafety, radiation safety and professional standards.
- Financial management and site-specific requirements (adequate resources - financial, human, equipment and infrastructure) for the research to proceed at the site
- Legal and Insurance – consent, indemnity and contracts
- Researchers have the necessary expertise and experience; if not relevant training is planned before carrying out their research study
- Monitoring of research throughout the life of the project

Instructions for the Principal Investigator:

- This form must be completed by the Principal Investigator (PI) responsible for the research project at this site.
- Applicants should begin negotiations with relevant Mater Health Services (MHS) personnel responsible for resources that will be required for the study, e.g. Heads of Departments or Managing Accountant, as early as possible.
- The completed form must be submitted to the Mater Research Governance Office for review prior to final Authorisation by the Mater Health Services Chief Executive Officer or delegate, before the research can begin.
- All aspects of the form are to be completed and the required associated documents attached.
- The checklist on the back of the SSA form must be reviewed prior to submission and will assist to ensure a full submission is completed before forwarding to the Mater Research Governance Office.

Please note – this form is designed to be completed in Microsoft Word and includes selectable tick boxes and dropdown options. Textboxes will expand as necessary.

This form is based on the Queensland Health SSA Form.

Components of the SSA form

Note: This table of contents may be used to link directly to a specific section of the SSA form. However, all sections of the form must be completed.

| | |
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1. Project details

1.1 Formal title of research project:

A cost-effectiveness modelling study of strategies to prevent post-caesarean infection

1.2 Short title/acronym of research project (if applicable):

Economics of preventing caesarean infections

1.3 Mater Research Hub Project ID (e.g. MR-2015-xx):

Click here to enter text. MR-2015-58135

1.4 Name of Human Research Ethics Committee (HREC) reviewing the research project:

MHS HREC

1.5 HREC application reference number:

HREC/16/MHS/20

1.6 Review type (as determined by the reviewing HREC):

Full SSA - For research involving more than low or negligible risk to participants

1.7 Mater sites at which the research project will be undertaken (select all that apply):

- | | |
|--|--|
| <input type="checkbox"/> Mater Hospital Brisbane | <input checked="" type="checkbox"/> Mater Private Hospital, South Brisbane |
| <input type="checkbox"/> Mater Children's Private Hospital, South Brisbane | <input checked="" type="checkbox"/> Mater Private Hospital, Redlands |
| <input checked="" type="checkbox"/> Mater Mothers' Hospitals, South Brisbane | <input type="checkbox"/> Mater Research, South Brisbane |
| <input type="checkbox"/> Mater Research, Translational Research Institute | <input type="checkbox"/> Other |

If Other, please provide details:

Click here to enter text.

1.8 Is this a single site or multi-centre study?

Multi-centre Study

1.9 Non-Mater Sites: List all locations at which study-related activities are conducted. Please indicate activity at each site. E.g. Recruitment only, data collection

The following public hospitals will provide data used in this research centrally to Queensland Health. There will be no research activity at each site:

Atherton Hospital
Ayr Hospital
Biloela Hospital
Bundaberg Hospital
Caboolture Hospital
Cairns Base Hospital
Charleville Hospital
Chinchilla Hospital
Dalby Hospital
Emerald Hospital
Gladstone Hospital
Gold Coast Hospital
Goondiwindi Hospital
Gympie Hospital
Hervey Bay Hospital
Innisfail Hospital

Ipswich Hospital
 Kingaroy Hospital
 Logan Hospital
 Longreach Hospital
 Mackay Base Hospital
 Mareeba Hospital
 Maryborough Hospital
 Mount Isa Hospital
 Nambour Hospital
 Proserpine Hospital
 Redcliffe Hospital
 Redland Hospital
 Rockhampton Hospital
 Roma Hospital
 Royal Brisbane and Women's Hospital
 St George Hospital
 Stanthorpe Hospital
 Thursday Island Hospital
 Toowoomba Hospital
 Townsville Hospital
 Warwick Hospital

The following private hospitals will provide datasets with information already collected. **There will be no research activity at each site:**

Mater Misericordiae Hospital Gladstone
 Mater Misericordiae Hospital Mackay
 Mater Misericordiae Hospital Rockhampton
 Mater Women's and Children's Hospital Townsville
 St Vincent's Hospital Toowoomba
 Sunshine Coast Private Hospital
 Wesley Private Hospital

1.10 Mater Research Theme/Centre to which this research project belongs (select one only):

If you are unsure about which Theme you or your project belong to, please contact the [Research Development Team](#).

Theme 3 - Mothers and Babies Health

1.11 Select study type:

Other

2. Lay summary

Provide a brief description (half page) of the aims and methods of the research project, including the nature of the research project at Mater. Include information on how the conduct of this research will impact on the Mater site (department or service) and the resources required.

This research will assess changes to costs and health outcomes if Queensland hospitals adopted the gold standard in preventing infections following caesarean section. Since 2010, evidence surrounding the most effective way to prevent c-section infections has strengthened significantly. However, clinicians have told us anecdotally that practice has not changed greatly since 2010. Cost-effectiveness research is needed to understand whether it is a wise use of the hospital's budget to

change practice and attempt to reduce the post-caesarean infection rate. This is a modelling study and not trialling a change to clinical practice.

The aim of this research is to evaluate the incremental cost-effectiveness of different interventions to prevent surgical site infection following caesarean section in Queensland. The research will also identify if decisions based on the criterion of cost-effectiveness vary by sub-groups such as hospital type, geographic region or patient risk status.

The objectives of this research are to:

- identify and assess the volume and quality of evidence around the competing risk reduction strategies or combination of strategies that are relevant to decision makers for the prevention of post-caesarean surgical site infection;
- build a cost-effectiveness model to describe the changes to total economic costs and changes to health benefits for each of the identified strategies;
- quantify the effect of uncertainty in the model; and
- assess whether cost-effectiveness varies by sub-group e.g. type of hospital and/or by patient risk category.

Important elements of this research to note are:

- The research requires linkage of four datasets. Two of Queensland Health's data sets already include data from Mater Health Services.
- Two datasets are requested from the Mater Health Services: 1) infection data from women who are readmitted to hospital with a caesarean wound complication; and 2) emergency department data from women who presented to emergency with a caesarean wound complication and were either readmitted or treated and returned home.
- The two datasets will include identifying patient variables which will be used for data linkage to the Queensland Health Admitted Patient Data Collection and the Perinatal Data Collection. Data linkage will be done by authorised Queensland Health staff in a secure location. The researcher will not see any identifying data. After data linkage, the identifying variables will be removed, a patient identifier will be allocated to each record, and a single dataset will be provided to the researcher for analysis.
- Acquiring all four datasets requires a waiver of consent and this was addressed in the ethics application and through Queensland Health's Public Health Act application process to the Director General.

At the Mater Hospitals, Elizabeth has been working with Jenny Stackelroth from infection control and Tracey Ecob from the emergency department. Jenny and Tracey will provide data on women who were identified in hospital, post-discharge or on presentation to emergency as having an infection following caesarean section.

Datasets will be prepared by Jenny and Tracey and forwarded to Queensland Health's Health Statistics Branch for linkage with other datasets Queensland Health holds for Mater patients. This is estimated to take between 15 minutes to 1 hour for Jenny and Tracey individually.

3. Research team

3.1 Research personnel relevant to Mater

Provide details below for each researcher involved with the conduct of the research project at this site. This includes anybody who will be accessing the Mater participants' data or Mater resources. All research personnel involved with the research at Mater must sign the SSA form (see [Section 16a](#)).

Note: Space has been provided for up to nine (9) researchers. If your study involves additional research personnel please download the "Additional research personnel" template from the Research Governance webpage.

a) Principal Investigator at Mater site

| | |
|---|--|
| Project Role: | Associate Investigator |
| Title: | Dr |
| Full Name: | Michael Beckmann |
| Position: | Director of Obstetrics and Gynaecology |
| Department: | Obstetrics and Gynaecology |
| Organisation: | Mater Health Services |
| Mailing Address: | Aubigny Place, Raymond Terrace South Brisbane Q 4101 |
| Phone: | 07 3163 8330 |
| Email: | Michael.Beckmann@mater.org.au |
| Qualifications (relevant to this project): | M.B.,B.S. (Qld), M.R.A.N.Z.C.O.G. (medal), F.R.A.N.Z.C.O.G. |
| Key responsibilities in project: | Clinical guidance |
| A CV for each researcher must be provided with your application, unless a CV has been provided to the Research Governance Office in the past 2 years. | |
| Is a (short) CV attached? | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> N/A |
| Clinical staff only: Does the credentialing scope of clinical practice cover all the relevant aspects of the investigator's participation in this study? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | |

b) Other research personnel relevant to Mater

| | |
|---|--|
| Project Role: | Student |
| Title: | Mrs |
| Full Name: | Elizabeth Martin |
| Position: | PhD Candidate |
| Department: | Institute of Health and Biomedical Innovation |
| Organisation: | Queensland University of Technology |
| Mailing Address: | 60 Musk Ave, Kelvin Grove Q 4509 |
| Phone: | 0422809021 |
| Email: | elizabethkate.martin@hdr.qut.edu.au |
| Qualifications (relevant to this project): | B. App. Sci. M Hlth. Econ. |
| Key responsibilities in project: | Coordinating principle Investigator |
| A CV for each researcher must be provided with your application, unless a CV has been provided to the Research Governance Office in the past 2 years. | |
| Is a (short) CV attached? | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> N/A |
| Clinical staff only: Does the credentialing scope of clinical practice cover all the relevant aspects of the investigator's participation in this study? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | |

| | |
|--|--|
| Project Role: | Principal Investigator |
| Title: | Prof |
| Full Name: | Nicholas Graves |
| Position: | Professor of Health Economics |
| Department: | Institute of Health and Biomedical Innovation |
| Organisation: | Queensland University of Technology |
| Mailing Address: | 60 Musk Ave, Kelvin Grove Q 4509 |
| Phone: | 07 3138 6115 |
| Email: | n.graves@qut.edu.au |
| Qualifications (relevant to this project): | PhD |
| Key responsibilities in project: | Principle supervisor of Elizabeth Martin |
| <i>A CV for each researcher must be provided with your application, unless a CV has been provided to the Research Governance Office in the past 2 years.</i> | |
| Is a (short) CV attached? | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> N/A |
| Clinical staff only: | |
| Does the credentialing scope of clinical practice cover all the relevant aspects of the investigator's participation in this study? | |
| <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A | |

| | |
|--|--|
| Project Role: | Associate Investigator |
| Title: | Dr |
| Full Name: | Kate Halton |
| Position: | Senior Research Fellow |
| Department: | Institute of Health and Biomedical Innovation |
| Organisation: | Queensland University of Technology |
| Mailing Address: | 60 Musk Ave, Kelvin Grove Q 4509 |
| Phone: | 0424 431 608 |
| Email: | k.halton@qut.edu.au |
| Qualifications (relevant to this project): | PhD |
| Key responsibilities in project: | Association supervisor for Elizabeth Martin |
| <i>A CV for each researcher must be provided with your application, unless a CV has been provided to the Research Governance Office in the past 2 years.</i> | |
| Is a (short) CV attached? | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> N/A |
| Clinical staff only: | |
| Does the credentialing scope of clinical practice cover all the relevant aspects of the investigator's participation in this study? | |
| <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A | |

| | |
|------------------|---|
| Project Role: | Associate Investigator |
| Title: | Dr |
| Full Name: | Katharina Merollini |
| Position: | Research Fellow |
| Department: | Faculty of Science, Health, Education and Engineering |
| Organisation: | University of the Sunshine Coast |
| Mailing Address: | 3 Utah St, Aroona Q 4551 |
| Phone: | 07 5456 3558 |

| | |
|--|--|
| Email: | kmerolli@usc.edu.au |
| Qualifications (relevant to this project): | PhD |
| Key responsibilities in project: | Association supervisor for Elizabeth Martin |
| <i>A CV for each researcher must be provided with your application, unless a CV has been provided to the Research Governance Office in the past 2 years.</i> | |
| Is a (short) CV attached? | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> N/A |
| Clinical staff only: | |
| Does the credentialing scope of clinical practice cover all the relevant aspects of the investigator's participation in this study? | |
| <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A | |

| | |
|--|---|
| Project Role: | Choose an item. |
| Title: | Choose an item. |
| Full Name: | Click here to enter text. |
| Position: | Click here to enter text. |
| Department: | Click here to enter text. |
| Organisation: | Click here to enter text. |
| Mailing Address: | Click here to enter text. |
| Phone: | Click here to enter text. |
| Email: | Click here to enter text. |
| Qualifications (relevant to this project): | Click here to enter text. |
| Key responsibilities in project: | Click here to enter text. |
| <i>A CV for each researcher must be provided with your application, unless a CV has been provided to the Research Governance Office in the past 2 years.</i> | |
| Is a (short) CV attached? | <input type="checkbox"/> Yes <input type="checkbox"/> N/A |
| Clinical staff only: | |
| Does the credentialing scope of clinical practice cover all the relevant aspects of the investigator's participation in this study? | |
| <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | |

| | |
|--|---|
| Project Role: | Choose an item. |
| Title: | Choose an item. |
| Full Name: | Click here to enter text. |
| Position: | Click here to enter text. |
| Department: | Click here to enter text. |
| Organisation: | Click here to enter text. |
| Mailing Address: | Click here to enter text. |
| Phone: | Click here to enter text. |
| Email: | Click here to enter text. |
| Qualifications (relevant to this project): | Click here to enter text. |
| Key responsibilities in project: | Click here to enter text. |
| <i>A CV for each researcher must be provided with your application, unless a CV has been provided to the Research Governance Office in the past 2 years.</i> | |
| Is a (short) CV attached? | <input type="checkbox"/> Yes <input type="checkbox"/> N/A |
| Clinical staff only: | |
| Does the credentialing scope of clinical practice cover all the relevant aspects of the investigator's participation in this study? | |

☐ Yes ☐ No ☐ N/A

| | |
|--|---|
| Project Role: | Choose an item. |
| Title: | Choose an item. |
| Full Name: | Click here to enter text. |
| Position: | Click here to enter text. |
| Department: | Click here to enter text. |
| Organisation: | Click here to enter text. |
| Mailing Address: | Click here to enter text. |
| Phone: | Click here to enter text. |
| Email: | Click here to enter text. |
| Qualifications (relevant to this project): | Click here to enter text. |
| Key responsibilities in project: | Click here to enter text. |
| <i>A CV for each researcher must be provided with your application, unless a CV has been provided to the Research Governance Office in the past 2 years.</i> | |
| Is a (short) CV attached? | <input type="checkbox"/> Yes <input type="checkbox"/> N/A |
| Clinical staff only: | |
| Does the credentialing scope of clinical practice cover all the relevant aspects of the investigator's participation in this study? | |
| <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | |

| | |
|--|---|
| Project Role: | Choose an item. |
| Title: | Choose an item. |
| Full Name: | Click here to enter text. |
| Position: | Click here to enter text. |
| Department: | Click here to enter text. |
| Organisation: | Click here to enter text. |
| Mailing Address: | Click here to enter text. |
| Phone: | Click here to enter text. |
| Email: | Click here to enter text. |
| Qualifications (relevant to this project): | Click here to enter text. |
| Key responsibilities in project: | Click here to enter text. |
| <i>A CV for each researcher must be provided with your application, unless a CV has been provided to the Research Governance Office in the past 2 years.</i> | |
| Is a (short) CV attached? | <input type="checkbox"/> Yes <input type="checkbox"/> N/A |
| Clinical staff only: | |
| Does the credentialing scope of clinical practice cover all the relevant aspects of the investigator's participation in this study? | |
| <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | |

3.2 Project Contact Person at Mater:

The PI will be responsible for ensuring there is a contact person (Mater Sponsor) at the site who will liaise with the site Research Governance Officer. The contact person may be the PI or a person nominated by the PI however they must be located at Mater.

Please complete the table below if the contact person is not already listed in section 3.1.

If the details of the contact person have been completed in section 3.1, enter their name here:

Dr Michael Beckmann

| | |
|------------------|---------------------------|
| Title: | Choose an item. |
| Full Name: | Click here to enter text. |
| Position: | Click here to enter text. |
| Department: | Click here to enter text. |
| Organisation: | Click here to enter text. |
| Mailing Address: | Click here to enter text. |
| Phone (Work): | Click here to enter text. |
| Phone (Mobile): | Click here to enter text. |
| Email: | Click here to enter text. |

Optional: If the project has a coordinator/contact person who is external to Mater who should be included in correspondence about the application, provide their details below.

| | |
|------------------|---|
| Title: | Mrs |
| Full Name: | Elizabeth Martin |
| Position: | PhD Candidate |
| Department: | Institute of Health and Biomedical Innovation |
| Organisation: | Queensland University of Technology |
| Mailing Address: | 60 Musk Ave, Kelvin Grove Q 4509 |
| Phone (Work): | 07 3138 0104 |
| Phone (Mobile): | 0422809021 |
| Email: | elizabethkate.martin@hdr.qut.edu.au |

3.3 Additional information required for studies involving non-Mater researchers and/or students:

a) Will non-Mater researchers be accessing the Mater site for purposes of this research?

☐ Yes ☒ No

If yes, please provide details:

Click here to enter text.

b) Will non-Mater researchers be approaching Mater participants for purposes of this research (e.g. providing project-related information, undertaking informed consent procedures)?

☐ Yes ☒ No

If yes, please provide details:

Click here to enter text.

c) Will non-Mater researchers be accessing identifiable or re-identifiable Mater participant data?

☒ Yes ☐ No

If yes, please provide details:

Identifiable data will be used to link the infection and emergency datasets to data that Queensland Health already holds for Mater Health Services patients. Data linkage will be done by authorised Queensland Health staff in a secure location. The researcher will not see any identifying data. After data linkage, the identifying variable will be removed, a patient identifier will be allocated to each record, and a single dataset will be provided to the researcher for analysis.

d) Will non-Mater researchers be storing identifiable or re-identifiable Mater participant data at a non-Mater site?

☒ Yes ☐ No

If yes, please provide details:

The identifiable data will be stored in a secure location at Queensland Health and then deleted once the non-identifiable data has been passed on to Elizabeth Martin at QUT.

e) Are students involved in the conduct of this research at the Mater site?

☐ Yes ☒ No

If yes, please provide details for each student (including student name/s, supervisor/s, name of university (and course) the student is enrolled in, and student qualifications):

Click here to enter text.

3.4 Training

a) Will any of the researchers at Mater require extra training to enable their participation in this project?

☐ Yes ☒ No

If yes, complete the table below.

| Researcher | Training required | Who will provide training? |
|---------------------------|---------------------------|----------------------------|
| Click here to enter text. | Click here to enter text. | Click here to enter text. |
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| Click here to enter text. | Click here to enter text. | Click here to enter text. |

b) Are any members of the research team certified in Good Clinical Practice (GCP)?

☐ Yes ☒ No

If yes, complete the table below.

| Researcher | Level of GCP training (e.g. Online course, half-day course, 2-day course etc.) | Year training was undertaken? |
|---------------------------|---|-------------------------------|
| Click here to enter text. | Click here to enter text. | Click here to enter text. |
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4. Recruitment

4.1 Participants

a) Does this project require prospective recruitment of human participants at Mater?

☐ Yes ☒ No

If yes, what is the proposed number of participants to be recruited at Mater?

Click here to enter text.

b) Does this project use existing collections of retrospective clinical data?

☒ Yes ☐ No

If yes, what is the planned number of Mater patient records to be reviewed?

For the infections data set, there will be approximately up to 3300 women who had a caesarean section and 75 women who had an infection between 1 June 2014 and 30 July 2015.

For the emergency dataset, it is estimated that there will be 13 patients who would have presented to emergency and their primary diagnosis was caesarean infection.

4.2 Recruitment process

a) What process will be used to identify potential participants at Mater?

There is no recruitment process. The research involves a waiver of consent and use of existing datasets.

b) How will initial contact be made with potential participants at Mater?

No contact will be made with participants at Mater.

5. Vulnerable participant groups at Mater

5.1 Participant details

a) At Mater, does the study include recruitment of participants whose primary language is other than English (LOTE)?

☐ Yes ☒ No

If yes, are the costs for interpreter services included in the study budget?

☐ Yes ☐ No

b) At Mater, does the study include recruitment of women who are pregnant and the human foetus?

☐ Yes ☒ No

c) At Mater, does the study include recruitment of children and/or young people (i.e. <18 years)?

☐ Yes ☒ No

d) At Mater, does the study include recruitment of people with a cognitive impairment, an intellectual disability or a mental illness?

☐ Yes ☒ No

5.2 Research involving adults with impaired capacity to consent Where a person is over the legal age of consent but is unable to give consent, written application to the Queensland Civil and Administrative Tribunal (QCAT) must be undertaken.

For further information please refer to the [Queensland Civil and Administrative Tribunal website](#).

Does this study involve adults with impaired capacity to consent?

☐ Yes ☒ No

5.3 Research into the health of Indigenous Australians

If the study involves recruitment of Aboriginal and Torres Strait Islander people at Mater (including incidental recruitment), have the researchers had relevant community engagement with Aboriginal and Torres Strait Islander individuals, communities and/or organisations in conceptualisation, development and approval, data collection and management, analysis, report writing and dissemination of results for this study, and/or consulted with the Australian and Torres Strait Islander Liaison Officer/s at Mater?

☐ Yes ☐ No ☒ N/A

Provide an explanation.

[Click here to enter text.](#)

5.4 Research involving access to coronial material

Research involving access to coronial material must be referred to the Queensland Health Forensic and Scientific Services Human Ethics Committee (FSS-HEC) for ethical and legal approvals. This also applies to clinical research projects where there is a component involving coronial material. In this context, examples of coronial material include tissues from coronial autopsies, slides and blocks, blood samples, autopsy reports and other documents and data relating to coronial autopsies. For further information please refer to [Accessing Coronial Materials for Research](#).

Does this study require access to coronial material?

☐ Yes ☒ No

6. Access to confidential information

If researchers require access to confidential information (e.g. patient records, databases, departmental records) to conduct their research then approval must be obtained from Mater Health Information Services Privacy Office. This is to determine whether the project complies with all Privacy Laws and that the data required for the study is collected and accessible for the research project.

Please note: Approval from the Privacy Office is required even if the information required for the purpose of the research is readily available to the researchers for clinical purposes.

Instructions on how to obtain Privacy Office Approval are provided on the [Mater Research Governance Webpage](#).

Please contact the Mater Contact/Sponsor or the [Research Governance Office](#) for further details.

Does this project require access to confidential information held by Mater Health Services?

☒ Yes ☐ No

If No, please give an explanation:

[Click here to enter text.](#)

7. Compliance with requirements of a Catholic organisation

All policies are accessible to Mater staff from the [Mater Document Centre](#).

Researchers external to Mater should liaise with their Mater Contact/Sponsor for a copy of relevant policies.

Please note: A selected number of Mater research policies are available on the [Mater Research Governance Webpage](#).

Does the research comply with requirements of the [Catholic Health Australia "Code of Ethical Standards for Catholic Health and Aged Care Services in Australia" 2001](#), particularly regarding the following types of research?

(i) Use of embryos in human research

(ii) Clinical trials where pregnancy must be avoided

For further information regarding acceptable wording in participant information and consent forms (PICF) suggested by Mater, please refer to the PICF guidelines available on the [Mater HREC and Research Governance Office Resources Webpage](#).

☒ Yes ☐ No

If No, please give an explanation:

[Click here to enter text.](#)

8. Timeline

Provide the anticipated start and finish dates for the research project at Mater.

| | |
|---------------------------|------------|
| Recruitment start date* : | 1 May 2016 |
| Finish date#: | 1 May 2017 |
| Duration (Months): | 12 months |

*Start date refers to the anticipated first point of recruitment i.e. the date when the advertising or screening for participants begins, or first access to data.

#Finish date refers to the date when no further contact with participants/data source, including data analysis and reporting period, is foreseen.

9. Resource and budget information

Instructions for researchers:

Mater may incur costs in providing support for your research over and above those costs associated with standard care. Any additional routine care costs to be met by Mater are to be clearly identified and detailed. This includes both the 'actual monetary' costs and 'in kind' support.

Confirmation of cost estimates, and agreement as to a funding source, is to be provided by the Managing Accountant in the first instance before approvals are obtained from the Head/s of Department/s and Executive Director/s of the relevant hospital/s and/or support service.

9.1 Departments and services involved in the research project at Mater

A signed declaration from the Head of Department must be attached with a completed SSA before Authorisation to begin the research project is given (see [Section 16b](#)).

| Department/location | Name of responsible person contacted |
|----------------------------------|--------------------------------------|
| Infection control and prevention | Jenny Stackelroth |
| Emergency Department | Tracey Ecob |
| Click here to enter text. | Click here to enter text. |
| Click here to enter text. | Click here to enter text. |
| Click here to enter text. | Click here to enter text. |

9.2 Funding source/s

| Type of funding | Name of funding organisation/source | Amount for this site (either \$/year or \$/participant) | Sought or Approved |
|--|-------------------------------------|---|--------------------|
| Overseas sources | nil | nil | Choose an item. |
| Business (commercially sponsored) | nil | nil | Choose an item. |
| Private Non-profit Organisations (e.g. collaborative groups) | nil | nil | Choose an item. |
| Donations/Bequests | nil | nil | Choose an item. |
| Australian Government (e.g. NHMRC, ARC) | nil | nil | Choose an item. |
| Joint Business/Government | nil | nil | Choose an item. |
| Non QLD state/local government | nil | nil | Choose an item. |

| | | | |
|--|-------------------------|-----|-----------------|
| University | QUT APA PhD Scholarship | nil | Approved |
| Other QLD Government Department (e.g. Treasury) | nil | nil | Choose an item. |
| Internal Institutional Competitive Research Grants | nil | nil | Choose an item. |
| Internal Department Funds | nil | nil | Choose an item. |
| Other Australian Sources | nil | nil | Choose an item. |
| Other (e.g. Researcher Self-Funded) | nil | nil | Choose an item. |

9.3 Study budget (site-specific)

Instructions for researchers:

- Document only those items which are above the usual standard care and are particular to the research study, e.g. extra documentation, extra tests.
- If actual monetary costs are involved, dollar values are to be supplied. If seeking in-kind support, please provide details of resources required, e.g. Mater investigator time, time of any other Mater staff involved (e.g. as participants), use of infrastructure, administrative support.
- The monetary costs need to be covered by a funds source /s which may be an existing source or new funds.
- If required by the RGO, attach the relevant site-specific departmental budgets.
- Please provide quotes from any department/s which may be supplying services.

Note: If a budget item does not fit under any of the categories listed in the first column, please choose the "Other" option at the bottom of the table and complete the relevant details.

If a detailed budget worksheet has already been prepared for the Mater site, this may be attached to the application instead of completing Section 9.3. If the budget is provided as an attachment please ensure that any requested 'in kind' support is listed below.

| Item/s | Budget for the site (\$ where appropriate, or relevant details) | In kind costs | Cost covered by sponsor or funder |
|---|---|---|---|
| Supply of drugs and/or other therapies | nil | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Radiology (e.g. MRI brain scan x 10) | nil | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Pathology (e.g. 4 x venepuncture per patient x 10 patients) | nil | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Pharmacy | nil | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Diagnostics – other (e.g. 3 x ECGs per patient x 10 patients) | nil | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Principal Investigator (e.g. 3 hours/patient, and corresponding \$ value if known) | 15 minutes per month for supervision of Elizabeth Martin | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Co-investigators (e.g. 6 hours/patient, and corresponding \$ value if known) | nil | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |

| | | | |
|---|--|---|---|
| Clinical Study Coordinator (e.g. 16 hours/fortnight, and corresponding \$ value if known) | nil | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Administrative Support | nil | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Other Infrastructure (E.g. computers, printing, office space, stationery etc.) | nil | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Use of Equipment | nil | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Patient Travel and Accommodation Costs | nil | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Staff Travel and Accommodation Costs | nil | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Archiving | nil | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Other, please state: Time for infection control and emergency data to be retrieved from databases and sent to Queensland Health | Jenny Stackelroth – max 60 minutes in total Tracey Ecob – max 60 minutes in total | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Other, please state: Click here to enter text. | Click here to enter text. | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Other, please state: Click here to enter text. | Click here to enter text. | <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| TOTAL | Click here to enter text. | | |

If costs are not covered by the sponsor or funding body please explain how the costs will be covered or explain how Mater will benefit from this research.

There are no direct costs involved in this research. Costs incurred are staff-time of Dr Michael Beckmann, Jenny Stackelroth and Tracey Ecob given in kind support of the research.

This application requests an exemption of fees for the SSA submission on the grounds that:

- Elizabeth Martin is a PhD student and this data is required for her research;
- The research is internally funded through in-kind support of staff at Mater Health Services including myself; and
- There is no funding for this research.

Benefits to Mater Health Services of the research:

This cost-effectiveness analysis will provide information to clinicians and decision makers such as obstetricians, midwives and senior infection control nurses, about what is the best allocation of health care resources. We will be able to advise which strategies make changes to post-caesarean infectious morbidity and what the cost-consequences are.

9.4 Finance authorisation

Confirmation of cost estimates, and agreement as to a funding source, is to be provided by the Managing Accountant in the first instance before approvals are obtained from the Head/s of Department/s and Executive Director/s of the relevant hospital/s.

Cost allocations and sources as described within the SSA form have been agreed by:

Note:- Nil cost MHH.

JAMES CRUICKSHANK *[Signature]* 11/5/16
N/A
Managing Accountant Name Signature Date
N/A
Principal Investigator Name Signature Date

10. Funds management

Where the research is funded, Mater has a responsibility to ensure appropriate financial management processes are in place. Additionally, the site PI must have a Mater cost centre set up for the study.

10.1 Cost centre details

Mater/Mater Research Cost Centre Code n/a

10.2 Externally managed funding

Complete Section 10.2 only if the research project is funded by external sources and funds are not being managed by Mater. If not applicable to the study, continue to [Section 11](#).

a) Name the organisation administering the funding:

n/a

b) Explain the process for funds management at Mater (i.e., funds to be paid in regular instalments OR Mater will be required to raise invoices. If the latter, how often will this occur.) Has this process been discussed with the relevant Mater Management Accountant?

n/a

11. Clinical trials information

11.1 Is the study a clinical trial?

- ☐ Yes If yes, please complete this section
☒ No If no, please proceed to [Section 12](#)

11.2 Select the study phase

Choose an item.

11.3 Is the research project being conducted under the Clinical Trial Notification (CTN) or Clinical Trial Exemption (CTX) schemes?

- ☐ CTN ☐ CTX ☐ N/A

Attach the relevant TGA form (with relevant sections signed by the Principal Investigator and HREC chair) for CEO/Research Delegate authorisation.

11.4 Clinical trials registry

Section 19 of the [Declaration of Helsinki \(2008\)](#) states:

"Every clinical trial must be registered in a publicly accessible database before recruitment of the first subject."

In addition, it is an essential criterion for publication of a trial in journals of the [International Committee of Medical Journal Editors \(ICMJE\)](#) that the details of a trial should be publicly available in a clinical trials registry.

a) Is the clinical trial registered on a publicly accessible clinical trials registry database?

☐ Yes ☐ No

b) If yes, please provide detail (name of registry, registry number).

If no, please explain why the study is not registered on a publicly accessible clinical trials registry database.

Click here to enter text.

11.5 Industry Sponsored/Contract Research Organisation (CRO) trials

If the study is not industry sponsored, please proceed to [Section 11.7](#).

a) Sponsor details

| | |
|---------------------|---------------------------|
| Organisation name: | Click here to enter text. |
| Contact person: | Click here to enter text. |
| Title: | Choose an item. |
| Full Name: | Click here to enter text. |
| Position: | Click here to enter text. |
| Department: | Click here to enter text. |
| Mailing address: | Click here to enter text. |
| Business phone no.: | Click here to enter text. |
| Mobile no.: | Click here to enter text. |
| Fax no.: | Click here to enter text. |
| Email address: | Click here to enter text. |
| Account details: | Click here to enter text. |
| ABN: | Click here to enter text. |

b) Contract Research Organisation (CRO) details

| | |
|---------------------|---------------------------|
| Organisation name: | Click here to enter text. |
| Contact person: | Click here to enter text. |
| Title: | Choose an item. |
| Full Name: | Click here to enter text. |
| Position: | Click here to enter text. |
| Department: | Click here to enter text. |
| Mailing address: | Click here to enter text. |
| Business phone no.: | Click here to enter text. |
| Mobile no.: | Click here to enter text. |
| Fax no.: | Click here to enter text. |
| Email address: | Click here to enter text. |
| Account details: | Click here to enter text. |
| ABN: | Click here to enter text. |

c) Invoicing details for Research Governance review fees

The Mater Research Governance Office has established a schedule of fees for SSA submissions. Refer to the [schedule of fees](#) located on the [Mater Research Governance website](#).

Please note that these fees are in line with other hospitals and universities in Brisbane.

Select the organisation that should be invoiced for Research Governance review fees:

Choose an item.

11.6 Is the fully executed Medicines Australia Standard Indemnity Form attached?

Please liaise with the Research Compliance Officer regarding signing of this form by Mater.

☐ Yes ☐ No ☐ N/A

If No or N/A please give an explanation:

Click here to enter text.

11.7 Clinical trial agreement

A copy of the fully executed Clinical Trial Agreement (CTA) must be supplied to the Mater Research Governance office when available. Mater Research Governance Authorisation cannot occur until all agreement requirements are in place.

a) Is the Medicines Australia Standard CTA attached?

☐ Yes ☐ No

If no, please give an explanation:

b) Has the CTA been reviewed by the Mater legal office?

☐ Yes ☐ No

If no, please contact the Research Compliance Officer.

For Mater – the delegated authority to sign ALL research agreements (including clinical trial agreements) is the Mater Health Services CEO/Research Delegate.

If the study is a clinical trial and the CTA is provided or in progress please proceed to Section 13.

12. Research study agreement/s

All collaborative research studies involving entities external to Mater require a study agreement. In addition, some studies involving multiple entities within Mater require a study agreement.

All agreements must be processed by the Research Compliance Officer. If you are unsure if an agreement is required, please seek advice from the Research Compliance Officer.

Please note: An SSA application can be submitted at any time, however please note that if an agreement is required, the Research Governance Office must receive a copy of the fully executed agreement before review of the application can be finalised. Mater Research Governance Authorisation cannot occur until all agreement requirements are in place.

Is there a written research study agreement, signed by all relevant parties attached?

☒ Yes ☐ No ☐ N/A

If no or N/A please give an explanation:

Dr Mike Beckmann has signed a memorandum of understanding with Queensland University of Technology regarding his supervision of Elizabeth Martin's PhD candidature (attached).

A research protocol has been prepared with input from all researchers (attached).

For Mater – the delegated authority to sign ALL research agreements (including collaborative research agreements) is the Mater Health Services CEO/Research Delegate.

13. Indemnity and insurance

If the research project is a clinical trial or if non-Mater investigators are accessing the Mater site for the purposes of this research, evidence of insurance is required (e.g. Certificates of Currency for Clinical Trial Insurance and/or Product and Public Liability and/or Professional Indemnity).

Is evidence of adequate insurance cover attached?

☒ Yes ☐ No ☐ N/A

If no or N/A please give an explanation:

[Click here to enter text.](#)

14. Intellectual Property considerations

14.1 Is there a possibility of new commercial intellectual property to be developed from this project?

☐ Yes ☒ No

14.2 Has a patent search been undertaken?

☐ Yes ☒ No

14.3 Does the research agreement include arrangements for the use of existing property and the parties' rights in relation to ownership?

☐ Yes ☐ No ☒ N/A

14.4 Does the research agreement include arrangements for the use of all new intellectual property developed through the research project?

☐ Yes ☐ No ☒ N/A

If the answer is 'yes' to any of the above questions then you should discuss the issue of incorporating intellectual property terms in the research agreement with your collaborators and any lawyer assisting with development of the research agreement.

Please contact the [Research Compliance Officer](#) if you are unsure about intellectual property considerations.

15. Biosafety, chemical and radiation safety

It may be necessary for research organisations to complete notification, registration or licence requirements for research involving biosafety, regulatory issues and/or radiation.

If 'yes' is ticked below, appropriate documentation of approval must be attached or forwarded to the Research Governance Officer.

15.1 For projects where ARPANSA Code compliance is required, is additional state-specific radiation safety approval and registration required?

Section 2.1.6 of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) Code on Exposure of Humans to Ionizing Radiation for Research (2005) states that a researcher must obtain an independent assessment or verification by a Medical Physicist of the total effective dose and relevant organ doses for those radiological procedures that are performed specifically for the research protocol.

☐ Yes ☒ No

15.2 Is Institutional Biosafety Committee (IBC) notification and/or licence application to the Office of the Gene Technology Regulator (OGTR) for approval of genetically modified organisms required?

☐ Yes ☒ No

15.3 Will the project require NHMRC Gene and Related Therapies Research Advisory Panel (GTRAP) or CTAC (Cellular Therapies Advisory Committee) assessment?

☐ Yes ☒ No

15.4 Will the project require application for a license to the NHMRC Licensing Committee to conduct embryo research?

☐ Yes ☒ No

16. Declarations

a) Declaration by the Principal Investigator and all other research personnel involved with the project at Mater (as listed in Section 3.1)

| | |
|---------------------------------|--|
| HREC application reference no.: | HREC/16/MHS/20 |
| Project title (in full): | A cost-effectiveness modelling study of strategies to prevent post-caesarean infection |
| Principal Investigator: | Michael Beckmann |

1. I declare the information in this form is truthful and accurate to the best of my knowledge and belief and I take responsibility for the conduct of the study at this site.
2. I will only start this research project after obtaining authorisation from the site and approval from the lead Human Research Ethics Committee (HREC).
3. I accept responsibility for the conduct of this research project according to the principles of the NHMRC National Statement on the Ethical Conduct in Human Research (2007), the Australian Code for the Responsible Conduct of Research (2007), Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and Catholic Health Australia "Code of Ethical Standards for Catholic Health and Aged Care Services in Australia" (2001).
4. I agree to conduct this research project in accordance with the protocols and procedures as approved by the HREC and the ethical and research arrangements of the organisation(s) involved.
5. I agree to conduct this research in accordance with Mater and Mater Research policies.
6. I agree to conduct this research in accordance with relevant legislation and regulations.
7. I agree to comply with the requirements of adverse or unexpected event reporting as stipulated by the HREC and NHMRC.
8. I will adhere to the conditions of approval stipulated by the HREC and will cooperate with HREC monitoring requirements.
9. I will inform the HREC and the research governance officer if the research project ceases before the expected date. I will discontinue the research if the HREC withdraws ethical approval.
10. I will adhere to the conditions of authorisation stipulated by the authorising authority at the site where I am Principal Investigator. I will discontinue the research if the authorising authority withdraws authorisation at the site where I am Principal Investigator.
11. I understand and agree that study files and documents and research records and data may be subject to inspection by the HREC, research governance officer, the sponsor or an independent body for audit and monitoring purposes.
12. I understand that information relating to this research, and about me as a researcher, will be held on file and in the research databases of the HREC and the Research Governance Office. This information will be used for reporting purposes and managed according to the principles established in the Privacy Act 1988 (Cth) and relevant laws in the States and Territories of Australia.

Dr Michael Beckmann

Print Name

Signature

28.4.16

Date

Role in Project: Principal Investigator at Mater Site

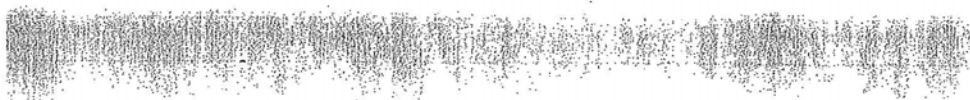
Elizabeth Martin

Print Name

Signature

28.4.16

Date



Role in Project: PhD Candidate

Professor Nicholas Graves

28.4.16

Print Name

Signature

Date

Role In Project: Principal Investigator and QUT Supervisor for Elizabeth Martin

Dr Kate Halton

28.4.16

Print Name

Signature

Date

Role in Project: Associate supervisor

Dr Katharina Merollini

28.4.16

Print Name

Signature

Date

Role in Project: Associate supervisor

RECEIVED
QUT
28.4.16

b) Declaration by Head of Department/s at this site where the Principal Investigator will do the research (as per departments/services listed in Section 9.1)

NOTE: Where an investigator is also Head of Department, a counter-signature must be sought from the person/position to whom the Head of Department reports (this may be the Executive Director who will then need to sign in 16b and 16c).
Where more than one Mater department or service area is involved, extra space has been provided to obtain multiple relevant signatures.

| | |
|---------------------------------|--|
| HREC application reference no.: | HREC/16/MHS/20 |
| Project title (in full): | A cost-effectiveness modelling study of strategies to prevent post-caesarean infection |
| Principal Investigator: | Michael Beckmann |

1. I certify that I have read the research project application named above.
2. I certify that I have discussed this research project and the resource implications for this department with the Principal Investigator.
3. I certify that all researchers/students from my department involved in the research project have the skills, training and experience necessary to undertake their role.
4. I certify that there are suitable and adequate facilities and resources for the research project to be conducted at this site. This includes 'actual costs' and 'in kind costs'.
5. My signature indicates that I support this research project being carried out using such resources.
6. I have determined, following discussions with the Investigators of this study, that all professional groups within the hospital / department (e.g. senior - medical, nursing/midwifery, allied health, etc.) who may be impacted by the conduct of this project have been consulted about the implications of this research.

Please list name and position of senior medical, nursing/midwifery, allied health staff consulted regarding this project:

| | |
|---------------------------|---------------------------|
| Jenny Stackelroth | Tracey Ecob |
| Click here to enter text. | Click here to enter text. |
| Click here to enter text. | Click here to enter text. |
| Click here to enter text. | Click here to enter text. |
| Click here to enter text. | Click here to enter text. |

Name of department: Emergency Department
 Name of Head of Department (or appropriate person): Dr. Helen Turner
 Signature: [Signature] Date: 28/4/16

To be completed only if Head of Department is an investigator on the study:

Declaration by Executive Director at the relevant hospital

1. I have liaised with the Head of Department who is an investigator on this study and confirm that the resources can be used as detailed in this application.

Sean Hubbard
 Chief Operating Officer
 Mater Health
 Name of alternate signatory: _____
 Position: _____
 Signature: [Signature] Date: 16/5/16

Where more than one Mater department or service area is involved, please use this page to obtain additional relevant signatures:

Name of department: Infection Control / ~~ESQ~~ J.P.

Name of Head of Department (or appropriate person): JODIE POWELL

Signature [Signature] Date 28/4/16

c) Declaration by Executive Director at the relevant hospital (NOT REQUIRED FOR LNR STUDIES)

To be completed by the Executive Director providing support or services to the research project – [must not have any direct staff member(s) on the research team]

Where more than one Mater hospital is involved, extra space has been provided to obtain multiple relevant signatures.

| |
|--|
| HREC application reference no.: HREC/16/MHS/20 |
| Project title (in full): A cost-effectiveness modelling study of strategies to prevent post-caesarean infection |
| Principal Investigator: Michael Beckmann |

I have discussed this project with the Principal Investigator and have confirmed that: (tick whichever applies)

☒ the investigations/services indicated are able to be performed within the present resources of the listed department/s

☐ the investigations/services indicated are able to be performed if the following financial assistance is provided:

| |
|--|
| |
|--|

☐ the investigations/services indicated are unable to be undertaken on the following grounds:

| |
|--|
| |
|--|

Name: Sean Hubbard

Mater Mothers' Hospitals, South Brisbane and Mater Private Hospitals, South Brisbane and
Hospital: Redlands
Signature  Date 11/5/16
Name: Sean Hubbard, Chief Operating Officer
Hospital:
Signature _____ Date _____

17. Checklist

Please complete this checklist to ensure you have provided all the required items and documentation in your SSA Application to the Mater Research Governance Office (RGO). Failure to do so will delay the review process of your application.

SSA Submission Requirements:

All Studies: The SSA application will consist of the completed signed Mater SSA form, all SSA supporting documentation and a full copy of all documents submitted to the reviewing HREC.

Full-SSA application – 1 hard copy and an electronic copy of all documentation is required.

LNR-SSA application – only electronic copies are required.

| FOR ALL RESEARCH GOVERNANCE APPLICATIONS | Yes | No | N/A |
|---|-------------------------------------|--------------------------|-------------------------------------|
| Has a cover letter, signed by the PI, been provided? Cover letter should include the project title, a list of supporting documents, and a brief description of the proposed study relevant to conduct at the Mater site. | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Have all declarations (Section 16) been signed? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Has a CV been attached for each investigator? (If not supplied to the RGO within the past 2 years) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Is proof of Medical Registration attached? (Not applicable for clinicians based in NSW and Queensland) | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Has a Mater Sponsor/Contact been appointed to this study (Section 3.2)? The PI is responsible for ensuring there is a contact person at the site who will liaise with Research Governance Office. | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Have all financial details in Section 9 been completed? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Have signed quotes for required services from MHS or Mater Research, been supplied? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Has Finance authorisation from the relevant Managing Accountant been obtained? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Has a copy of the HREC Approval letter been provided (if this approval has been granted)? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Has a copy of the research protocol been provided? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Are all Participant Information Sheet(s) and Consent Form(s) provided? For Multi-centre studies with HREC approval under the single ethical review process: BOTH a Site Specific version of the Participant Information Sheet and Consent Form, and the HREC Approved MASTER, on which the site version is based, are required. The site specific documents must include: | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| <ul style="list-style-type: none"> Mater Version number and date followed by MASTER version number and date, as listed on the HREC Approval letter (NOTE: the Mater version MUST make reference to the HREC-approved MASTER document). For example only: <i>MHS Participant Information & Consent Form, Version 1.0, 20 January 2015; based on Master Participant Information & Consent Form, Version 2.0, 10 December 2014</i> Mater Research Letterhead or Logo to be used on all documents to be supplied to Mater participants (contact RGO for a copy of logo if required) The following sentence containing Research Governance Office contact details is to be included in the Complaints/Concerns section, immediately following the contact details of the reviewing HREC (this section is usually found on the last page of the Participant Information Sheet): 'If you wish | | | |

| | | | |
|---|-------------------------------------|--------------------------|-------------------------------------|
| <i>to speak to someone at the Mater please contact the Research Governance Officer on 07 3163 8836 or email: research.governance@mmri.mater.org.au.</i> | | | |
| Has a copy of all documents submitted to the HREC been provided (e.g. advertising material, questionnaires, ethics application form etc.)? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| If relevant to the research project: Has evidence of biosafety, chemical and/or radiation approvals been provided? (Section 15) | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| ADDITIONAL REQUIREMENTS FOR INDUSTRY-SPONSORED CLINICAL TRIALS | Yes | No | N/A |
| Is a CTN/CTX form, signed by the Chair of the reviewing HREC and the Site Principal Investigator, attached? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Are Certificates of Currency, for all project-appropriate Insurances, provided (e.g. Clinical Trials Insurance, Product and Public Liability, Professional Indemnity)? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Has the Medicines Australia Standard Clinical Trial Agreement been provided to the Research Compliance Officer for review by Mater Legal? Note: a copy of the fully executed agreement will be required by the RGO prior to study authorisation. | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Has the Medicines Australia standard indemnity form been provided to the Research Compliance Officer for review by Mater Legal? Note: a copy of the fully executed document will be required by the RGO prior to study authorisation. | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| ADDITIONAL REQUIREMENTS FOR INVESTIGATOR-INITIATED CLINICAL TRIALS/COLLABORATIVE RESEARCH STUDIES | Yes | No | N/A |
| If applicable: Is a CTN/CTX form, signed by the Chair of the reviewing HREC and the Site Principal Investigator, attached? | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Has the Clinical Trial Agreement/Collaborative Research Agreement been provided to the Research Compliance Officer for review by Mater Legal? Note: a copy of the fully executed agreement will be required by the RGO prior to study authorisation. | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Are Certificates of Currency, for all project-appropriate Insurances, provided? (E.g. Clinical Trials Insurance, Product and Public Liability, Professional Indemnity). | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Checklist 4: ADDITIONAL REQUIREMENTS FOR STUDENT RESEARCHERS | Yes | No | N/A |
| Are the name, contact details and a current CV of your research supervisor/s attached? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| If the research is for the purpose of obtaining a degree or other educational qualification, has this been clearly stated in the cover letter to the Research Governance Office and in the Participant Information Sheet? | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| It is possible an agreement will be required for studies involving student researchers. Has the Research Compliance Officer been consulted to determine any legal requirements? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

For internal use only – not to be completed by the researcher

For full SSA (more than low or negligible risk):
Recommendation by the Research Governance Officer

| |
|--|
| HREC application reference no.: HREC/16/MHS/20 |
| Project title (in full): A cost-effectiveness modelling study of strategies to prevent post-caesarean infection |
| Principal Investigator: Michael Beckmann |

The Site-Specific Assessment (SSA) form for the above research project has been completed (with all attachments).

SSA Authorisation is:

- ☐ Recommended
- ☐ Not recommended
- ☐ Requires Chief Executive/delegate consideration

If not recommended or requires Chief Executive/delegate consideration, give reasons.

| |
|----------------------|
| |
|----------------------|

Research Governance Officer (or equivalent)

Name:

Signature Date

For LNR SSA (low or negligible risk):

The application has been reviewed and all Mater Research Governance requirements have been met.

Study Authorised, under delegation from the MHS CEO, by the Research Governance Officer (or equivalent)

Name:

Signature Date

Authorisation by Chief Executive Officer/Delegate – *in case of litigation*

| |
|--|
| HREC application reference no.: |
| HREC/16/MHS/20 |
| Project title (in full): |
| A cost-effectiveness modelling study of strategies to prevent post-caesarean infection |
| Principal Investigator: |
| Michael Beckmann |

This research is:

☐ Authorised

☐ Not authorised

Specify, conditions applying to authorisation or reasons for not authorising.

| |
|----------------------|
| |
|----------------------|

My signature indicates that I authorise/do not authorise this research project to commence at this site.

Name of Chief Executive Officer:

Name of Organisation:

Signature Date

16th March 2016

Ms Elizabeth Martin
Queensland University of Technology
60 Musk Avenue
Kelvin Grove Qld 4059

Dear Ms Martin,

Re: A cost-effectiveness modelling study of strategies to prevent post-caesarean infection.
MHSNQ Reference No.: MHS20160316-01

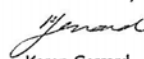
Thank you for your application for the above study, which was disseminated electronically to the members of the Mater Health Services North Queensland Human Research Ethics Committee (HREC) on the 10th March 2016. We have reviewed the NEAF and supporting documentation and are pleased to advise that your project has been granted ethics approval by the Mater Health Services North Queensland HREC.

In regard to the above research project the Committee would ask the following:

- Principal investigators provide annual reports (failure to provide these may result in Committee approval being suspended with failure to comply after a 6 month period resulting in Committee approval likely being withdrawn).
- Principal investigators are to request additional time for the provision of annual reports prior to the due date should they require more time.
- Prompt reports from principal investigators in the event of a serious or unexpected adverse effect in a participant.
- When multiple safety updates are provided, a summary on any issues of concern is required.
- Prompt reports from principal investigators about proposed changes in the protocol.
- Report to the Committee immediately about any unforeseen events that may affect the continued ethical acceptability of the mentioned project.
- Reports from principal investigators if the project is to be discontinued before the expected completion date.
- That you include the above reference number in all correspondence.

Your project will now be presented to the Executive Committee in order to seek approval to conduct the above research at the Mater Health Services North Queensland. The Committee wishes you well with your ongoing research.

Yours sincerely



Karen Gerrard
Chairperson
Human Research Ethics Committee
Email: research.ethics@matertsv.org.au

Locked Bag 1000
Aitkenvale BC,
Qld 4814

Mater Health Services North Queensland Limited
A Ministry of the Sisters of Mercy
ACN: 094 529 263

Mater Hospital Pimlico Mater Outreach Services
Mater Women's & Children's Hospital Hyde Park

ph: 07 4727 4444
fx: 07 4725 1034
www.matertsv.org.au

26 April 2016

Ms Elizabeth Martin
Queensland University of Technology
60 Musk Avenue
KELVIN GROVE QLD 4059

Dear Ms Martin

Re: A cost-effectiveness modelling study of strategies to prevent post-caesarean infection
MHSNQ Reference No.: MHS20160316-01

The above project and supporting documents were reviewed and approved on 10 March 2016 by Mater Health Services North Queensland's Human Research Ethics Committee and forwarded to me, as Director of Medical Services, for governance review.

I am pleased to confirm this research project has been approved by MHSNQ and is valid from 1 May 2016 to 1 May 2017.

MHSNQ requires submission of annual reports and other documents as detailed in the letter you have received from the Human Research Ethics Committee.

The nominated participating sites in this project are:

Mater Hospital Pimlico
Mater Hospital Hyde Park

MHSNQ wishes you every success in your research.

Yours sincerely



Dr Jon Hodge
Director of Medical Services / Executive Officer

Locked Bag 1000
Aitkenvale BC,
QLD 4814

P: 07 4727 4444
F: 07 4725 1034
www.materhsq.org.au

Mater Health Services North Queensland Limited
A Ministry of the Sisters of Mercy ACN: 094 529 263

Mater Hospital Pimlico | Mater Outreach Services | Mater Women's & Children's Hospital Hyde Park



Mercy Health and Aged Care
Central Queensland Limited

CORPORATE OFFICE
...Caring for you for life

20 May 2016.

Ms Elizabeth Martin
PhD Candidate
Centre of Research Excellence
Reducing healthcare Associated Infections

Ph: +61 7 3138 0104
Mob: +61 422 809 021

Dear Elizabeth

Thank you for your recent confirmation letter of Mater HREC Ethics approval of your research project.

Further to your recent discussions with Mr Ian Mill, it is my pleasure on behalf of Mercy Health and Aged Care Central Qld, to approve MHAACCQL participation in your research project which involves retrieval of data from the Mater Misericordiae Hospitals in Gladstone, Mackay and Rockhampton on women who have had a caesarean section and whether or not they've been diagnosed with a surgical site infection. I note the request date period is inclusive of one year's worth of data from 1 July 2014 to 30 June 2015.

We support that the data acquisition will involve a Mercy CQ the Mater Hospitals site infection control nurses retrieving the data into an Excel spreadsheet or equivalent with specific data items (as listed below) for each woman who has had a caesarean section.

We note that this data will then be linked to patient admission data and perinatal data that Queensland Health already holds for Mater Misericordiae patients and that authorised Queensland Health statisticians will do the data linkage in a secure area.

We note that for the data linkage to occur, Queensland Health will need identifiable patient information and that this issue has been considered in the Mater HREC ethics approval and deemed appropriate because as the researcher, you will never see the identifiable patient information. We note that Queensland Health will prepare the linked dataset, and remove all patient identifiers before you receive it. We further note that Mercy CQ hospitals will not be identifiable during your research as Hospitals will be grouped into 'public' or 'private' categories.

We support that you will be working with the hospitals to prepare their infection datasets for Queensland Health and the data linkage process.

CORPORATE OFFICE

263 Agnes Street, Rockhampton Qld 4700
PO Box 1380

Telephone: 07 4931 7490
Facsimile: 07 4931 7497
Email: maccadmin@mercyq.com

www.mercyq.com

ACN 096 724 033
ABN 24 096 724 033

CORPORATE OFFICE

Rockhampton
MATER HOSPITALS
Rockhampton
Mater Misericordiae Hospital
Mackay
Mater Misericordiae Hospital
Mater Misericordiae Day Unit

Bundaberg
Mater Misericordiae Hospital
Gladstone
Mater Misericordiae Hospital
Yeppoon
Mater Misericordiae Hospital
CORPORATE SERVICES
Mercy Linen Service
Mercy Food Service

MERCY AGED CARE SERVICES

Leinster Place
McAuley Place
Bethany Nursing Home
Bethany Village
The Range Village
Mercy Day Therapy Centre
Mercy Day Respite Centre

I note your data items request as follows:

For all caesarean births at the Mater Misericordiae Hospitals in Gladstone, Mackay and Rockhampton between 1 July 2014 and 30 June 2015 (ICD-10-AM codes O82 and O84.2) provide as much of the following variables for data linkage (will be removed when the statisticians provide the dataset to me):

Patient name
Patient date of birth
Patient address
Procedure date (date patient gave birth) (this included in comments but not a separate column)
Infection notification date UR number
Hospital name

For women who were diagnosed with a surgical site infection including endometritis provide some or all of the data items collected at the Mater Misericordiae hospitals (variable names are from MultiPrac, so they may be different for our data reports):

Procedure code (easy to add- same for each)
Procedure (emergency or elective)
Procedure date as above
Procedure duration
NNIS Total (risk index)
AB Admin (antibiotics administered or not)
Antibiotic count (number of doses given)
Antibiotics combined across procedure (list of antibiotics given)
Surgical wound class (by CDC definition)
Place of onset
Infection type
Organism
ABN Time (timing of antibiotic prophylaxis – greater than 1 hour before incision, within 1 hour of incision or after incision)

Elizabeth, the contact details for Infection Control Managers of Mater Hospitals Rockhampton, Gladstone and Mackay are noted below. For your information the Executive Officers / Managers of our hospital sites has also been included:

Mater Hospitals Rockhampton & Gladstone

Annette Czerkesow – Executive Officer aczerkesow@mercyq.com
Frances Forbes – Manager, Mater Hospital Gladstone fforbes@mercyq.com
Donna Goltz Infection Control Manager | T: 07 49313420 | Email: dgoltz@mercyq.com

Mater Hospital Mackay

Beth Thomas – Acting Executive Officer / Director of Nursing ethomas@mercyq.com
Lyn Ruggeri Infection Control Manager | T: 07 4965 5814 | Email: lruggeri@mercyq.com

Mater Hospital Bundaberg

Ivan Rasmussen – Executive Officer irasmussen@mercyq.com

Tony Roberts – Director of Nursing & Clinical Services | T: 07 491539403 |

Email: troberts@mercyq.com

(Tony is the first contact for infection control requests at Bundaberg)

The Executive Officers /Managers and Infection Control Managers of Mater Hospitals Rockhampton, Gladstone and Mackay will be provided with a copy of this approval letter and your contact details.

Best Wishes for your research project Elizabeth

Yours sincerely,



Lynne Sheehan
Director of Operations



**ST VINCENT'S
HEALTH & AGED CARE**

A COMPANY OF THE ST VINCENT'S HEALTH AUSTRALIA GROUP

**St Vincent's Health &
Aged Care Limited**
ABN 50 055 210 378

48 Montpelier Road
Bowen Hills QLD 4006
PO Box 555
Spring Hill QLD 4004

Telephone 07 3326 3739
Facsimile 07 3326 3782

12/04/2016

Elizabeth Martin
Queensland University of Technology
60 Musk Avenue
KELVIN GROVE QLD 4059

Dear Elizabeth,

HREC Reference number: 16/05

Project title: A cost-effectiveness modelling study of strategies to prevent post-caesarean surgical site infection

Thank you for submitting the above research project for single ethical review. This project was considered by the St Vincent's Health & Aged Care (SVHAC) Human Research Ethics Committee (HREC) at its meeting held on 08/04/2016.

I am pleased to advise you that the SVHAC HREC has granted ethical approval of this research project.

The nominated participating site in this project is
St. Vincent's Private Hospital Toowoomba

Date of Decision: 08/04/2016

Approved Timeframe: 08/04/2016 to 08/04/2017

[Note: If additional sites are engaged prior to the commencement of, or during the research project, the Coordinating Principal Investigator is required to notify SVHAC HREC. Notification of withdrawn sites should also be provided to the SVHAC HREC in a timely fashion.

The approved documents include:

| Document Name | Version | Date |
|---|---------|------------|
| 1. SVHAC HREC Cover Sheet | — | 24/03/2016 |
| 2. Cover Letter | — | 24/03/2016 |
| 3. SVHAC Low and negligible risk research form | — | 24/03/2016 |
| 4. SVPHT Site Approval (signed) | — | 24/03/2016 |
| 5. QUT UHREC Application (Track Changes) | — | July 2014 |
| 6. QUT UHREC email RE additional Information required | — | 26/02/2016 |
| 7. QUT HREC email original approval | — | 26/11/2014 |
| 8. Mater HREC LNR Application | — | 04/03/2016 |
| 9. Mater HREC Approval Letter | — | 16/03/2016 |
| 10. Mater email query process for approval to access de-identified data (1) | — | 10/03/2016 |

St Vincent's Care Services
St Vincent's Private Hospital Toowoomba
St Vincent's Private Hospital Brisbane
Holy Spirit Northside Private Hospital

UNDER THE STEWARDSHIP OF MARY AIKENHEAD MINISTRIES

| | | |
|---|--|------------|
| 11. Mater email query process for approval to access de-identified data (2) | | 10/03/2016 |
| 12. CV Nicholas Graves | | |
| 13. CV Kate Halton | | |
| 14. CV Katharina Merollini | | |
| 15. CV Michael Beckmann | | |
| 16. CV Elizabeth Martin | | |

Approval of this project from SVHAC HREC is valid from 08/04/2016 subject to the following conditions being met. The Coordinating Principal Investigator will:

- immediately report anything that might warrant review of ethical approval of the project,
- notify SVHAC HREC of any event that requires a modification to the protocol or other project documents and submit any required amendments in accordance with the instructions provided by the HREC,
- submit any necessary reports related to the safety of research participants in accordance with SVHAC HREC policy and procedures,
- report to the SVHAC HREC annually in the specified format and notify the HREC when the project is completed at all sites,
- report to the SVHAC HREC quarterly; the numbers of participants currently involved in the research study and identify the sites participants are attending for the research study,
- notify the SVHAC HREC if the project is discontinued at a participating site before the expected completion date, with reasons provide,
- notify the SVHAC HREC of any plan to extend the duration of the project past the approval period listed above and will submit any associated required documentation, and
- notify the SVHAC HREC of his or her inability to continue as Coordinating Principal Investigator including the name of and contact information for a replacement.

A copy of this ethical approval letter must be submitted by all site Principal Investigators to the Research Governance Office or equivalent body or individual at each participating institution in a timely manner to enable the institution to authorise the commencement of the project at its site/s.

This letter constitutes ethical approval only. This project cannot proceed at any site until separate research governance authorisation has been obtained from the CEO or Delegate of the institution under whose auspices the research will be conducted at that site.

Should you have any queries about the SVHAC HREC consideration of your project please contact Kath Eady, Research Governance Officer, SVHAC HREC Secretariat on 07 4690 4493 or by email svhac.hrec@svha.org.au.

The SVHAC HREC wishes you every success in your research.

Yours sincerely



Christine Foley

Chair

SVHAC HREC

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research (2007)*. The processes used by this HREC to review multi-centre research proposals have been certified by the National Health and Medical Research Council.

Application Approval Form

ABN: 87 842 457 440

Elizabeth Martin
Queensland University of Technology
60 Musk Avenue
Kelvin Grove
QLD 4059

UnitingCare Health Human Research Ethics Committee
Ground Floor Moorlands House
The Wesley Hospital
451 Coronation Drive, Auchenflower QLD 4066
PO Box 499 Toowong QLD 4066
Phone: 3232 7500
Email: ethics@uchealth.com.au

Our Ref: 2016.05.183

12 April 2016

Correspondence: from Elizabeth Martin dated 4 March 2016
Study Title: A cost-effectiveness modelling study of strategies to prevent post-caesarean surgical site infection
Investigators: Prof Nicholas Graves, Ms Elizabeth Martin, Dr Michael Beckmann, Dr Katherina Merollini

The above project and following documents were reviewed and approved on 12 April 2016 by UnitingCare Health's Human Research Ethics Committee and The Wesley Hospital's Director of Medical Services:

- Application to conduct above named research project at The Wesley Hospital

Approval of this project from UnitingCare Health is valid from 1 April 2016 to 1 April 2017.

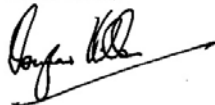
Please could you provide a copy of the Director General's authorization once it is issued?

The UnitingCare Health HREC requires the submission of an annual report and once the project closes the submission of a closure or final report.

The UnitingCare Health HREC is constituted and functions in accordance with the National Statement on Ethical Conduct in Research Involving Humans (2007).

The Investigator was not a member of the UnitingCare Health HREC at the time the above-mentioned study was reviewed and approved.

Yours sincerely



Douglas Killer MBBS FRACP
Executive Officer

The UnitingCare Health Human Research Ethics Committee is constituted and operates in accordance with the National Health and Medical Research Council's National Statement on Human Experimentation and Supplementary Notes

Application Approval Form

ABN: 87 842 457 440

Elizabeth Martin
Queensland University of Technology
60 Musk Avenue
Kelvin Grove
QLD 4059

UnitingCare Health Human Research Ethics Committee
Ground Floor Moorlands House
The Wesley Hospital
451 Coronation Drive, Auchenflower QLD 4066
PO Box 499 Toowong QLD 4066
Phone: 3232 7500
Email: ethics@uchealth.com.au

Our Ref: 2016.05.183

20 May 2016

Correspondence: from Elizabeth Martin dated 4 March 2016
Study Title: A cost-effectiveness modelling study of strategies to prevent post-caesarean surgical site infection
Investigators: Prof Nicholas Graves, Ms Elizabeth Martin, Dr Michael Beckmann, Dr Katherina Merollini

The above project and following documents were reviewed and approved on 12 April 2016 by UnitingCare Health's Human Research Ethics Committee and The Sunshine Coast Private Hospital's Director of Medical Services:

- Application to conduct above named research project at The Sunshine Coast Private Hospital

Approval of this project from UnitingCare Health is valid from 1 April 2016 to 1 April 2017.

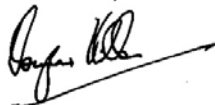
Please could you provide a copy of the Director General's authorization once it is issued?

The UnitingCare Health HREC requires the submission of an annual report and once the project closes the submission of a closure or final report.

The UnitingCare Health HREC is constituted and functions in accordance with the National Statement on Ethical Conduct in Research Involving Humans (2007).

The Investigator was not a member of the UnitingCare Health HREC at the time the above-mentioned study was reviewed and approved.

Yours sincerely



Douglas Killer MBBS FRACP
Executive Officer

The UnitingCare Health Human Research Ethics Committee is constituted and operates in accordance with the National Health and Medical Research Council's National Statement on Human Experimentation and Supplementary Notes

Appendix H

Public Health Act Application and Approval

V12 2/10/2015

Martin Amend
26.10.16



Queensland
Government

Public Health Act – Application and Information for Researchers

For the Release of Confidential Information for the Purposes of Research under the provision of Section 280 of the Public Health Act 2005

- Chapter 6 Part 4 of the *Public Health Act 2005* (PHA) establishes the process for accessing health information held by Queensland Health for approved research projects.
- The PHA requires researchers to apply to the Director-General of Queensland Health or his/her delegate, for access to health information held by Queensland Health.
- The Director-General or his/her delegate may grant access to health information for the purposes of research only if he/she are satisfied that the giving of health information held by the department is in the public interest: s.284 (2) and (3).
- Details of all applications approved to access identifiable or potentially re-identifiable health information for the purposes of research will be kept in a register, known as "*The Research Register*" (the register) held by Health and Medical Research Unit, Healthcare Innovation and Research Branch. Access to the register must be made available to anyone who makes a request.

Data Custodian

- Researchers must consult with the information providers/data custodians prior to applying for ethics approval to ensure that relevant data items are available and that there are adequate local resources available to the data custodian to be able to provide that data for the specified study.
- Evidence of this consultation and confirmation that the necessary data is available, should be included in the application. See section (10) Authorisation from Data Custodian in the application form.
- Contact information for common Queensland Health data custodians can be found at http://www.health.qld.gov.au/ohmr/documents/data_custodian_list.pdf This list is not conclusive.

What Research requires a PHA Application?

- The PHA applies to all researchers (internal and external to Queensland Health) who are undertaking research using identifiable or potentially re-identifiable health information for which the researchers are unable to obtain participant consent to use their personal or identifying information for a clearly specified research study.
- This may also apply in circumstances in which it may be inappropriate or difficult to contact participants/patients for consent to access their health information. In these circumstances the views of a Human Research Ethics Committee should be taken into consideration when waiver of consent is required. See Chapter 2.3 'Qualifying or Waiving Conditions for Consent' of the *National Statement on Ethical Conduct of Research In Humans*.
- The PHA **does not apply** to health information held by Queensland Health if its disclosure is authorised under another Act. The most relevant exceptions are:
 - Where the disclosure is with the consent of the person to whom the information relates (s.139 *Hospital and Health Boards Act 2011*)
 - If the disclosure is in a form that could not or does not identify any person.

Reviewed November 2009

Page1 of 18

- In the case of 'Clinical Audit and Review' follow the procedures set out here: <http://www.health.qld.gov.au/psu/qac/default.asp>
- All confidential health information held in the private sector or by the Commonwealth is dealt with under the *Privacy Act 1988* (Cth). Queensland Health has no jurisdictional authority or administrative responsibility for health information data held by the private health sector or the Commonwealth Government.

What decision may be given on your application?

- Provided the researchers provide adequate information, as detailed below, the Chief Executive or Delegated person may choose to:
 - grant approval,
 - grant approval subject to certain conditions (Section 284),
 - request additional information, or
 - deny approval. If approval is not granted or granted conditionally, the Chief Executive is required to provide the applicants with the reasons for this decision.
- In accordance with the *Public Health Act 2005*, the details of approved applications will be entered and stored in a designated database, known as the 'Research Registry'. The approval for release of data will only cover that study described in the NEAF/ LNR form and approved by a HREC. A change to the scope of data requested may necessitate a resubmission to the reviewing HREC for approval.
- A list of names and contact details for common data custodians can be accessed at http://www.health.qld.gov.au/ohmr/documents/data_custodian_list.pdf. In some cases, a fee may be charged to recover the data.

How to Apply

- To apply for access to identifiable or potentially re-identifiable health information held by Queensland Health researchers need to meet the requirements in s282 of the PHA and must have approval from a Human Research Ethics Committee (HREC) prior to making application.
- The Application Form and all supporting documentation is emailed to PHA@health.qld.gov.au

Recovery of Costs

- In some instances, provision/extraction of health information or data may incur a fee. When consulting the information providers/data custodians, ensure you determine whether there is a cost associated for the extraction (s284 (5a))
- For tissue samples and information held by Pathology Queensland, contact the Executive Director Medical Services at pathqldclients@health.qld.gov.au

Notification of Approval/No Approval

- Applicants are notified by mail of the outcome of their application.
- The obligations when accessing identifiable or potentially re-identifiable confidential health information are outlined in the correspondence you receive, along with, the timeframe of access and reporting requirements.

Reporting requirements

- The Director-General may make it a condition when granting the application that researchers provide feedback on the progress and results of the research under s.284. Reporting templates may be accessed at:
http://www.health.qld.gov.au/ohmr/html/regu/reporting_templates.asp

Useful Information

Health Information is not restricted simply to names and personal data but also includes tissues and tissue blocks.

Identifiable data are data that enables a person to establish the identity of a person or organisation to which some data relates. It is not necessary for the data to enable identification of all persons and organisations to which the data relate – only one or more persons or organisations.

Unidentifiable data are data that do not contain any identifiers such as name, street, postal address or Medicare number.

However when unidentifiable data are used in various combinations, it may reveal enough detail about the characteristics of a person or organisation to enable identification to be made. This becomes re-identifiable data. An example would be data that holds date of birth and an area code – in an area consisting of 200 – 300 residents. Researchers should consider the following factors when determining whether their research involves potentially re-identifiable data:

- Presence of rare characteristics in a statistical local area (SLA);
- Accuracy of the data;
- Age of the data;
- Coverage of the data (completeness);
- Presence of other information that can assist in identification, includes:
 - publicly available information;
 - restricted access data holdings that a data user may have access to; and
 - personal knowledge that a user may have.

Dataset guidance

The Australian Institute of Health and Welfare (AIHW) has useful guidance on **Health sector national minimum data sets and datasets specification**. Visit the following site:
<http://meteor.aihw.gov.au/content/index.php/itemId/344846>

Documentation that is required prior to submission

1. Copy of the HREC approval
2. Evidence of Data custodian consultation
3. Completion of the application template
4. Email to PHA@health.qld.gov.au

PUBLIC HEALTH ACT – APPLICATION

Instructions: The information required from the researcher is provided in italics. This information should be inserted into the corresponding boxes, which may be expanded as required. **The data custodian/s must sign your application form before submission, or provide a letter/email of support.** Completed applications are to be submitted to Health and Medical Research Unit at email: PHA@health.qld.gov.au with the relevant attachments.

1 Title of Research Project:

A cost-effectiveness modelling study of strategies to prevent post-caesarean surgical site infection

2 HREC Number:

1400000858

3 Research Category:

Tick the research category to which the research proposal most closely aligns

- ☐ Biomedical Study
 ☒ Evaluation and Planning Study
 ☐ Epidemiological Study
☐ Clinical and applied Study
 ☐ Monitoring & Surveillance Study

4 Coordinating Principal Investigator / Additional Applicants:

This section should list:

- *The name/names of all the person/s proposing to conduct the research and who will be given or have access to the identifiable information for this research.*

None of these people will have access to the identifiable information

- *Principal investigator: Elizabeth Martin*
- *Supervisor: Professor Nicholas Graves*
- *Associate supervisor: Dr Kate Halton*
- *Associate supervisor: Dr Michael Beckman*
- *Associate supervisor: Dr Katharina Merollini*

5 Address of the Coordinating Principal Investigator:

Elizabeth Martin, Prof Graves and Dr Halton:
 Street: 60 Musk Ave, Kelvin Grove Q 4059
 Postal: 60 Musk Ave, Kelvin Grove Q 4059
 Telephone: 04220 809021
 Email: elizabethkate.martin@hdr.qut.edu.au
 Email: n.graves@qut.edu.au

Email: k.halton@qut.edu.au

Dr Beckman:

Street: Aubigny Place, Raymond Tce, South Brisbane Q 4101

Postal: Aubigny Place, Raymond Tce, South Brisbane Q 4101

Telephone: 07 3163 8330

Email: Michael.Beckmann@mater.org.au

Dr Merollini

Street: 90 Sippy Sowns Dr, Sippy Downs Q 4556

Postal: 90 Sippy Sowns Dr, Sippy Downs Q 4556

Telephone: 07 5456 3558

Email: kmerollini@usc.edu.au

6 Location/s where project will be conducted:

Institute of Health and Biomedical Innovation, Queensland University of Technology
60 Musk Ave, Kelvin Grove Q 4059

7 Description of the proposed research study:

In this section please provide:

7.1 -- Describe the research study including the research objectives, benefits and outcomes.

This research will assess changes to costs and health outcomes if Queensland hospitals adopted the gold standard in preventing infections following caesarean section. Since 2010, evidence surrounding the most effective way to prevent c-section infections has strengthened significantly. However, clinicians have told us anecdotally that practice has not changed greatly since 2010. Cost-effectiveness research is needed to understand whether it is a wise use of the hospital's budget to change practice and attempt to reduce the post-caesarean infection rate. This is a modelling study and not trialling a change to clinical practice.

The aim of this research is to evaluate the incremental cost-effectiveness of different interventions to prevent surgical site infection following caesarean section in Queensland. The research will also identify if decisions based on the criterion of cost-effectiveness vary by sub-groups such as hospital type, geographic region or patient risk status.

The objectives of this research are to:

- identify and assess the volume and quality of evidence around the competing risk reduction strategies or combination of strategies that are relevant to decision makers for the prevention of post-caesarean surgical site infection;*
- build a cost-effectiveness model to describe the changes to total economic costs and changes to health benefits for each of the identified strategies;*
- quantify the effect of uncertainty in the model; and*
- assess whether cost-effectiveness varies by sub-group e.g. type of hospital and/or by patient risk category.*

Background

Large numbers of women undergo caesarean section, at least 18.5 million per year worldwide [1] and the number increases every year [2, 3]. Therefore, small differences in post-caesarean infectious morbidity due to infection prevention strategies could mean improved health for a large

Reviewed November 2009

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number of women and substantial savings for health services. No change to post-caesarean infection rates will increase health system costs significantly.

However, the Australian health system only has limited funding available to spend on the provision of health care [4]. Carefully allocating scarce health care resources so that health gains are maximised for every dollar spent is important [5]. This cost-effectiveness analysis will provide information to clinicians and decision makers about what is the best allocation of health care resources. We will be able to advise which strategies make changes to post-caesarean infectious morbidity and what the cost-consequences are.

1. Gibbons, L., et al., Inequities in the use of caesarean section deliveries in the world. *American Journal of Obstetrics and Gynecology*, 2012. 206(4): p. 331 e1-19.
2. Li, Z., et al., Australia's mothers and babies 2011. Perinatal statistics series no. 28. Cat. no. PER 59, 2013, Australian Institute of Health and Welfare National Perinatal Epidemiology and Statistics Unit: Canberra.
3. Organization for Economic Co-operation and Development, *Health at a Glance 2013*. OECD Publishing.
4. Australian Institute of Health and Welfare, *Health expenditure Australia 2010-11. 2012*, AIHW: Canberra.
5. Drummond, M.F. and A. McGuire, *Economic evaluation in health care: merging theory with practice*. 2001, Oxford: Oxford University Press.

7.2 - Describe the methodology used in the research project.

The research design is a cost-effectiveness modelling study that requires existing Queensland data to inform the model parameters.

Four types of de-identified datasets for the financial year 2014-2015 will be sourced from 38 public and 9 private hospitals.

1. Infection data will tell us which women who had a caesarean section acquired a surgical site infection.
2. The Queensland Health Admitted Patient Data Collection (QHAPDC) will give information about further complications experienced by women who had a caesarean section and whether these were related to a post-birth infection. QHAPDC will also provide some data to examine surgical infections following vaginal birth and to estimate the costs of implementing current practice.
3. The Perinatal Data Collection (PDC) will provide data from public and private hospitals on risk factors for infection such as pre-pregnancy body mass index.
4. The Emergency Department Information System will be used to identify if any women presented to public hospital emergency departments with an infection following birth and what treatment was provided.

Together, these datasets will provide information on approximately 50 000 women in Queensland and will be used to analyse the probability of acquiring an infection following c-section and vaginal birth, and the probabilities of following different treatment pathways for women who had varying risk factors for infection. These probabilities will be used in the cost-effectiveness model to evaluate the current practice baseline scenario.

A decision analytic model will be developed to predict the cost and health outcomes (measured using Quality Adjusted Life Years – QALYs) of two approaches to conducting caesarean section: current practice and implementing a gold standard infection control bundle. A Markov model will be used to represent the major health states that a woman moves through from caesarean birth to having an infection, or not, and if applicable having the infection treated (see figure 1 below). A hypothetical cohort of patients will move through the health states based on the probabilities of transitioning from one health state to another. This process is called the 'model simulation'.

The linked data set provided by Queensland Health will be used to calculate the transition probabilities for the simulation and the costs of treatment for each health state. Health outcomes for each health state will be sourced from the literature.

In the model simulation, patients will move from state to state in cycles, and cycle length will be 48 hours for the first two weeks, weekly for the remainder of the first month, then monthly for a total of 12 months. The Markov model process ends when all patients are in a health state that they cannot leave, called an 'absorbing state', often 'death' or in the Markov model figure below 'no infection'.

When the model simulation is complete, the output is a series of health outcomes and costs that are used to evaluate the Markov model and calculate the cost-effectiveness of each strategy. Evaluating a Markov model uses the average amount of time a person spends in each health state. The expected health outcome (utility) and costs for a patient moving through the model are given by

$$\text{Expected utility} = \sum_{s=1}^n t_s \times u_s$$

and

$$\text{Expected cost} = \sum_{s=1}^n t_s \times c_s$$

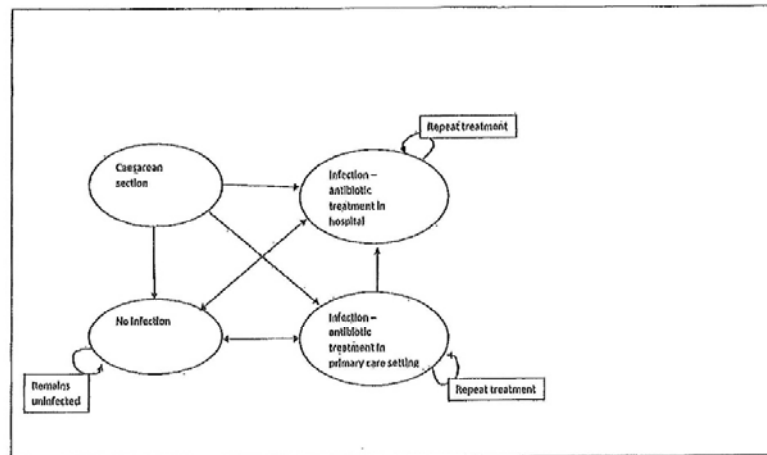
where t_s is the time spent in state s , u_s is the utility associated with that health state, and c_s is the cost associated with that health state. Summing utility values across all cycles will result in the overall expected health outcome (QALY value) for the strategy; summing up costs across all cycles will result in overall expected costs for the strategy. This process is repeated for the gold standard approach to infection control and each strategy is compared using an Incremental Cost-Effectiveness Ratio (ICER).

The change to costs and health outcomes if Queensland hospitals moved from current practice to a gold standard approach will be calculated using the ICER. The ICER is given by:

$$\text{ICER} = \frac{C_i - C_o}{E_i - E_o} = \frac{\Delta C}{\Delta E}$$

where C is the cost, and E is the effectiveness. An ICER greater than the conservative cost-effectiveness threshold of \$40 000 per QALY will indicate the gold standard approach is not cost-effective; less than the threshold, it is cost-effective.

Figure 1: Decision analytic Markov model



7.3 – Describe the rationale for using identifiable confidential health information.

Identifiable and confidential health information is required for three reasons:

1) The data is identifiable so that datasets can be linked by Health Statistics Branch.

2) Utilising already existing datasets is a more sensible use of resources than conducting new research with this cohort of women. The processes of data collection within Queensland Health are likely far more accurate than a woman's recollection of her medical records around the arrival of a new child, particularly in relation to knowing diagnoses codes for any complications, medical details of the days and hours prior to a caesarean section being performed, antibiotics given and infection classifications.

3) The data items 'readmission date', 'procedure date', 'culture date' and 'date of ward transfer to HOME' requested require a dd-mm-yyyy format and this increases the likelihood of a patient being identified. An accurate date format is required for these data items because of their use in calculating parameters for the cost-effectiveness modelling. The researcher will use the number of days between procedure date and culture date (date surgical site infection is confirmed) to calculate the probability of a patient becoming infected following caesarean delivery at various time points after the surgery. Procedure dates for other healthcare interventions will similarly be used to examine length of time between 'culture date' and treatment so that probabilities for the cost-effectiveness model can be calculated. 'Readmission date' and 'date of ward transfer to HOME' will be used in the same way as procedure date for calculating the number of days between various events so that the probability of a patient experiencing that event at time points following the surgery can be calculated.

7.4 – Describe the benefits of this research study for the community.

This cost-effectiveness analysis will provide information to clinicians and decision makers such as obstetricians, midwives and senior infection control nurses, about what is the best allocation of health care resources. We will be able to advise which strategies make changes to post-caesarean infectious morbidity and what the cost-consequences are.

7.5 - How do the benefits to the public outweigh the risks for the individuals' whose identifiable information will be used?

The benefits of this research outweigh the risks because adopting the research's recommendations will result in a more efficient use of hospitals resources. Budgets may be freed-up to spend in other areas, benefiting staff and patients.

7.6 - What is the estimated duration of the research project?

18 months

8 Name/Description of Database and Data Items required:

8.1. - What is the scope of the data that the applicant/s is requesting access to for the purposes of research?

- o Applicant/s **must list specific data items** required to undertake the research study. This may include but is not limited to – demographics (eg. date of birth, sex), hospital episode information, details of diagnostic data and/or details relating to health services accessed by individuals.
- o It is important that all items of data are listed to ensure that data custodians can determine the availability of data requested and/or time and resources required in providing the data.

Data sets to be linked – PDC, QHAPDC, EDIS and Infection Data (sourced from Communicable Diseases Branch and participating private hospitals)

Unlinked data to be provided for QHAPDC and EDIS.

Key dataset of QHAPDC/ PDC mothers

QHAPDC Scope: All QHAPDC records where the mother gave birth (regardless of gestation) between 1 July 2014 and 30 June 2015 where the PD or OD was O80, O81, O82, O83, O84 in one of the listed public or private hospitals.

QHAPDC records to be linked to PDC where the mother gave birth (via caesarean section or a vaginal birth) from 1 July 2014 to 30 June 2015 in one of the listed public or private hospitals. Any QHAPDC records that do not link to PDC but meet the QHAPDC scope, are also to be included.

This dataset of QHAPDC/ PDC mothers is then to be linked to EDIS and Infection data.

For all mothers in the QHAPDC/PDC dataset, provide the following QHAPDC data items to the researcher:

Created record id

Hospital name (only available for public hospitals, Private hospitals (labelled -Private A, Private B, etc...))

Age at admission (not grouped)

Indigenous Status (Aboriginal, Torres Strait Islander, both Aboriginal and Torres Strait Islander, non-Indigenous)

Australian South Sea Island Status

Country of Birth (broad country of birth codes)

Public or Private Hospital

Hospital Accessibility Remoteness Index for Australia (ARIA) classification (Major city, Inner regional, Outer regional, Remote, Very remote)

Length of stay (capped at 30+days)

AR-DRG code

Principal diagnosis (ICD 10- AM code (7th edition, 2010), as listed above in the QHAPDC scope)

Other diagnosis codes - one or more of the following codes:

O10 Pre-existing hypertension
 O11 Pre-eclampsia superimposed on chronic hypertension
 O12 Gestational oedema
 O13 Gestational hypertension without significant proteinuria
 O14 Gestational hypertension
 O15 Eclampsia
 O16 Unspecified maternal hypertension
 O23 Infections of genitourinary tract in pregnancy
 O24 Diabetes mellitus in pregnancy
 O25 Malnutrition in pregnancy
 O26 Maternal care for other conditions
 O30 Multiple gestation
 O41.1 Infection of amniotic sac and membranes
 O42 Premature rupture of membranes
 O63 Long labour
 O67 Labour and delivery complicated by Intrapartum haemorrhage
 O70 Perineal laceration during delivery
 O71 Other obstetric trauma
 O85 Puerperal sepsis with additional codes:
 A40-A41 - type of sepsis
 B95-B97 - Infectious agent
 N71 - endometritis
 O86.0 Other puerperal infections with additional code:
 B95-B97 - Infectious agent
 O90.0 Disruption of caesarean section wound
 O90.1 Disruption of perineal obstetric wound
 O95 Death unspecified
 O96 Death from obstetric cause >42 days
 O97 Death > 1 year
 O98 Maternal infectious and parasitic diseases
 M72.6 Necrotising fasciitis with additional code:
 B95-B97 - Infectious agent

Procedure codes - (All codes)

Flag to indicate (Y/N) if any of the following ACHI procedure codes are present:

[1920] any or all codes within this block

[0987] an or all codes within this block

[1628] 90686-01

Procedure date for the following ACHI codes (dd-mm-yyy) Justification below:

[1340] an or all codes within this block

[1920] any or all codes within this block

[0987] an or all codes within this block

[1628] 90686-01

Where the patient has been transferred to a HOME ward, provide ward name (HOME) and date of ward transfer to HOME (dd-mm-yyy)

QHAPDC re-admissions

For all mothers in the QHAPDC/PDC dataset, provide the following QHAPDC data items for any re-admissions up to 630 days after of the PDC date of birth (child's DOB) related to post-birth infection (PD or OD ICD-10-AM O85 (with additional codes - A40-A41 type of sepsis/B95-B97 Infectious agent/N71 endometritis localised infection), N71, O86.0 (with additional codes B95-B97), O90.0, O90.1 or M72.6 (with additional codes - B95-B97 Infectious agent)):

Created record id

Episode counter

Hospital name (only available for public hospitals, Private hospital (labelled Private A, -Private B etc))

Age at admission (not grouped)

Indigenous Status (Aboriginal, Torres Strait Islander, both Aboriginal and Torres Strait Islander, non-Indigenous)

Australian South Sea Island Status

Country of Birth (broad country of birth codes)

Public or Private Hospital

Hospital Accessibility Remoteness Index for Australia (ARIA) classification (Major city, Inner regional, outer regional, remote, very remote)
 Readmission date (dd-mm-yy) Justification below
 Length of stay (capped at 30+days)
 AR-DRG code
 Principal diagnosis (ICD 10- AM code)
 Other diagnosis codes (all – see list above)
 Procedure codes – (All codes)
 Flag to indicate (Y/N) if any of the following ACHI procedure codes are present:
 [1340] an or all codes within this block
 [1920] any or all codes within this block
 [0987] an or all codes within this block
 [1628] 90686-01
 Procedure date for the following ACHI codes (dd-mm-yy) Justification below:
 [1340] an or all codes within this block
 [1920] any or all codes within this block
 [0987] an or all codes within this block
 [1628] 90686-01
 Where the patient has been transferred to a HOME ward, provide ward name (HOME) and date of ward transfer to HOME (dd-mm-yy)

For all linked records in the QHAPDC/PDC dataset, provide the following Perinatal data items to the researcher:

Perinatal Data Collection data items requested:

Created record id
Hospital name (only available for public hospitals, Private hospitals labelled Private A, Private B etc)
 Number of previous caesareans
 Pre-pregnancy BMI
 Current medical conditions
 Pregnancy complications
 Smoking during the first 20 weeks of pregnancy – Yes/No
 How many cigarettes per day during the first 20 weeks of pregnancy
 Smoking after the first 20 weeks of pregnancy – Yes/No
 How many cigarettes per day after the first 20 weeks of pregnancy
 Onset of labour
 Methods used to induce labour or augment labour
 Membranes ruptured
 Length of 1st stage of labour
 Length of 2nd stage of labour
 Method of birth
 Water birth
 Reason for caesarean
 Cervical dilation prior to caesarean
 Antibiotics at time of caesarean
 Damage to the perineum
 Other genital trauma
 Surgical repair of the vagina or perineum
 Labour and delivery complications
 Foetal scalp pH
 Lactate
 Foetal Scalp Electrode in labour (FSE in labour)
 Puerperium complications (all responses)
 Puerperium procedures and operations (all responses)

Infection data items to be provided by Communicable Diseases Branch and participating private hospitals to SSB for linkage purposes:

Patient name
 Patient date of birth
 Patient address
 Procedure date (date patient gave birth)
 Infection notification date/CultureDate (dd-mm-yyy)
 UR number
 Hospital name

Where the QHAPDC/PDC dataset links to the Infection data, the following Infection data items are to be provided to the researcher:

Created patient ID
 Hospital name (only available for public hospitals, Private hospitals labelled Private A, Private B etc.)

Procedure code
 Procedure (emergency or elective)
 Procedure date
 Procedure duration
 NNIS Total
 AB Admin
 Antibiotic count
 Antibiotics combined across procedure
 Surgical wound class
 Place of onset
 Infection type

Infection notification date/CultureDate (dd-mm-yyy) Justification below

Organism

ABN Time

(Infection data items requested for caesarean births only (ICD-10-AM codes O82 and O84.2) private hospitals are providing infection data to SSB separately from the MultiPrac dataset held by Communicable Diseases Branch.)

In the linked infection data worksheet, please provide an additional "Assumed No Infection" category within the Infection type data item for private hospitals where infection information is blank following linkage to QHAPDC or no infection data was provided by private hospitals.

Linked EDIS data

Where the QHAPDC/PDC dataset links to the EDIS data (where the date of ED presentation is 930 days after the PDC date of birth) related to post-birth infection (EDIS ICD Code O90.1- or O90.8), the following data items are to be provided to the researcher from the EDIS record:

Created patient ID
 Hospital name for public hospitals
 Patient age
 Patient country of birth
 Patient Indigenous status
 Patient South Sea Islander status
 Public or private hospital
 Hospital ARIA category
 Length of stay
 AR-DRG code
 Service commencement date
 Diagnosis ICD Code Primary - O90.1 (Dehiscence of perineal wound) or O90.8 (Caesarean section wound complication)
 Additional diagnosis 1
 Additional diagnosis 2

Emergency Department Information System data items requested (private hospitals with emergency facilities are providing data to SSB separately from the EDIS dataset held by HAAT)

Unlinked EDIS data

Where records in EDIS records have a principle diagnosis code of O90.1 (Dehiscence of perineal wound) or O90.8 (Caesarean section wound complication) and presentation at the Emergency Department was between 1 July 2014 and 30 June 2015 but are not linked to the QHAPDC/PDC dataset, provide the following data items:

Created patient ID

Hospital name for public hospitals.

Patient age

Patient country of birth

Patient Indigenous status

Patient South Sea Islander status

Public or private hospital

Hospital ARIA category

Length of stay

AR-DRG code

Service commencement date

Diagnosis ICD Code Primary - O90.1 (Dehiscence of perineal wound) or O90.8 (Caesarean section wound complication)

Additional diagnosis 1

Additional diagnosis 2

Where the QHAPDC/PDC dataset or the unlinked EDIS records link to the Deaths data, the following data items are to be provided to the researcher:

Created patient ID

Deceased/not deceased

Cause of death (text field)

Date of death (mm-yyyy)

List of Public and participating Private Hospitals for the study

Queensland public birthing hospitals and private hospitals who have given ethics and governance approvals will include their infection and emergency data (where available) in this study. The hospitals are:

Atherton Hospital

Ayr Hospital

Beaudesert Hospital

Biloela Hospital

Bundaberg Hospital

Caboolture Hospital

Cairns Base Hospital

Charleville Hospital

Chinchilla Hospital

Dalby Hospital

Emerald Hospital

Gladstone Hospital

Gold Coast Hospital

Goondiwindi Hospital

Gympie Hospital

Hervey Bay Hospital
 Innisfail Hospital
 Ipswich Hospital
 Kingaroy Hospital
 Logan Hospital
 Longreach Hospital
 Mackay Base Hospital
 Mareeba Hospital
 Maryborough Hospital
 Mater Mothers' Public Hospital
 Mount Isa Hospital
 Nambour Hospital
 Proserpine Hospital
 Redcliffe Hospital
 Redland Hospital
 Rockhampton Hospital
 Roma Hospital
 Royal Brisbane and Women's Hospital
 St George Hospital
 Stanthorpe Hospital
 Thursday Island Hospital
 Toowoomba Hospital
 Townsville Hospital
 Warwick Hospital

Mater Misericordiae Hospital Gladstone – unable to provide emergency data
 Mater Misericordiae Hospital Mackay – unable to provide emergency data
 Mater Misericordiae Hospital Rockhampton – unable to provide emergency data
 Mater Mothers' Private Hospital
 Mater Mothers' Private Redland
 Mater Women's and Children's Hospital Townsville – unable to provide emergency data
 St Vincent's Hospital Toowoomba
 Sunshine Coast Private Hospital
 Wesley Private Hospital

The data items 'readmission date', 'procedure date', 'culture date' and 'date of ward transfer to HOME' requested require a dd-mm-yyyy format and this increases the likelihood of a patient being identified. An accurate date format is required for these data items because of their use in calculating parameters for the cost-effectiveness modelling. The researcher will use the number of days between procedure date and culture date (date surgical site infection is confirmed) to calculate the probability of a patient becoming infected following caesarean delivery at various time points after the surgery. Procedure dates for other healthcare interventions will similarly be used to examine length of time between 'culture date' and treatment so that probabilities for the cost-effectiveness model can be calculated. 'Readmission date' and 'date of ward transfer to HOME' will be used in the same way as procedure date for calculating the number of days between various events so that the probability of a patient experiencing that event at time points following the surgery can be calculated.

We would like 6030-day readmission data, that is, data items below collected within 630 days of the original admission to hospital for caesarean section or vaginal birth and including multiple admissions or presentations to emergency. Women may have been in labour prior to a caesarean section hence some data on labour processes is also requested. Other diagnosis codes of interest are important – we need to know if any of these data items were recorded or not for each woman.

Please include non-linked QHAPDC cases. Not all hospitals included in the list above will provide infection data, however we still need information on women for whom no infection data is available. This will enable us to calculate the proportion of cases for which infection surveillance was undertaken.

8.2 - What date range will this request cover (what are the dates of the information you require e.g. Jan 2000 - Dec 2004)?

July 1 2014 - June 30 2015

8.3 - How frequently will the information be provided to you (e.g. once only, every 3 months etc)?

Once only

9 Privacy and Confidentiality

9.1 - Who is providing the confidential information and how will the disclosure take place?

The individual hospitals will send the data file with the confidential information in it to the Health Statistics Unit for them to link with the QHAPDC and Perinatal data. These data will be transmitted electronically via password protected files and the password will be given by phone. The HSU will remove all identifiable information before disclosing the final file to the researchers.

9.2 - In what form will data be disclosed (electronic or paper)?

The data will be supplied in electronic format if the firewalls at QUT allow. If this is not successful then the data will be burned to CD.

9.3 - How will the security associated with the transfer of data be maintained?

All files will be password protected. If files are sent electronically the password will be transmitted by phone upon safe receipt of the files. If the data are burned to CD they will be picked up in person by an approved researcher for the project.

9.4 - How will data security be maintained?

All data will be nonidentifiable for the researcher's during analysis. Electronic data will be stored on secure, password protected network drives at QUT with routine backup procedures. Data will only be seen by the named people on the project responsible for data management and analysis.

10 Authorisation from Data Custodian:

Dataset name: QHAPDC, PDC and Deaths

I have considered this proposal and consulted the appropriate personnel and I confirm that I have seen all relevant documents that are required.

- ☒ able to confirm that the data services indicated will be provided, within the present resources;
☐ unable to provide data services indicated, on the following grounds:

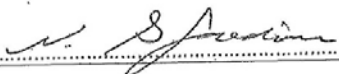
The custodian has supplied these data for an approved research request, but makes no warranty as to the fitness of the data, nor of the proposed methods, for the purpose for which the data has been provided and do not necessarily represent those of Queensland Health.

Name NEIL GARDINER

Date 3/11/16

Position DIR SSB

Hospital / HHS:

Signature 

Authorisation from Data Custodian:

Dataset name: EDIS

I have considered this proposal and consulted the appropriate personnel and I confirm that I have seen all relevant documents that are required.

- ☒ able to confirm that the data services indicated will be provided, within the present resources;
☐ unable to provide data services indicated, on the following grounds:

DATA IS ONLY FOR QLD PUBLIC HOSPITALS

The custodian has supplied these data for an approved research request, but makes no warranty as to the fitness of the data, nor of the proposed methods, for the purpose for which the data has been provided and do not necessarily represent those of Queensland Health.

Name JOHN GOMES

Date 24/11/16

Position PRINCIPAL PROJECT OFFICER

Hospital / HHS:

HEALTHCARE IMPROVEMENT UNIT

Signature 

Authorisation from Data Custodian:

Dataset name:

I have considered this proposal and consulted the appropriate personnel and I confirm that I have seen all relevant documents that are required.

- ☒ able to confirm that the data services indicated will be provided, within the present resources;
☐ unable to provide data services indicated, on the following grounds:

The custodian has supplied these data for an approved research request, but makes no warranty as to the fitness of the data, nor of the proposed methods, for the purpose for which the data has been provided and do not necessarily represent those of Queensland Health.

Name DR ALUN RICHARDS

Date 24/11/16

Position ACTING EXECUTIVE DIRECTOR, COMMUNICABLE DISEASES BRANCH Hospital / HHS:

Signature *A. Richards*

Authorisation from Data Custodian:

Dataset name:

I have considered this proposal and consulted the appropriate personnel and I confirm that I have seen all relevant documents that are required.

- ☐ able to confirm that the data services indicated will be provided, within the present resources;
☐ unable to provide data services indicated, on the following grounds:

The custodian has supplied these data for an approved research request, but makes no warranty as to the fitness of the data, nor of the proposed methods, for the purpose for which the data has been provided and do not necessarily represent those of Queensland Health.

Name

Date

Position

Hospital / HHS:

Signature

*(Repeat "Authorisation from Data Custodian" if more than one required).
 (A letter of support or email may be used, instead)*

11 Human Research Ethics Committee (HREC) Approval

11.1 - State the name of the Human Research Ethics Committee that approved this research proposal

Evidence should be provided as an attachment that the research proposal has been reviewed by a human research ethics committee, including the contact details for each committee this applies to.

12 Undertaking of Confidentiality

- 12.1 In the course of using confidential information for research purposes, I acknowledge that I will be exposed to information which if inappropriately used or disclosed may impact on individuals, public or private facilities or communities, such as discrete non urban indigenous communities.
- 12.2 I will not disclose confidential information in any released output (eg in reports, publications).
- 12.3 I will not use this confidential information for purposes other than for performing the specific activities detailed in my application as approved by the Chief Executive under the Act.
- 12.4 I will not use the confidential information except during the defined time period for which access to and use of this information was approved.
- 12.5 I agree to take all the reasonable steps necessary to ensure that the confidential information is kept confidential, including storing or disposing of all data, information, documents and associated correspondence in a secure manner.
- 12.6 I agree to re-apply for approval from the Chief-Executive if:
 - 12.6.1 - I require additional confidential information, or if
 - 12.6.2 - I want to extend the approved time period for access to or use of the confidential information,
- 12.7 The declaration of my interests in Research Proposals and associated documents shall be held in strict confidence by the relevant Queensland Health Human Research Ethics Committee and Queensland Health employees, and it shall not be used or disclosed to any other person without my prior consent or when it is legally required to be disclosed.

In signing this declaration, I declare that all researchers accessing identifiable data described in this application will adhere to the obligations specified above.

Signed by Coordinating Principal Investigator

Coordinating Principal Investigators Name (Please print)

Date: / /

Attachments:

Please complete all the details required and attach the relevant documents.

11 Human Research Ethics Committee (HREC) Approval

11.1 - State the name of the Human Research Ethics Committee that approved this research proposal

Evidence should be provided as an attachment that the research proposal has been reviewed by a human research ethics committee, including the contact details for each committee this applies to.

12 Undertaking of Confidentiality

- 12.1 In the course of using confidential information for research purposes, I acknowledge that I will be exposed to information which if inappropriately used or disclosed may impact on individuals, public or private facilities or communities, such as discrete non urban indigenous communities.
- 12.2 I will not disclose confidential information in any released output (eg in reports, publications).
- 12.3 I will not use this confidential information for purposes other than for performing the specific activities detailed in my application as approved by the Chief Executive under the Act.
- 12.4 I will not use the confidential information except during the defined time period for which access to and use of this information was approved.
- 12.5 I agree to take all the reasonable steps necessary to ensure that the confidential information is kept confidential, including storing or disposing of all data, information, documents and associated correspondence in a secure manner.
- 12.6 I agree to re-apply for approval from the Chief-Executive if:
 - 12.6.1 - I require additional confidential information, or if
 - 12.6.2 - I want to extend the approved time period for access to or use of the confidential information,
- 12.7 The declaration of my interests in Research Proposals and associated documents shall be held in strict confidence by the relevant Queensland Health Human Research Ethics Committee and Queensland Health employees, and it shall not be used or disclosed to any other person without my prior consent or when it is legally required to be disclosed.

In signing this declaration, I declare that all researchers accessing identifiable data described in this application will adhere to the obligations specified above.

E. Martin

Signed by Coordinating Principal Investigator

Elizabeth Martin

Coordinating Principal Investigators Name (Please print)

Date: 30/11/16

Attachments:

Please complete all the details required and attach the relevant documents.

V12 2/10/2015

- | |
|---|
| <ol style="list-style-type: none">1. Evidence of Approval from HREC Dated: / /2. Evidence of Approval from the Data Custodian3. Evidence of Approval from Pathology Queensland |
|---|

Reviewed November 2009

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Queensland
Government

Department of Health

Enquiries to: Claudine Wilson
Health Innovation, Investment and
Research Office
Office of the Director-General
Telephone: 07 3199 3175
Ref: QCHO/009321/ RD006591
Amendment: 1

Mrs Elizabeth Martin
c/- Professor Nicholas Graves
Institute of Biomedical and Health Innovation
School of Public Health
Queensland University of Technology
60 Musk Avenue
KELVIN GROVE QLD 4059

Dear Mrs Martin

Research Title: A cost-effectiveness modelling study of strategies to prevent post-caesarean surgical site infection

HREC / Project Number: 1400000868

I am writing to inform you that your request to amend your *Public Health Act 2005* application (original approval RD006304, dated 20 May 2016) has been approved under the delegation of the Director-General. In accordance with Section 284 of the *Public Health Act 2005*, the researchers listed in the application can access and use the specified confidential information, providing they act within the limits detailed in your submission.

This approval:

- is valid to 2 February 2018
- allows additional information (as described in the Public Health Act application signed by Mrs Martin on 30 November 2016) to be given for the amended period from 1 July 2014 to 30 June 2015 from the following repositories:
 - Emergency Department Information System (EDIS) for Queensland public hospitals only
 - Perinatal Data Collection (PDC)
 - Queensland Hospital Admitted Patient Data Collection (QHAPDC)
 - Death Registry
 - Multiprac

The following researchers may be given the information as noted in the above application:

- Mrs Elizabeth Martin
- Professor Nicholas Graves
- Dr Kate Halton
- Dr Michael Beckman
- Dr Katharina Merollini

Office
HIIRO, ODG
Department of Health
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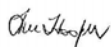
Please display this letter and a copy of your application when requesting the confidential information from the relevant data custodian and provide a copy of this approval to the Human Research Ethics Committee that reviewed your protocol.

Please be aware, this letter constitutes *Public Health Act 2005* approval only. The project cannot proceed until separate Research Governance authorisation has been obtained from the relevant authority.

It should be noted that all requirements in the original approval including the requirement to provide an annual progress report and a final report at the completion of your project to Health Innovation, Investment and Research Office, Office of the Director-General still apply. Templates can be found on the web page
http://www.health.qld.gov.au/ohmr/html/regu/aces_conf_hth_info.asp

Please contact Health Innovation, Investment and Research Office, Office of the Director-General on email PHA@health.qld.gov.au or phone 07 3199 3175 if you have any queries on this matter.

Yours sincerely



Sue Hooper PhD
Director
Health Innovation, Investment and Research Office
Office of the Director-General
6/12/2016

RD006591 Elizabeth Martin

Appendix I **Evidence of Logistic Regression Assumptions Met by Current Practice Survey Data**

A tolerance less than 0.2 and an inflation factor greater than 5 was indicative of multi-collinearity*.

| Coefficients ^a | | | |
|---------------------------|--|-------------------------|-------|
| Model | | Collinearity Statistics | |
| | | Tolerance | VIF |
| 1 | D8 Years practicing in obstetrics_grouped | .983 | 1.017 |
| | D3 Number of caesareans performed annually? | .958 | 1.044 |
| | D4 Type of hospital mainly performing caesarean sections in? | .878 | 1.139 |
| | D6 ARIA classification code | .768 | 1.302 |
| | D7 State of hospital | .851 | 1.175 |
| | CP3 Use a surgical or patient safety checklist | .962 | 1.039 |

a. Dependent Variable: D1 RANZCOG membership status

| Coefficients ^a | | | |
|---------------------------|--|-------------------------|-------|
| Model | | Collinearity Statistics | |
| | | Tolerance | VIF |
| 1 | D3 Number of caesareans performed annually? | .922 | 1.084 |
| | D4 Type of hospital mainly performing caesarean sections in? | .848 | 1.180 |
| | D6 ARIA classification code | .621 | 1.611 |
| | D7 State of hospital | .847 | 1.180 |
| | CP3 Use a surgical or patient safety checklist | .969 | 1.032 |
| | D1 RANZCOG membership status | .673 | 1.486 |

a. Dependent Variable: D8 Years practicing in obstetrics_grouped

Coefficients^a

| Model | | Collinearity Statistics | |
|-------|--|-------------------------|-------|
| | | Tolerance | VIF |
| 1 | D4 Type of hospital mainly performing caesarean sections in? | .851 | 1.175 |
| | D6 ARIA classification code | .614 | 1.629 |
| | D7 State of hospital | .846 | 1.182 |
| | CP3 Use a surgical or patient safety checklist | .963 | 1.038 |
| | D1 RANZCOG membership status | .694 | 1.441 |
| | D8 Years practicing in obstetrics_grouped | .976 | 1.025 |

a. Dependent Variable: D3 Number of caesareans performed annually?

Coefficients^a

| Model | | Collinearity Statistics | |
|-------|--|-------------------------|-------|
| | | Tolerance | VIF |
| 1 | D6 ARIA classification code | .632 | 1.583 |
| | D7 State of hospital | .846 | 1.182 |
| | CP3 Use a surgical or patient safety checklist | .967 | 1.034 |
| | D1 RANZCOG membership status | .691 | 1.448 |
| | D8 Years practicing in obstetrics_grouped | .973 | 1.027 |
| | D3 Number of caesareans performed annually? | .924 | 1.082 |

a. Dependent Variable: D4 Type of hospital mainly performing caesarean sections in?

Coefficients^a

| Model | | Collinearity Statistics | |
|-------|--|-------------------------|-------|
| | | Tolerance | VIF |
| 1 | D7 State of hospital | .965 | 1.036 |
| | CP3 Use a surgical or patient safety checklist | .963 | 1.039 |
| | D1 RANZCOG membership status | .833 | 1.200 |
| | D8 Years practicing in obstetrics_grouped | .983 | 1.017 |
| | D3 Number of caesareans performed annually? | .919 | 1.088 |
| | D4 Type of hospital mainly performing caesarean sections in? | .872 | 1.147 |

a. Dependent Variable: D6 ARIA classification code

Coefficients^a

| Model | | Collinearity Statistics | |
|-------|--|-------------------------|-------|
| | | Tolerance | VIF |
| 1 | CP3 Use a surgical or patient safety checklist | .971 | 1.030 |
| | D1 RANZCOG membership status | .670 | 1.492 |
| | D8 Years practicing in obstetrics_grouped | .974 | 1.026 |
| | D3 Number of caesareans performed annually? | .919 | 1.088 |
| | D4 Type of hospital mainly performing caesarean sections in? | .847 | 1.181 |
| | D6 ARIA classification code | .700 | 1.428 |

a. Dependent Variable: D7 State of hospital

Coefficients^a

| Model | | Collinearity Statistics | |
|-------|--|-------------------------|-------|
| | | Tolerance | VIF |
| 1 | D1 RANZCOG membership status | .667 | 1.499 |
| | D8 Years practicing in obstetrics_grouped | .981 | 1.020 |
| | D3 Number of caesareans performed annually? | .922 | 1.085 |
| | D4 Type of hospital mainly performing caesarean sections in? | .853 | 1.173 |
| | D6 ARIA classification code | .615 | 1.626 |
| | D7 State of hospital | .855 | 1.169 |

a. Dependent Variable: CP3 Use a surgical or patient safety checklist

*O'Brien RM. A Caution Regarding Rules of Thumb for Variance Inflation Factors. *Quality & Quantity* 2007;41(5):673-90.

Appendix J

Coefficients From Logistic Regression Output, and Transition Probabilities: Original Economic Model

Coefficients for transition from caesarean section, women from current practice hospitals

| | Transition to normal recovery at home | | Transition to infection in hospital | |
|--------------------------------|---------------------------------------|----------------|-------------------------------------|----------------|
| | Coefficient | Standard error | Coefficient | Standard error |
| Current practice | -0.003 | 0.041 | -0.549 | 0.41 |
| Time-constant intercept | -3.523 | 0.105 | -7.095 | 0.914 |
| Linear time trend | 1.06 | 0.025 | -0.009 | 0.164 |
| Quadratic time trend | -0.073 | 0.002 | -0.549 | 0.009 |
| Hospital type (public/private) | -0.378 | 0.030 | -0.205 | 0.293 |
| BMI | -0.041 | 0.013 | -0.318 | 0.152 |
| NNIS index | -0.228 | 0.032 | 0.177 | 0.335 |

Transition probabilities for transition from caesarean section, women from current practice hospitals

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 1 | 0.926219988 | 0.073340412 | 0.000439601 |
| 2 | 0.844299605 | 0.155012757 | 0.000687638 |
| 3 | 0.730627454 | 0.268782819 | 0.000589727 |
| 4 | 0.610578606 | 0.38893298 | 0.000488413 |
| 5 | 0.511789968 | 0.48780431 | 0.000405723 |
| 6 | 0.447781782 | 0.551866418 | 0.000351799 |
| 7 | 0.420538004 | 0.579134561 | 0.000327435 |
| 8 | 0.429086272 | 0.570582631 | 0.000331098 |
| 9 | 0.47385164 | 0.525785996 | 0.000362364 |
| 10 | 0.555286329 | 0.444292837 | 0.000420834 |
| 11 | 0.666966045 | 0.332533011 | 0.000500944 |
| 12 | 0.787886297 | 0.21152724 | 0.000586463 |
| 13 | 0.888361484 | 0.110983189 | 0.000655327 |
| 14 | 0.951503534 | 0.047800849 | 0.000695617 |
| 15 | 0.982142899 | 0.017145518 | 0.000711583 |
| 16 | 0.994075012 | 0.005211213 | 0.000713775 |
| 17 | 0.99793232 | 0.001357555 | 0.000710125 |
| 18 | 0.998990738 | 0.000304753 | 0.000704509 |
| 19 | 0.999242556 | 5.90718E-05 | 0.000698373 |
| 20 | 0.999297953 | 9.89281E-06 | 0.000692154 |
| 21 | 0.999312606 | 1.43164E-06 | 0.000685962 |
| 22 | 0.999319999 | 1.79036E-07 | 0.000679822 |
| 23 | 0.999326246 | 1.93481E-08 | 0.000673735 |
| 24 | 0.999332296 | 1.80687E-09 | 0.000667702 |
| 25 | 0.999338276 | 1.45818E-10 | 0.000661724 |

| | | | |
|----|-------------|-------------|-------------|
| 26 | 0.999344201 | 1.01692E-11 | 0.000655799 |
| 27 | 0.999350073 | 6.12854E-13 | 0.000649927 |
| 28 | 0.999355892 | 3.19168E-14 | 0.000644108 |
| 29 | 0.999361659 | 1.4364E-15 | 0.000638341 |
| 30 | 0 | 1 | 0 |
| 31 | 0 | 1 | 0 |
| 32 | 0 | 1 | 0 |
| 33 | 0 | 1 | 0 |
| 34 | 0 | 1 | 0 |
| 35 | 0 | 1 | 0 |
| 36 | 0 | 1 | 0 |
| 37 | 0 | 1 | 0 |
| 38 | 0 | 1 | 0 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Coefficients for transition from caesarean section, women from better practice hospitals

| | Transition to normal recovery at home | | Transition to infection in hospital | |
|--------------------------------------|---------------------------------------|----------------|-------------------------------------|----------------|
| | Coefficient | Standard error | Coefficient | Standard error |
| Time-constant intercept | -3.52 | 0.064 | -6.546 | 0.504 |
| Linear time trend | 1.06 | 0.025 | -0.009 | 0.164 |
| Quadratic time trend | -0.073 | 0.002 | -0.549 | 0.009 |
| Hospital behaviour (better practice) | -0.003 | 0.041 | -0.549 | 0.410 |
| Hospital type (public/private) | -0.378 | 0.030 | -0.205 | 0.293 |
| BMI | -0.041 | 0.013 | -0.318 | 0.152 |
| NNIS index | -0.228 | 0.032 | 0.177 | 0.335 |

Transition probabilities for transition from caesarean section, women from better practice hospitals

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 1 | 0.925718314 | 0.07352092 | 0.000760766 |
| 2 | 0.84437513 | 0.155492401 | 0.000132469 |
| 3 | 0.730463004 | 0.269529699 | 7.29679E-06 |
| 4 | 0.610163532 | 0.389836339 | 1.29443E-07 |
| 5 | 0.511248102 | 0.488751898 | 7.68254E-10 |
| 6 | 0.447197615 | 0.552802385 | 1.58767E-12 |
| 7 | 0.419944799 | 0.580055201 | 1.17485E-15 |
| 8 | 0.428493571 | 0.571506429 | 3.15074E-19 |
| 9 | 0.473275493 | 0.526724507 | 3.05073E-23 |
| 10 | 0.554779235 | 0.445220765 | 1.04562E-27 |
| 11 | 0.666633959 | 0.333366041 | 1.22533E-32 |
| 12 | 0.787847636 | 0.212152364 | 4.71045E-38 |
| 13 | 0.88864752 | 0.11135248 | 5.76433E-44 |
| 14 | 0.952029053 | 0.047970947 | 2.23467E-50 |
| 15 | 0.982791609 | 0.017208391 | 2.78429E-57 |
| 16 | 0.994769478 | 0.005230522 | 1.13451E-64 |
| 17 | 0.998637404 | 0.001362596 | 1.52923E-72 |
| 18 | 0.999694116 | 0.000305884 | 6.85574E-81 |
| 19 | 0.999940709 | 5.92906E-05 | 1.0243E-89 |
| 20 | 0.999990071 | 9.92941E-06 | 5.1034E-99 |
| 21 | 0.999998563 | 1.43693E-06 | 8.4805E-109 |
| 22 | 0.99999982 | 1.79696E-07 | 4.7003E-119 |
| 23 | 0.999999981 | 1.94193E-08 | 8.689E-130 |
| 24 | 0.999999998 | 1.81351E-09 | 5.3575E-141 |
| 25 | 1 | 1.46353E-10 | 1.1018E-152 |
| 26 | 1 | 1.02065E-11 | 7.5575E-165 |
| 27 | 1 | 6.15095E-13 | 1.729E-177 |
| 28 | 1 | 3.20333E-14 | 1.3194E-190 |
| 29 | 1 | 1.44163E-15 | 3.358E-204 |
| 30 | 0 | 1 | 0 |
| 31 | 0 | 1 | 0 |
| 32 | 0 | 1 | 0 |

| | | | |
|----|---|---|---|
| 33 | 0 | 1 | 0 |
| 34 | 0 | 1 | 0 |
| 35 | 0 | 1 | 0 |
| 36 | 0 | 1 | 0 |
| 37 | 0 | 1 | 0 |
| 38 | 0 | 1 | 0 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Coefficients for transition from normal recovery at home, women from current practice hospitals

| | Transition to infection in hospital | |
|--------------------------------|-------------------------------------|----------------|
| | Coefficient | Standard error |
| Current practice | -0.424 | 0.336 |
| Time-constant intercept | -6.458 | 0.73 |
| Linear time trend | -0.129 | 0.023 |
| Hospital type (public/private) | 0.141 | 0.251 |
| BMI | 0.107 | 0.119 |
| NNIS index | 0.146 | 0.282 |

Transition probabilities for transition from normal recovery at home, women from current practice hospitals

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 1 | 0.994494914 | 0.004128815 | 0.001376272 |
| 2 | 0.995160366 | 0.003629725 | 0.001209908 |
| 3 | 0.995745465 | 0.003190901 | 0.001063634 |
| 4 | 0.996259893 | 0.00280508 | 0.000935027 |
| 5 | 0.996712171 | 0.002465871 | 0.000821957 |
| 6 | 0.997109797 | 0.002167652 | 0.000722551 |
| 7 | 0.997459364 | 0.001905477 | 0.000635159 |

| | | | |
|----|-------------|-------------|-------------|
| 8 | 0.997766676 | 0.001674993 | 0.000558331 |
| 9 | 0.998036834 | 0.001472375 | 0.000490792 |
| 10 | 0.998274325 | 0.001294256 | 0.000431419 |
| 11 | 0.998483098 | 0.001137677 | 0.000379226 |
| 12 | 0.998666621 | 0.001000034 | 0.000333345 |
| 13 | 0.998827947 | 0.000879039 | 0.000293013 |
| 14 | 0.99896976 | 0.00077268 | 0.00025756 |
| 15 | 0.999094417 | 0.000679187 | 0.000226396 |
| 16 | 0.999203995 | 0.000597004 | 0.000199001 |
| 17 | 0.999300315 | 0.000524764 | 0.000174921 |
| 18 | 0.999384982 | 0.000461263 | 0.000153754 |
| 19 | 0.999459405 | 0.000405446 | 0.000135149 |
| 20 | 0.999524824 | 0.000356382 | 0.000118794 |
| 21 | 0.999582326 | 0.000313255 | 0.000104418 |
| 22 | 0.999632871 | 0.000275347 | 9.17822E-05 |
| 23 | 0.9996773 | 0.000242025 | 8.06751E-05 |
| 24 | 0.999716352 | 0.000212736 | 7.0912E-05 |
| 25 | 0.999750679 | 0.000186991 | 6.23303E-05 |
| 26 | 0.999780851 | 0.000164361 | 5.47872E-05 |
| 27 | 0.999807373 | 0.00014447 | 4.81568E-05 |
| 28 | 0.999830685 | 0.000126986 | 4.23288E-05 |
| 29 | 0.999851176 | 0.000111618 | 3.72061E-05 |
| 30 | 1 | 0 | 0 |
| 31 | 1 | 0 | 0 |
| 32 | 1 | 0 | 0 |
| 33 | 1 | 0 | 0 |
| 34 | 1 | 0 | 0 |
| 35 | 1 | 0 | 0 |
| 36 | 1 | 0 | 0 |
| 37 | 1 | 0 | 0 |
| 38 | 1 | 0 | 0 |
| 39 | 1 | 0 | 0 |
| 40 | 1 | 0 | 0 |
| 41 | 1 | 0 | 0 |
| 42 | 1 | 0 | 0 |
| 43 | 1 | 0 | 0 |
| 44 | 1 | 0 | 0 |
| 45 | 1 | 0 | 0 |
| 46 | 1 | 0 | 0 |
| 47 | 1 | 0 | 0 |
| 48 | 1 | 0 | 0 |
| 49 | 1 | 0 | 0 |
| 50 | 1 | 0 | 0 |
| 51 | 1 | 0 | 0 |

| | | | |
|----|---|---|---|
| 52 | 1 | 0 | 0 |
| 53 | 1 | 0 | 0 |
| 54 | 1 | 0 | 0 |

Coefficients for transition from normal recovery at home, women from better practice hospitals

| | Transition to infection in hospital | |
|--------------------------------------|--|-----------------------|
| | Coefficient | Standard error |
| Time-constant intercept | -6.034 | 0.394 |
| Linear time trend | -0.129 | 0.023 |
| Hospital behaviour (better practice) | -0.424 | 0.336 |
| Hospital type (public/private) | 0.141 | 0.251 |
| BMI | 0.107 | 0.119 |
| NNIS index | 0.146 | 0.282 |

Transition probabilities for transition from normal recovery at home, women from better practice hospitals

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|--------------|--|--|--|
| 1 | 0.991593998 | 0.006304501 | 0.0021015 |
| 2 | 0.992609464 | 0.005542902 | 0.001847634 |
| 3 | 0.993502458 | 0.004873156 | 0.001624385 |
| 4 | 0.994287707 | 0.00428422 | 0.001428073 |
| 5 | 0.994978175 | 0.003766369 | 0.001255456 |
| 6 | 0.995585276 | 0.003311043 | 0.001103681 |
| 7 | 0.996119054 | 0.002910709 | 0.000970236 |
| 8 | 0.996588349 | 0.002558738 | 0.000852913 |
| 9 | 0.997000938 | 0.002249297 | 0.000749766 |
| 10 | 0.997363663 | 0.001977253 | 0.000659084 |
| 11 | 0.997682544 | 0.001738092 | 0.000579364 |
| 12 | 0.997962874 | 0.001527845 | 0.000509282 |
| 13 | 0.998209308 | 0.001343019 | 0.000447673 |
| 14 | 0.998425943 | 0.001180542 | 0.000393514 |
| 15 | 0.998616379 | 0.001037715 | 0.000345905 |
| 16 | 0.998783783 | 0.000912163 | 0.000304054 |
| 17 | 0.998930937 | 0.000801797 | 0.000267266 |
| 18 | 0.999060291 | 0.000704782 | 0.000234927 |
| 19 | 0.999173997 | 0.000619502 | 0.000206501 |
| 20 | 0.999273947 | 0.00054454 | 0.000181513 |
| 21 | 0.999361804 | 0.000478647 | 0.000159549 |
| 22 | 0.999439032 | 0.000420726 | 0.000140242 |
| 23 | 0.999506915 | 0.000369814 | 0.000123271 |
| 24 | 0.999566585 | 0.000325062 | 0.000108354 |

| | | | |
|----|-------------|-------------|-------------|
| 25 | 0.999619034 | 0.000285724 | 9.52415E-05 |
| 26 | 0.999665137 | 0.000251147 | 8.37157E-05 |
| 27 | 0.999705661 | 0.000220754 | 7.35847E-05 |
| 28 | 0.999741282 | 0.000194039 | 6.46796E-05 |
| 29 | 0.999772591 | 0.000170556 | 5.68521E-05 |
| 30 | 1 | 0 | 0 |
| 31 | 1 | 0 | 0 |
| 32 | 1 | 0 | 0 |
| 33 | 1 | 0 | 0 |
| 34 | 1 | 0 | 0 |
| 35 | 1 | 0 | 0 |
| 36 | 1 | 0 | 0 |
| 37 | 1 | 0 | 0 |
| 38 | 1 | 0 | 0 |
| 39 | 1 | 0 | 0 |
| 40 | 1 | 0 | 0 |
| 41 | 1 | 0 | 0 |
| 42 | 1 | 0 | 0 |
| 43 | 1 | 0 | 0 |
| 44 | 1 | 0 | 0 |
| 45 | 1 | 0 | 0 |
| 46 | 1 | 0 | 0 |
| 47 | 1 | 0 | 0 |
| 48 | 1 | 0 | 0 |
| 49 | 1 | 0 | 0 |
| 50 | 1 | 0 | 0 |
| 51 | 1 | 0 | 0 |
| 52 | 1 | 0 | 0 |
| 53 | 1 | 0 | 0 |
| 54 | 1 | 0 | 0 |

Coefficients for transition from infection at home, women from current practice hospitals

| | Transition to post-infection recovery | | Transition to infection in hospital | |
|--------------------------------|---------------------------------------|----------------|-------------------------------------|----------------|
| | Coefficient | Standard error | Coefficient | Standard error |
| Current practice | -1.085 | 0.245 | 0.075 | 0.6 |
| Time-constant intercept | -4.354 | 0.856 | -2.466 | 2.061 |
| Linear time trend | 0.184 | 0.066 | -0.137 | 0.18 |
| Quadratic time trend | -0.003 | 0.002 | 0.002 | 0.005 |
| Hospital type (public/private) | 0.097 | 0.197 | -0.667 | 0.565 |
| BMI | -0.111 | 0.085 | 0.794 | 0.3 |
| NNIS index | -0.023 | 0.215 | -0.614 | 0.598 |

Transition probabilities for transition from infection at home, women from current practice hospitals

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 1 | 0.917763512 | 0.01413904 | 0.068097448 |
| 2 | 0.922984947 | 0.016938903 | 0.06007615 |
| 3 | 0.926734765 | 0.020139185 | 0.053126051 |
| 4 | 0.929134943 | 0.023765952 | 0.047099104 |
| 5 | 0.930292268 | 0.027840695 | 0.041867037 |
| 6 | 0.930301792 | 0.032378967 | 0.037319241 |
| 7 | 0.929250258 | 0.037389058 | 0.033360684 |
| 8 | 0.927219317 | 0.042870765 | 0.029909918 |
| 9 | 0.924288406 | 0.048814341 | 0.026897253 |
| 10 | 0.920537189 | 0.055199693 | 0.024263118 |
| 11 | 0.916047493 | 0.061995897 | 0.02195661 |
| 12 | 0.910904692 | 0.06916108 | 0.019934228 |
| 13 | 0.905198524 | 0.076642694 | 0.018158782 |
| 14 | 0.89902336 | 0.084378195 | 0.016598445 |
| 15 | 0.892477948 | 0.092296092 | 0.015225959 |
| 16 | 0.885664723 | 0.10031733 | 0.014017947 |
| 17 | 0.878688729 | 0.108356933 | 0.012954338 |
| 18 | 0.871656289 | 0.116325836 | 0.012017876 |
| 19 | 0.86467349 | 0.124132801 | 0.011193709 |
| 20 | 0.857844602 | 0.131686351 | 0.010469047 |
| 21 | 0.851270513 | 0.138896626 | 0.009832861 |
| 22 | 0.845047249 | 0.145677102 | 0.009275649 |
| 23 | 0.839264644 | 0.151946135 | 0.008789221 |
| 24 | 0.834005184 | 0.157628282 | 0.008366533 |
| 25 | 0.829343055 | 0.162655406 | 0.008001539 |
| 26 | 0.825343377 | 0.166967555 | 0.007689067 |
| 27 | 0.822061625 | 0.170513652 | 0.007424723 |
| 28 | 0.819543212 | 0.17325199 | 0.007204798 |

| | | | |
|----|-------------|-------------|-------------|
| 29 | 0.817823199 | 0.1751506 | 0.007026201 |
| 30 | 0.816926118 | 0.176187481 | 0.006886401 |
| 31 | 0.816865874 | 0.17635075 | 0.006783376 |
| 32 | 0.817645712 | 0.175638715 | 0.006715573 |
| 33 | 0.819258245 | 0.174059875 | 0.00668188 |
| 34 | 0.821685523 | 0.171632875 | 0.006681602 |
| 35 | 0.824899182 | 0.168386373 | 0.006714445 |
| 36 | 0.828860657 | 0.164358835 | 0.006780508 |
| 37 | 0.833521504 | 0.159598215 | 0.006880281 |
| 38 | 0.838823853 | 0.154161497 | 0.007014649 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Coefficients for transition from infection at home, women from better practice hospitals

| | Transition to post-infection recovery | | Transition to infection in hospital | |
|--------------------------------------|---------------------------------------|----------------|-------------------------------------|----------------|
| | Coefficient | Standard error | Coefficient | Standard error |
| Time-constant intercept | -3.269 | 0.611 | -2.541 | 1.461 |
| Linear time trend | 0.184 | 0.066 | -0.137 | 0.18 |
| Quadratic time trend | -0.003 | 0.002 | 0.002 | 0.005 |
| Hospital behaviour (better practice) | 0.075 | 0.245 | -1.085 | 0.599 |
| Hospital type (public/private) | 0.097 | 0.197 | -0.667 | 0.565 |
| BMI | -0.111 | 0.085 | 0.794 | 0.3 |
| NNIS index | -0.023 | 0.215 | -0.614 | 0.598 |

Transition probabilities for transition from infection at home, women from better practice hospitals

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 1 | 0.897318897 | 0.040911505 | 0.061769599 |
| 2 | 0.897103626 | 0.048723983 | 0.054172391 |
| 3 | 0.894857422 | 0.057550591 | 0.047591987 |
| 4 | 0.890688604 | 0.067423585 | 0.041887811 |
| 5 | 0.884706021 | 0.078355441 | 0.036938538 |
| 6 | 0.877024254 | 0.090335873 | 0.032639873 |
| 7 | 0.867767959 | 0.103329649 | 0.028902392 |
| 8 | 0.857075014 | 0.117275451 | 0.025649535 |
| 9 | 0.845098252 | 0.132085956 | 0.022815791 |
| 10 | 0.832005701 | 0.147649215 | 0.020345084 |
| 11 | 0.817979357 | 0.163831277 | 0.018189365 |
| 12 | 0.803212671 | 0.18047992 | 0.016307409 |
| 13 | 0.787907017 | 0.197429209 | 0.014663774 |
| 14 | 0.772267503 | 0.21450456 | 0.013227937 |
| 15 | 0.756498504 | 0.23152794 | 0.011973556 |
| 16 | 0.740799286 | 0.248322852 | 0.010877862 |
| 17 | 0.725360051 | 0.264718806 | 0.009921143 |
| 18 | 0.710358632 | 0.280555049 | 0.00908632 |
| 19 | 0.695958004 | 0.29568341 | 0.008358586 |
| 20 | 0.682304656 | 0.309970232 | 0.007725112 |
| 21 | 0.669527801 | 0.323297415 | 0.007174784 |
| 22 | 0.657739339 | 0.335562662 | 0.006697998 |
| 23 | 0.647034444 | 0.346679087 | 0.006286469 |
| 24 | 0.637492608 | 0.356574317 | 0.005933075 |
| 25 | 0.629178997 | 0.365189278 | 0.005631725 |
| 26 | 0.622145968 | 0.372476795 | 0.005377237 |
| 27 | 0.616434604 | 0.378400153 | 0.005165243 |
| 28 | 0.612076167 | 0.382931733 | 0.0049921 |
| 29 | 0.609093374 | 0.386051808 | 0.004854818 |

| Cycle | Remain in infection at home | Transition to post- infection recovery | Transition to infection in hospital |
|--------------|--|---|--|
| 30 | 0.607501433 | 0.38774757 | 0.004750997 |
| 31 | 0.60730879 | 0.38801243 | 0.00467878 |
| 32 | 0.608517552 | 0.386845642 | 0.004636806 |
| 33 | 0.611123583 | 0.384252236 | 0.004624181 |
| 34 | 0.615116259 | 0.380243291 | 0.00464045 |
| 35 | 0.620477898 | 0.37483652 | 0.004685581 |
| 36 | 0.627182902 | 0.368057143 | 0.004759955 |
| 37 | 0.635196631 | 0.359939012 | 0.004864357 |
| 38 | 0.644474102 | 0.350525914 | 0.004999984 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Coefficients for transition from infection in hospital, women from current practice hospitals

| | Transition to infection at home | | Transition to infection in hospital with surgery | | Transition to infection at home with NPWT | |
|--------------------------------|---------------------------------|----------------|--|----------------|---|----------------|
| | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Current practice | -0.086 | 0.346 | -2.068 | 1.096 | -0.78 | 0.63 |
| Time-constant intercept | -0.936 | 0.844 | -25.464 | 7.395 | -7.77 | 3.02 |
| Linear time trend | -0.037 | 0.069 | 2.992 | 1.626 | 0.572 | 0.321 |
| Quadratic time trend | 0.002 | 0.002 | -0.18 | 0.098 | -0.017 | 0.011 |
| Hospital type (public/private) | -0.006 | 0.253 | -10.097 | 0 | -0.531 | 0.592 |
| BMI | -0.205 | 0.122 | -0.981 | 0.502 | 0.621 | 0.296 |
| NNIS index | 0.253 | 0.306 | 1.519 | 0.997 | -1.264 | 0.727 |

Transition probabilities for transition from infection in hospital, women from current practice hospitals

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 1 | 0.724932059 | 0.274534775 | 1.0536E-10 | 0.00053317 |
| 2 | 0.730789692 | 0.268305356 | 1.2332E-09 | 0.00090495 |
| 3 | 0.735629784 | 0.26288771 | 1.0057E-08 | 0.0014825 |
| 4 | 0.739421435 | 0.258234487 | 5.7133E-08 | 0.00234402 |
| 5 | 0.742122796 | 0.254300013 | 2.2611E-07 | 0.00357697 |
| 6 | 0.743688889 | 0.251042635 | 6.2337E-07 | 0.00526785 |
| 7 | 0.744083773 | 0.248428139 | 1.1971E-06 | 0.00748689 |
| 8 | 0.743295797 | 0.246433967 | 1.6014E-06 | 0.01026863 |
| 9 | 0.741352989 | 0.24505358 | 1.4922E-06 | 0.01359194 |
| 10 | 0.73833492 | 0.244300138 | 9.6865E-07 | 0.01736397 |
| 11 | 0.73437737 | 0.24420866 | 4.3814E-07 | 0.02141353 |
| 12 | 0.729666448 | 0.244835733 | 1.3812E-07 | 0.02549768 |
| 13 | 0.724420776 | 0.246256187 | 3.0353E-08 | 0.02932301 |
| 14 | 0.718863898 | 0.248556963 | 4.6515E-09 | 0.03257913 |
| 15 | 0.713191861 | 0.251829048 | 4.9721E-10 | 0.03497909 |
| 16 | 0.707542071 | 0.256158679 | 3.7079E-11 | 0.03629925 |
| 17 | 0.701969234 | 0.261619086 | 1.9293E-12 | 0.03641168 |
| 18 | 0.696432906 | 0.26826397 | 7.0035E-14 | 0.03530312 |
| 19 | 0.690798973 | 0.276123674 | 1.7733E-15 | 0.03307735 |
| 20 | 0.68485497 | 0.285204679 | 3.1311E-17 | 0.02994035 |

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 21 | 0.678336646 | 0.29549257 | 3.8536E-19 | 0.02617078 |
| 22 | 0.670961079 | 0.306958062 | 3.3044E-21 | 0.02208086 |
| 23 | 0.662460368 | 0.319565012 | 1.9732E-23 | 0.01797462 |
| 24 | 0.652609828 | 0.333278822 | 8.2025E-26 | 0.01411135 |
| 25 | 0.641246157 | 0.348073409 | 2.3727E-28 | 0.01068043 |
| 26 | 0.628273714 | 0.363935234 | 4.7748E-31 | 0.00779105 |
| 27 | 0.613660088 | 0.380863549 | 6.6831E-34 | 0.00547636 |
| 28 | 0.597424526 | 0.398866973 | 6.5047E-37 | 0.0037085 |
| 29 | 0.579623707 | 0.417957232 | 4.4019E-40 | 0.00241906 |
| 30 | 0.560338853 | 0.438141403 | 2.0708E-43 | 0.00151974 |
| 31 | 0.539666662 | 0.459413951 | 6.7713E-47 | 0.00091939 |
| 32 | 0.517714849 | 0.481749662 | 1.5387E-50 | 0.00053549 |
| 33 | 0.49460166 | 0.505098122 | 2.4293E-54 | 0.00030022 |
| 34 | 0 | 1 | 0 | 0 |
| 35 | 0 | 1 | 0 | 0 |
| 36 | 0 | 1 | 0 | 0 |
| 37 | 0 | 1 | 0 | 0 |
| 38 | 0 | 1 | 0 | 0 |
| 39 | 0 | 1 | 0 | 0 |
| 40 | 0 | 1 | 0 | 0 |
| 41 | 0 | 1 | 0 | 0 |
| 42 | 0 | 1 | 0 | 0 |
| 43 | 0 | 1 | 0 | 0 |
| 44 | 0 | 1 | 0 | 0 |
| 45 | 0 | 1 | 0 | 0 |
| 46 | 0 | 1 | 0 | 0 |
| 47 | 0 | 1 | 0 | 0 |
| 48 | 0 | 1 | 0 | 0 |
| 49 | 0 | 1 | 0 | 0 |
| 50 | 0 | 1 | 0 | 0 |
| 51 | 0 | 1 | 0 | 0 |
| 52 | 0 | 1 | 0 | 0 |
| 53 | 0 | 1 | 0 | 0 |
| 54 | 0 | 1 | 0 | 0 |

Coefficients for transition from infection in hospital, women from better practice hospitals

| | Transition to infection at home | | Transition to infection in hospital with surgery | | Transition to infection at home with NPWT | |
|--------------------------------------|---------------------------------|----------------|--|----------------|---|----------------|
| | Coefficient | Standard error | Coefficient | Standard error | Coefficient | Standard error |
| Time-constant intercept | -0.85 | 0.498 | -23.396 | 6.299 | -6.99 | 2.39 |
| Linear time trend | -0.037 | 0.069 | 2.992 | 1.626 | 0.572 | 0.321 |
| Quadratic time trend | 0.002 | 0.002 | -0.18 | 0.098 | -0.017 | 0.011 |
| Hospital behaviour (better practice) | -0.086 | 0.346 | -2.068 | 1.096 | -0.780 | 0.630 |
| Hospital type (public/private) | -0.006 | 0.253 | -10.097 | 0 | -0.531 | 0.592 |
| BMI | -0.205 | 0.122 | -0.981 | 0.502 | 0.621 | 0.296 |
| NNIS index | 0.253 | 0.306 | 1.519 | 0.997 | -1.264 | 0.727 |

Transition probabilities for transition from infection in hospital, women from better practice hospitals

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 1 | 0.707054275 | 0.29181132 | 8.1271E-10 | 0.0011344 |
| 2 | 0.712851009 | 0.285223315 | 9.5142E-09 | 0.00192567 |
| 3 | 0.717435213 | 0.279410674 | 7.7571E-08 | 0.00315404 |
| 4 | 0.720711138 | 0.274304394 | 4.4043E-07 | 0.00498403 |
| 5 | 0.722566253 | 0.269834583 | 1.7412E-06 | 0.00759742 |
| 6 | 0.722888955 | 0.265935985 | 4.7923E-06 | 0.01117027 |
| 7 | 0.721595785 | 0.262556193 | 9.1818E-06 | 0.01583884 |
| 8 | 0.718663949 | 0.259665395 | 1.2245E-05 | 0.02165841 |
| 9 | 0.714160493 | 0.257265266 | 1.1369E-05 | 0.02856287 |
| 10 | 0.70826113 | 0.25539538 | 7.349E-06 | 0.03633614 |
| 11 | 0.701254321 | 0.25413627 | 3.3089E-06 | 0.0446061 |
| 12 | 0.693524424 | 0.253607161 | 1.0383E-06 | 0.05286738 |
| 13 | 0.685511232 | 0.25395698 | 2.2716E-07 | 0.06053156 |
| 14 | 0.677653508 | 0.255350244 | 3.4679E-08 | 0.06699621 |
| 15 | 0.67032922 | 0.257950825 | 3.6961E-09 | 0.07171995 |
| 16 | 0.663803259 | 0.261906039 | 2.7513E-10 | 0.0742907 |
| 17 | 0.65819009 | 0.267332655 | 1.4307E-11 | 0.07447726 |
| 18 | 0.653435869 | 0.274306034 | 5.1971E-13 | 0.0722581 |
| 19 | 0.649321834 | 0.282853327 | 1.3183E-14 | 0.06782484 |
| 20 | 0.645488633 | 0.292951657 | 2.3341E-16 | 0.06155971 |

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 21 | 0.64147908 | 0.304532122 | 2.8822E-18 | 0.0539888 |
| 22 | 0.636794084 | 0.317490007 | 2.4803E-20 | 0.04571591 |
| 23 | 0.63095341 | 0.331700358 | 1.4864E-22 | 0.03734623 |
| 24 | 0.623550673 | 0.347036525 | 6.1985E-25 | 0.0294128 |
| 25 | 0.614292342 | 0.36338793 | 1.7977E-27 | 0.02231973 |
| 26 | 0.60301429 | 0.380673059 | 3.6246E-30 | 0.01631265 |
| 27 | 0.589675549 | 0.39884484 | 5.0791E-33 | 0.01147961 |
| 28 | 0.574334957 | 0.417887716 | 4.9457E-36 | 0.00777733 |
| 29 | 0.557119823 | 0.437807948 | 3.3463E-39 | 0.00507223 |
| 30 | 0.538195651 | 0.458620082 | 1.5731E-42 | 0.00318427 |
| 31 | 0.517743085 | 0.480332775 | 5.1379E-46 | 0.00192414 |
| 32 | 0.495944458 | 0.50293651 | 1.1658E-49 | 0.00111903 |
| 33 | 0.472979087 | 0.526394627 | 1.8373E-53 | 0.00062629 |
| 34 | 0 | 1 | 0 | 0 |
| 35 | 0 | 1 | 0 | 0 |
| 36 | 0 | 1 | 0 | 0 |
| 37 | 0 | 1 | 0 | 0 |
| 38 | 0 | 1 | 0 | 0 |
| 39 | 0 | 1 | 0 | 0 |
| 40 | 0 | 1 | 0 | 0 |
| 41 | 0 | 1 | 0 | 0 |
| 42 | 0 | 1 | 0 | 0 |
| 43 | 0 | 1 | 0 | 0 |
| 44 | 0 | 1 | 0 | 0 |
| 45 | 0 | 1 | 0 | 0 |
| 46 | 0 | 1 | 0 | 0 |
| 47 | 0 | 1 | 0 | 0 |
| 48 | 0 | 1 | 0 | 0 |
| 49 | 0 | 1 | 0 | 0 |
| 50 | 0 | 1 | 0 | 0 |
| 51 | 0 | 1 | 0 | 0 |
| 52 | 0 | 1 | 0 | 0 |
| 53 | 0 | 1 | 0 | 0 |
| 54 | 0 | 1 | 0 | 0 |

Coefficients for transition from infection at home with NPWT, women from current practice hospitals

| | Transition to post-infection recovery | |
|-------------------------|---------------------------------------|----------------|
| | Coefficient | Standard error |
| Current practice | 1.921 | 1.072 |
| Time-constant intercept | 2.349 | 9.858 |

| | Transition to post-infection recovery | |
|--------------------------------|--|-----------------------|
| | Coefficient | Standard error |
| Linear time trend | -1.248 | 1.17 |
| Quadratic time trend | 0.059 | 0.038 |
| Hospital type (public/private) | -1.086 | 1.034 |
| BMI | -0.066 | 0.566 |
| NNIS index | 0.189 | 0.855 |

Transition probabilities for transition from infection at home with NPWT, women from current practice hospitals

| Cycle | Remain in infection at home with NPWT | Transition to post-infection recovery |
|--------------|--|--|
| 1 | 0.238667285 | 0.761332715 |
| 2 | 0.477764675 | 0.522235325 |
| 3 | 0.703495691 | 0.296504309 |
| 4 | 0.845404084 | 0.154595916 |
| 5 | 0.918039275 | 0.081960725 |
| 6 | 0.953247195 | 0.046752805 |
| 7 | 0.970573743 | 0.029426257 |
| 8 | 0.979346486 | 0.020653514 |
| 9 | 0.983761524 | 0.016238476 |
| 10 | 0.985670475 | 0.014329525 |
| 11 | 0.985797039 | 0.014202961 |
| 12 | 0.984187256 | 0.015812744 |
| 13 | 0.980237332 | 0.019762668 |
| 14 | 0.972320677 | 0.027679323 |
| 15 | 0.956727447 | 0.043272553 |
| 16 | 0.925186708 | 0.074813292 |
| 17 | 0.860085466 | 0.139914534 |
| 18 | 0.730861921 | 0.269138079 |
| 19 | 0.515994541 | 0.484005459 |
| 20 | 0.271109642 | 0.728890358 |
| 21 | 0.103400451 | 0.896599549 |
| 22 | 0.030798695 | 0.969201305 |
| 23 | 0.007721463 | 0.992278537 |
| 24 | 0.001690566 | 0.998309434 |
| 25 | 0.0003274 | 0.9996726 |
| 26 | 5.62865E-05 | 0.999943714 |
| 27 | 8.59776E-06 | 0.999991402 |
| 28 | 1.16709E-06 | 0.999998833 |
| 29 | 1.40789E-07 | 0.999999859 |
| 30 | 0 | 1 |
| 31 | 0 | 1 |

| Cycle | Remain in infection at home with NPWT | Transition to post-infection recovery |
|-------|---------------------------------------|---------------------------------------|
| 32 | 0 | 1 |
| 33 | 0 | 1 |
| 34 | 0 | 1 |
| 35 | 0 | 1 |
| 36 | 0 | 1 |
| 37 | 0 | 1 |
| 38 | 0 | 1 |
| 39 | 0 | 1 |
| 40 | 0 | 1 |
| 41 | 0 | 1 |
| 42 | 0 | 1 |
| 43 | 0 | 1 |
| 44 | 0 | 1 |
| 45 | 0 | 1 |
| 46 | 0 | 1 |
| 47 | 0 | 1 |
| 48 | 0 | 1 |
| 49 | 0 | 1 |
| 50 | 0 | 1 |
| 51 | 0 | 1 |
| 52 | 0 | 1 |
| 53 | 0 | 1 |
| 54 | 0 | 1 |

Coefficients for transition from infection at home with NPWT, women from better practice hospitals

| | Transition to post-infection recovery | |
|--------------------------------------|---------------------------------------|----------------|
| | Coefficient | Standard error |
| Time-constant intercept | 0.428 | 8.786 |
| Linear time trend | -1.248 | 1.17 |
| Quadratic time trend | 0.059 | 0.038 |
| Hospital behaviour (better practice) | 1.921 | 1.072 |
| Hospital type (public/private) | -1.086 | 1.034 |
| BMI | -0.066 | 0.566 |
| NNIS index | 0.189 | 0.855 |

Transition probabilities for transition from infection at home with NPWT, women from better practice hospitals

| Cycle | Remain in infection at home with NPWT | Transition to post-infection recovery |
|--------------|--|--|
| 1 | 0.681570805 | 0.318429195 |
| 2 | 0.861999811 | 0.138000189 |
| 3 | 0.941859849 | 0.058140151 |
| 4 | 0.973915925 | 0.026084075 |
| 5 | 0.987093071 | 0.012906929 |
| 6 | 0.992867957 | 0.007132043 |
| 7 | 0.995579182 | 0.004420818 |
| 8 | 0.996920795 | 0.003079205 |
| 9 | 0.997588279 | 0.002411721 |
| 10 | 0.997875305 | 0.002124695 |
| 11 | 0.997894301 | 0.002105699 |
| 12 | 0.997652373 | 0.002347627 |
| 13 | 0.997055889 | 0.002944111 |
| 14 | 0.995847981 | 0.004152019 |
| 15 | 0.993419223 | 0.006580777 |
| 16 | 0.988295403 | 0.011704597 |
| 17 | 0.976728971 | 0.023271029 |
| 18 | 0.948826299 | 0.051173701 |
| 19 | 0.879213157 | 0.120786843 |
| 20 | 0.717480866 | 0.282519134 |
| 21 | 0.4405328 | 0.5594672 |
| 22 | 0.178286498 | 0.821713502 |
| 23 | 0.050450261 | 0.949549739 |
| 24 | 0.011430203 | 0.988569797 |
| 25 | 0.00223116 | 0.99776884 |
| 26 | 0.000384186 | 0.999615814 |
| 27 | 5.87007E-05 | 0.999941299 |
| 28 | 7.96855E-06 | 0.999992031 |
| 29 | 9.61279E-07 | 0.999999039 |
| 30 | 0 | 1 |
| 31 | 0 | 1 |
| 32 | 0 | 1 |
| 33 | 0 | 1 |
| 34 | 0 | 1 |
| 35 | 0 | 1 |
| 36 | 0 | 1 |
| 37 | 0 | 1 |
| 38 | 0 | 1 |
| 39 | 0 | 1 |
| 40 | 0 | 1 |
| 41 | 0 | 1 |

| Cycle | Remain in infection at home with NPWT | Transition to post-infection recovery |
|--------------|--|--|
| 42 | 0 | 1 |
| 43 | 0 | 1 |
| 44 | 0 | 1 |
| 45 | 0 | 1 |
| 46 | 0 | 1 |
| 47 | 0 | 1 |
| 48 | 0 | 1 |
| 49 | 0 | 1 |
| 50 | 0 | 1 |
| 51 | 0 | 1 |
| 52 | 0 | 1 |
| 53 | 0 | 1 |
| 54 | 0 | 1 |

Probability of remaining in post-infection recovery, women from current and better practice hospitals

| Cycle | Expert's estimate | alpha | beta |
|-------|-------------------|-------|------|
| 1 | 0.75 | 3.35 | 2.85 |
| 2 | 0.75 | 3.35 | 2.85 |
| 3 | 0.75 | 3.35 | 2.85 |
| 4 | 0.75 | 3.35 | 2.85 |
| 5 | 0.75 | 3.35 | 2.85 |
| 6 | 0.75 | 3.35 | 2.85 |
| 7 | 0.75 | 3.35 | 2.85 |
| 8 | 0.66 | 1.01 | 4.46 |
| 9 | 0.66 | 1.01 | 4.46 |
| 10 | 0.66 | 1.01 | 4.46 |
| 11 | 0.66 | 1.01 | 4.46 |
| 12 | 0.66 | 1.01 | 4.46 |
| 13 | 0.66 | 1.01 | 4.46 |
| 14 | 0.66 | 1.01 | 4.46 |
| 15 | 0.5 | 2.27 | 6.61 |
| 16 | 0.5 | 2.27 | 6.61 |
| 17 | 0.5 | 2.27 | 6.61 |
| 18 | 0.5 | 2.27 | 6.61 |
| 19 | 0.5 | 2.27 | 6.61 |
| 20 | 0.5 | 2.27 | 6.61 |
| 21 | 0.5 | 2.27 | 6.61 |
| 22 | 0.4 | 1.89 | 8.2 |
| 23 | 0.4 | 1.89 | 8.2 |
| 24 | 0.4 | 1.89 | 8.2 |
| 25 | 0.4 | 1.89 | 8.2 |
| 26 | 0.4 | 1.89 | 8.2 |
| 27 | 0.4 | 1.89 | 8.2 |
| 28 | 0.4 | 1.89 | 8.2 |
| 29 | 0.3 | 1.68 | 10 |
| 30 | 0.3 | 1.68 | 10 |
| 31 | 0.3 | 1.68 | 10 |
| 32 | 0.3 | 1.68 | 10 |
| 33 | 0.3 | 1.68 | 10 |
| 34 | 0.3 | 1.68 | 10 |
| 35 | 0.3 | 1.68 | 10 |
| 36 | 0.25 | 1.4 | 10 |
| 37 | 0.25 | 1.4 | 10 |
| 38 | 0.25 | 1.4 | 10 |
| 39 | 0.25 | 1.4 | 10 |
| 40 | 0.25 | 1.4 | 10 |

| Cycle | Expert's estimate | alpha | beta |
|--------------|------------------------------|-------------------|-------------|
| 41 | 0.25 | 1.4 | 10 |
| 42 | 0.25 | 1.4 | 10 |
| 43 | 0.2 | 1.12 | 10 |
| 44 | 0.18 | 1.01 | 10 |
| 45 | 0.15 | 1.01 | 10 |
| 46 | 0.1 | 1.01 | 10 |
| 47 | 0.08 | 1.01 | 10 |
| 48 | 0.05 | 1.01 | 10 |
| 49 | 0.03 | 1.01 | 10 |
| 50 | 0.02 | 1.01 | 1.14 |
| 51 | 0.02 | 1.01 | 1.14 |
| 52 | 0.01 | 1.01 | 1.1 |
| 53 | 0.01 | 1.01 | 1.1 |
| 54 | 0 | Not probabilistic | |

Appendix K

Transition Probabilities: Emergency Caesarean Section Sub-Group

Transition probabilities for transition from caesarean section, women from current practice hospitals

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 1 | 0.970651 | 0.02853 | 0.000819 |
| 2 | 0.924083 | 0.075097 | 0.000821 |
| 3 | 0.84053 | 0.158699 | 0.000771 |
| 4 | 0.730164 | 0.269144 | 0.000691 |
| 5 | 0.62279 | 0.376601 | 0.000609 |
| 6 | 0.54508 | 0.45437 | 0.00055 |
| 7 | 0.508485 | 0.490985 | 0.00053 |
| 8 | 0.515215 | 0.484231 | 0.000554 |
| 9 | 0.565024 | 0.434348 | 0.000628 |
| 10 | 0.653816 | 0.345434 | 0.00075 |
| 11 | 0.765513 | 0.23358 | 0.000907 |
| 12 | 0.870095 | 0.128841 | 0.001064 |
| 13 | 0.941932 | 0.056878 | 0.001189 |
| 14 | 0.978478 | 0.020246 | 0.001276 |
| 15 | 0.992749 | 0.005915 | 0.001336 |
| 16 | 0.997176 | 0.001437 | 0.001386 |
| 17 | 0.998275 | 0.000293 | 0.001433 |
| 18 | 0.99847 | 5E-05 | 0.00148 |
| 19 | 0.998465 | 7.18E-06 | 0.001528 |
| 20 | 0.998422 | 8.66E-07 | 0.001577 |
| 21 | 0.998371 | 8.78E-08 | 0.001628 |
| 22 | 0.998319 | 7.47E-09 | 0.001681 |
| 23 | 0.998264 | 5.35E-10 | 0.001736 |
| 24 | 0.998208 | 3.22E-11 | 0.001792 |
| 25 | 0.99815 | 1.63E-12 | 0.00185 |
| 26 | 0.99809 | 6.91E-14 | 0.00191 |
| 27 | 0.998028 | 2.46E-15 | 0.001972 |
| 28 | 0.997964 | 7.39E-17 | 0.002036 |
| 29 | 0.997897 | 1.86E-18 | 0.002103 |
| 30 | 0 | 1 | 0 |
| 31 | 0 | 1 | 0 |
| 32 | 0 | 1 | 0 |
| 33 | 0 | 1 | 0 |
| 34 | 0 | 1 | 0 |
| 35 | 0 | 1 | 0 |
| 36 | 0 | 1 | 0 |
| 37 | 0 | 1 | 0 |
| 38 | 0 | 1 | 0 |
| 39 | 0 | 1 | 0 |

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from caesarean section, women from better practice hospitals

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 1 | 0.938604 | 0.05972 | 0.001676 |
| 2 | 0.84914 | 0.149382 | 0.001479 |
| 3 | 0.70904 | 0.2898 | 0.001159 |
| 4 | 0.555735 | 0.443444 | 0.000821 |
| 5 | 0.432843 | 0.566601 | 0.000557 |
| 6 | 0.356434 | 0.643182 | 0.000384 |
| 7 | 0.323508 | 0.676211 | 0.000281 |
| 8 | 0.329464 | 0.670314 | 0.000222 |
| 9 | 0.375291 | 0.624519 | 0.000189 |
| 10 | 0.466401 | 0.533429 | 0.000169 |
| 11 | 0.602128 | 0.397721 | 0.000151 |
| 12 | 0.757165 | 0.242708 | 0.000127 |
| 13 | 0.88431 | 0.115594 | 9.53E-05 |
| 14 | 0.957067 | 0.042869 | 6.37E-05 |
| 15 | 0.987228 | 0.012733 | 3.91E-05 |
| 16 | 0.996867 | 0.003111 | 2.26E-05 |
| 17 | 0.999353 | 0.000634 | 1.25E-05 |
| 18 | 0.999885 | 0.000108 | 6.65E-06 |
| 19 | 0.999981 | 1.56E-05 | 3.4E-06 |
| 20 | 0.999996 | 1.88E-06 | 1.67E-06 |
| 21 | 0.999999 | 1.9E-07 | 7.93E-07 |
| 22 | 1 | 1.62E-08 | 3.62E-07 |
| 23 | 1 | 1.16E-09 | 1.59E-07 |

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 24 | 1 | 6.98E-11 | 6.71E-08 |
| 25 | 1 | 3.53E-12 | 2.73E-08 |
| 26 | 1 | 1.5E-13 | 1.07E-08 |
| 27 | 1 | 5.34E-15 | 4.04E-09 |
| 28 | 1 | 1.6E-16 | 1.47E-09 |
| 29 | 1 | 4.04E-18 | 5.12E-10 |
| 30 | 0 | 1 | 0 |
| 31 | 0 | 1 | 0 |
| 32 | 0 | 1 | 0 |
| 33 | 0 | 1 | 0 |
| 34 | 0 | 1 | 0 |
| 35 | 0 | 1 | 0 |
| 36 | 0 | 1 | 0 |
| 37 | 0 | 1 | 0 |
| 38 | 0 | 1 | 0 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from normal recovery at home, women from current practice hospitals

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|--------------|--|--|--|
| 1 | 0.986658 | 0.010007 | 0.003336 |
| 2 | 0.988384 | 0.008712 | 0.002904 |
| 3 | 0.989888 | 0.007584 | 0.002528 |
| 4 | 0.991197 | 0.006602 | 0.002201 |
| 5 | 0.992337 | 0.005747 | 0.001916 |
| 6 | 0.99333 | 0.005002 | 0.001667 |
| 7 | 0.994194 | 0.004354 | 0.001451 |
| 8 | 0.994947 | 0.00379 | 0.001263 |
| 9 | 0.995602 | 0.003299 | 0.0011 |
| 10 | 0.996172 | 0.002871 | 0.000957 |
| 11 | 0.996668 | 0.002499 | 0.000833 |
| 12 | 0.9971 | 0.002175 | 0.000725 |
| 13 | 0.997477 | 0.001893 | 0.000631 |
| 14 | 0.997804 | 0.001647 | 0.000549 |
| 15 | 0.998089 | 0.001433 | 0.000478 |
| 16 | 0.998337 | 0.001248 | 0.000416 |
| 17 | 0.998552 | 0.001086 | 0.000362 |
| 18 | 0.99874 | 0.000945 | 0.000315 |
| 19 | 0.998904 | 0.000822 | 0.000274 |
| 20 | 0.999046 | 0.000716 | 0.000239 |
| 21 | 0.99917 | 0.000623 | 0.000208 |
| 22 | 0.999277 | 0.000542 | 0.000181 |
| 23 | 0.999371 | 0.000472 | 0.000157 |
| 24 | 0.999453 | 0.00041 | 0.000137 |
| 25 | 0.999524 | 0.000357 | 0.000119 |
| 26 | 0.999586 | 0.000311 | 0.000104 |
| 27 | 0.999639 | 0.00027 | 9.02E-05 |
| 28 | 0.999686 | 0.000235 | 7.85E-05 |
| 29 | 0.999727 | 0.000205 | 6.83E-05 |
| 30 | 1 | 0 | 0 |
| 31 | 1 | 0 | 0 |
| 32 | 1 | 0 | 0 |
| 33 | 1 | 0 | 0 |
| 34 | 1 | 0 | 0 |

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 35 | 1 | 0 | 0 |
| 36 | 1 | 0 | 0 |
| 37 | 1 | 0 | 0 |
| 38 | 1 | 0 | 0 |
| 39 | 1 | 0 | 0 |
| 40 | 1 | 0 | 0 |
| 41 | 1 | 0 | 0 |
| 42 | 1 | 0 | 0 |
| 43 | 1 | 0 | 0 |
| 44 | 1 | 0 | 0 |
| 45 | 1 | 0 | 0 |
| 46 | 1 | 0 | 0 |
| 47 | 1 | 0 | 0 |
| 48 | 1 | 0 | 0 |
| 49 | 1 | 0 | 0 |
| 50 | 1 | 0 | 0 |
| 51 | 1 | 0 | 0 |
| 52 | 1 | 0 | 0 |
| 53 | 1 | 0 | 0 |
| 54 | 1 | 0 | 0 |

Transition probabilities for transition from normal recovery at home, women from better practice hospitals

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 1 | 0.981318 | 0.014012 | 0.004671 |
| 2 | 0.983732 | 0.012201 | 0.004067 |
| 3 | 0.985836 | 0.010623 | 0.003541 |
| 4 | 0.987668 | 0.009249 | 0.003083 |
| 5 | 0.989264 | 0.008052 | 0.002684 |
| 6 | 0.990654 | 0.007009 | 0.002336 |
| 7 | 0.991865 | 0.006102 | 0.002034 |
| 8 | 0.992919 | 0.005311 | 0.00177 |
| 9 | 0.993836 | 0.004623 | 0.001541 |
| 10 | 0.994635 | 0.004024 | 0.001341 |
| 11 | 0.99533 | 0.003502 | 0.001167 |
| 12 | 0.995936 | 0.003048 | 0.001016 |
| 13 | 0.996463 | 0.002653 | 0.000884 |

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|--------------|--|--|--|
| 14 | 0.996921 | 0.002309 | 0.00077 |
| 15 | 0.997321 | 0.00201 | 0.00067 |
| 16 | 0.997668 | 0.001749 | 0.000583 |
| 17 | 0.997971 | 0.001522 | 0.000507 |
| 18 | 0.998234 | 0.001325 | 0.000442 |
| 19 | 0.998463 | 0.001153 | 0.000384 |
| 20 | 0.998662 | 0.001003 | 0.000334 |
| 21 | 0.998836 | 0.000873 | 0.000291 |
| 22 | 0.998987 | 0.00076 | 0.000253 |
| 23 | 0.999118 | 0.000661 | 0.00022 |
| 24 | 0.999233 | 0.000575 | 0.000192 |
| 25 | 0.999332 | 0.000501 | 0.000167 |
| 26 | 0.999419 | 0.000436 | 0.000145 |
| 27 | 0.999494 | 0.000379 | 0.000126 |
| 28 | 0.99956 | 0.00033 | 0.00011 |
| 29 | 0.999617 | 0.000287 | 9.57E-05 |
| 30 | 1 | 0 | 0 |
| 31 | 1 | 0 | 0 |
| 32 | 1 | 0 | 0 |
| 33 | 1 | 0 | 0 |
| 34 | 1 | 0 | 0 |
| 35 | 1 | 0 | 0 |
| 36 | 1 | 0 | 0 |
| 37 | 1 | 0 | 0 |
| 38 | 1 | 0 | 0 |
| 39 | 1 | 0 | 0 |
| 40 | 1 | 0 | 0 |
| 41 | 1 | 0 | 0 |
| 42 | 1 | 0 | 0 |
| 43 | 1 | 0 | 0 |
| 44 | 1 | 0 | 0 |
| 45 | 1 | 0 | 0 |
| 46 | 1 | 0 | 0 |
| 47 | 1 | 0 | 0 |
| 48 | 1 | 0 | 0 |
| 49 | 1 | 0 | 0 |
| 50 | 1 | 0 | 0 |
| 51 | 1 | 0 | 0 |
| 52 | 1 | 0 | 0 |
| 53 | 1 | 0 | 0 |
| 54 | 1 | 0 | 0 |

Transition probabilities for transition from infection at home, women from current practice hospitals

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|--------------|------------------------------------|--|--|
| 1 | 0.955688 | 0.041569 | 0.002743 |
| 2 | 0.946961 | 0.049659 | 0.00338 |
| 3 | 0.937122 | 0.058776 | 0.004102 |
| 4 | 0.926175 | 0.068922 | 0.004902 |
| 5 | 0.914159 | 0.080071 | 0.00577 |
| 6 | 0.901147 | 0.092165 | 0.006688 |
| 7 | 0.887251 | 0.105114 | 0.007635 |
| 8 | 0.872617 | 0.118797 | 0.008586 |
| 9 | 0.857422 | 0.133066 | 0.009512 |
| 10 | 0.841864 | 0.147752 | 0.010384 |
| 11 | 0.826161 | 0.162667 | 0.011172 |
| 12 | 0.810536 | 0.177614 | 0.01185 |
| 13 | 0.795215 | 0.192391 | 0.012394 |
| 14 | 0.780415 | 0.206798 | 0.012787 |
| 15 | 0.766341 | 0.220642 | 0.013017 |
| 16 | 0.75318 | 0.233742 | 0.013078 |
| 17 | 0.741098 | 0.24593 | 0.012972 |
| 18 | 0.73024 | 0.257055 | 0.012705 |
| 19 | 0.720728 | 0.266981 | 0.012291 |
| 20 | 0.712661 | 0.275592 | 0.011747 |
| 21 | 0.706118 | 0.282788 | 0.011094 |
| 22 | 0.701159 | 0.288487 | 0.010354 |
| 23 | 0.697826 | 0.292623 | 0.009551 |
| 24 | 0.696145 | 0.295147 | 0.008708 |
| 25 | 0.696127 | 0.296026 | 0.007847 |
| 26 | 0.697766 | 0.295243 | 0.00699 |
| 27 | 0.701046 | 0.2928 | 0.006155 |
| 28 | 0.705931 | 0.288713 | 0.005356 |
| 29 | 0.712374 | 0.28302 | 0.004605 |
| 30 | 0.720309 | 0.275778 | 0.003913 |
| 31 | 0.729653 | 0.267063 | 0.003284 |
| 32 | 0.740303 | 0.256974 | 0.002723 |
| 33 | 0.752139 | 0.245632 | 0.002229 |
| 34 | 0.765018 | 0.233181 | 0.001801 |
| 35 | 0.77878 | 0.219784 | 0.001437 |
| 36 | 0.793246 | 0.205624 | 0.001131 |
| 37 | 0.808222 | 0.1909 | 0.000878 |
| 38 | 0.823504 | 0.175824 | 0.000672 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|--------------|------------------------------------|--|--|
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from infection at home, women from better practice hospitals

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|--------------|------------------------------------|--|--|
| 1 | 0.958265 | 0.036069 | 0.005666 |
| 2 | 0.949909 | 0.043106 | 0.006985 |
| 3 | 0.940476 | 0.051044 | 0.00848 |
| 4 | 0.929973 | 0.059887 | 0.01014 |
| 5 | 0.918443 | 0.069615 | 0.011942 |
| 6 | 0.905967 | 0.080182 | 0.013851 |
| 7 | 0.89266 | 0.091515 | 0.015824 |
| 8 | 0.878675 | 0.103515 | 0.01781 |
| 9 | 0.864192 | 0.116058 | 0.01975 |
| 10 | 0.849413 | 0.129004 | 0.021583 |
| 11 | 0.834556 | 0.142195 | 0.023249 |
| 12 | 0.819845 | 0.155464 | 0.024692 |
| 13 | 0.805498 | 0.168639 | 0.025863 |
| 14 | 0.791728 | 0.181547 | 0.026724 |
| 15 | 0.778731 | 0.19402 | 0.027249 |
| 16 | 0.766681 | 0.205895 | 0.027424 |
| 17 | 0.755732 | 0.217019 | 0.02725 |
| 18 | 0.746014 | 0.227248 | 0.026738 |
| 19 | 0.737634 | 0.236452 | 0.025914 |
| 20 | 0.730675 | 0.244513 | 0.024812 |
| 21 | 0.725203 | 0.251326 | 0.023472 |
| 22 | 0.721259 | 0.2568 | 0.021941 |
| 23 | 0.718873 | 0.26086 | 0.020268 |

| Cycle | Remain in infection at home | Transition to post- infection recovery | Transition to infection in hospital |
|--------------|--|---|--|
| 24 | 0.718053 | 0.263444 | 0.018502 |
| 25 | 0.718798 | 0.26451 | 0.016692 |
| 26 | 0.721089 | 0.264029 | 0.014881 |
| 27 | 0.724895 | 0.261995 | 0.01311 |
| 28 | 0.730171 | 0.258418 | 0.011412 |
| 29 | 0.736857 | 0.25333 | 0.009813 |
| 30 | 0.744879 | 0.246785 | 0.008336 |
| 31 | 0.754145 | 0.238861 | 0.006993 |
| 32 | 0.76455 | 0.229657 | 0.005793 |
| 33 | 0.775969 | 0.219293 | 0.004737 |
| 34 | 0.788262 | 0.207915 | 0.003824 |
| 35 | 0.801271 | 0.195683 | 0.003045 |
| 36 | 0.814829 | 0.182779 | 0.002392 |
| 37 | 0.828753 | 0.169393 | 0.001854 |
| 38 | 0.842858 | 0.155726 | 0.001416 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from infection in hospital, women from current practice hospitals

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 1 | 0.780971 | 0.218392 | 4.86E-18 | 0.000637 |
| 2 | 0.78194 | 0.216921 | 2.98E-17 | 0.001139 |
| 3 | 0.781975 | 0.216064 | 1.42E-16 | 0.001961 |
| 4 | 0.780968 | 0.215786 | 5.25E-16 | 0.003246 |
| 5 | 0.77879 | 0.216047 | 1.51E-15 | 0.005163 |
| 6 | 0.7753 | 0.216806 | 3.39E-15 | 0.007893 |
| 7 | 0.770375 | 0.218029 | 5.91E-15 | 0.011596 |
| 8 | 0.763938 | 0.219695 | 7.99E-15 | 0.016367 |
| 9 | 0.756001 | 0.221805 | 8.41E-15 | 0.022194 |
| 10 | 0.746689 | 0.224394 | 6.87E-15 | 0.028917 |
| 11 | 0.73625 | 0.227539 | 4.37E-15 | 0.03621 |
| 12 | 0.725041 | 0.231361 | 2.16E-15 | 0.043598 |
| 13 | 0.713483 | 0.236019 | 8.31E-16 | 0.050498 |
| 14 | 0.702001 | 0.241698 | 2.49E-16 | 0.056301 |
| 15 | 0.690953 | 0.248595 | 5.81E-17 | 0.060452 |
| 16 | 0.680568 | 0.256898 | 1.06E-17 | 0.062534 |
| 17 | 0.670904 | 0.266768 | 1.5E-18 | 0.062328 |
| 18 | 0.661834 | 0.278319 | 1.66E-19 | 0.059847 |
| 19 | 0.653054 | 0.291609 | 1.43E-20 | 0.055337 |
| 20 | 0.644129 | 0.306633 | 9.56E-22 | 0.049238 |
| 21 | 0.634546 | 0.323327 | 4.99E-23 | 0.042127 |
| 22 | 0.623796 | 0.341578 | 2.02E-24 | 0.034626 |
| 23 | 0.611434 | 0.361247 | 6.36E-26 | 0.027319 |
| 24 | 0.59714 | 0.382185 | 1.55E-27 | 0.020675 |
| 25 | 0.58074 | 0.404259 | 2.94E-29 | 0.015 |
| 26 | 0.56221 | 0.427361 | 4.31E-31 | 0.01043 |
| 27 | 0.541647 | 0.451406 | 4.9E-33 | 0.006948 |
| 28 | 0.519236 | 0.476331 | 4.32E-35 | 0.004433 |
| 29 | 0.495216 | 0.502074 | 2.95E-37 | 0.00271 |
| 30 | 0.469849 | 0.528565 | 1.56E-39 | 0.001586 |
| 31 | 0.443406 | 0.555705 | 6.41E-42 | 0.000889 |
| 32 | 0.416157 | 0.583366 | 2.03E-44 | 0.000477 |
| 33 | 0.388374 | 0.611381 | 5E-47 | 0.000245 |
| 34 | 0 | 1 | 0 | 0 |
| 35 | 0 | 1 | 0 | 0 |
| 36 | 0 | 1 | 0 | 0 |
| 37 | 0 | 1 | 0 | 0 |
| 38 | 0 | 1 | 0 | 0 |
| 39 | 0 | 1 | 0 | 0 |
| 40 | 0 | 1 | 0 | 0 |

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 41 | 0 | 1 | 0 | 0 |
| 42 | 0 | 1 | 0 | 0 |
| 43 | 0 | 1 | 0 | 0 |
| 44 | 0 | 1 | 0 | 0 |
| 45 | 0 | 1 | 0 | 0 |
| 46 | 0 | 1 | 0 | 0 |
| 47 | 0 | 1 | 0 | 0 |
| 48 | 0 | 1 | 0 | 0 |
| 49 | 0 | 1 | 0 | 0 |
| 50 | 0 | 1 | 0 | 0 |
| 51 | 0 | 1 | 0 | 0 |
| 52 | 0 | 1 | 0 | 0 |
| 53 | 0 | 1 | 0 | 0 |
| 54 | 0 | 1 | 0 | 0 |

Transition probabilities for transition from infection in hospital, women from better practice hospitals

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 1 | 0.784518 | 0.214188 | 5.69E-18 | 0.001294 |
| 2 | 0.785058 | 0.212627 | 3.48E-17 | 0.002315 |
| 3 | 0.784414 | 0.211605 | 1.66E-16 | 0.003981 |
| 4 | 0.782368 | 0.211053 | 6.13E-16 | 0.006579 |
| 5 | 0.77866 | 0.210894 | 1.76E-15 | 0.010445 |
| 6 | 0.773025 | 0.21105 | 3.94E-15 | 0.015925 |
| 7 | 0.765245 | 0.211448 | 6.84E-15 | 0.023308 |
| 8 | 0.755217 | 0.212043 | 9.21E-15 | 0.03274 |
| 9 | 0.743027 | 0.212835 | 9.63E-15 | 0.044138 |
| 10 | 0.728989 | 0.213886 | 7.82E-15 | 0.057125 |
| 11 | 0.713649 | 0.21533 | 4.94E-15 | 0.071021 |
| 12 | 0.697731 | 0.217373 | 2.42E-15 | 0.084895 |
| 13 | 0.682046 | 0.220276 | 9.26E-16 | 0.097679 |
| 14 | 0.667367 | 0.224331 | 2.76E-16 | 0.108302 |
| 15 | 0.654323 | 0.22984 | 6.42E-17 | 0.115837 |
| 16 | 0.64331 | 0.237083 | 1.17E-17 | 0.119607 |
| 17 | 0.634442 | 0.246295 | 1.65E-18 | 0.119263 |
| 18 | 0.627534 | 0.257644 | 1.83E-19 | 0.114822 |
| 19 | 0.622118 | 0.271215 | 1.58E-20 | 0.106667 |
| 20 | 0.617496 | 0.286992 | 1.07E-21 | 0.095513 |
| 21 | 0.612818 | 0.304859 | 5.61E-23 | 0.082323 |

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|--------------|--|--|---|--|
| 22 | 0.607191 | 0.32461 | 2.29E-24 | 0.068199 |
| 23 | 0.599796 | 0.345977 | 7.26E-26 | 0.054227 |
| 24 | 0.589996 | 0.368669 | 1.79E-27 | 0.041335 |
| 25 | 0.577404 | 0.392417 | 3.4E-29 | 0.030178 |
| 26 | 0.5619 | 0.417008 | 5.02E-31 | 0.021092 |
| 27 | 0.543593 | 0.442298 | 5.74E-33 | 0.014109 |
| 28 | 0.522762 | 0.468206 | 5.07E-35 | 0.009031 |
| 29 | 0.499774 | 0.494693 | 3.47E-37 | 0.005533 |
| 30 | 0.475025 | 0.52173 | 1.84E-39 | 0.003244 |
| 31 | 0.448906 | 0.549273 | 7.56E-42 | 0.001821 |
| 32 | 0.421779 | 0.577243 | 2.4E-44 | 0.000978 |
| 33 | 0.39398 | 0.605517 | 5.91E-47 | 0.000503 |
| 34 | 0 | 1 | 0 | 0 |
| 35 | 0 | 1 | 0 | 0 |
| 36 | 0 | 1 | 0 | 0 |
| 37 | 0 | 1 | 0 | 0 |
| 38 | 0 | 1 | 0 | 0 |
| 39 | 0 | 1 | 0 | 0 |
| 40 | 0 | 1 | 0 | 0 |
| 41 | 0 | 1 | 0 | 0 |
| 42 | 0 | 1 | 0 | 0 |
| 43 | 0 | 1 | 0 | 0 |
| 44 | 0 | 1 | 0 | 0 |
| 45 | 0 | 1 | 0 | 0 |
| 46 | 0 | 1 | 0 | 0 |
| 47 | 0 | 1 | 0 | 0 |
| 48 | 0 | 1 | 0 | 0 |
| 49 | 0 | 1 | 0 | 0 |
| 50 | 0 | 1 | 0 | 0 |
| 51 | 0 | 1 | 0 | 0 |
| 52 | 0 | 1 | 0 | 0 |
| 53 | 0 | 1 | 0 | 0 |
| 54 | 0 | 1 | 0 | 0 |

Transition probabilities for transition from infection at home with NPWT, women from current practice hospitals

| Cycle | Remain in infection at home with NPWT | Transition to post-infection recovery |
|-------|---------------------------------------|---------------------------------------|
| 1 | 0.238667 | 0.761333 |
| 2 | 0.477765 | 0.522235 |
| 3 | 0.703496 | 0.296504 |
| 4 | 0.845404 | 0.154596 |
| 5 | 0.918039 | 0.081961 |
| 6 | 0.953247 | 0.046753 |
| 7 | 0.970574 | 0.029426 |
| 8 | 0.979346 | 0.020654 |
| 9 | 0.983762 | 0.016238 |
| 10 | 0.98567 | 0.01433 |
| 11 | 0.985797 | 0.014203 |
| 12 | 0.984187 | 0.015813 |
| 13 | 0.980237 | 0.019763 |
| 14 | 0.972321 | 0.027679 |
| 15 | 0.956727 | 0.043273 |
| 16 | 0.925187 | 0.074813 |
| 17 | 0.860085 | 0.139915 |
| 18 | 0.730862 | 0.269138 |
| 19 | 0.515995 | 0.484005 |
| 20 | 0.27111 | 0.72889 |
| 21 | 0.1034 | 0.8966 |
| 22 | 0.030799 | 0.969201 |
| 23 | 0.007721 | 0.992279 |
| 24 | 0.001691 | 0.998309 |
| 25 | 0.000327 | 0.999673 |
| 26 | 5.63E-05 | 0.999944 |
| 27 | 8.6E-06 | 0.999991 |
| 28 | 1.17E-06 | 0.999999 |
| 29 | 1.41E-07 | 1 |
| 30 | 0 | 1 |
| 31 | 0 | 1 |
| 32 | 0 | 1 |
| 33 | 0 | 1 |
| 34 | 0 | 1 |
| 35 | 0 | 1 |
| 36 | 0 | 1 |
| 37 | 0 | 1 |
| 38 | 0 | 1 |
| 39 | 0 | 1 |
| 40 | 0 | 1 |

| Cycle | Remain in infection at home with NPWT | Transition to post- infection recovery |
|--------------|--|---|
| 41 | 0 | 1 |
| 42 | 0 | 1 |
| 43 | 0 | 1 |
| 44 | 0 | 1 |
| 45 | 0 | 1 |
| 46 | 0 | 1 |
| 47 | 0 | 1 |
| 48 | 0 | 1 |
| 49 | 0 | 1 |
| 50 | 0 | 1 |
| 51 | 0 | 1 |
| 52 | 0 | 1 |
| 53 | 0 | 1 |
| 54 | 0 | 1 |

Transition probabilities for transition from infection at home with NPWT, women from better practice hospitals

| Cycle | Remain in infection at home with NPWT | Transition to post- infection recovery |
|--------------|--|---|
| 1 | 0.681571 | 0.318429 |
| 2 | 0.862 | 0.138 |
| 3 | 0.94186 | 0.05814 |
| 4 | 0.973916 | 0.026084 |
| 5 | 0.987093 | 0.012907 |
| 6 | 0.992868 | 0.007132 |
| 7 | 0.995579 | 0.004421 |
| 8 | 0.996921 | 0.003079 |
| 9 | 0.997588 | 0.002412 |
| 10 | 0.997875 | 0.002125 |
| 11 | 0.997894 | 0.002106 |
| 12 | 0.997652 | 0.002348 |
| 13 | 0.997056 | 0.002944 |
| 14 | 0.995848 | 0.004152 |
| 15 | 0.993419 | 0.006581 |
| 16 | 0.988295 | 0.011705 |
| 17 | 0.976729 | 0.023271 |
| 18 | 0.948826 | 0.051174 |
| 19 | 0.879213 | 0.120787 |
| 20 | 0.717481 | 0.282519 |
| 21 | 0.440533 | 0.559467 |

| Cycle | Remain in infection at home with NPWT | Transition to post- infection recovery |
|--------------|--|---|
| 22 | 0.178286 | 0.821714 |
| 23 | 0.05045 | 0.94955 |
| 24 | 0.01143 | 0.98857 |
| 25 | 0.002231 | 0.997769 |
| 26 | 0.000384 | 0.999616 |
| 27 | 5.87E-05 | 0.999941 |
| 28 | 7.97E-06 | 0.999992 |
| 29 | 9.61E-07 | 0.999999 |
| 30 | 0 | 1 |
| 31 | 0 | 1 |
| 32 | 0 | 1 |
| 33 | 0 | 1 |
| 34 | 0 | 1 |
| 35 | 0 | 1 |
| 36 | 0 | 1 |
| 37 | 0 | 1 |
| 38 | 0 | 1 |
| 39 | 0 | 1 |
| 40 | 0 | 1 |
| 41 | 0 | 1 |
| 42 | 0 | 1 |
| 43 | 0 | 1 |
| 44 | 0 | 1 |
| 45 | 0 | 1 |
| 46 | 0 | 1 |
| 47 | 0 | 1 |
| 48 | 0 | 1 |
| 49 | 0 | 1 |
| 50 | 0 | 1 |
| 51 | 0 | 1 |
| 52 | 0 | 1 |
| 53 | 0 | 1 |
| 54 | 0 | 1 |

Appendix L

Transition Probabilities: Elective Caesarean Section Sub-Group

Transition probabilities for transition from caesarean section, women from current practice hospitals

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 1 | 0.909319 | 0.090185 | 0.000496 |
| 2 | 0.808812 | 0.190705 | 0.000483 |
| 3 | 0.673814 | 0.325746 | 0.00044 |
| 4 | 0.538921 | 0.460693 | 0.000385 |
| 5 | 0.433948 | 0.565713 | 0.00034 |
| 6 | 0.368266 | 0.631419 | 0.000315 |
| 7 | 0.339473 | 0.660209 | 0.000318 |
| 8 | 0.34441 | 0.655237 | 0.000353 |
| 9 | 0.383703 | 0.615867 | 0.00043 |
| 10 | 0.461026 | 0.538408 | 0.000566 |
| 11 | 0.576643 | 0.422583 | 0.000774 |
| 12 | 0.715274 | 0.283675 | 0.001051 |
| 13 | 0.842665 | 0.155981 | 0.001355 |
| 14 | 0.929137 | 0.069229 | 0.001634 |
| 15 | 0.972961 | 0.025166 | 0.001873 |
| 16 | 0.990246 | 0.007668 | 0.002085 |
| 17 | 0.995715 | 0.001991 | 0.002294 |
| 18 | 0.997042 | 0.000444 | 0.002514 |
| 19 | 0.997164 | 8.53E-05 | 0.002751 |
| 20 | 0.996977 | 1.41E-05 | 0.003009 |
| 21 | 0.996706 | 2.02E-06 | 0.003292 |
| 22 | 0.996399 | 2.48E-07 | 0.003601 |
| 23 | 0.996062 | 2.64E-08 | 0.003938 |
| 24 | 0.995692 | 2.42E-09 | 0.004308 |
| 25 | 0.995289 | 1.91E-10 | 0.004711 |
| 26 | 0.994847 | 1.3E-11 | 0.005153 |
| 27 | 0.994365 | 7.64E-13 | 0.005635 |
| 28 | 0.993837 | 3.87E-14 | 0.006163 |
| 29 | 0.993261 | 1.69E-15 | 0.006739 |
| 30 | 0 | 1 | 0 |
| 31 | 0 | 1 | 0 |
| 32 | 0 | 1 | 0 |
| 33 | 0 | 1 | 0 |
| 34 | 0 | 1 | 0 |
| 35 | 0 | 1 | 0 |
| 36 | 0 | 1 | 0 |
| 37 | 0 | 1 | 0 |

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 38 | 0 | 1 | 0 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from caesarean section, women from better practice hospitals

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 1 | 0.911856 | 0.086691 | 0.001453 |
| 2 | 0.814489 | 0.184091 | 0.00142 |
| 3 | 0.682443 | 0.316255 | 0.001302 |
| 4 | 0.548989 | 0.449865 | 0.001146 |
| 5 | 0.444061 | 0.554925 | 0.001014 |
| 6 | 0.377919 | 0.621136 | 0.000945 |
| 7 | 0.348796 | 0.65025 | 0.000954 |
| 8 | 0.35377 | 0.645172 | 0.001059 |
| 9 | 0.393411 | 0.605301 | 0.001288 |
| 10 | 0.471016 | 0.527297 | 0.001687 |
| 11 | 0.586027 | 0.411676 | 0.002297 |
| 12 | 0.722302 | 0.2746 | 0.003098 |
| 13 | 0.84593 | 0.150101 | 0.00397 |
| 14 | 0.928886 | 0.066344 | 0.004769 |
| 15 | 0.970485 | 0.024063 | 0.005452 |
| 16 | 0.986611 | 0.007324 | 0.006065 |
| 17 | 0.991431 | 0.0019 | 0.006668 |
| 18 | 0.992274 | 0.000424 | 0.007303 |
| 19 | 0.991931 | 8.13E-05 | 0.007988 |

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 20 | 0.991253 | 1.35E-05 | 0.008734 |
| 21 | 0.99045 | 1.92E-06 | 0.009549 |
| 22 | 0.989561 | 2.36E-07 | 0.010438 |
| 23 | 0.98859 | 2.51E-08 | 0.01141 |
| 24 | 0.987529 | 2.3E-09 | 0.012471 |
| 25 | 0.98637 | 1.81E-10 | 0.01363 |
| 26 | 0.985106 | 1.23E-11 | 0.014894 |
| 27 | 0.983726 | 7.24E-13 | 0.016274 |
| 28 | 0.98222 | 3.67E-14 | 0.01778 |
| 29 | 0.980579 | 1.6E-15 | 0.019421 |
| 30 | 0 | 1 | 0 |
| 31 | 0 | 1 | 0 |
| 32 | 0 | 1 | 0 |
| 33 | 0 | 1 | 0 |
| 34 | 0 | 1 | 0 |
| 35 | 0 | 1 | 0 |
| 36 | 0 | 1 | 0 |
| 37 | 0 | 1 | 0 |
| 38 | 0 | 1 | 0 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from normal recovery at home, women from current practice hospitals

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 1 | 0.991885961 | 0.006085529 | 0.00202851 |
| 2 | 0.992801842 | 0.005398619 | 0.00179954 |
| 3 | 0.993614507 | 0.00478912 | 0.001596373 |
| 4 | 0.994335553 | 0.004248335 | 0.001416112 |
| 5 | 0.994975282 | 0.003768539 | 0.00125618 |
| 6 | 0.995542842 | 0.003342869 | 0.00111429 |
| 7 | 0.996046357 | 0.002965232 | 0.000988411 |
| 8 | 0.996493041 | 0.002630219 | 0.00087674 |
| 9 | 0.996889298 | 0.002333026 | 0.000777675 |
| 10 | 0.997240812 | 0.002069391 | 0.000689797 |
| 11 | 0.997552629 | 0.001835528 | 0.000611843 |
| 12 | 0.997829227 | 0.00162808 | 0.000542693 |
| 13 | 0.998074579 | 0.001444066 | 0.000481355 |
| 14 | 0.998292211 | 0.001280841 | 0.000426947 |
| 15 | 0.998485254 | 0.001136059 | 0.000378686 |
| 16 | 0.998656484 | 0.001007637 | 0.000335879 |
| 17 | 0.998808363 | 0.000893728 | 0.000297909 |
| 18 | 0.998943077 | 0.000792692 | 0.000264231 |
| 19 | 0.999062565 | 0.000703076 | 0.000234359 |
| 20 | 0.999168548 | 0.000623589 | 0.000207863 |
| 21 | 0.999262551 | 0.000553087 | 0.000184362 |
| 22 | 0.999345928 | 0.000490554 | 0.000163518 |
| 23 | 0.999419879 | 0.000435091 | 0.00014503 |
| 24 | 0.99948547 | 0.000385897 | 0.000128632 |
| 25 | 0.999543647 | 0.000342265 | 0.000114088 |
| 26 | 0.999595246 | 0.000303566 | 0.000101189 |
| 27 | 0.999641011 | 0.000269242 | 8.97473E-05 |
| 28 | 0.999681602 | 0.000238798 | 7.95995E-05 |
| 29 | 0.999717604 | 0.000211797 | 7.0599E-05 |
| 30 | 1 | 0 | 0 |
| 31 | 1 | 0 | 0 |
| 32 | 1 | 0 | 0 |
| 33 | 1 | 0 | 0 |
| 34 | 1 | 0 | 0 |
| 35 | 1 | 0 | 0 |
| 36 | 1 | 0 | 0 |
| 37 | 1 | 0 | 0 |
| 38 | 1 | 0 | 0 |
| 39 | 1 | 0 | 0 |
| 40 | 1 | 0 | 0 |

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 41 | 1 | 0 | 0 |
| 42 | 1 | 0 | 0 |
| 43 | 1 | 0 | 0 |
| 44 | 1 | 0 | 0 |
| 45 | 1 | 0 | 0 |
| 46 | 1 | 0 | 0 |
| 47 | 1 | 0 | 0 |
| 48 | 1 | 0 | 0 |
| 49 | 1 | 0 | 0 |
| 50 | 1 | 0 | 0 |
| 51 | 1 | 0 | 0 |
| 52 | 1 | 0 | 0 |
| 53 | 1 | 0 | 0 |
| 54 | 1 | 0 | 0 |

Transition probabilities for transition from normal recovery at home, women from better practice hospitals

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 1 | 0.986220705 | 0.010334471 | 0.003444824 |
| 2 | 0.9877741 | 0.009169425 | 0.003056475 |
| 3 | 0.98915285 | 0.008135362 | 0.002711787 |
| 4 | 0.99037649 | 0.007217633 | 0.002405878 |
| 5 | 0.99146239 | 0.006403208 | 0.002134403 |
| 6 | 0.992425991 | 0.005680507 | 0.001893502 |
| 7 | 0.993281018 | 0.005039237 | 0.001679746 |
| 8 | 0.994039665 | 0.004470251 | 0.001490084 |
| 9 | 0.994712766 | 0.003965425 | 0.001321808 |
| 10 | 0.995309943 | 0.003517542 | 0.001172514 |
| 11 | 0.995839741 | 0.003120194 | 0.001040065 |
| 12 | 0.996309748 | 0.002767689 | 0.000922563 |
| 13 | 0.996726698 | 0.002454976 | 0.000818325 |
| 14 | 0.997096573 | 0.00217757 | 0.000725857 |
| 15 | 0.99742468 | 0.00193149 | 0.00064383 |
| 16 | 0.99771573 | 0.001713203 | 0.000571068 |
| 17 | 0.997973903 | 0.001519573 | 0.000506524 |
| 18 | 0.99820291 | 0.001347817 | 0.000449272 |
| 19 | 0.998406044 | 0.001195467 | 0.000398489 |
| 20 | 0.998586224 | 0.001060332 | 0.000353444 |
| 21 | 0.998746043 | 0.000940468 | 0.000313489 |

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|--------------|--|--|--|
| 22 | 0.9988878 | 0.00083415 | 0.00027805 |
| 23 | 0.999013536 | 0.000739848 | 0.000246616 |
| 24 | 0.999125061 | 0.000656204 | 0.000218735 |
| 25 | 0.999223979 | 0.000582015 | 0.000194005 |
| 26 | 0.999311716 | 0.000516213 | 0.000172071 |
| 27 | 0.999389535 | 0.000457849 | 0.000152616 |
| 28 | 0.999458557 | 0.000406082 | 0.000135361 |
| 29 | 0.999519776 | 0.000360168 | 0.000120056 |
| 30 | 1 | 0 | 0 |
| 31 | 1 | 0 | 0 |
| 32 | 1 | 0 | 0 |
| 33 | 1 | 0 | 0 |
| 34 | 1 | 0 | 0 |
| 35 | 1 | 0 | 0 |
| 36 | 1 | 0 | 0 |
| 37 | 1 | 0 | 0 |
| 38 | 1 | 0 | 0 |
| 39 | 1 | 0 | 0 |
| 40 | 1 | 0 | 0 |
| 41 | 1 | 0 | 0 |
| 42 | 1 | 0 | 0 |
| 43 | 1 | 0 | 0 |
| 44 | 1 | 0 | 0 |
| 45 | 1 | 0 | 0 |
| 46 | 1 | 0 | 0 |
| 47 | 1 | 0 | 0 |
| 48 | 1 | 0 | 0 |
| 49 | 1 | 0 | 0 |
| 50 | 1 | 0 | 0 |
| 51 | 1 | 0 | 0 |
| 52 | 1 | 0 | 0 |
| 53 | 1 | 0 | 0 |
| 54 | 1 | 0 | 0 |

Transition probabilities for transition from infection at home, women from current practice hospitals

| Cycle | Remain in infection at home | Transition to post- infection recovery | Transition to infection in hospital |
|--------------|--|---|--|
| 1 | 0.714029 | 0.023845 | 0.262126 |
| 2 | 0.770096 | 0.030483 | 0.199421 |
| 3 | 0.811768 | 0.037859 | 0.150372 |
| 4 | 0.841044 | 0.045939 | 0.113018 |
| 5 | 0.860257 | 0.054702 | 0.085041 |
| 6 | 0.871587 | 0.064135 | 0.064278 |
| 7 | 0.876859 | 0.074218 | 0.048923 |
| 8 | 0.877514 | 0.084924 | 0.037562 |
| 9 | 0.874663 | 0.096207 | 0.029129 |
| 10 | 0.869156 | 0.108006 | 0.022838 |
| 11 | 0.861643 | 0.120242 | 0.018115 |
| 12 | 0.852635 | 0.13282 | 0.014545 |
| 13 | 0.842541 | 0.145633 | 0.011826 |
| 14 | 0.831698 | 0.158561 | 0.009741 |
| 15 | 0.820392 | 0.171477 | 0.008131 |
| 16 | 0.808869 | 0.184252 | 0.006879 |
| 17 | 0.797345 | 0.196754 | 0.005901 |
| 18 | 0.786011 | 0.208855 | 0.005134 |
| 19 | 0.775039 | 0.22043 | 0.00453 |
| 20 | 0.76458 | 0.231364 | 0.004056 |
| 21 | 0.754765 | 0.241549 | 0.003685 |
| 22 | 0.745713 | 0.250888 | 0.003398 |
| 23 | 0.737524 | 0.259295 | 0.003181 |
| 24 | 0.730283 | 0.266693 | 0.003023 |
| 25 | 0.724062 | 0.27302 | 0.002918 |
| 26 | 0.718919 | 0.278221 | 0.00286 |
| 27 | 0.714899 | 0.282254 | 0.002846 |
| 28 | 0.712035 | 0.285087 | 0.002878 |
| 29 | 0.710348 | 0.286696 | 0.002955 |
| 30 | 0.709849 | 0.287068 | 0.003083 |
| 31 | 0.710535 | 0.286198 | 0.003267 |
| 32 | 0.712392 | 0.284091 | 0.003517 |
| 33 | 0.715395 | 0.28076 | 0.003845 |
| 34 | 0.719503 | 0.276228 | 0.004269 |
| 35 | 0.724659 | 0.270526 | 0.004814 |
| 36 | 0.730792 | 0.263696 | 0.005513 |
| 37 | 0.737805 | 0.255787 | 0.006408 |
| 38 | 0.745577 | 0.246861 | 0.007561 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from infection at home, women from current practice hospitals

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 1 | 0.639803236 | 0.027620838 | 0.332575927 |
| 2 | 0.705297809 | 0.03609051 | 0.258611682 |
| 3 | 0.756096168 | 0.045584984 | 0.198318847 |
| 4 | 0.793094949 | 0.056000059 | 0.150904992 |
| 5 | 0.818212992 | 0.067257766 | 0.114529243 |
| 6 | 0.833648178 | 0.079298663 | 0.08705316 |
| 7 | 0.84145474 | 0.092069344 | 0.066475917 |
| 8 | 0.843371821 | 0.105511266 | 0.051116913 |
| 9 | 0.84079808 | 0.119553185 | 0.039648735 |
| 10 | 0.83483213 | 0.134107332 | 0.031060539 |
| 11 | 0.826332386 | 0.149068644 | 0.024598971 |
| 12 | 0.815974462 | 0.164316239 | 0.019709299 |
| 13 | 0.8042982 | 0.179716372 | 0.015985429 |
| 14 | 0.791743151 | 0.19512626 | 0.013130589 |
| 15 | 0.778674028 | 0.210398281 | 0.010927691 |
| 16 | 0.76539836 | 0.225384139 | 0.009217501 |
| 17 | 0.752178514 | 0.239938702 | 0.007882784 |
| 18 | 0.73923984 | 0.25392329 | 0.006836869 |
| 19 | 0.726776281 | 0.267208299 | 0.00601542 |
| 20 | 0.714954381 | 0.279675091 | 0.005370528 |
| 21 | 0.703916353 | 0.291217186 | 0.004866461 |
| 22 | 0.693782575 | 0.301740815 | 0.00447661 |
| 23 | 0.68465378 | 0.311164926 | 0.004181294 |

| Cycle | Remain in infection at home | Transition to post- infection recovery | Transition to infection in hospital |
|--------------|--|---|--|
| 24 | 0.676613023 | 0.319420783 | 0.003966194 |
| 25 | 0.669727479 | 0.326451268 | 0.003821253 |
| 26 | 0.664050063 | 0.332210014 | 0.003739923 |
| 27 | 0.659620821 | 0.336660484 | 0.003718694 |
| 28 | 0.656468071 | 0.339775076 | 0.003756853 |
| 29 | 0.654609213 | 0.341534342 | 0.003856446 |
| 30 | 0.654051179 | 0.341926364 | 0.004022458 |
| 31 | 0.654790459 | 0.34094633 | 0.004263212 |
| 32 | 0.656812641 | 0.338596321 | 0.004591039 |
| 33 | 0.660091399 | 0.334885308 | 0.005023294 |
| 34 | 0.664586844 | 0.329829337 | 0.00558382 |
| 35 | 0.670243108 | 0.32345186 | 0.006305032 |
| 36 | 0.676984999 | 0.315784151 | 0.00723085 |
| 37 | 0.684713459 | 0.306865715 | 0.008420826 |
| 38 | 0.693299461 | 0.296744598 | 0.009955942 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from infection in hospital, women from current practice hospitals

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 1 | 0.725318774 | 0.274681226 | 1.05412E-10 | 0 |
| 2 | 0.73145162 | 0.268548379 | 1.23435E-09 | 0 |
| 3 | 0.736721972 | 0.263278018 | 1.00716E-08 | 0 |
| 4 | 0.741158727 | 0.258841216 | 5.7267E-08 | 0 |
| 5 | 0.744786873 | 0.2552129 | 2.26923E-07 | 0 |
| 6 | 0.747627279 | 0.252372094 | 6.26667E-07 | 0 |
| 7 | 0.74969667 | 0.250302124 | 1.20614E-06 | 0 |
| 8 | 0.751007619 | 0.248990763 | 1.61797E-06 | 0 |
| 9 | 0.751568259 | 0.248430228 | 1.51273E-06 | 0 |
| 10 | 0.751381895 | 0.248617119 | 9.85772E-07 | 0 |
| 11 | 0.750447093 | 0.24955246 | 4.47725E-07 | 0 |
| 12 | 0.748758041 | 0.251241817 | 1.4173E-07 | 0 |
| 13 | 0.746304673 | 0.253695296 | 3.12695E-08 | 0 |
| 14 | 0.743072559 | 0.256927436 | 4.80811E-09 | 0 |
| 15 | 0.73904291 | 0.260957089 | 5.15234E-10 | 0 |
| 16 | 0.734192716 | 0.265807284 | 3.84761E-11 | 0 |
| 17 | 0.728494959 | 0.271505041 | 2.0022E-12 | 0 |
| 18 | 0.721918898 | 0.278081102 | 7.25977E-14 | 0 |
| 19 | 0.714430441 | 0.285569559 | 1.83401E-15 | 0 |
| 20 | 0.705992638 | 0.294007362 | 3.22778E-17 | 0 |
| 21 | 0.696566333 | 0.303433667 | 3.95715E-19 | 0 |
| 22 | 0.686111 | 0.313889 | 3.37897E-21 | 0 |
| 23 | 0.674585791 | 0.325414209 | 2.00933E-23 | 0 |
| 24 | 0.661950848 | 0.338049152 | 8.31989E-26 | 0 |
| 25 | 0.648168882 | 0.351831118 | 2.39834E-28 | 0 |
| 26 | 0.633207063 | 0.366792937 | 4.81232E-31 | 0 |
| 27 | 0.617039219 | 0.382960781 | 6.71988E-34 | 0 |
| 28 | 0.599648323 | 0.400351677 | 6.52889E-37 | 0 |
| 29 | 0.581029252 | 0.418970748 | 4.41254E-40 | 0 |
| 30 | 0.561191721 | 0.438808279 | 2.07397E-43 | 0 |
| 31 | 0.540163281 | 0.459836719 | 6.77755E-47 | 0 |
| 32 | 0.517992228 | 0.482007772 | 1.5395E-50 | 0 |
| 33 | 0.494750193 | 0.505249807 | 2.43E-54 | 0 |
| 34 | 0 | 1 | 0 | 0 |
| 35 | 0 | 1 | 0 | 0 |
| 36 | 0 | 1 | 0 | 0 |
| 37 | 0 | 1 | 0 | 0 |
| 38 | 0 | 1 | 0 | 0 |

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 39 | 0 | 1 | 0 | 0 |
| 40 | 0 | 1 | 0 | 0 |
| 41 | 0 | 1 | 0 | 0 |
| 42 | 0 | 1 | 0 | 0 |
| 43 | 0 | 1 | 0 | 0 |
| 44 | 0 | 1 | 0 | 0 |
| 45 | 0 | 1 | 0 | 0 |
| 46 | 0 | 1 | 0 | 0 |
| 47 | 0 | 1 | 0 | 0 |
| 48 | 0 | 1 | 0 | 0 |
| 49 | 0 | 1 | 0 | 0 |
| 50 | 0 | 1 | 0 | 0 |
| 51 | 0 | 1 | 0 | 0 |
| 52 | 0 | 1 | 0 | 0 |
| 53 | 0 | 1 | 0 | 0 |
| 54 | 0 | 1 | 0 | 0 |

Transition probabilities for transition from infection in hospital, women from better practice hospitals

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 1 | 0.707857271 | 0.292142728 | 8.13632E-10 | 0 |
| 2 | 0.714226371 | 0.28577362 | 9.53253E-09 | 0 |
| 3 | 0.719705189 | 0.280294733 | 7.78164E-08 | 0 |
| 4 | 0.724321175 | 0.275678383 | 4.42635E-07 | 0 |
| 5 | 0.728097921 | 0.271900325 | 1.75451E-06 | 0 |
| 6 | 0.731055036 | 0.268940118 | 4.84644E-06 | 0 |
| 7 | 0.733208965 | 0.266781706 | 9.32954E-06 | 0 |
| 8 | 0.734573646 | 0.265413837 | 1.25165E-05 | 0 |
| 9 | 0.735158738 | 0.264829559 | 1.1703E-05 | 0 |
| 10 | 0.734966994 | 0.265025379 | 7.62613E-06 | 0 |
| 11 | 0.733994974 | 0.266001562 | 3.46342E-06 | 0 |
| 12 | 0.732235811 | 0.267763093 | 1.09621E-06 | 0 |
| 13 | 0.729679895 | 0.270319864 | 2.41801E-07 | 0 |
| 14 | 0.726313781 | 0.273686182 | 3.71697E-08 | 0 |
| 15 | 0.722119603 | 0.277880393 | 3.98167E-09 | 0 |
| 16 | 0.717075285 | 0.282924714 | 2.97212E-10 | 0 |
| 17 | 0.71115496 | 0.28884504 | 1.54585E-11 | 0 |

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 18 | 0.704329369 | 0.295670631 | 5.60185E-13 | 0 |
| 19 | 0.696566333 | 0.303433667 | 1.41425E-14 | 0 |
| 20 | 0.687831331 | 0.312168669 | 2.48718E-16 | 0 |
| 21 | 0.67808825 | 0.32191175 | 3.04668E-18 | 0 |
| 22 | 0.667300325 | 0.332699675 | 2.59916E-20 | 0 |
| 23 | 0.6554313 | 0.3445687 | 1.54405E-22 | 0 |
| 24 | 0.642446835 | 0.357553165 | 6.38631E-25 | 0 |
| 25 | 0.628316188 | 0.371683812 | 1.83875E-27 | 0 |
| 26 | 0.613014176 | 0.386985824 | 3.68469E-30 | 0 |
| 27 | 0.596523406 | 0.403476594 | 5.13804E-33 | 0 |
| 28 | 0.57883676 | 0.42116324 | 4.98448E-36 | 0 |
| 29 | 0.559960069 | 0.440039931 | 3.36332E-39 | 0 |
| 30 | 0.539914885 | 0.460085115 | 1.57811E-42 | 0 |
| 31 | 0.518741216 | 0.481258784 | 5.14777E-46 | 0 |
| 32 | 0.496500057 | 0.503499943 | 1.16707E-49 | 0 |
| 33 | 0.473275493 | 0.526724507 | 1.83847E-53 | 0 |
| 34 | 0 | 1 | 0 | 0 |
| 35 | 0 | 1 | 0 | 0 |
| 36 | 0 | 1 | 0 | 0 |
| 37 | 0 | 1 | 0 | 0 |
| 38 | 0 | 1 | 0 | 0 |
| 39 | 0 | 1 | 0 | 0 |
| 40 | 0 | 1 | 0 | 0 |
| 41 | 0 | 1 | 0 | 0 |
| 42 | 0 | 1 | 0 | 0 |
| 43 | 0 | 1 | 0 | 0 |
| 44 | 0 | 1 | 0 | 0 |
| 45 | 0 | 1 | 0 | 0 |
| 46 | 0 | 1 | 0 | 0 |
| 47 | 0 | 1 | 0 | 0 |
| 48 | 0 | 1 | 0 | 0 |
| 49 | 0 | 1 | 0 | 0 |
| 50 | 0 | 1 | 0 | 0 |
| 51 | 0 | 1 | 0 | 0 |
| 52 | 0 | 1 | 0 | 0 |
| 53 | 0 | 1 | 0 | 0 |
| 54 | 0 | 1 | 0 | 0 |

Transition probabilities for transition from infection at home with NPWT, women from current practice hospitals

| Cycle | Remain in infection at home with NPWT | Transition to post-infection recovery |
|-------|---------------------------------------|---------------------------------------|
| 1 | 0 | 1 |
| 2 | 0 | 1 |
| 3 | 0 | 1 |
| 4 | 0 | 1 |
| 5 | 0 | 1 |
| 6 | 0 | 1 |
| 7 | 0 | 1 |
| 8 | 0 | 1 |
| 9 | 0 | 1 |
| 10 | 0 | 1 |
| 11 | 0 | 1 |
| 12 | 0 | 1 |
| 13 | 0 | 1 |
| 14 | 0 | 1 |
| 15 | 0 | 1 |
| 16 | 0 | 1 |
| 17 | 0 | 1 |
| 18 | 0 | 1 |
| 19 | 0 | 1 |
| 20 | 0 | 1 |
| 21 | 0 | 1 |
| 22 | 0 | 1 |
| 23 | 0 | 1 |
| 24 | 0 | 1 |
| 25 | 0 | 1 |
| 26 | 0 | 1 |
| 27 | 0 | 1 |
| 28 | 0 | 1 |
| 29 | 0 | 1 |
| 30 | 0 | 1 |
| 31 | 0 | 1 |
| 32 | 0 | 1 |
| 33 | 0 | 1 |
| 34 | 0 | 1 |
| 35 | 0 | 1 |
| 36 | 0 | 1 |
| 37 | 0 | 1 |
| 38 | 0 | 1 |

| Cycle | Remain in infection at home with NPWT | Transition to post-infection recovery |
|--------------|--|--|
| 39 | 0 | 1 |
| 40 | 0 | 1 |
| 41 | 0 | 1 |
| 42 | 0 | 1 |
| 43 | 0 | 1 |
| 44 | 0 | 1 |
| 45 | 0 | 1 |
| 46 | 0 | 1 |
| 47 | 0 | 1 |
| 48 | 0 | 1 |
| 49 | 0 | 1 |
| 50 | 0 | 1 |
| 51 | 0 | 1 |
| 52 | 0 | 1 |
| 53 | 0 | 1 |
| 54 | 0 | 1 |

Transition probabilities for transition from infection at home with NPWT, women from better practice hospitals

| Cycle | Remain in infection at home with NPWT | Transition to post-infection recovery |
|--------------|--|--|
| 1 | 0 | 1 |
| 2 | 0 | 1 |
| 3 | 0 | 1 |
| 4 | 0 | 1 |
| 5 | 0 | 1 |
| 6 | 0 | 1 |
| 7 | 0 | 1 |
| 8 | 0 | 1 |
| 9 | 0 | 1 |
| 10 | 0 | 1 |
| 11 | 0 | 1 |
| 12 | 0 | 1 |
| 13 | 0 | 1 |
| 14 | 0 | 1 |
| 15 | 0 | 1 |
| 16 | 0 | 1 |
| 17 | 0 | 1 |
| 18 | 0 | 1 |

| Cycle | Remain in infection at home with NPWT | Transition to post-infection recovery |
|--------------|--|--|
| 19 | 0 | 1 |
| 20 | 0 | 1 |
| 21 | 0 | 1 |
| 22 | 0 | 1 |
| 23 | 0 | 1 |
| 24 | 0 | 1 |
| 25 | 0 | 1 |
| 26 | 0 | 1 |
| 27 | 0 | 1 |
| 28 | 0 | 1 |
| 29 | 0 | 1 |
| 30 | 0 | 1 |
| 31 | 0 | 1 |
| 32 | 0 | 1 |
| 33 | 0 | 1 |
| 34 | 0 | 1 |
| 35 | 0 | 1 |
| 36 | 0 | 1 |
| 37 | 0 | 1 |
| 38 | 0 | 1 |
| 39 | 0 | 1 |
| 40 | 0 | 1 |
| 41 | 0 | 1 |
| 42 | 0 | 1 |
| 43 | 0 | 1 |
| 44 | 0 | 1 |
| 45 | 0 | 1 |
| 46 | 0 | 1 |
| 47 | 0 | 1 |
| 48 | 0 | 1 |
| 49 | 0 | 1 |
| 50 | 0 | 1 |
| 51 | 0 | 1 |
| 52 | 0 | 1 |
| 53 | 0 | 1 |
| 54 | 0 | 1 |

Appendix M

Transition Probabilities: Obese Women Sub-Group

Transition probabilities for transition from caesarean section, women from current practice hospitals

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 1 | 0.894772385 | 0.105019964 | 0.00020765 |
| 2 | 0.81315577 | 0.186513531 | 0.000330699 |
| 3 | 0.712730833 | 0.286771272 | 0.000497895 |
| 4 | 0.611714949 | 0.38755102 | 0.000734032 |
| 5 | 0.527003628 | 0.471910115 | 0.001086257 |
| 6 | 0.467373243 | 0.530971992 | 0.001654764 |
| 7 | 0.434805589 | 0.56255005 | 0.002644361 |
| 8 | 0.428628553 | 0.566893695 | 0.004477752 |
| 9 | 0.448122567 | 0.543836082 | 0.008041352 |
| 10 | 0.492512591 | 0.492306321 | 0.015181088 |
| 11 | 0.558043463 | 0.412409979 | 0.029546558 |
| 12 | 0.632349405 | 0.31013981 | 0.057510785 |
| 13 | 0.690420182 | 0.201720176 | 0.107859642 |
| 14 | 0.701961582 | 0.109668236 | 0.188370181 |
| 15 | 0.651068445 | 0.048822725 | 0.30010883 |
| 16 | 0.548218456 | 0.017712223 | 0.434069322 |
| 17 | 0.421486141 | 0.00526651 | 0.573247349 |
| 18 | 0.29935202 | 0.001298489 | 0.699349491 |
| 19 | 0.199428964 | 0.000269561 | 0.800301475 |
| 20 | 0.126685816 | 4.78967E-05 | 0.873266287 |
| 21 | 0.077877685 | 7.39257E-06 | 0.922114922 |
| 22 | 0.046862944 | 1.00257E-06 | 0.953136053 |
| 23 | 0.027826905 | 1.20433E-07 | 0.972172975 |
| 24 | 0.016390446 | 1.28815E-08 | 0.983609541 |
| 25 | 0.009607756 | 1.2308E-09 | 0.990392243 |
| 26 | 0.005615851 | 1.05261E-10 | 0.994384149 |
| 27 | 0.003277046 | 8.06706E-12 | 0.996722954 |
| 28 | 0.0019104 | 5.54416E-13 | 0.9980896 |
| 29 | 0.001113058 | 3.41825E-14 | 0.998886942 |
| 30 | 0 | 1 | 0 |
| 31 | 0 | 1 | 0 |
| 32 | 0 | 1 | 0 |
| 33 | 0 | 1 | 0 |
| 34 | 0 | 1 | 0 |
| 35 | 0 | 1 | 0 |
| 36 | 0 | 1 | 0 |
| 37 | 0 | 1 | 0 |

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 38 | 0 | 1 | 0 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from caesarean section, women from better practice hospitals

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 1 | 0.896203008 | 0.103230914 | 0.000566078 |
| 2 | 0.815577874 | 0.18358877 | 0.000833357 |
| 3 | 0.716097351 | 0.282765384 | 0.001137264 |
| 4 | 0.61571306 | 0.382826714 | 0.001460225 |
| 5 | 0.531292574 | 0.466899605 | 0.001807821 |
| 6 | 0.471780114 | 0.526006945 | 0.002212941 |
| 7 | 0.439379115 | 0.557891238 | 0.002729647 |
| 8 | 0.433674775 | 0.562896788 | 0.003428437 |
| 9 | 0.454405998 | 0.541201932 | 0.00439207 |
| 10 | 0.501922751 | 0.492378448 | 0.005698801 |
| 11 | 0.575343029 | 0.41728433 | 0.007372641 |
| 12 | 0.668794674 | 0.321912091 | 0.009293235 |
| 13 | 0.768514545 | 0.220359629 | 0.011125826 |
| 14 | 0.856299242 | 0.131291665 | 0.012409093 |
| 15 | 0.919514234 | 0.067670269 | 0.012815497 |
| 16 | 0.957316895 | 0.03035423 | 0.012328875 |
| 17 | 0.976852188 | 0.01197878 | 0.011169032 |
| 18 | 0.986183697 | 0.00419815 | 0.009618153 |
| 19 | 0.990766545 | 0.001314269 | 0.007919187 |
| 20 | 0.993379286 | 0.000368584 | 0.00625213 |
| 21 | 0.995168784 | 9.27093E-05 | 0.004738506 |

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 22 | 0.996530062 | 2.09227E-05 | 0.003449016 |
| 23 | 0.99758451 | 4.23716E-06 | 0.002411253 |
| 24 | 0.998380012 | 7.70043E-07 | 0.001619218 |
| 25 | 0.998955394 | 1.2559E-07 | 0.001044481 |
| 26 | 0.99935277 | 1.83829E-08 | 0.000647211 |
| 27 | 0.999614731 | 2.41496E-09 | 0.000385266 |
| 28 | 0.999779676 | 2.84747E-10 | 0.000220324 |
| 29 | 0.999878951 | 3.01354E-11 | 0.000121049 |
| 30 | 0 | 1 | 0 |
| 31 | 0 | 1 | 0 |
| 32 | 0 | 1 | 0 |
| 33 | 0 | 1 | 0 |
| 34 | 0 | 1 | 0 |
| 35 | 0 | 1 | 0 |
| 36 | 0 | 1 | 0 |
| 37 | 0 | 1 | 0 |
| 38 | 0 | 1 | 0 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from normal recovery at home, women from current practice hospitals

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|--------------|--|--|--|
| 1 | 0.980502935 | 0.014622799 | 0.004874266 |
| 2 | 0.982852472 | 0.012860646 | 0.004286882 |
| 3 | 0.984919945 | 0.011310041 | 0.003770014 |
| 4 | 0.986738974 | 0.00994577 | 0.003315257 |
| 5 | 0.988339224 | 0.008745582 | 0.002915194 |
| 6 | 0.989746864 | 0.007689852 | 0.002563284 |
| 7 | 0.990984964 | 0.006761277 | 0.002253759 |
| 8 | 0.992073856 | 0.005944608 | 0.001981536 |
| 9 | 0.993031455 | 0.005226409 | 0.001742136 |
| 10 | 0.993873538 | 0.004594846 | 0.001531615 |
| 11 | 0.994614001 | 0.004039499 | 0.0013465 |
| 12 | 0.995265076 | 0.003551193 | 0.001183731 |
| 13 | 0.995837529 | 0.003121854 | 0.001040618 |
| 14 | 0.996340835 | 0.002744374 | 0.000914791 |
| 15 | 0.996783333 | 0.0024125 | 0.000804167 |
| 16 | 0.997172358 | 0.002120731 | 0.00070691 |
| 17 | 0.997514364 | 0.001864227 | 0.000621409 |
| 18 | 0.997815026 | 0.00163873 | 0.000546243 |
| 19 | 0.998079338 | 0.001440496 | 0.000480165 |
| 20 | 0.99831169 | 0.001266232 | 0.000422077 |
| 21 | 0.998515944 | 0.001113042 | 0.000371014 |
| 22 | 0.998695495 | 0.000978379 | 0.000326126 |
| 23 | 0.998853328 | 0.000860004 | 0.000286668 |
| 24 | 0.998992071 | 0.000755947 | 0.000251982 |
| 25 | 0.999114029 | 0.000664478 | 0.000221493 |
| 26 | 0.999221234 | 0.000584075 | 0.000194692 |
| 27 | 0.999315469 | 0.000513398 | 0.000171133 |
| 28 | 0.999398302 | 0.000451273 | 0.000150424 |
| 29 | 0.999471114 | 0.000396665 | 0.000132222 |
| 30 | 1 | 0 | 0 |
| 31 | 1 | 0 | 0 |
| 32 | 1 | 0 | 0 |
| 33 | 1 | 0 | 0 |
| 34 | 1 | 0 | 0 |
| 35 | 1 | 0 | 0 |
| 36 | 1 | 0 | 0 |
| 37 | 1 | 0 | 0 |
| 38 | 1 | 0 | 0 |
| 39 | 1 | 0 | 0 |
| 40 | 1 | 0 | 0 |

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 41 | 1 | 0 | 0 |
| 42 | 1 | 0 | 0 |
| 43 | 1 | 0 | 0 |
| 44 | 1 | 0 | 0 |
| 45 | 1 | 0 | 0 |
| 46 | 1 | 0 | 0 |
| 47 | 1 | 0 | 0 |
| 48 | 1 | 0 | 0 |
| 49 | 1 | 0 | 0 |
| 50 | 1 | 0 | 0 |
| 51 | 1 | 0 | 0 |
| 52 | 1 | 0 | 0 |
| 53 | 1 | 0 | 0 |
| 54 | 1 | 0 | 0 |

Transition probabilities for transition from normal recovery at home, women from better practice hospitals

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 1 | 0.968585626 | 0.02356078 | 0.007853593 |
| 2 | 0.972361313 | 0.020729015 | 0.006909672 |
| 3 | 0.975685981 | 0.018235514 | 0.006078505 |
| 4 | 0.978612877 | 0.016040342 | 0.005346781 |
| 5 | 0.981189103 | 0.014108173 | 0.004702724 |
| 6 | 0.983456295 | 0.012407778 | 0.004135926 |
| 7 | 0.985451232 | 0.010911576 | 0.003637192 |
| 8 | 0.98720638 | 0.009595215 | 0.003198405 |
| 9 | 0.988750386 | 0.00843721 | 0.002812403 |
| 10 | 0.990108516 | 0.007418613 | 0.002472871 |
| 11 | 0.99130304 | 0.00652272 | 0.00217424 |
| 12 | 0.992353587 | 0.00573481 | 0.001911603 |
| 13 | 0.993277446 | 0.005041915 | 0.001680638 |
| 14 | 0.994089848 | 0.004432614 | 0.001477538 |
| 15 | 0.994804201 | 0.003896849 | 0.00129895 |
| 16 | 0.99543231 | 0.003425767 | 0.001141922 |
| 17 | 0.995984565 | 0.003011577 | 0.001003859 |
| 18 | 0.996470108 | 0.002647419 | 0.000882473 |
| 19 | 0.996896985 | 0.002327261 | 0.000775754 |
| 20 | 0.997272275 | 0.002045794 | 0.000681931 |
| 21 | 0.997602203 | 0.001798348 | 0.000599449 |
| 22 | 0.997892246 | 0.001580816 | 0.000526939 |
| 23 | 0.998147221 | 0.001389584 | 0.000463195 |

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|--------------|--|--|--|
| 24 | 0.998371364 | 0.001221477 | 0.000407159 |
| 25 | 0.998568401 | 0.001073699 | 0.0003579 |
| 26 | 0.998741607 | 0.000943795 | 0.000314598 |
| 27 | 0.998893863 | 0.000829603 | 0.000276534 |
| 28 | 0.999027702 | 0.000729223 | 0.000243074 |
| 29 | 0.99914535 | 0.000640987 | 0.000213662 |
| 30 | 1 | 0 | 0 |
| 31 | 1 | 0 | 0 |
| 32 | 1 | 0 | 0 |
| 33 | 1 | 0 | 0 |
| 34 | 1 | 0 | 0 |
| 35 | 1 | 0 | 0 |
| 36 | 1 | 0 | 0 |
| 37 | 1 | 0 | 0 |
| 38 | 1 | 0 | 0 |
| 39 | 1 | 0 | 0 |
| 40 | 1 | 0 | 0 |
| 41 | 1 | 0 | 0 |
| 42 | 1 | 0 | 0 |
| 43 | 1 | 0 | 0 |
| 44 | 1 | 0 | 0 |
| 45 | 1 | 0 | 0 |
| 46 | 1 | 0 | 0 |
| 47 | 1 | 0 | 0 |
| 48 | 1 | 0 | 0 |
| 49 | 1 | 0 | 0 |
| 50 | 1 | 0 | 0 |
| 51 | 1 | 0 | 0 |
| 52 | 1 | 0 | 0 |
| 53 | 1 | 0 | 0 |
| 54 | 1 | 0 | 0 |

Transition probabilities for transition from infection at home, women from current practice hospitals

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|--------------|------------------------------------|--|--|
| 1 | 0.821071329 | 0.070754687 | 0.108173983 |
| 2 | 0.824690997 | 0.07471027 | 0.100598733 |
| 3 | 0.827691303 | 0.078826486 | 0.093482211 |
| 4 | 0.830087316 | 0.083107894 | 0.086804789 |
| 5 | 0.83189426 | 0.087559113 | 0.080546628 |

| Cycle | Remain in infection at home | Transition to post- infection recovery | Transition to infection in hospital |
|-------|--------------------------------|---|--|
| 6 | 0.833127347 | 0.092184805 | 0.074687848 |
| 7 | 0.833801652 | 0.096989657 | 0.069208691 |
| 8 | 0.833931996 | 0.101978363 | 0.064089642 |
| 9 | 0.833532859 | 0.107155594 | 0.059311548 |
| 10 | 0.832618313 | 0.11252598 | 0.054855707 |
| 11 | 0.831201973 | 0.118094082 | 0.050703945 |
| 12 | 0.829296965 | 0.123864362 | 0.046838673 |
| 13 | 0.82691591 | 0.129841154 | 0.043242937 |
| 14 | 0.824070922 | 0.136028632 | 0.039900446 |
| 15 | 0.82077362 | 0.142430781 | 0.036795599 |
| 16 | 0.817035149 | 0.149051356 | 0.033913495 |
| 17 | 0.812866209 | 0.155893851 | 0.031239941 |
| 18 | 0.808277092 | 0.162961461 | 0.028761447 |
| 19 | 0.803277735 | 0.170257045 | 0.02646522 |
| 20 | 0.797877759 | 0.177783088 | 0.024339153 |
| 21 | 0.792086532 | 0.185541661 | 0.022371807 |
| 22 | 0.785913226 | 0.193534383 | 0.020552391 |
| 23 | 0.779366872 | 0.201762384 | 0.018870744 |
| 24 | 0.772456427 | 0.210226265 | 0.017317309 |
| 25 | 0.76519083 | 0.218926062 | 0.015883108 |
| 26 | 0.75757907 | 0.22786121 | 0.01455972 |
| 27 | 0.749630238 | 0.23703051 | 0.013339252 |
| 28 | 0.741353588 | 0.246432097 | 0.012214315 |
| 29 | 0.732758594 | 0.25606341 | 0.011177996 |
| 30 | 0.723854998 | 0.265921165 | 0.010223837 |
| 31 | 0.714652856 | 0.276001337 | 0.009345807 |
| 32 | 0.705162586 | 0.286299136 | 0.008538278 |
| 33 | 0.695395 | 0.296808999 | 0.007796001 |
| 34 | 0.685361338 | 0.307524574 | 0.007114088 |
| 35 | 0.675073291 | 0.318438723 | 0.006487986 |
| 36 | 0.664543024 | 0.329543519 | 0.005913457 |
| 37 | 0.653783184 | 0.340830257 | 0.005386558 |
| 38 | 0.642806908 | 0.352289465 | 0.004903628 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from infection at home, women from better practice hospitals

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 1 | 0.796242457 | 0.076296734 | 0.127460809 |
| 2 | 0.800673643 | 0.080654922 | 0.118671435 |
| 3 | 0.804421839 | 0.085187116 | 0.110391044 |
| 4 | 0.807501213 | 0.089897574 | 0.102601213 |
| 5 | 0.809926654 | 0.094790585 | 0.09528276 |
| 6 | 0.811713562 | 0.099870458 | 0.08841598 |
| 7 | 0.812877647 | 0.105141494 | 0.08198086 |
| 8 | 0.813434763 | 0.110607968 | 0.075957269 |
| 9 | 0.813400773 | 0.116274101 | 0.070325126 |
| 10 | 0.812791427 | 0.122144031 | 0.065064542 |
| 11 | 0.811622273 | 0.128221784 | 0.060155944 |
| 12 | 0.809908582 | 0.134511242 | 0.055580175 |
| 13 | 0.807665305 | 0.141016111 | 0.051318584 |
| 14 | 0.804907031 | 0.147739883 | 0.047353086 |
| 15 | 0.801647978 | 0.154685803 | 0.043666219 |
| 16 | 0.797901987 | 0.161856828 | 0.040241185 |
| 17 | 0.793682535 | 0.169255592 | 0.037061873 |
| 18 | 0.789002756 | 0.176884365 | 0.03411288 |
| 19 | 0.783875469 | 0.184745013 | 0.031379517 |
| 20 | 0.778313224 | 0.192838962 | 0.028847815 |
| 21 | 0.772328336 | 0.201167152 | 0.026504512 |
| 22 | 0.765932944 | 0.209730008 | 0.024337049 |
| 23 | 0.759139055 | 0.218527392 | 0.022333553 |
| 24 | 0.751958605 | 0.227558575 | 0.02048282 |
| 25 | 0.744403511 | 0.236822198 | 0.018774291 |
| 26 | 0.736485723 | 0.246316243 | 0.017198034 |
| 27 | 0.728217286 | 0.256038001 | 0.015744714 |
| 28 | 0.719610381 | 0.265984046 | 0.014405573 |
| 29 | 0.710677384 | 0.276150216 | 0.013172401 |
| 30 | 0.7014309 | 0.28653159 | 0.01203751 |

| Cycle | Remain in infection at home | Transition to post- infection recovery | Transition to infection in hospital |
|--------------|--|---|--|
| 31 | 0.691883812 | 0.297122479 | 0.010993709 |
| 32 | 0.682049309 | 0.307916412 | 0.010034279 |
| 33 | 0.671940919 | 0.318906137 | 0.009152944 |
| 34 | 0.661572528 | 0.330083621 | 0.008343851 |
| 35 | 0.650958401 | 0.341440059 | 0.007601541 |
| 36 | 0.640113184 | 0.352965886 | 0.00692093 |
| 37 | 0.629051912 | 0.3646508 | 0.006297287 |
| 38 | 0.61779 | 0.376483791 | 0.00572621 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from infection in hospital, women from current practice hospitals

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 1 | 0.724932059 | 0.274534775 | 1.05356E-10 | 0.000533166 |
| 2 | 0.730789692 | 0.268305356 | 1.23323E-09 | 0.000904951 |
| 3 | 0.735629784 | 0.26288771 | 1.00567E-08 | 0.001482496 |
| 4 | 0.739421435 | 0.258234487 | 5.71328E-08 | 0.002344021 |
| 5 | 0.742122796 | 0.254300013 | 2.26111E-07 | 0.003576965 |
| 6 | 0.743688889 | 0.251042635 | 6.23366E-07 | 0.005267853 |
| 7 | 0.744083773 | 0.248428139 | 1.19711E-06 | 0.007486891 |
| 8 | 0.743295797 | 0.246433967 | 1.60135E-06 | 0.010268635 |
| 9 | 0.741352989 | 0.24505358 | 1.49217E-06 | 0.013591939 |
| 10 | 0.73833492 | 0.244300138 | 9.68655E-07 | 0.017363973 |
| 11 | 0.73437737 | 0.24420866 | 4.38138E-07 | 0.021413531 |
| 12 | 0.729666448 | 0.244835733 | 1.38117E-07 | 0.025497681 |
| 13 | 0.724420776 | 0.246256187 | 3.03526E-08 | 0.029323006 |
| 14 | 0.718863898 | 0.248556963 | 4.65147E-09 | 0.032579135 |
| 15 | 0.713191861 | 0.251829048 | 4.97212E-10 | 0.034979091 |
| 16 | 0.707542071 | 0.256158679 | 3.70795E-11 | 0.03629925 |
| 17 | 0.701969234 | 0.261619086 | 1.9293E-12 | 0.036411679 |
| 18 | 0.696432906 | 0.26826397 | 7.00348E-14 | 0.035303124 |
| 19 | 0.690798973 | 0.276123674 | 1.77335E-15 | 0.033077353 |
| 20 | 0.68485497 | 0.285204679 | 3.13114E-17 | 0.029940351 |
| 21 | 0.678336646 | 0.29549257 | 3.85359E-19 | 0.026170784 |
| 22 | 0.670961079 | 0.306958062 | 3.30436E-21 | 0.022080859 |
| 23 | 0.662460368 | 0.319565012 | 1.97321E-23 | 0.017974619 |
| 24 | 0.652609828 | 0.333278822 | 8.20248E-26 | 0.01411135 |
| 25 | 0.641246157 | 0.348073409 | 2.37273E-28 | 0.010680433 |
| 26 | 0.628273714 | 0.363935234 | 4.77483E-31 | 0.007791052 |
| 27 | 0.613660088 | 0.380863549 | 6.68308E-34 | 0.005476363 |
| 28 | 0.597424526 | 0.398866973 | 6.50467E-37 | 0.003708502 |
| 29 | 0.579623707 | 0.417957232 | 4.40186E-40 | 0.00241906 |
| 30 | 0.560338853 | 0.438141403 | 2.07082E-43 | 0.001519744 |
| 31 | 0.539666662 | 0.459413951 | 6.77132E-47 | 0.000919387 |
| 32 | 0.517714849 | 0.481749662 | 1.53868E-50 | 0.000535489 |
| 33 | 0.49460166 | 0.505098122 | 2.42927E-54 | 0.000300218 |
| 34 | 0 | 1 | 0 | 0 |
| 35 | 0 | 1 | 0 | 0 |
| 36 | 0 | 1 | 0 | 0 |
| 37 | 0 | 1 | 0 | 0 |
| 38 | 0 | 1 | 0 | 0 |
| 39 | 0 | 1 | 0 | 0 |
| 40 | 0 | 1 | 0 | 0 |

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 41 | 0 | 1 | 0 | 0 |
| 42 | 0 | 1 | 0 | 0 |
| 43 | 0 | 1 | 0 | 0 |
| 44 | 0 | 1 | 0 | 0 |
| 45 | 0 | 1 | 0 | 0 |
| 46 | 0 | 1 | 0 | 0 |
| 47 | 0 | 1 | 0 | 0 |
| 48 | 0 | 1 | 0 | 0 |
| 49 | 0 | 1 | 0 | 0 |
| 50 | 0 | 1 | 0 | 0 |
| 51 | 0 | 1 | 0 | 0 |
| 52 | 0 | 1 | 0 | 0 |
| 53 | 0 | 1 | 0 | 0 |
| 54 | 0 | 1 | 0 | 0 |

Transition probabilities for transition from infection in hospital, women from better practice hospitals

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 1 | 0.707054275 | 0.29181132 | 8.12709E-10 | 0.001134404 |
| 2 | 0.712851009 | 0.285223315 | 9.51418E-09 | 0.001925667 |
| 3 | 0.717435213 | 0.279410674 | 7.7571E-08 | 0.003154035 |
| 4 | 0.720711138 | 0.274304394 | 4.40429E-07 | 0.004984028 |
| 5 | 0.722566253 | 0.269834583 | 1.74118E-06 | 0.007597423 |
| 6 | 0.722888955 | 0.265935985 | 4.7923E-06 | 0.011170268 |
| 7 | 0.721595785 | 0.262556193 | 9.18177E-06 | 0.01583884 |
| 8 | 0.718663949 | 0.259665395 | 1.22454E-05 | 0.021658411 |
| 9 | 0.714160493 | 0.257265266 | 1.13687E-05 | 0.028562873 |
| 10 | 0.70826113 | 0.25539538 | 7.34903E-06 | 0.036336141 |
| 11 | 0.701254321 | 0.25413627 | 3.30893E-06 | 0.0446061 |
| 12 | 0.693524424 | 0.253607161 | 1.03826E-06 | 0.052867377 |
| 13 | 0.685511232 | 0.25395698 | 2.27165E-07 | 0.06053156 |
| 14 | 0.677653508 | 0.255350244 | 3.46794E-08 | 0.066996214 |
| 15 | 0.67032922 | 0.257950825 | 3.6961E-09 | 0.071719951 |
| 16 | 0.663803259 | 0.261906039 | 2.75132E-10 | 0.074290702 |
| 17 | 0.65819009 | 0.267332655 | 1.43072E-11 | 0.074477255 |
| 18 | 0.653435869 | 0.274306034 | 5.19707E-13 | 0.072258097 |
| 19 | 0.649321834 | 0.282853327 | 1.31833E-14 | 0.067824839 |
| 20 | 0.645488633 | 0.292951657 | 2.33407E-16 | 0.06155971 |
| 21 | 0.64147908 | 0.304532122 | 2.8822E-18 | 0.053988798 |

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|--------------|--|--|---|--|
| 22 | 0.636794084 | 0.317490007 | 2.48033E-20 | 0.045715909 |
| 23 | 0.63095341 | 0.331700358 | 1.48639E-22 | 0.037346232 |
| 24 | 0.623550673 | 0.347036525 | 6.19847E-25 | 0.029412802 |
| 25 | 0.614292342 | 0.36338793 | 1.79771E-27 | 0.022319728 |
| 26 | 0.60301429 | 0.380673059 | 3.62458E-30 | 0.01631265 |
| 27 | 0.589675549 | 0.39884484 | 5.07906E-33 | 0.011479611 |
| 28 | 0.574334957 | 0.417887716 | 4.94571E-36 | 0.007777328 |
| 29 | 0.557119823 | 0.437807948 | 3.34626E-39 | 0.005072229 |
| 30 | 0.538195651 | 0.458620082 | 1.57309E-42 | 0.003184267 |
| 31 | 0.517743085 | 0.480332775 | 5.13787E-46 | 0.00192414 |
| 32 | 0.495944458 | 0.50293651 | 1.16577E-49 | 0.001119032 |
| 33 | 0.472979087 | 0.526394627 | 1.83732E-53 | 0.000626286 |
| 34 | 0 | 1 | 0 | 0 |
| 35 | 0 | 1 | 0 | 0 |
| 36 | 0 | 1 | 0 | 0 |
| 37 | 0 | 1 | 0 | 0 |
| 38 | 0 | 1 | 0 | 0 |
| 39 | 0 | 1 | 0 | 0 |
| 40 | 0 | 1 | 0 | 0 |
| 41 | 0 | 1 | 0 | 0 |
| 42 | 0 | 1 | 0 | 0 |
| 43 | 0 | 1 | 0 | 0 |
| 44 | 0 | 1 | 0 | 0 |
| 45 | 0 | 1 | 0 | 0 |
| 46 | 0 | 1 | 0 | 0 |
| 47 | 0 | 1 | 0 | 0 |
| 48 | 0 | 1 | 0 | 0 |
| 49 | 0 | 1 | 0 | 0 |
| 50 | 0 | 1 | 0 | 0 |
| 51 | 0 | 1 | 0 | 0 |
| 52 | 0 | 1 | 0 | 0 |
| 53 | 0 | 1 | 0 | 0 |
| 54 | 0 | 1 | 0 | 0 |

Transition probabilities for transition from infection at home with NPWT, women from current practice hospitals

| Cycle | Remain in infection at home with NPWT | Transition to post-infection recovery |
|--------------|--|--|
| 1 | 0.983231113 | 0.016768887 |
| 2 | 0.986188133 | 0.013811867 |
| 3 | 0.987935129 | 0.012064871 |
| 4 | 0.988819261 | 0.011180739 |
| 5 | 0.989005655 | 0.010994345 |
| 6 | 0.988528128 | 0.011471872 |
| 7 | 0.987299336 | 0.012700664 |
| 8 | 0.98508439 | 0.01491561 |
| 9 | 0.98142737 | 0.01857263 |
| 10 | 0.975501003 | 0.024498997 |
| 11 | 0.965819412 | 0.034180588 |
| 12 | 0.949708499 | 0.050291501 |
| 13 | 0.922393376 | 0.077606624 |
| 14 | 0.875699285 | 0.124300715 |
| 15 | 0.797270105 | 0.202729895 |
| 16 | 0.673996983 | 0.326003017 |
| 17 | 0.505829486 | 0.494170514 |
| 18 | 0.323073904 | 0.676926096 |
| 19 | 0.173262278 | 0.826737722 |
| 20 | 0.079754964 | 0.920245036 |
| 21 | 0.03265109 | 0.96734891 |
| 22 | 0.012228513 | 0.987771487 |
| 23 | 0.004258032 | 0.995741968 |
| 24 | 0.001389139 | 0.998610861 |
| 25 | 0.000425985 | 0.999574015 |
| 26 | 0.000122941 | 0.999877059 |
| 27 | 3.3408E-05 | 0.999966592 |
| 28 | 8.54906E-06 | 0.999991451 |
| 29 | 2.06025E-06 | 0.99999794 |
| 30 | 0 | 1 |
| 31 | 0 | 1 |
| 32 | 0 | 1 |
| 33 | 0 | 1 |
| 34 | 0 | 1 |
| 35 | 0 | 1 |
| 36 | 0 | 1 |
| 37 | 0 | 1 |
| 38 | 0 | 1 |
| 39 | 0 | 1 |
| 40 | 0 | 1 |

| Cycle | Remain in infection at home with NPWT | Transition to post- infection recovery |
|--------------|--|---|
| 41 | 0 | 1 |
| 42 | 0 | 1 |
| 43 | 0 | 1 |
| 44 | 0 | 1 |
| 45 | 0 | 1 |
| 46 | 0 | 1 |
| 47 | 0 | 1 |
| 48 | 0 | 1 |
| 49 | 0 | 1 |
| 50 | 0 | 1 |
| 51 | 0 | 1 |
| 52 | 0 | 1 |
| 53 | 0 | 1 |
| 54 | 0 | 1 |

Transition probabilities for transition from infection at home with NPWT, women from better practice hospitals

| Cycle | Remain in infection at home with NPWT | Transition to post- infection recovery |
|--------------|--|---|
| 1 | 0.999033921 | 0.000966079 |
| 2 | 0.999206528 | 0.000793472 |
| 3 | 0.999308045 | 0.000691955 |
| 4 | 0.999359293 | 0.000640707 |
| 5 | 0.999370087 | 0.000629913 |
| 6 | 0.999342428 | 0.000657572 |
| 7 | 0.999271139 | 0.000728861 |
| 8 | 0.999142214 | 0.000857786 |
| 9 | 0.998928151 | 0.001071849 |
| 10 | 0.998578043 | 0.001421957 |
| 11 | 0.997997387 | 0.002002613 |
| 12 | 0.997006452 | 0.002993548 |
| 13 | 0.995252121 | 0.004747879 |
| 14 | 0.992015987 | 0.007984013 |
| 15 | 0.985787206 | 0.014212794 |
| 16 | 0.973306995 | 0.026693005 |
| 17 | 0.947514137 | 0.052485863 |
| 18 | 0.893813295 | 0.106186705 |
| 19 | 0.787060662 | 0.212939338 |
| 20 | 0.604511265 | 0.395488735 |
| 21 | 0.3731558 | 0.6268442 |

| Cycle | Remain in infection at home with NPWT | Transition to post- infection recovery |
|--------------|--|---|
| 22 | 0.179211028 | 0.820788972 |
| 23 | 0.070129487 | 0.929870513 |
| 24 | 0.023946342 | 0.976053658 |
| 25 | 0.007460073 | 0.992539927 |
| 26 | 0.002163846 | 0.997836154 |
| 27 | 0.000588878 | 0.999411122 |
| 28 | 0.000150755 | 0.999849245 |
| 29 | 3.63347E-05 | 0.999963665 |
| 30 | 0 | 1 |
| 31 | 0 | 1 |
| 32 | 0 | 1 |
| 33 | 0 | 1 |
| 34 | 0 | 1 |
| 35 | 0 | 1 |
| 36 | 0 | 1 |
| 37 | 0 | 1 |
| 38 | 0 | 1 |
| 39 | 0 | 1 |
| 40 | 0 | 1 |
| 41 | 0 | 1 |
| 42 | 0 | 1 |
| 43 | 0 | 1 |
| 44 | 0 | 1 |
| 45 | 0 | 1 |
| 46 | 0 | 1 |
| 47 | 0 | 1 |
| 48 | 0 | 1 |
| 49 | 0 | 1 |
| 50 | 0 | 1 |
| 51 | 0 | 1 |
| 52 | 0 | 1 |
| 53 | 0 | 1 |
| 54 | 0 | 1 |

Appendix N

Transition Probabilities: Private Hospitals Sub-Group

Transition probabilities for transition from caesarean section, women from current practice hospitals

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 1 | 0.992030532 | 0.007969468 | 6.70882E-12 |
| 2 | 0.948148934 | 0.051851066 | 1.44715E-11 |
| 3 | 0.786530259 | 0.213469741 | 2.08281E-11 |
| 4 | 0.504533901 | 0.495466099 | 2.31803E-11 |
| 5 | 0.278510131 | 0.721489869 | 2.22007E-11 |
| 6 | 0.167163649 | 0.832836351 | 2.31187E-11 |
| 7 | 0.12522398 | 0.87477602 | 3.00473E-11 |
| 8 | 0.122833839 | 0.877166161 | 5.11367E-11 |
| 9 | 0.158175831 | 0.841824169 | 1.14249E-10 |
| 10 | 0.256953422 | 0.743046578 | 3.22004E-10 |
| 11 | 0.466086176 | 0.533913823 | 1.01337E-09 |
| 12 | 0.751408057 | 0.24859194 | 2.83449E-09 |
| 13 | 0.934876929 | 0.065123065 | 6.11857E-09 |
| 14 | 0.989419807 | 0.010580182 | 1.1235E-08 |
| 15 | 0.998804649 | 0.001195331 | 1.96775E-08 |
| 16 | 0.999902327 | 9.7639E-05 | 3.41776E-08 |
| 17 | 0.999994132 | 5.80877E-06 | 5.93032E-08 |
| 18 | 0.999999645 | 2.51924E-07 | 1.02891E-07 |
| 19 | 0.999999814 | 7.96558E-09 | 1.78514E-07 |
| 20 | 0.99999969 | 1.83623E-10 | 3.0972E-07 |
| 21 | 0.999999463 | 3.08603E-12 | 5.3736E-07 |
| 22 | 0.999999068 | 3.78125E-14 | 9.32313E-07 |
| 23 | 0.999998382 | 3.3778E-16 | 1.61755E-06 |
| 24 | 0.999997194 | 2.19986E-18 | 2.80643E-06 |
| 25 | 0.999995131 | 1.04452E-20 | 4.8691E-06 |
| 26 | 0.999991552 | 3.6158E-23 | 8.4478E-06 |
| 27 | 0.999985343 | 9.1254E-26 | 1.46567E-05 |
| 28 | 0.999974571 | 1.67904E-28 | 2.5429E-05 |
| 29 | 0.999955882 | 2.25231E-31 | 4.41181E-05 |
| 30 | 0 | 1 | 0 |
| 31 | 0 | 1 | 0 |
| 32 | 0 | 1 | 0 |
| 33 | 0 | 1 | 0 |
| 34 | 0 | 1 | 0 |
| 35 | 0 | 1 | 0 |
| 36 | 0 | 1 | 0 |
| 37 | 0 | 1 | 0 |
| 38 | 0 | 1 | 0 |
| 39 | 0 | 1 | 0 |

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from caesarean section, women from better practice hospitals

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 1 | 0.996365505 | 0.0036335 | 9.94527E-07 |
| 2 | 0.975775928 | 0.024223305 | 7.6769E-07 |
| 3 | 0.890310324 | 0.10968935 | 3.26269E-07 |
| 4 | 0.691665574 | 0.308334356 | 6.97736E-08 |
| 5 | 0.459567923 | 0.54043207 | 7.54164E-09 |
| 6 | 0.306595932 | 0.693404067 | 4.83688E-10 |
| 7 | 0.239744243 | 0.760255757 | 2.14877E-11 |
| 8 | 0.235757358 | 0.764242642 | 7.09434E-13 |
| 9 | 0.292746482 | 0.707253518 | 1.74785E-14 |
| 10 | 0.43239599 | 0.56760401 | 3.02706E-16 |
| 11 | 0.657892786 | 0.342107214 | 3.19141E-18 |
| 12 | 0.869428803 | 0.130571197 | 1.72707E-20 |
| 13 | 0.969347763 | 0.030652237 | 4.65978E-23 |
| 14 | 0.995169282 | 0.004830718 | 6.84154E-26 |
| 15 | 0.999457032 | 0.000542968 | 5.80702E-29 |
| 16 | 0.999955675 | 4.4325E-05 | 2.90177E-32 |
| 17 | 0.999997363 | 2.63686E-06 | 8.56517E-36 |
| 18 | 0.999999886 | 1.1436E-07 | 1.49401E-39 |
| 19 | 0.999999996 | 3.61593E-09 | 1.54003E-43 |
| 20 | 1 | 8.33546E-11 | 9.38139E-48 |
| 21 | 1 | 1.40088E-12 | 3.37727E-52 |
| 22 | 1 | 1.71648E-14 | 7.18498E-57 |
| 23 | 1 | 1.53333E-16 | 9.03331E-62 |

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|--------------|--|--|--|
| 24 | 1 | 9.98615E-19 | 6.71165E-67 |
| 25 | 1 | 4.74157E-21 | 2.94695E-72 |
| 26 | 1 | 1.64138E-23 | 7.64675E-78 |
| 27 | 1 | 4.14248E-26 | 1.17258E-83 |
| 28 | 1 | 7.62208E-29 | 1.0626E-89 |
| 29 | 1 | 1.02247E-31 | 5.69058E-96 |
| 30 | 0 | 1 | 0 |
| 31 | 0 | 1 | 0 |
| 32 | 0 | 1 | 0 |
| 33 | 0 | 1 | 0 |
| 34 | 0 | 1 | 0 |
| 35 | 0 | 1 | 0 |
| 36 | 0 | 1 | 0 |
| 37 | 0 | 1 | 0 |
| 38 | 0 | 1 | 0 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from normal recovery at home, women from current practice hospitals

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 1 | 0.999888203 | 0 | 0.000111797 |
| 2 | 0.999903678 | 0 | 9.63219E-05 |
| 3 | 0.999917011 | 0 | 8.29891E-05 |
| 4 | 0.999928498 | 0 | 7.15017E-05 |
| 5 | 0.999938396 | 0 | 6.16042E-05 |
| 6 | 0.999946923 | 0 | 5.30768E-05 |
| 7 | 0.99995427 | 0 | 4.57296E-05 |
| 8 | 0.999960601 | 0 | 3.93995E-05 |
| 9 | 0.999966054 | 0 | 3.39456E-05 |
| 10 | 0.999970753 | 0 | 2.92466E-05 |
| 11 | 0.999974802 | 0 | 2.51981E-05 |
| 12 | 0.99997829 | 0 | 2.17099E-05 |
| 13 | 0.999981295 | 0 | 1.87047E-05 |
| 14 | 0.999983885 | 0 | 1.61154E-05 |
| 15 | 0.999986115 | 0 | 1.38846E-05 |
| 16 | 0.999988037 | 0 | 1.19625E-05 |
| 17 | 0.999989693 | 0 | 1.03066E-05 |
| 18 | 0.99999112 | 0 | 8.87984E-06 |
| 19 | 0.999992349 | 0 | 7.6506E-06 |
| 20 | 0.999993408 | 0 | 6.59153E-06 |
| 21 | 0.999994321 | 0 | 5.67907E-06 |
| 22 | 0.999995107 | 0 | 4.89291E-06 |
| 23 | 0.999995784 | 0 | 4.21558E-06 |
| 24 | 0.999996368 | 0 | 3.63202E-06 |
| 25 | 0.999996871 | 0 | 3.12924E-06 |
| 26 | 0.999997304 | 0 | 2.69606E-06 |
| 27 | 0.999997677 | 0 | 2.32284E-06 |
| 28 | 0.999997999 | 0 | 2.00129E-06 |
| 29 | 0.999998276 | 0 | 1.72425E-06 |
| 30 | 1 | 0 | 0 |
| 31 | 1 | 0 | 0 |
| 32 | 1 | 0 | 0 |
| 33 | 1 | 0 | 0 |
| 34 | 1 | 0 | 0 |
| 35 | 1 | 0 | 0 |
| 36 | 1 | 0 | 0 |
| 37 | 1 | 0 | 0 |
| 38 | 1 | 0 | 0 |
| 39 | 1 | 0 | 0 |
| 40 | 1 | 0 | 0 |

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 41 | 1 | 0 | 0 |
| 42 | 1 | 0 | 0 |
| 43 | 1 | 0 | 0 |
| 44 | 1 | 0 | 0 |
| 45 | 1 | 0 | 0 |
| 46 | 1 | 0 | 0 |
| 47 | 1 | 0 | 0 |
| 48 | 1 | 0 | 0 |
| 49 | 1 | 0 | 0 |
| 50 | 1 | 0 | 0 |
| 51 | 1 | 0 | 0 |
| 52 | 1 | 0 | 0 |
| 53 | 1 | 0 | 0 |
| 54 | 1 | 0 | 0 |

Transition probabilities for transition from normal recovery at home, women from better practice hospitals

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 1 | 0.999311697 | 4.91787E-05 | 0.000639124 |
| 2 | 0.999403677 | 4.56254E-05 | 0.000550698 |
| 3 | 0.999483171 | 4.23288E-05 | 0.000474501 |
| 4 | 0.999551888 | 3.92704E-05 | 0.000408842 |
| 5 | 0.999611302 | 3.6433E-05 | 0.000352266 |
| 6 | 0.999662684 | 3.38005E-05 | 0.000303516 |
| 7 | 0.999707131 | 3.13583E-05 | 0.000261511 |
| 8 | 0.99974559 | 2.90925E-05 | 0.000225318 |
| 9 | 0.999778877 | 2.69905E-05 | 0.000194133 |
| 10 | 0.999807696 | 2.50403E-05 | 0.000167263 |
| 11 | 0.999832657 | 2.3231E-05 | 0.000144112 |
| 12 | 0.999854282 | 2.15524E-05 | 0.000124165 |
| 13 | 0.999873026 | 1.99952E-05 | 0.000106979 |
| 14 | 0.999889279 | 1.85504E-05 | 9.2171E-05 |
| 15 | 0.999903377 | 1.721E-05 | 7.94127E-05 |
| 16 | 0.999915613 | 1.59665E-05 | 6.84203E-05 |
| 17 | 0.999926238 | 1.48129E-05 | 5.89494E-05 |
| 18 | 0.999935468 | 1.37425E-05 | 5.07894E-05 |
| 19 | 0.999943492 | 1.27496E-05 | 4.37588E-05 |
| 20 | 0.99995047 | 1.18283E-05 | 3.77015E-05 |
| 21 | 0.999956544 | 1.09737E-05 | 3.24826E-05 |
| 22 | 0.999961833 | 1.01808E-05 | 2.79861E-05 |
| 23 | 0.999966443 | 9.44515E-06 | 2.41121E-05 |

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 24 | 0.999970463 | 8.76268E-06 | 2.07743E-05 |
| 25 | 0.999973972 | 8.12952E-06 | 1.78985E-05 |
| 26 | 0.999977037 | 7.54212E-06 | 1.54209E-05 |
| 27 | 0.999979717 | 6.99715E-06 | 1.32862E-05 |
| 28 | 0.999982061 | 6.49157E-06 | 1.1447E-05 |
| 29 | 0.999984115 | 6.02251E-06 | 9.86238E-06 |
| 30 | 1 | 0 | 0 |
| 31 | 1 | 0 | 0 |
| 32 | 1 | 0 | 0 |
| 33 | 1 | 0 | 0 |
| 34 | 1 | 0 | 0 |
| 35 | 1 | 0 | 0 |
| 36 | 1 | 0 | 0 |
| 37 | 1 | 0 | 0 |
| 38 | 1 | 0 | 0 |
| 39 | 1 | 0 | 0 |
| 40 | 1 | 0 | 0 |
| 41 | 1 | 0 | 0 |
| 42 | 1 | 0 | 0 |
| 43 | 1 | 0 | 0 |
| 44 | 1 | 0 | 0 |
| 45 | 1 | 0 | 0 |
| 46 | 1 | 0 | 0 |
| 47 | 1 | 0 | 0 |
| 48 | 1 | 0 | 0 |
| 49 | 1 | 0 | 0 |
| 50 | 1 | 0 | 0 |
| 51 | 1 | 0 | 0 |
| 52 | 1 | 0 | 0 |
| 53 | 1 | 0 | 0 |
| 54 | 1 | 0 | 0 |

Transition probabilities for transition from infection at home, women from current practice hospitals

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 1 | 0.925807276 | 0.074192724 | 0 |
| 2 | 0.922513623 | 0.077486377 | 0 |
| 3 | 0.919086533 | 0.080913467 | 0 |
| 4 | 0.915521749 | 0.084478251 | 0 |
| 5 | 0.911814981 | 0.088185019 | 0 |

| Cycle | Remain in infection at home | Transition to post- infection recovery | Transition to infection in hospital |
|-------|--------------------------------|---|--|
| 6 | 0.907961917 | 0.092038083 | 0 |
| 7 | 0.903958234 | 0.096041766 | 0 |
| 8 | 0.89979961 | 0.10020039 | 0 |
| 9 | 0.895481736 | 0.104518264 | 0 |
| 10 | 0.891000336 | 0.108999664 | 0 |
| 11 | 0.886351173 | 0.113648827 | 0 |
| 12 | 0.881530076 | 0.118469924 | 0 |
| 13 | 0.876532952 | 0.123467048 | 0 |
| 14 | 0.871355807 | 0.128644193 | 0 |
| 15 | 0.865994765 | 0.134005235 | 0 |
| 16 | 0.860446092 | 0.139553908 | 0 |
| 17 | 0.854706214 | 0.145293786 | 0 |
| 18 | 0.848771747 | 0.151228253 | 0 |
| 19 | 0.842639516 | 0.157360484 | 0 |
| 20 | 0.836306583 | 0.163693417 | 0 |
| 21 | 0.82977027 | 0.17022973 | 0 |
| 22 | 0.82302819 | 0.17697181 | 0 |
| 23 | 0.816078273 | 0.183921727 | 0 |
| 24 | 0.808918789 | 0.191081211 | 0 |
| 25 | 0.801548382 | 0.198451618 | 0 |
| 26 | 0.793966092 | 0.206033908 | 0 |
| 27 | 0.786171387 | 0.213828613 | 0 |
| 28 | 0.778164185 | 0.221835815 | 0 |
| 29 | 0.769944881 | 0.230055119 | 0 |
| 30 | 0.761514373 | 0.238485627 | 0 |
| 31 | 0.752874083 | 0.247125917 | 0 |
| 32 | 0.74402598 | 0.25597402 | 0 |
| 33 | 0.734972599 | 0.265027401 | 0 |
| 34 | 0.725717057 | 0.274282943 | 0 |
| 35 | 0.716263068 | 0.283736932 | 0 |
| 36 | 0.706614954 | 0.293385046 | 0 |
| 37 | 0.696777653 | 0.303222347 | 0 |
| 38 | 0.686756727 | 0.313243273 | 0 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from infection at home, women from better practice hospitals

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 1 | 0.876759017 | 0.114003845 | 0.009237139 |
| 2 | 0.871615091 | 0.118788894 | 0.009596015 |
| 3 | 0.866289135 | 0.123744472 | 0.009966393 |
| 4 | 0.860777453 | 0.128874105 | 0.010348442 |
| 5 | 0.855076506 | 0.134181176 | 0.010742319 |
| 6 | 0.849182936 | 0.139668902 | 0.011148162 |
| 7 | 0.843093593 | 0.145340312 | 0.011566095 |
| 8 | 0.836805553 | 0.151198226 | 0.011996222 |
| 9 | 0.83031615 | 0.157245225 | 0.012438625 |
| 10 | 0.823622998 | 0.163483636 | 0.012893366 |
| 11 | 0.81672402 | 0.169915498 | 0.013360482 |
| 12 | 0.809617473 | 0.176542542 | 0.013839985 |
| 13 | 0.802301973 | 0.183366166 | 0.01433186 |
| 14 | 0.794776529 | 0.190387407 | 0.014836064 |
| 15 | 0.787040561 | 0.197606916 | 0.015352522 |
| 16 | 0.779093932 | 0.205024938 | 0.01588113 |
| 17 | 0.77093697 | 0.212641281 | 0.016421749 |
| 18 | 0.762570493 | 0.2204553 | 0.016974207 |
| 19 | 0.753995832 | 0.228465872 | 0.017538296 |
| 20 | 0.745214853 | 0.236671374 | 0.018113773 |
| 21 | 0.736229975 | 0.24506967 | 0.018700356 |
| 22 | 0.727044185 | 0.253658089 | 0.019297726 |
| 23 | 0.717661058 | 0.262433415 | 0.019905526 |
| 24 | 0.708084764 | 0.271391875 | 0.020523361 |
| 25 | 0.698320076 | 0.280529127 | 0.021150796 |
| 26 | 0.688372381 | 0.28984026 | 0.021787359 |
| 27 | 0.678247675 | 0.299319787 | 0.022432539 |
| 28 | 0.667952563 | 0.30896165 | 0.023085787 |
| 29 | 0.657494257 | 0.318759222 | 0.023746521 |
| 30 | 0.646880558 | 0.328705321 | 0.02441412 |

| Cycle | Remain in infection at home | Transition to post- infection recovery | Transition to infection in hospital |
|--------------|--|---|--|
| 31 | 0.63611985 | 0.338792217 | 0.025087933 |
| 32 | 0.625221074 | 0.349011651 | 0.025767276 |
| 33 | 0.614193708 | 0.359354858 | 0.026451434 |
| 34 | 0.603047742 | 0.369812591 | 0.027139667 |
| 35 | 0.591793643 | 0.380375148 | 0.027831208 |
| 36 | 0.580442322 | 0.391032406 | 0.028525272 |
| 37 | 0.569005092 | 0.401773856 | 0.029221051 |
| 38 | 0.557493631 | 0.412588645 | 0.029917724 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from infection in hospital, women from current practice hospitals

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 1 | 0.724932059 | 0.274534775 | 1.05356E-10 | 0.000533166 |
| 2 | 0.730789692 | 0.268305356 | 1.23323E-09 | 0.000904951 |
| 3 | 0.735629784 | 0.26288771 | 1.00567E-08 | 0.001482496 |
| 4 | 0.739421435 | 0.258234487 | 5.71328E-08 | 0.002344021 |
| 5 | 0.742122796 | 0.254300013 | 2.26111E-07 | 0.003576965 |
| 6 | 0.743688889 | 0.251042635 | 6.23366E-07 | 0.005267853 |
| 7 | 0.744083773 | 0.248428139 | 1.19711E-06 | 0.007486891 |
| 8 | 0.743295797 | 0.246433967 | 1.60135E-06 | 0.010268635 |
| 9 | 0.741352989 | 0.24505358 | 1.49217E-06 | 0.013591939 |
| 10 | 0.73833492 | 0.244300138 | 9.68655E-07 | 0.017363973 |
| 11 | 0.73437737 | 0.24420866 | 4.38138E-07 | 0.021413531 |
| 12 | 0.729666448 | 0.244835733 | 1.38117E-07 | 0.025497681 |
| 13 | 0.724420776 | 0.246256187 | 3.03526E-08 | 0.029323006 |
| 14 | 0.718863898 | 0.248556963 | 4.65147E-09 | 0.032579135 |
| 15 | 0.713191861 | 0.251829048 | 4.97212E-10 | 0.034979091 |
| 16 | 0.707542071 | 0.256158679 | 3.70795E-11 | 0.03629925 |
| 17 | 0.701969234 | 0.261619086 | 1.9293E-12 | 0.036411679 |
| 18 | 0.696432906 | 0.26826397 | 7.00348E-14 | 0.035303124 |
| 19 | 0.690798973 | 0.276123674 | 1.77335E-15 | 0.033077353 |
| 20 | 0.68485497 | 0.285204679 | 3.13114E-17 | 0.029940351 |
| 21 | 0.678336646 | 0.29549257 | 3.85359E-19 | 0.026170784 |
| 22 | 0.670961079 | 0.306958062 | 3.30436E-21 | 0.022080859 |
| 23 | 0.662460368 | 0.319565012 | 1.97321E-23 | 0.017974619 |
| 24 | 0.652609828 | 0.333278822 | 8.20248E-26 | 0.01411135 |
| 25 | 0.641246157 | 0.348073409 | 2.37273E-28 | 0.010680433 |
| 26 | 0.628273714 | 0.363935234 | 4.77483E-31 | 0.007791052 |
| 27 | 0.613660088 | 0.380863549 | 6.68308E-34 | 0.005476363 |
| 28 | 0.597424526 | 0.398866973 | 6.50467E-37 | 0.003708502 |
| 29 | 0.579623707 | 0.417957232 | 4.40186E-40 | 0.00241906 |
| 30 | 0.560338853 | 0.438141403 | 2.07082E-43 | 0.001519744 |
| 31 | 0.539666662 | 0.459413951 | 6.77132E-47 | 0.000919387 |
| 32 | 0.517714849 | 0.481749662 | 1.53868E-50 | 0.000535489 |
| 33 | 0.49460166 | 0.505098122 | 2.42927E-54 | 0.000300218 |
| 34 | 0 | 1 | 0 | 0 |
| 35 | 0 | 1 | 0 | 0 |
| 36 | 0 | 1 | 0 | 0 |
| 37 | 0 | 1 | 0 | 0 |
| 38 | 0 | 1 | 0 | 0 |
| 39 | 0 | 1 | 0 | 0 |
| 40 | 0 | 1 | 0 | 0 |

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 41 | 0 | 1 | 0 | 0 |
| 42 | 0 | 1 | 0 | 0 |
| 43 | 0 | 1 | 0 | 0 |
| 44 | 0 | 1 | 0 | 0 |
| 45 | 0 | 1 | 0 | 0 |
| 46 | 0 | 1 | 0 | 0 |
| 47 | 0 | 1 | 0 | 0 |
| 48 | 0 | 1 | 0 | 0 |
| 49 | 0 | 1 | 0 | 0 |
| 50 | 0 | 1 | 0 | 0 |
| 51 | 0 | 1 | 0 | 0 |
| 52 | 0 | 1 | 0 | 0 |
| 53 | 0 | 1 | 0 | 0 |
| 54 | 0 | 1 | 0 | 0 |

Transition probabilities for transition from infection in hospital, women from better practice hospitals

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 1 | 0.707054275 | 0.29181132 | 8.12709E-10 | 0.001134404 |
| 2 | 0.712851009 | 0.285223315 | 9.51418E-09 | 0.001925667 |
| 3 | 0.717435213 | 0.279410674 | 7.7571E-08 | 0.003154035 |
| 4 | 0.720711138 | 0.274304394 | 4.40429E-07 | 0.004984028 |
| 5 | 0.722566253 | 0.269834583 | 1.74118E-06 | 0.007597423 |
| 6 | 0.722888955 | 0.265935985 | 4.7923E-06 | 0.011170268 |
| 7 | 0.721595785 | 0.262556193 | 9.18177E-06 | 0.01583884 |
| 8 | 0.718663949 | 0.259665395 | 1.22454E-05 | 0.021658411 |
| 9 | 0.714160493 | 0.257265266 | 1.13687E-05 | 0.028562873 |
| 10 | 0.70826113 | 0.25539538 | 7.34903E-06 | 0.036336141 |
| 11 | 0.701254321 | 0.25413627 | 3.30893E-06 | 0.0446061 |
| 12 | 0.693524424 | 0.253607161 | 1.03826E-06 | 0.052867377 |
| 13 | 0.685511232 | 0.25395698 | 2.27165E-07 | 0.06053156 |
| 14 | 0.677653508 | 0.255350244 | 3.46794E-08 | 0.066996214 |
| 15 | 0.67032922 | 0.257950825 | 3.6961E-09 | 0.071719951 |
| 16 | 0.663803259 | 0.261906039 | 2.75132E-10 | 0.074290702 |
| 17 | 0.65819009 | 0.267332655 | 1.43072E-11 | 0.074477255 |
| 18 | 0.653435869 | 0.274306034 | 5.19707E-13 | 0.072258097 |
| 19 | 0.649321834 | 0.282853327 | 1.31833E-14 | 0.067824839 |
| 20 | 0.645488633 | 0.292951657 | 2.33407E-16 | 0.06155971 |
| 21 | 0.64147908 | 0.304532122 | 2.8822E-18 | 0.053988798 |

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|--------------|--|--|---|--|
| 22 | 0.636794084 | 0.317490007 | 2.48033E-20 | 0.045715909 |
| 23 | 0.63095341 | 0.331700358 | 1.48639E-22 | 0.037346232 |
| 24 | 0.623550673 | 0.347036525 | 6.19847E-25 | 0.029412802 |
| 25 | 0.614292342 | 0.36338793 | 1.79771E-27 | 0.022319728 |
| 26 | 0.60301429 | 0.380673059 | 3.62458E-30 | 0.01631265 |
| 27 | 0.589675549 | 0.39884484 | 5.07906E-33 | 0.011479611 |
| 28 | 0.574334957 | 0.417887716 | 4.94571E-36 | 0.007777328 |
| 29 | 0.557119823 | 0.437807948 | 3.34626E-39 | 0.005072229 |
| 30 | 0.538195651 | 0.458620082 | 1.57309E-42 | 0.003184267 |
| 31 | 0.517743085 | 0.480332775 | 5.13787E-46 | 0.00192414 |
| 32 | 0.495944458 | 0.50293651 | 1.16577E-49 | 0.001119032 |
| 33 | 0.472979087 | 0.526394627 | 1.83732E-53 | 0.000626286 |
| 34 | 0 | 1 | 0 | 0 |
| 35 | 0 | 1 | 0 | 0 |
| 36 | 0 | 1 | 0 | 0 |
| 37 | 0 | 1 | 0 | 0 |
| 38 | 0 | 1 | 0 | 0 |
| 39 | 0 | 1 | 0 | 0 |
| 40 | 0 | 1 | 0 | 0 |
| 41 | 0 | 1 | 0 | 0 |
| 42 | 0 | 1 | 0 | 0 |
| 43 | 0 | 1 | 0 | 0 |
| 44 | 0 | 1 | 0 | 0 |
| 45 | 0 | 1 | 0 | 0 |
| 46 | 0 | 1 | 0 | 0 |
| 47 | 0 | 1 | 0 | 0 |
| 48 | 0 | 1 | 0 | 0 |
| 49 | 0 | 1 | 0 | 0 |
| 50 | 0 | 1 | 0 | 0 |
| 51 | 0 | 1 | 0 | 0 |
| 52 | 0 | 1 | 0 | 0 |
| 53 | 0 | 1 | 0 | 0 |
| 54 | 0 | 1 | 0 | 0 |

Transition probabilities for transition from infection at home with NPWT, women from current practice hospitals

| Cycle | Remain in infection at home with NPWT | Transition to post-infection recovery |
|--------------|--|--|
| 1 | 0.238667285 | 0.761332715 |
| 2 | 0.477764675 | 0.522235325 |
| 3 | 0.703495691 | 0.296504309 |
| 4 | 0.845404084 | 0.154595916 |
| 5 | 0.918039275 | 0.081960725 |
| 6 | 0.953247195 | 0.046752805 |
| 7 | 0.970573743 | 0.029426257 |
| 8 | 0.979346486 | 0.020653514 |
| 9 | 0.983761524 | 0.016238476 |
| 10 | 0.985670475 | 0.014329525 |
| 11 | 0.985797039 | 0.014202961 |
| 12 | 0.984187256 | 0.015812744 |
| 13 | 0.980237332 | 0.019762668 |
| 14 | 0.972320677 | 0.027679323 |
| 15 | 0.956727447 | 0.043272553 |
| 16 | 0.925186708 | 0.074813292 |
| 17 | 0.860085466 | 0.139914534 |
| 18 | 0.730861921 | 0.269138079 |
| 19 | 0.515994541 | 0.484005459 |
| 20 | 0.271109642 | 0.728890358 |
| 21 | 0.103400451 | 0.896599549 |
| 22 | 0.030798695 | 0.969201305 |
| 23 | 0.007721463 | 0.992278537 |
| 24 | 0.001690566 | 0.998309434 |
| 25 | 0.0003274 | 0.9996726 |
| 26 | 5.62865E-05 | 0.999943714 |
| 27 | 8.59776E-06 | 0.999991402 |
| 28 | 1.16709E-06 | 0.999998833 |
| 29 | 1.40789E-07 | 0.999999859 |
| 30 | 0 | 1 |
| 31 | 0 | 1 |
| 32 | 0 | 1 |
| 33 | 0 | 1 |
| 34 | 0 | 1 |
| 35 | 0 | 1 |
| 36 | 0 | 1 |
| 37 | 0 | 1 |
| 38 | 0 | 1 |
| 39 | 0 | 1 |
| 40 | 0 | 1 |

| Cycle | Remain in infection at home with NPWT | Transition to post- infection recovery |
|--------------|--|---|
| 41 | 0 | 1 |
| 42 | 0 | 1 |
| 43 | 0 | 1 |
| 44 | 0 | 1 |
| 45 | 0 | 1 |
| 46 | 0 | 1 |
| 47 | 0 | 1 |
| 48 | 0 | 1 |
| 49 | 0 | 1 |
| 50 | 0 | 1 |
| 51 | 0 | 1 |
| 52 | 0 | 1 |
| 53 | 0 | 1 |
| 54 | 0 | 1 |

Transition probabilities for transition from infection at home with NPWT, women from better practice hospitals

| Cycle | Remain in infection at home with NPWT | Transition to post- infection recovery |
|--------------|--|---|
| 1 | 0.681570805 | 0.318429195 |
| 2 | 0.861999811 | 0.138000189 |
| 3 | 0.941859849 | 0.058140151 |
| 4 | 0.973915925 | 0.026084075 |
| 5 | 0.987093071 | 0.012906929 |
| 6 | 0.992867957 | 0.007132043 |
| 7 | 0.995579182 | 0.004420818 |
| 8 | 0.996920795 | 0.003079205 |
| 9 | 0.997588279 | 0.002411721 |
| 10 | 0.997875305 | 0.002124695 |
| 11 | 0.997894301 | 0.002105699 |
| 12 | 0.997652373 | 0.002347627 |
| 13 | 0.997055889 | 0.002944111 |
| 14 | 0.995847981 | 0.004152019 |
| 15 | 0.993419223 | 0.006580777 |
| 16 | 0.988295403 | 0.011704597 |
| 17 | 0.976728971 | 0.023271029 |
| 18 | 0.948826299 | 0.051173701 |
| 19 | 0.879213157 | 0.120786843 |
| 20 | 0.717480866 | 0.282519134 |
| 21 | 0.4405328 | 0.5594672 |

| Cycle | Remain in infection at home with NPWT | Transition to post- infection recovery |
|--------------|--|---|
| 22 | 0.178286498 | 0.821713502 |
| 23 | 0.050450261 | 0.949549739 |
| 24 | 0.011430203 | 0.988569797 |
| 25 | 0.00223116 | 0.99776884 |
| 26 | 0.000384186 | 0.999615814 |
| 27 | 5.87007E-05 | 0.999941299 |
| 28 | 7.96855E-06 | 0.999992031 |
| 29 | 9.61279E-07 | 0.999999039 |
| 30 | 0 | 1 |
| 31 | 0 | 1 |
| 32 | 0 | 1 |
| 33 | 0 | 1 |
| 34 | 0 | 1 |
| 35 | 0 | 1 |
| 36 | 0 | 1 |
| 37 | 0 | 1 |
| 38 | 0 | 1 |
| 39 | 0 | 1 |
| 40 | 0 | 1 |
| 41 | 0 | 1 |
| 42 | 0 | 1 |
| 43 | 0 | 1 |
| 44 | 0 | 1 |
| 45 | 0 | 1 |
| 46 | 0 | 1 |
| 47 | 0 | 1 |
| 48 | 0 | 1 |
| 49 | 0 | 1 |
| 50 | 0 | 1 |
| 51 | 0 | 1 |
| 52 | 0 | 1 |
| 53 | 0 | 1 |
| 54 | 0 | 1 |

Appendix O

Transition Probabilities: Public Hospitals Sub-Group

Transition probabilities for transition from caesarean section, women from current practice hospitals

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 1 | 0.885819259 | 0.113271312 | 0.000909429 |
| 2 | 0.768524468 | 0.230383521 | 0.001092011 |
| 3 | 0.610562895 | 0.388251883 | 0.001185222 |
| 4 | 0.449808745 | 0.548998375 | 0.001192881 |
| 5 | 0.320172157 | 0.678667857 | 0.001159986 |
| 6 | 0.23062991 | 0.768228568 | 0.001141523 |
| 7 | 0.174120738 | 0.824701875 | 0.001177387 |
| 8 | 0.140784697 | 0.857914762 | 0.001300541 |
| 9 | 0.123353417 | 0.87508983 | 0.001556753 |
| 10 | 0.117784722 | 0.880184523 | 0.002030754 |
| 11 | 0.122757294 | 0.874351256 | 0.002891449 |
| 12 | 0.139374151 | 0.856140973 | 0.004484876 |
| 13 | 0.171305641 | 0.821163583 | 0.007530776 |
| 14 | 0.224982825 | 0.761505248 | 0.013511927 |
| 15 | 0.308207693 | 0.666504494 | 0.025287813 |
| 16 | 0.423324856 | 0.529224573 | 0.047450571 |
| 17 | 0.553378671 | 0.361881035 | 0.084740295 |
| 18 | 0.658447272 | 0.203803734 | 0.137748994 |
| 19 | 0.705038427 | 0.093459231 | 0.201502343 |
| 20 | 0.693567733 | 0.035627646 | 0.270804621 |
| 21 | 0.644567005 | 0.011609826 | 0.343823169 |
| 22 | 0.576553266 | 0.003294784 | 0.42015195 |
| 23 | 0.500701198 | 0.000821423 | 0.49847738 |
| 24 | 0.423636692 | 0.000180531 | 0.576182776 |
| 25 | 0.349871838 | 3.50437E-05 | 0.650093118 |
| 26 | 0.282608921 | 6.02003E-06 | 0.717385059 |
| 27 | 0.223818682 | 9.1747E-07 | 0.776180401 |
| 28 | 0.174286286 | 1.24398E-07 | 0.82571359 |
| 29 | 0.133825611 | 1.50491E-08 | 0.866174374 |
| 30 | 0 | 1 | 0 |
| 31 | 0 | 1 | 0 |
| 32 | 0 | 1 | 0 |
| 33 | 0 | 1 | 0 |
| 34 | 0 | 1 | 0 |
| 35 | 0 | 1 | 0 |
| 36 | 0 | 1 | 0 |
| 37 | 0 | 1 | 0 |

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 38 | 0 | 1 | 0 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from caesarean section, women from better practice hospitals

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 1 | 0.880029432 | 0.118465544 | 0.001505024 |
| 2 | 0.758823135 | 0.239471767 | 0.001705098 |
| 3 | 0.597977555 | 0.400302303 | 0.001720142 |
| 4 | 0.436973186 | 0.561458933 | 0.001567882 |
| 5 | 0.309038334 | 0.689614074 | 0.001347592 |
| 6 | 0.221639398 | 0.777216174 | 0.001144429 |
| 7 | 0.166885819 | 0.83212 | 0.000994181 |
| 8 | 0.134736842 | 0.864360871 | 0.000902287 |
| 9 | 0.117985327 | 0.881149293 | 0.00086538 |
| 10 | 0.112679248 | 0.886438785 | 0.000881967 |
| 11 | 0.117558999 | 0.881484244 | 0.000956757 |
| 12 | 0.133780148 | 0.865116833 | 0.00110302 |
| 13 | 0.165166499 | 0.833489289 | 0.001344212 |
| 14 | 0.218767879 | 0.779519774 | 0.001712347 |
| 15 | 0.304516201 | 0.693250281 | 0.002233518 |
| 16 | 0.430516983 | 0.566599991 | 0.002883026 |
| 17 | 0.590181833 | 0.406302307 | 0.003515861 |
| 18 | 0.75130997 | 0.244810663 | 0.003879367 |
| 19 | 0.874194286 | 0.121993705 | 0.003812009 |
| 20 | 0.945478277 | 0.0511293 | 0.003392424 |
| 21 | 0.978628402 | 0.018556475 | 0.002815122 |

| Cycle | Remain in caesarean section | Transition to normal recovery at home | Transition to infection in hospital |
|-------|--------------------------------|--|--|
| 22 | 0.991804692 | 0.005966694 | 0.002228614 |
| 23 | 0.996574514 | 0.001721147 | 0.001704339 |
| 24 | 0.998286109 | 0.000447852 | 0.00126604 |
| 25 | 0.99897928 | 0.000105336 | 0.000915383 |
| 26 | 0.999332947 | 2.24101E-05 | 0.000644643 |
| 27 | 0.999553418 | 4.31342E-06 | 0.000442269 |
| 28 | 0.999703631 | 7.51173E-07 | 0.000295618 |
| 29 | 0.999807367 | 1.18361E-07 | 0.000192515 |
| 30 | 0 | 1 | 0 |
| 31 | 0 | 1 | 0 |
| 32 | 0 | 1 | 0 |
| 33 | 0 | 1 | 0 |
| 34 | 0 | 1 | 0 |
| 35 | 0 | 1 | 0 |
| 36 | 0 | 1 | 0 |
| 37 | 0 | 1 | 0 |
| 38 | 0 | 1 | 0 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from normal recovery at home, women from current practice hospitals

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 1 | 0.995066835 | 0.003699873 | 0.001233291 |
| 2 | 0.995645867 | 0.0032656 | 0.001088533 |
| 3 | 0.996156999 | 0.002882251 | 0.00096075 |
| 4 | 0.996608181 | 0.002543864 | 0.000847955 |
| 5 | 0.997006432 | 0.002245176 | 0.000748392 |
| 6 | 0.997357953 | 0.001981535 | 0.000660512 |
| 7 | 0.997668221 | 0.001748834 | 0.000582945 |
| 8 | 0.997942071 | 0.001543447 | 0.000514482 |
| 9 | 0.998183774 | 0.001362169 | 0.000454056 |
| 10 | 0.998397101 | 0.001202174 | 0.000400725 |
| 11 | 0.99858538 | 0.001060965 | 0.000353655 |
| 12 | 0.99875155 | 0.000936337 | 0.000312112 |
| 13 | 0.99898207 | 0.000826345 | 0.000275448 |
| 14 | 0.999027639 | 0.000729271 | 0.00024309 |
| 15 | 0.99914187 | 0.000643597 | 0.000214532 |
| 16 | 0.999242684 | 0.000567987 | 0.000189329 |
| 17 | 0.999331656 | 0.000501258 | 0.000167086 |
| 18 | 0.999410177 | 0.000442367 | 0.000147456 |
| 19 | 0.999479474 | 0.000390395 | 0.000130132 |
| 20 | 0.99954063 | 0.000344527 | 0.000114842 |
| 21 | 0.999594602 | 0.000304048 | 0.000101349 |
| 22 | 0.999642233 | 0.000268325 | 8.94416E-05 |
| 23 | 0.999684269 | 0.000236798 | 7.89328E-05 |
| 24 | 0.999721366 | 0.000208976 | 6.96586E-05 |
| 25 | 0.999754104 | 0.000184422 | 6.1474E-05 |
| 26 | 0.999782996 | 0.000162753 | 5.4251E-05 |
| 27 | 0.999808493 | 0.00014363 | 4.78766E-05 |
| 28 | 0.999830995 | 0.000126754 | 4.22512E-05 |
| 29 | 0.999850853 | 0.00011186 | 3.72868E-05 |
| 30 | 1 | 0 | 0 |
| 31 | 1 | 0 | 0 |
| 32 | 1 | 0 | 0 |
| 33 | 1 | 0 | 0 |
| 34 | 1 | 0 | 0 |
| 35 | 1 | 0 | 0 |
| 36 | 1 | 0 | 0 |
| 37 | 1 | 0 | 0 |
| 38 | 1 | 0 | 0 |
| 39 | 1 | 0 | 0 |
| 40 | 1 | 0 | 0 |

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 41 | 1 | 0 | 0 |
| 42 | 1 | 0 | 0 |
| 43 | 1 | 0 | 0 |
| 44 | 1 | 0 | 0 |
| 45 | 1 | 0 | 0 |
| 46 | 1 | 0 | 0 |
| 47 | 1 | 0 | 0 |
| 48 | 1 | 0 | 0 |
| 49 | 1 | 0 | 0 |
| 50 | 1 | 0 | 0 |
| 51 | 1 | 0 | 0 |
| 52 | 1 | 0 | 0 |
| 53 | 1 | 0 | 0 |
| 54 | 1 | 0 | 0 |

Transition probabilities for transition from normal recovery at home, women from better practice hospitals

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|-------|-----------------------------------|---------------------------------|-------------------------------------|
| 1 | 0.990428294 | 0.007178779 | 0.002392926 |
| 2 | 0.991550623 | 0.006337032 | 0.002112344 |
| 3 | 0.9925416 | 0.0055938 | 0.0018646 |
| 4 | 0.993416543 | 0.004937593 | 0.001645864 |
| 5 | 0.994188996 | 0.004358253 | 0.001452751 |
| 6 | 0.994870931 | 0.003846802 | 0.001282267 |
| 7 | 0.99547293 | 0.003395302 | 0.001131767 |
| 8 | 0.996004344 | 0.002996742 | 0.000998914 |
| 9 | 0.996473432 | 0.002644926 | 0.000881642 |
| 10 | 0.996887492 | 0.002334381 | 0.000778127 |
| 11 | 0.99725297 | 0.002060272 | 0.000686757 |
| 12 | 0.997575559 | 0.001818331 | 0.00060611 |
| 13 | 0.997860286 | 0.001604785 | 0.000534928 |
| 14 | 0.99811159 | 0.001416307 | 0.000472102 |
| 15 | 0.998333392 | 0.001249956 | 0.000416652 |
| 16 | 0.998529151 | 0.001103136 | 0.000367712 |
| 17 | 0.998701925 | 0.000973557 | 0.000324519 |
| 18 | 0.998854409 | 0.000859193 | 0.000286398 |
| 19 | 0.998988985 | 0.000758261 | 0.000252754 |
| 20 | 0.999107756 | 0.000669183 | 0.000223061 |
| 21 | 0.999212577 | 0.000590567 | 0.000196856 |
| 22 | 0.999305086 | 0.000521186 | 0.000173729 |
| 23 | 0.999386728 | 0.000459954 | 0.000153318 |

| Cycle | Remain in normal recovery at home | Transition to infection at home | Transition to infection in hospital |
|--------------|--|--|--|
| 24 | 0.999458779 | 0.000405916 | 0.000135305 |
| 25 | 0.999522367 | 0.000358225 | 0.000119408 |
| 26 | 0.999578484 | 0.000316137 | 0.000105379 |
| 27 | 0.999628009 | 0.000278993 | 9.29977E-05 |
| 28 | 0.999671716 | 0.000246213 | 8.20711E-05 |
| 29 | 0.999710287 | 0.000217285 | 7.24282E-05 |
| 30 | 1 | 0 | 0 |
| 31 | 1 | 0 | 0 |
| 32 | 1 | 0 | 0 |
| 33 | 1 | 0 | 0 |
| 34 | 1 | 0 | 0 |
| 35 | 1 | 0 | 0 |
| 36 | 1 | 0 | 0 |
| 37 | 1 | 0 | 0 |
| 38 | 1 | 0 | 0 |
| 39 | 1 | 0 | 0 |
| 40 | 1 | 0 | 0 |
| 41 | 1 | 0 | 0 |
| 42 | 1 | 0 | 0 |
| 43 | 1 | 0 | 0 |
| 44 | 1 | 0 | 0 |
| 45 | 1 | 0 | 0 |
| 46 | 1 | 0 | 0 |
| 47 | 1 | 0 | 0 |
| 48 | 1 | 0 | 0 |
| 49 | 1 | 0 | 0 |
| 50 | 1 | 0 | 0 |
| 51 | 1 | 0 | 0 |
| 52 | 1 | 0 | 0 |
| 53 | 1 | 0 | 0 |
| 54 | 1 | 0 | 0 |

Transition probabilities for transition from infection at home, women from current practice hospitals

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|--------------|------------------------------------|--|--|
| 1 | 0.88323641 | 0.039575969 | 0.07718762 |
| 2 | 0.876947723 | 0.046529038 | 0.07652324 |
| 3 | 0.869895578 | 0.05432597 | 0.075778452 |
| 4 | 0.862060119 | 0.062988629 | 0.074951252 |
| 5 | 0.853436086 | 0.072522717 | 0.074041196 |

| Cycle | Remain in infection at home | Transition to post- infection recovery | Transition to infection in hospital |
|-------|--------------------------------|---|--|
| 6 | 0.844034817 | 0.082915577 | 0.073049605 |
| 7 | 0.833885694 | 0.094134587 | 0.071979718 |
| 8 | 0.823036898 | 0.106126336 | 0.070836766 |
| 9 | 0.811555361 | 0.11881668 | 0.069627959 |
| 10 | 0.799525872 | 0.132111742 | 0.068362386 |
| 11 | 0.787049364 | 0.145899813 | 0.067050823 |
| 12 | 0.774240462 | 0.160054071 | 0.065705467 |
| 13 | 0.76122447 | 0.174435925 | 0.064339606 |
| 14 | 0.748133977 | 0.188898772 | 0.062967251 |
| 15 | 0.735105319 | 0.203291921 | 0.06160276 |
| 16 | 0.722275106 | 0.217464431 | 0.060260464 |
| 17 | 0.709777017 | 0.231268659 | 0.058954325 |
| 18 | 0.697739015 | 0.244563339 | 0.057697646 |
| 19 | 0.686281087 | 0.257216075 | 0.056502838 |
| 20 | 0.675513549 | 0.269105209 | 0.055381242 |
| 21 | 0.665535926 | 0.280121047 | 0.054343027 |
| 22 | 0.656436352 | 0.290166512 | 0.053397136 |
| 23 | 0.648291418 | 0.299157298 | 0.052551284 |
| 24 | 0.641166382 | 0.307021626 | 0.051811992 |
| 25 | 0.635115617 | 0.313699731 | 0.051184652 |
| 26 | 0.630183227 | 0.319143171 | 0.050673603 |
| 27 | 0.626403702 | 0.323314086 | 0.050282212 |
| 28 | 0.623802562 | 0.32618448 | 0.050012958 |
| 29 | 0.622396906 | 0.327735605 | 0.049867489 |
| 30 | 0.622195811 | 0.327957508 | 0.04984668 |
| 31 | 0.623200568 | 0.326848776 | 0.049950655 |
| 32 | 0.62540471 | 0.324416498 | 0.050178792 |
| 33 | 0.62879385 | 0.320676447 | 0.050529704 |
| 34 | 0.633345329 | 0.315653476 | 0.051001195 |
| 35 | 0.639027714 | 0.309382082 | 0.051590205 |
| 36 | 0.64580018 | 0.301907095 | 0.052292725 |
| 37 | 0.65361185 | 0.293284426 | 0.053103724 |
| 38 | 0.662401155 | 0.28358178 | 0.054017066 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from infection at home, women from better practice hospitals

| Cycle | Remain in infection at home | Transition to post-infection recovery | Transition to infection in hospital |
|-------|-----------------------------|---------------------------------------|-------------------------------------|
| 1 | 0.81359249 | 0.034419381 | 0.151988128 |
| 2 | 0.828343546 | 0.041495632 | 0.130160822 |
| 3 | 0.838975492 | 0.049468777 | 0.111555731 |
| 4 | 0.845894697 | 0.058355586 | 0.095749718 |
| 5 | 0.849493526 | 0.06815609 | 0.082350384 |
| 6 | 0.850143707 | 0.078851442 | 0.071004851 |
| 7 | 0.848194943 | 0.090402389 | 0.061402668 |
| 8 | 0.843976436 | 0.102748553 | 0.05327501 |
| 9 | 0.837799609 | 0.115808636 | 0.046391755 |
| 10 | 0.829960877 | 0.129481597 | 0.040557526 |
| 11 | 0.820743818 | 0.14364877 | 0.035607412 |
| 12 | 0.810420438 | 0.158176796 | 0.031402766 |
| 13 | 0.799251498 | 0.172921176 | 0.027827325 |
| 14 | 0.78748604 | 0.187730203 | 0.024783756 |
| 15 | 0.775360342 | 0.202449015 | 0.022190642 |
| 16 | 0.763096578 | 0.216923509 | 0.019979913 |
| 17 | 0.750901433 | 0.231003901 | 0.018094666 |
| 18 | 0.738964896 | 0.244547758 | 0.016487347 |
| 19 | 0.727459368 | 0.257422408 | 0.015118225 |
| 20 | 0.716539194 | 0.269506672 | 0.013954133 |
| 21 | 0.706340628 | 0.280691948 | 0.012967424 |
| 22 | 0.696982199 | 0.290882694 | 0.012135107 |
| 23 | 0.688565438 | 0.299996425 | 0.011438137 |
| 24 | 0.681175844 | 0.30796332 | 0.010860836 |
| 25 | 0.674884017 | 0.314725569 | 0.010390414 |
| 26 | 0.669746844 | 0.320236567 | 0.010016589 |
| 27 | 0.665808644 | 0.32446008 | 0.009731277 |
| 28 | 0.663102203 | 0.327369444 | 0.009528353 |
| 29 | 0.661649625 | 0.328946903 | 0.009403472 |
| 30 | 0.661462953 | 0.329183115 | 0.009353932 |

| Cycle | Remain in infection at home | Transition to post- infection recovery | Transition to infection in hospital |
|--------------|--|---|--|
| 31 | 0.662544523 | 0.328076876 | 0.009378601 |
| 32 | 0.664887046 | 0.325635081 | 0.009477873 |
| 33 | 0.668473399 | 0.321872918 | 0.009653682 |
| 34 | 0.673276159 | 0.316814296 | 0.009909545 |
| 35 | 0.679256888 | 0.310492451 | 0.010250661 |
| 36 | 0.686365237 | 0.302950705 | 0.010684058 |
| 37 | 0.69453792 | 0.294243296 | 0.011218785 |
| 38 | 0.703697632 | 0.284436197 | 0.011866171 |
| 39 | 0 | 1 | 0 |
| 40 | 0 | 1 | 0 |
| 41 | 0 | 1 | 0 |
| 42 | 0 | 1 | 0 |
| 43 | 0 | 1 | 0 |
| 44 | 0 | 1 | 0 |
| 45 | 0 | 1 | 0 |
| 46 | 0 | 1 | 0 |
| 47 | 0 | 1 | 0 |
| 48 | 0 | 1 | 0 |
| 49 | 0 | 1 | 0 |
| 50 | 0 | 1 | 0 |
| 51 | 0 | 1 | 0 |
| 52 | 0 | 1 | 0 |
| 53 | 0 | 1 | 0 |
| 54 | 0 | 1 | 0 |

Transition probabilities for transition from infection in hospital, women from current practice hospitals

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 1 | 0.717709973 | 0.281163584 | 2.36436E-06 | 0.001124078 |
| 2 | 0.7246321 | 0.273563885 | 2.76633E-05 | 0.001776352 |
| 3 | 0.729907287 | 0.267144209 | 0.000225284 | 0.002723221 |
| 4 | 0.733017755 | 0.261658711 | 0.001276163 | 0.004047371 |
| 5 | 0.732579308 | 0.256580564 | 0.005019145 | 0.005820984 |
| 6 | 0.726929604 | 0.251313394 | 0.013674292 | 0.008082711 |
| 7 | 0.717118163 | 0.246192002 | 0.025840125 | 0.01084971 |
| 8 | 0.70864761 | 0.243040836 | 0.034125547 | 0.014186007 |
| 9 | 0.706544366 | 0.24353413 | 0.031724013 | 0.01819749 |
| 10 | 0.709257082 | 0.247173164 | 0.020715992 | 0.022853762 |
| 11 | 0.710769478 | 0.251947128 | 0.009421893 | 0.027861501 |
| 12 | 0.707571079 | 0.256648948 | 0.002969893 | 0.03281008 |
| 13 | 0.700448587 | 0.261541264 | 0.000649475 | 0.037360675 |
| 14 | 0.691326964 | 0.267330036 | 9.87959E-05 | 0.041244204 |
| 15 | 0.681302056 | 0.274479577 | 1.04693E-05 | 0.044207898 |
| 16 | 0.670741171 | 0.283228623 | 7.73234E-07 | 0.046029432 |
| 17 | 0.65970929 | 0.293732758 | 3.98052E-08 | 0.046557912 |
| 18 | 0.648138946 | 0.306119698 | 1.42804E-09 | 0.045741354 |
| 19 | 0.635869397 | 0.320494236 | 3.56927E-11 | 0.043636366 |
| 20 | 0.62266523 | 0.336931661 | 6.2124E-13 | 0.040403108 |
| 21 | 0.608241702 | 0.355470918 | 7.52538E-15 | 0.036287381 |
| 22 | 0.59229808 | 0.3761098 | 6.34007E-17 | 0.03159212 |
| 23 | 0.574555074 | 0.398802799 | 3.71228E-19 | 0.026642126 |
| 24 | 0.554791124 | 0.42346158 | 1.50955E-21 | 0.021747295 |
| 25 | 0.532872316 | 0.449957412 | 4.25995E-24 | 0.017170272 |
| 26 | 0.508771897 | 0.478124365 | 8.33722E-27 | 0.013103737 |
| 27 | 0.482577579 | 0.507761979 | 1.13093E-29 | 0.009660442 |
| 28 | 0.454487265 | 0.538636525 | 1.06271E-32 | 0.00687621 |
| 29 | 0.424795804 | 0.570480902 | 6.91439E-36 | 0.004723293 |
| 30 | 0.393876124 | 0.602994185 | 3.11363E-39 | 0.003129691 |
| 31 | 0.362157759 | 0.63584258 | 9.70044E-43 | 0.001999661 |
| 32 | 0.330104761 | 0.668663646 | 2.09019E-46 | 0.001231592 |
| 33 | 0.298193897 | 0.701075115 | 3.11407E-50 | 0.000730988 |
| 34 | 0 | 1 | 0 | 0 |
| 35 | 0 | 1 | 0 | 0 |
| 36 | 0 | 1 | 0 | 0 |
| 37 | 0 | 1 | 0 | 0 |
| 38 | 0 | 1 | 0 | 0 |
| 39 | 0 | 1 | 0 | 0 |
| 40 | 0 | 1 | 0 | 0 |

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 41 | 0 | 1 | 0 | 0 |
| 42 | 0 | 1 | 0 | 0 |
| 43 | 0 | 1 | 0 | 0 |
| 44 | 0 | 1 | 0 | 0 |
| 45 | 0 | 1 | 0 | 0 |
| 46 | 0 | 1 | 0 | 0 |
| 47 | 0 | 1 | 0 | 0 |
| 48 | 0 | 1 | 0 | 0 |
| 49 | 0 | 1 | 0 | 0 |
| 50 | 0 | 1 | 0 | 0 |
| 51 | 0 | 1 | 0 | 0 |
| 52 | 0 | 1 | 0 | 0 |
| 53 | 0 | 1 | 0 | 0 |
| 54 | 0 | 1 | 0 | 0 |

Transition probabilities for transition from infection in hospital, women from better practice hospitals

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|-------|---------------------------------|---------------------------------|--|---|
| 1 | 0.710135258 | 0.286819459 | 1.42912E-05 | 0.003030992 |
| 2 | 0.716262178 | 0.278785807 | 0.00016704 | 0.004784975 |
| 3 | 0.719737605 | 0.271587456 | 0.001357055 | 0.007317884 |
| 4 | 0.717510285 | 0.264062226 | 0.007630991 | 0.010796498 |
| 5 | 0.701947903 | 0.253472843 | 0.029379281 | 0.015199974 |
| 6 | 0.665933788 | 0.23736232 | 0.07652525 | 0.020178643 |
| 7 | 0.619078974 | 0.219122371 | 0.136273425 | 0.025525229 |
| 8 | 0.58743108 | 0.207712815 | 0.17280943 | 0.032046675 |
| 9 | 0.588288434 | 0.209058656 | 0.161361609 | 0.041291302 |
| 10 | 0.615181091 | 0.22103348 | 0.1097656 | 0.054019829 |
| 11 | 0.643806409 | 0.235284536 | 0.052134586 | 0.068774468 |
| 12 | 0.655321212 | 0.245064886 | 0.016802976 | 0.082810926 |
| 13 | 0.651047594 | 0.250630627 | 0.003687738 | 0.094634041 |
| 14 | 0.640150082 | 0.255213424 | 0.000558854 | 0.104077639 |
| 15 | 0.628027478 | 0.260859362 | 5.89547E-05 | 0.111054205 |
| 16 | 0.616380954 | 0.268342112 | 4.34077E-06 | 0.115272594 |
| 17 | 0.60555669 | 0.277979031 | 2.23205E-07 | 0.116464055 |
| 18 | 0.595496359 | 0.289974438 | 8.01517E-09 | 0.114529196 |
| 19 | 0.585938498 | 0.304482109 | 2.00921E-10 | 0.109579392 |
| 20 | 0.576463525 | 0.321600332 | 3.51348E-12 | 0.101936143 |
| 21 | 0.566532944 | 0.341358325 | 4.28192E-14 | 0.092108731 |

| Cycle | Remain in infection in hospital | Transition to infection at home | Transition to infection in hospital with surgery | Transition to infection at home with NPWT |
|--------------|--|--|---|--|
| 22 | 0.555543016 | 0.363705161 | 3.63272E-16 | 0.080751823 |
| 23 | 0.542891285 | 0.388505213 | 2.14281E-18 | 0.068603502 |
| 24 | 0.528048519 | 0.415542822 | 8.77714E-21 | 0.056408659 |
| 25 | 0.510624754 | 0.444536641 | 2.4937E-23 | 0.044838605 |
| 26 | 0.490417124 | 0.475161051 | 4.90936E-26 | 0.034421825 |
| 27 | 0.467430396 | 0.507069438 | 6.69187E-29 | 0.025500166 |
| 28 | 0.441867993 | 0.539913359 | 6.31173E-32 | 0.018218648 |
| 29 | 0.414098877 | 0.573353399 | 4.11755E-35 | 0.012547724 |
| 30 | 0.384610708 | 0.607060935 | 1.85733E-38 | 0.008328357 |
| 31 | 0.353960367 | 0.640713532 | 5.79175E-42 | 0.005326101 |
| 32 | 0.322729942 | 0.673988723 | 1.24835E-45 | 0.003281335 |
| 33 | 0.291491803 | 0.706560892 | 1.85959E-49 | 0.001947305 |
| 34 | 0 | 1 | 0 | 0 |
| 35 | 0 | 1 | 0 | 0 |
| 36 | 0 | 1 | 0 | 0 |
| 37 | 0 | 1 | 0 | 0 |
| 38 | 0 | 1 | 0 | 0 |
| 39 | 0 | 1 | 0 | 0 |
| 40 | 0 | 1 | 0 | 0 |
| 41 | 0 | 1 | 0 | 0 |
| 42 | 0 | 1 | 0 | 0 |
| 43 | 0 | 1 | 0 | 0 |
| 44 | 0 | 1 | 0 | 0 |
| 45 | 0 | 1 | 0 | 0 |
| 46 | 0 | 1 | 0 | 0 |
| 47 | 0 | 1 | 0 | 0 |
| 48 | 0 | 1 | 0 | 0 |
| 49 | 0 | 1 | 0 | 0 |
| 50 | 0 | 1 | 0 | 0 |
| 51 | 0 | 1 | 0 | 0 |
| 52 | 0 | 1 | 0 | 0 |
| 53 | 0 | 1 | 0 | 0 |
| 54 | 0 | 1 | 0 | 0 |

Transition probabilities for transition from infection at home with NPWT, women from current practice hospitals

| Cycle | Remain in infection at home with NPWT | Transition to post-infection recovery |
|-------|---------------------------------------|---------------------------------------|
| 1 | 0.497588319 | 0.502411681 |
| 2 | 0.677728673 | 0.322271327 |
| 3 | 0.802873767 | 0.197126233 |
| 4 | 0.877970824 | 0.122029176 |
| 5 | 0.920587276 | 0.079412724 |
| 6 | 0.944556614 | 0.055443386 |
| 7 | 0.958047253 | 0.041952747 |
| 8 | 0.965422185 | 0.034577815 |
| 9 | 0.968881904 | 0.031118096 |
| 10 | 0.969390384 | 0.030609616 |
| 11 | 0.96708485 | 0.03291515 |
| 12 | 0.961333701 | 0.038666299 |
| 13 | 0.95046883 | 0.04953117 |
| 14 | 0.931077074 | 0.068922926 |
| 15 | 0.896632289 | 0.103367711 |
| 16 | 0.835532079 | 0.164467921 |
| 17 | 0.730734675 | 0.269265325 |
| 18 | 0.569387645 | 0.430612355 |
| 19 | 0.37013288 | 0.62986712 |
| 20 | 0.192375691 | 0.807624309 |
| 21 | 0.080939737 | 0.919060263 |
| 22 | 0.028842272 | 0.971157728 |
| 23 | 0.009052265 | 0.990947735 |
| 24 | 0.002556269 | 0.997443731 |
| 25 | 0.000655375 | 0.999344625 |
| 26 | 0.000153042 | 0.999846958 |
| 27 | 3.25843E-05 | 0.999967416 |
| 28 | 6.3272E-06 | 0.999993673 |
| 29 | 1.1206E-06 | 0.999998879 |
| 30 | 0 | 1 |
| 31 | 0 | 1 |
| 32 | 0 | 1 |
| 33 | 0 | 1 |
| 34 | 0 | 1 |
| 35 | 0 | 1 |
| 36 | 0 | 1 |
| 37 | 0 | 1 |
| 38 | 0 | 1 |
| 39 | 0 | 1 |
| 40 | 0 | 1 |

| Cycle | Remain in infection at home with NPWT | Transition to post- infection recovery |
|--------------|--|---|
| 41 | 0 | 1 |
| 42 | 0 | 1 |
| 43 | 0 | 1 |
| 44 | 0 | 1 |
| 45 | 0 | 1 |
| 46 | 0 | 1 |
| 47 | 0 | 1 |
| 48 | 0 | 1 |
| 49 | 0 | 1 |
| 50 | 0 | 1 |
| 51 | 0 | 1 |
| 52 | 0 | 1 |
| 53 | 0 | 1 |
| 54 | 0 | 1 |

Transition probabilities for transition from infection at home with NPWT, women from better practice hospitals

| Cycle | Remain in infection at home with NPWT | Transition to post- infection recovery |
|--------------|--|---|
| 1 | 0.852106172 | 0.147893828 |
| 2 | 0.924436884 | 0.075563116 |
| 3 | 0.959504125 | 0.040495875 |
| 4 | 0.976665619 | 0.023334381 |
| 5 | 0.985388348 | 0.014611652 |
| 6 | 0.990010851 | 0.009989149 |
| 7 | 0.992528919 | 0.007471081 |
| 8 | 0.993880986 | 0.006119014 |
| 9 | 0.994509425 | 0.005490575 |
| 10 | 0.994601476 | 0.005398524 |
| 11 | 0.994183462 | 0.005816538 |
| 12 | 0.99313354 | 0.00686646 |
| 13 | 0.991121606 | 0.008878394 |
| 14 | 0.987435261 | 0.012564739 |
| 15 | 0.980568109 | 0.019431891 |
| 16 | 0.967270979 | 0.032729021 |
| 17 | 0.940431758 | 0.059568242 |
| 18 | 0.884955312 | 0.115044688 |
| 19 | 0.773681414 | 0.226318586 |
| 20 | 0.580838509 | 0.419161491 |
| 21 | 0.338769289 | 0.661230711 |

| Cycle | Remain in infection at home with NPWT | Transition to post- infection recovery |
|--------------|--|---|
| 22 | 0.147319214 | 0.852680786 |
| 23 | 0.050460633 | 0.949539367 |
| 24 | 0.014690084 | 0.985309916 |
| 25 | 0.003800619 | 0.996199381 |
| 26 | 0.000889658 | 0.999110342 |
| 27 | 0.000189528 | 0.999810472 |
| 28 | 3.68071E-05 | 0.999963193 |
| 29 | 6.519E-06 | 0.999993481 |
| 30 | 0 | 1 |
| 31 | 0 | 1 |
| 32 | 0 | 1 |
| 33 | 0 | 1 |
| 34 | 0 | 1 |
| 35 | 0 | 1 |
| 36 | 0 | 1 |
| 37 | 0 | 1 |
| 38 | 0 | 1 |
| 39 | 0 | 1 |
| 40 | 0 | 1 |
| 41 | 0 | 1 |
| 42 | 0 | 1 |
| 43 | 0 | 1 |
| 44 | 0 | 1 |
| 45 | 0 | 1 |
| 46 | 0 | 1 |
| 47 | 0 | 1 |
| 48 | 0 | 1 |
| 49 | 0 | 1 |
| 50 | 0 | 1 |
| 51 | 0 | 1 |
| 52 | 0 | 1 |
| 53 | 0 | 1 |
| 54 | 0 | 1 |