COVER SHEET

TITLE PAGE

IMPROVING PAEDIATRIC NURSES' KNOWLEDGE AND ATTITUDES IN CHILDHOOD FEVER MANAGEMENT

Short Title: Peer education improves knowledge and attitudes

Authors:

Prof. Helen Edwards, PhD, BA (Hons), BA, Dip AppSc, EM, RN. Head, School of Nursing, Institute of Health and Biomedical Innovation, Queensland University of Technology, Victoria Park Road, Kelvin Grove, Australia 4059. Tel: +617 3864 3844, Fax: +617 3864 3814, Email: h.edwards@qut.edu.au

Anne Walsh, MHSc, Grad Dip HProm, BA, Dip AppSc, EM, RN. PhD Candidate, School of Nursing, Institute of Health and Biomedical Innovation, Queensland University of Technology, Corner Musk Avenue & Blamey St, Kelvin Grove, Australia 4059. Tel: +617 3138 6113, Fax: +617 3138 6030, Email: am.walsh@qut.edu.lau

Prof. Mary Courtney, PhD, MHP, BCom, Cert MCH, EM, RN. Director of Research, School of Nursing and Domain Leader, Human Health and Well-being, Institute of Health and Biomedical Innovation, Queensland University of Technology, Corner Musk Avenue & Blamey St, Kelvin Grove, Australia 4059. Tel: +617 3138 6171, Fax: +617 3138 6030, Email: m.courtney@qut.edu.au

Sarah Monaghan, BNurs, DipNurs. Clinical Nurse, Department of Emergency Medicine, Royal Children's Hospital, Herston Road, Herston, Australia 4029. Tel: +617 3636 8640, Email: Sarah_Monaghan@health.qld.gov.au

Jenny Wilson, BNurs, EM, RN. Clinical Nurse, Royal Children's Hospital, Herston Road, Herston, Australia 4029. Tel: 3636 7860, Email: JenniferE_Wilson@health.qld.gov.au

Dr. Jeanine Young, PhD, BSc (Hons), Dip AdNursCare, EM, RN. Director Nursing Research, Royal Children's Hospital, Herston Road, Herston, Australia 4029. Tel: 3636 1962, Fax: +617 3636 7215, Email: jeanine_young@health.qld.gov.au

Contact person

Anne Walsh, PhD Candidate, School of Nursing, Institute of Health and Biomedical Innovation, Queensland University of Technology, Corner Musk Avenue & Blamey St, Kelvin Grove, Australia 4059. Tel: +617 3138 6113, Fax: +617 3138 6030, Email: am.walsh@qut.edu.lau

ABSTRACT

Aim

This study evaluated the effectiveness of a Peer Education Programme (PEP) in positively impacting paediatric nurses' evidence-based knowledge and attitudes toward fever management and the sustainability of significant changes.

Background

Paediatric nurses' knowledge deficits and negative or inconsistent attitudes toward evidence-based fever management continue to be reported. Limited research explores educational interventions in this area.

Method

A quasi-experiment was conducted. Data were collected August 2002 to March 2003 inclusive. The PEP was based on the Theory of Planned Behavior. Peer support and education were promoted as mechanisms for educating those unable to attend the four one hour sessions. Attendance at two sessions was considered sufficient to precipitate increases in knowledge and positive attitudes. Seventy-seven nurses were eligible to attend the PEP; 74.0% attended at least one session, 52% two or more.

Survey data were collected one month prior and one and four months post-PEP from 56.3% to 77.8% of eligible experimental and 40.9% to 51.6% of eligible control group nurses. Organisational groups, nurses employed in the two medical wards at two metropolitan paediatric hospitals, were allocated to experimental and control groups. Two-factor Univariate ANOVAs were conducted to explore between and within group differences and significant interactions were explored through pair-wise comparisons.

Findings

Interaction effects between group and time were found in overall knowledge ($p=0.01$), specifically knowledge of the physiology of fever ($p=0.001$), and attitudes toward evidence-based fever management ($p=0.05$). Additionally, experimental group nurses demonstrated significantly more knowledge of general fever management principles four months post-PEP than control group nurses ($p=0.01$), and with their own knowledge pre-PEP ($p<0.001$).

Conclusions

Findings demonstrate the PEP's effectiveness in eliminating barriers to practice change, peers and setting influences. Increases in knowledge and positive attitudes post-PEP were maintained. Incorporation of peer support and education in the PEP supported information transfer to those not attending sessions.

Key words

Attitudes, Child Nursing, Nurse Education, Clinical Decision-Making, Evidence-based Practice, Experimental Design

SUMMARY STATEMENT

What is already known about this topic

- Paediatric nurses do not report expert knowledge about fever and evidence-based fever management practices
- Negative and inconsistent attitudes toward fever, febrile convulsions and antipyretic use in fever management are consistently reported
- Paediatric nurses' inconsistent fever management practices have been reported for more than a decade

What this study adds

- Theoretically based educational programmes are effective in improving knowledge about, and attitudes toward, everyday nursing practices
- Increases in knowledge and attitudes achieved by the Peer Education Programme continued to increase up to four months post programme
- Peer education and support facilitated educational information to reach those who did not participate in the programme

IMPROVING PAEDIATRIC NURSES' KNOWLEDGE AND ATTITUDES IN CHILDHOOD FEVER MANAGEMENT

INTRODUCTION

Despite continued reports of paediatric nurses' inconsistent practices in childhood fever management, research exploring their knowledge and attitudes is limited, despite spanning nearly 20 years (Abdullah *et al.* 1987, Poirier *et al.* 2000, Sarrell *et al.* 2002, Walsh *et al.* 2005). Reported practices are not based on the latest scientific information implying inadequate knowledge about and negative attitudes toward fever (Poirier *et al.* 2000, Sarrell *et al.* 2002, Walsh *et al.* 2005). Inconsistent nursing practices cause confusion about best-practice among novice practitioners and parents of hospitalised children (Edwards *et al.* 2001b). It is therefore essential paediatric nurses' practice when caring for febrile children reflects the latest scientific evidence. Despite reports from numerous educational interventions targeting parents' fever management, knowledge and attitudes (Crocetti *et al.* 2001, Sarrell & Kahan 2003) there is a dearth of literature addressing paediatric nurses' fever management practices. It is timely that education targeting paediatric nurses is explored. This paper describes a controlled trial of a Peer Education Programme (PEP) targeting paediatric nurses' knowledge about, and challenging negative and inconsistent attitudes toward, fever and fever management.

BACKGROUND

Nurses' knowledge

Current research exploring paediatric nurses' (nurses) knowledge about fever focus primarily on temperatures nurses consider representative of fever and when interventions to reduce fever are initiated. Temperatures reported as defining fever by nurses studied in the United Kingdom (UK), United States (US), Canada and Australia are consistently around 38.0°C (Blumenthal 2000, Poirier *et al.* 2000, Edwards *et al.* 2001b, Karwowska *et al.* 2002). Temperatures at which the majority of nurses reported initiating fever reduction strategies increased from 38.0°C in Saudi Arabia (Abdullah *et al.* 1987) and 38.3°C in the US (Thomas *et al.* 1994) in the late 1980s and 1990s to 39.9°C in the US (Poirier *et al.* 2000) and 38.6°C in Canada (Karwowska *et al.* 2002) in the 21st century. Changes in Australia have not been as significant (mean 38.3°C, SD 0.4°C) (Edwards *et al.* 2001b). A comprehensive exploration of Australian nurses' knowledge about fever and fever management identified average knowledge with 62% of 20 multiple choice items answered correctly in the study sample (Walsh *et al.* 2006). Deficits in physiological knowledge were related to physiological and immunological changes associated with fever. Deficits in general fever management principles were related to side effects of fever and when to initiate fever reduction, and deficits about antipyretics identified poor knowledge of the peak absorption time and side effects of paracetamol (Walsh *et al.* 2005). A disconcerting finding was similar knowledge levels in novices and most experienced nurses; those with between one and four years experience were most knowledgeable. Specialised paediatric education and employment at a higher level of practice reflected greater knowledge, specifically related to physiological aspects of fever.

Nurses' attitudes

Most studies identify negative attitudes relating to fever. Nurses report fever as being harmful and febrile convulsions as the greatest harm fever can cause (Abdullah *et al.* 1987, Poirier *et al.* 2000, Karwowska *et al.* 2002, Sarrell *et al.* 2002, Walsh *et al.* 2005). Other harmful outcomes from fever include brain damage and dehydration (Abdullah *et al.* 1987, Poirier *et al.* 2000, Karwowska *et al.* 2002). Reports of fever management practices confirm negative attitudes. Nurses report actively treating fevers to reduce fever and/or prevent febrile convulsions, to increase comfort and reduce parental anxiety (Abdullah *et al.* 1987, Thomas *et al.* 1994, Sarrell

et al. 2002, Walsh *et al.* 2005). Reports of waking febrile children for an antipyretic are prevalent; more than 70% in the UK (Blumenthal 2000), 52% in Israel (Sarrell *et al.* 2002) and 37% in Australia (Walsh *et al.* 2005). More than one-third of US emergency nurses studied reported administering an alternate antipyretic to children whose temperature had not reduced sufficiently within one hour, some repeated the same antipyretic (Poirier *et al.* 2000).

When Australian nurses' attitudes toward fever and fever management were explored inconsistent attitudes, particularly in relation to febrile convulsions, were identified (Walsh *et al.* 2005). For example: nurses agreed febrile convulsions do not cause neurological damage (92%), fever must be reduced to prevent febrile convulsions (86%), initial febrile convulsions are not preventable (90%) and antipyretics have minimal preventative effect with recurrent febrile convulsions (72%). These findings influence inconsistent practices and when associated with inaccurate knowledge about fever and fever management (Walsh *et al.* 2005) shed some light on reasons for inconsistent practices. Few attitudinal differences were related to experience, specialised paediatric education or level of practice (Walsh *et al.* 2006).

Nurses' practices

Nurses with limited knowledge and negative or inconsistent attitudes caring for febrile hospitalised children highlight the potential for inconsistent practices and raise concerns about quality of care. Exploration of predictors of nurses' intentions to administer paracetamol to febrile children through the Theory of Planned Behavior (TPB) (Ajzen 1985) provides insight into fever management practice variability (Walsh *et al.* 2005). Twenty-five percent of variability of nurses' intentions to reduce fevers with antipyretics were predicted by their attitudes toward paracetamol (eg., its ability to increase comfort, reduce irritability, temperature and risk of febrile convulsions) and their perception of the expectations of others, peers, doctors and parents. These factors must be considered when developing programmes to enhance fever management.

Fever management education

It is predicted that major barriers to changing fever management behaviours will be similar to those experienced in pain management: the influence of peers and the setting (Czurylo *et al.* 1999). Previous research identified nurses' preference for ward based education and benefits of discussing practices with peers (Edwards *et al.* 2001a, Edwards *et al.* 2001b). Peer discussion is an integral aspect of educational programmes based on the TPB (Ajzen 1985, Edwards *et al.* 2001a). Participants identify current practices and determinants of these, barriers to desired behaviours and strategies to promote desired behaviours. Therefore, a TPB based programme incorporating information giving and identification of current attitudes and barriers to evidence-based fever management through peer discussion could overcome potential barriers to behaviour change, peers and setting (Czurylo *et al.* 1999).

THE STUDY

Aims

The aim of the study was to evaluate the effectiveness of a Peer Education Programme (PEP) on nurses' antipyretic administration to febrile children compared with a control group. Through peer education and support the PEP, based on the TPB, aimed to promote evidence-based antipyretic use in childhood fever by targeting key antecedents of fever management with antipyretics: knowledge, attitudes and intentions to administer antipyretics. PEP's effectiveness in promoting evidence-based intentions are reported elsewhere (Edwards *et al.* in press). This paper reports the effectiveness of the PEP on increasing evidence-based knowledge about, and attitudes toward, fever management.

Hypotheses

The following hypotheses were tested. Following the PEP there will be no differences in experimental group nurses':

1. Pre-PEP, post-PEP and latency knowledge scores.
2. Pre-PEP, post-PEP and latency attitudes.
3. Post-PEP and latency knowledge scores compared with control group nurses.
4. Post-PEP and latency attitudes compared with control group nurses.

Design

A quasi-experimental study explored the effects of a Peer Educational Programme on nurses' knowledge about, and attitudes toward, fever and the management of fever in children admitted to hospital for a febrile illness. Surveys collected data at three time points at an experimental and control hospital one month pre PEP and one and four months post PEP, from August 2002 to March 2003.

Sample

A purposive sample of Level 1 and Level 2 registered nurses, who provide care for children with febrile illnesses, were recruited from two metropolitan paediatric hospitals in Queensland, Australia. In Australia, Level 1 registered nurses provide direct patient care. Level 2 registered nurses provide direct patient care and have additional responsibilities in the unit, such as the orientation and preceptorship of new staff, staff development, providing continuing education and research as part of their responsibilities (ANRAC 1990). Staff mobility and flexible rostering made it impossible to follow one sample of nurses for the 8-month study period therefore organisational units were targeted as the unit of analysis. Organisational units consisted of the two paediatric medical wards at each targeted hospital. One hospital was assigned to the experimental condition; the other to control. Control group nurses maintained routine practice with individuals free to undertake their own professional development. All nurses employed in Level 1 and Level 2 positions in targeted wards of targeted hospitals, when surveys were collected and the PEP presented, were eligible to participate. As the sample was finite power calculations were not performed, however retrospective power calculations revealed power of 95.98% (mean difference 1.80; SD1=1.90, SD2=2.50; n1=39, n2=48) for total knowledge score 99.47 (mean difference 5.90; SD1=5.20, SD2=6.80; n1=40, n2=49) for the attitude scale.

Data collection

Survey

An instrument developed for our earlier research (Walsh *et al.* 2005), with content and face validity and a total instrument Kappa of 0.644 was modified slightly to include items targeting specific knowledge and attitudes addressed by the PEP. The Fever Management Survey (FMS) used in this study comprised three instruments: Fever Management Knowledge (FMK) (24 items), Fever Management Attitudes (FMA) (32 items), Fever Management Practices (FMP) (28 items) and a section targeting demographics. The FMK and FMA instruments reported in this paper explored nurses' knowledge about, and attitudes toward, fever and evidence-based fever management. Findings from the FMP instrument are reported elsewhere (Edwards *et al.* in press).

Following permission to use items from a continuing education test (Murtha & Waldman 1995) 10 items were modified to include an "unsure" option and incorporated into the FMK

instrument. Another 14 items were developed from the literature. The FMK instrument targeted knowledge about:

- the physiology of fever (ten items, eg., "Which is NOT a beneficial effect of fever: *an increase in serum iron production; stimulation of T-lymphocyte production; acceleration of white blood cell production; promotion of antibiotic activity; unsure*"),
- general fever management principles (seven items, eg., "Sponging febrile children with tepid water may be implemented when: *an antibiotic is given; 30 minutes after the administration of an antipyretic; when the temperature is below 40°C; when irritability and crying are present; unsure*"),
- antipyretic medications (seven items, eg., "The peak absorption time for paracetamol is: *10 – 60 minutes; 30 – 60 minutes; 60 – 90 minutes; 60 – 180 minutes; unsure*").

The FMA instrument was measured on a 5-point Liket scale (strongly disagree = 1, unsure = 3 and strongly agree = 5) and targeted attitudes toward:

- fever (nine items, eg., "fever is the most common reason for taking a child to the doctor"; "Temperature, in children, is often unrelated to the severity of the illness),
- fever management (14 items; 12 items targeted fever management with antipyretics, eg., "In all children, it is important to treat fever aggressively with antipyretics to prevent febrile convulsions"; and two items targeted temperature measurement),
- febrile convulsions (seven items, eg., "The first febrile convulsion is preventable") and
- parent education (two items, eg., "Most parents would like to learn more about fever management").

Survey procedure

Survey data were collected during August 2002, December 2002 and March 2003. Two weeks prior to each survey a team member addressed nurses during a ward meeting outlining their potential involvement. Surveys were sent to each nurse's ward address and completed surveys returned to a sealed box in the ward. The same procedure was followed for each data collection period.

Peer Education Programme

An educational programme was developed to address identified factors influencing nurses' fever management (Edwards *et al.* 2001b, 2003, Walsh *et al.* 2005, Walsh *et al.* 2006). It consisted of four one hour sessions and was modelled on an Australian TPB peer education programme developed to enhance nurses' 'as required' opioid administration (Edwards *et al.* 2001a). Sessions included information giving, peer discussion in small groups and session evaluation. Session aims addressed the following areas of fever management:

- physiological knowledge of fever and evidence-based practice,
- myths and misconceptions
- inconsistent and negative attitudes
- external factors influencing fever management and strategies to control these
- effective strategies to promote evidence-based fever management and
- peer education and support as mechanisms to promote and maintain changes in fever management practices.

A more detailed account of the PEP is available in Edwards et al. (under review). A user-friendly manual, developed to enable this education programme to be implemented by educators and clinicians, is available at http://www.hlth.qut.edu.au/nrs/research/instedu/

In Queensland, 2002-2003, all paediatric medications including antipyretics were checked by two registered nurses to reduce medication errors. As this interaction can influence practice it was targeted as a peer education and support opportunity for new staff and peers unable to attend sessions. Additionally, session information was available on each ward and session relevant posters used to stimulate peer and nurse-parent discussions.

PEP procedure
Two weeks following pre-test data collection and immediately prior to PEP commencement a team member, during ward meetings, invited eligible nurses to attend PEP sessions. Session times and an evidence-based fever management article (JBIEBNM 2001) were distributed to stimulate interest. PEP sessions were presented at ward level in accordance with findings from earlier research (Edwards *et al.* 2001b). Sessions were presented at each ward two to three times a week over a two week period to suit ward requirements.

Validity and reliability
Face and content validity of the modified instrument and PEP were determined by a team of experts including paediatric nurse researchers, Level 2 paediatric nurses and academic researchers familiar with TPB programmes. Following minor revisions the FMK and FMS were re-evaluated and considered ready for implementation.

Ethical considerations
Ethical approval was gained from the University and targeted hospitals. To prevent social desirability influencing responses and ensure participant confidentiality, voluntary participation and anonymity, the PEP was presented and data were collected by a university employed senior research assistant (Polit & Hungler 1999, p351).

Data analysis
Data were entered into SPSS Version 11.0 (SPSS 2001), searched for outliers and irregularities and all data were checked for data entry reliability. Between group data, for each data collection time point, were examined for between group differences using chi square and t-tests.

Knowledge
Missing responses were recoded 'incorrect' on the premise that a known answer would have been recorded. Scores were calculated for overall knowledge and the three sub-scales, physiological, general fever management principles and antipyretic medication knowledge.

Attitudes
Missing data, less than 0.003%, were set to a neutral score of 3 = unsure. Items were recoded to ensure a higher score indicated a more positive attitude. Principal component analysis was determined through factor analyses performed on each individual participants' first completed survey (N=111). All 32 items were included and formed 11 factors with eigenvalues greater than 1.0 which were responsible for 65.0 percent of the variance in responses. A four factor extraction was undertaken on factors with eigenvalues between 1.97 and 4.32 responsible for 34% of the variance. Varimax rotation was performed, however, items fell in a more meaningful pattern in non-rotated factor analysis with a KMO=0.61 and Bartlett's Specificity Approximate Chi Square 862.549 degrees of freedom 496, $p<0.01$. Although a KMO of 0.61 is low and possibly due to the small sample size, KMO values of 0.6 are acceptable for factor analyses (Tabachnick & Fidell 2001, p589), therefore the KMO for this study was deemed acceptable. The reliability procedure in SPSS was used to assess the reliability of the items in each factor. One scale measuring attitudes toward evidence-based fever management consisting of 11 items with a

Cronbach's Alpha of 0.76 was established. Total scale scores were calculated by summation of each individual's score for a set of items describing beliefs about evidence-based fever management and has been named the "Attitude toward Evidence-Based Fever Management" scale. The other three scales had low reliability and were discarded from this analysis.

Two-factor Univariate ANOVAs were conducted on the total knowledge scale, the three knowledge sub-scales and attitude scale. Between subjects factor was group (experimental or control) and within subject factor was time of data collection (pre-test, post-test and latency test). Significant interactions were further explored through pair-wise comparisons.

RESULTS

Sample

Table 1 gives a detailed description of sample size and relevant demographic characteristics of each group for each data collection time point. Response rates were highest in the experimental group, 56.3%, 77.8% and 63.4% compared with 44.4%, 51.6% and 40.9% for pre-test, post-test and latency surveys respectively. No significant differences were found in gender, marital status, qualifications, undertaking a paediatric certificate or current clinical experience length, between groups, of those who completed surveys at each data collection period. Significant group differences were found in age, when latency data were collected (t_{57}=2.40, p=0.02), and length of paediatric nursing experience when post-test (t_{63}=2.62, p=0.01) and latency data (t_{61}=2.60, p=0.01) were collected. Earlier research found length of paediatric experience positively influenced knowledge and beliefs that antipyretics do not prevent recurrent febrile convulsions; age had no significant influence on knowledge or beliefs (Walsh *et al.* 2006).

Insert Table 1

PEP Attendance

Seventy-seven Level 1 and Level 2 registered nurses employed in the two targeted wards during the two month period the PEP was presented were eligible to participate. Thirty-eight attended Session 1 (34 Level 1, 4 Level 2), 34 Session 2 (26 Level 1 and 8 Level 2), 26 Session 3 (23 Level 1, 3 Level 2) and 20 attended Session 4 (18 Level 1, 2 Level 2). No other demographic data were collected. Session attendance was influenced by shift allocation and ward needs. Non-attendance at earlier sessions did not excluded attendance at later sessions. Seventy-four percent of nurses attended at least one PEP session and more than 50% (40 nurses) attended two or more sessions. Overall 20 nurses did not attend any sessions, 17 attended one, 25 attended two, nine attended three and six attended four sessions.

PEP influence on nurses' knowledge

Knowledge findings are discussed as overall knowledge representing the total knowledge score, knowledge of the physiology of fever, general fever management principles and the evidence-based use of antipyretics in fever management. See Table 2.

Insert Table 2 here

Overall knowledge

There was a significant interaction between experimental and control groups' overall knowledge and across data collection time points (F[2,172]=4.941, $\underline{p}$=0.01, η_p^2=.05). See Figure 1. Examination of simple main effects identified experimental group nurses as significantly more knowledgeable in post-test (p=0.01) and latency data (p<0.01) compared with control group nurses (see Table 2). Experimental group nurses reported significantly more overall knowledge when latency data were collected compared with pre-test data (p<0.01). Findings do not support the hypothesis. Experimental group nurses' overall knowledge increased following the PEP.

Insert Figure 1 here

Knowledge of the physiology of fever

There was a significant interaction between experimental and control groups' knowledge of the physiology of fever and across data collection time points ($F[2,170]=8.409$, $\underline{p}=0.00$, $\eta_p^2=0.09$). See Figure 2. Examination of simple main effects revealed experimental group nurses were significantly more knowledgeable about the physiology of fever than control group nurses in post-test ($p<.01$) and latency data ($p=0.01$). Additionally, experimental group nurses demonstrated significantly more knowledge about the physiology of fever in latency than pre-test data ($p=0.05$). These data highlight a specific area of PEP effectiveness. Following the PEP nurses were more knowledgeable about the physiological benefits, changes and therefore, needs of febrile children.

Insert Figure 2 here

Knowledge of general fever management principles

Significant main effects identified an increase in knowledge of general fever management principles between groups ($F[1,182]=3.990$, $\underline{p}=0.05$, $\eta_p^2=0.02$) and data collection time points ($F[2,182]=3.281$, $\underline{p}=0.04$, $\eta_p^2=0.04$). Experimental group nurses were more knowledgeable about general fever management principles when latency data were collected ($p=0.01$) than control group nurses. Additionally, nurses in the experimental group had significantly more knowledge in latency data compared with pre-test data ($p<0.01$). Again, these findings highlight an area of PEP effectiveness. Experimental group nurses were more knowledgeable about general fever management principles, such as, symptoms and side effects of fever and when antipyretic use and tepid sponging are appropriate following the PEP (see Table 2).

Knowledge of antipyretic medications

No significant differences were discovered in nurses' knowledge about antipyretics between groups, experimental and control, or within groups, across the three data collection time points. The PEP did not improve specific knowledge about antipyretic medications. However, mean knowledge of antipyretic medications was the only knowledge aspect above the midline for each group at each time point (see Table 2). Nurses in both groups were aware of the correct dosage, side effects and peak absorption time for antipyretic medications in use at the time of the study, paracetamol and ibuprofen.

PEP influence on nurses' attitudes

Attitudinal influences of the PEP will be reported by the scale: attitudes toward evidence-based fever management (see Table 3). A higher mean indicates a more positive attitude.

Insert Table 3 here

Attitudes toward evidence-based fever management

There was a significant interaction between experimental and control groups' attitudes toward evidence-based fever management and across data collection time points ($F[2,182]=4.362$, $\underline{p}=0.05$, $\eta_p^2=0.01$). See Figure 3. Examination of simple main effects revealed significantly more positive reports of attitudes toward evidence-based fever management by experimental group nurses than control group nurses in post-test ($p<0.01$) and latency data ($p<0.01$) than pre-test data. Findings do not support the hypothesis. The PEP improved attitudes toward fever management. Following the PEP more positive attitudes toward: benefits of fever (Blatteis *et al.* 1998, Lorin 1999, Blatteis 2003); correct use of antipyretics in fever management (Anderson 1988); and antipyretics having minimal preventative effect in recurring febrile convulsions (eg.,

Rantala *et al.* 2000, van Esch *et al.* 2000, Baumann 2001) were reported. See Table 4 for items included in this scale.

Insert Figure 3 and Table 4 here

DISCUSSION

This study explored the effectiveness of a PEP, based on the TPB, in increasing paediatric nurses' knowledge about, and challenging negative and inconsistent attitudes toward, evidence-based fever management. The PEP successfully increased knowledge of the physiology of fever and general fever management principles and positive attitudes toward evidence-based fever management. Knowledge and attitudinal increases were evident both one and four months following the PEP. Findings highlight the effectiveness of a theoretically based programme promoting peer support and education in not only improving knowledge and enhancing attitudes but maintaining changes over time. Findings will be discussed under the hypotheses: there would be no difference in knowledge about and attitudes toward fever and evidence-based fever management following the PEP.

PEP influence on nurses' knowledge

Significant findings in overall knowledge highlight the PEP's impact on experimental group nurses' fever management knowledge. Increases in experimental group nurses' knowledge post PEP and continued increases in latency data is suggestive that peer education facilitated PEP information reaching nurses unable to attend PEP sessions and nurses new to the experimental group at different data collection time points.

Specific areas where knowledge increased were the physiology of fever and general fever management principles. During the PEP physiological changes associated with the febrile state were discussed. These included set-point and immune response, benefits of mild to moderate fevers and antipyretics' role in reducing temperature set-point and potentially reducing immunological benefits and prolonging illness (Lorin 1994, Zeisberger 1999, Knoebel *et al.* 2002, Blatteis *et al.* 2004). Some nurses were unaware of the body's temperature controlling mechanisms, the role of the hypothalamus in maintaining the febrile state and mechanisms through which antipyretics reduce temperatures. Increases in physiological knowledge about fever were significant both following the PEP and over time. Nurses knowledgeable about scientific rationales behind evidence-based fever management are likely to incorporate this knowledge into practice, deciding to observe the child, rather than reducing fever unnecessarily. Additionally, children at risk from physiological changes associated with fever, those with cardiac, respiratory, neurological and metabolic disorders (Lorin 1999), will be treated appropriately, their fevers reduced.

General fever management principles targeted by the PEP included the need for increased fluids during fever to replace increased insensible fluid loss, the importance of observing children's interaction with the environment rather than temperature to determine well-being and appropriate antipyretic use (Connell 1997). Caution with the use of tepid sponging, as temperature can be increased through shivering or crying, was addressed and the correct method of tepid sponging – 30 minutes following antipyretic administration – reinforced (Sharber 1997, Watts *et al.* 2001). Nurses knowledgeable about evidence-based fever management principles incorporated them into practice.

Prior to the PEP all nurses were generally knowledgeable about antipyretics and their use in fever management. Although there was a slight increase in antipyretic knowledge in the experimental group and reduction in the control group this was not significant. Adverse effects

of antipyretics, peak absorption time and dosages were not specifically addressed during the PEP. These areas need to be considered in further presentations of the programme.

PEP influence on nurses' attitudes

Significant positive attitudinal changes in toward evidence-based fever management in experimental group nurses were maintained over time. Interestingly control group nurses' attitudes remained stable over time, even though the same nurses did not answer the surveys at each time point, possibly indicating the significant effect of colleagues on salient attitudes (Ajzen 2005, p29-30). Positive attitudinal changes reflected the influence of evidence-based knowledge of the physiology of fever and general fever management principle. This is evident in scale items such as *'Fevers below 40°C may not be harmful'* and *'Regular administration of antipyretic medication may mask a fever indicative of a progressive infective process'*. Positive attitudes influenced by accurate knowledge about risk factors for and the benign nature of febrile convulsions (D'Auria 1997, Kolfen *et al.* 1998, Hutt *et al*. 1999, Chang *et al.* 2000, Chang *et al*. 2001), based on the latest scientific evidence, were indicated in responses to items such as *'Neurological damage is common in a child who has had a febrile convulsion'* and *'Antipyretic treatments have minimal effect in preventing recurring febrile convulsions'*. Influences of increases in knowledge and positive attitudes on nurses intended and actual practice was found in another arm of this study reported elsewhere (Edwards *et al.* under review). There was a significant reduction in experimental group nurses' intentions to administer antipyretics to febrile children in post and latency data. Additionally the temperatures at which antipyretics were administered post PEP increased, highlighting the influence of knowledge and attitudes on practice.

Educational and clinical importance

Earlier research identified a need for fever management education and nurses' preferences in the presentation of continuing education programmes (Poirier *et al.* 2000, Edwards *et al.* 2001a, Edwards *et al.* 2001b, 2003, Walsh *et al.* 2005). Similarities in novice and experienced paediatric nurses' knowledge and attitudes highlight the need to target all nurses caring for children hospitalised for a febrile illness, not only novice paediatric nurses (Walsh *et al.* 2006). Another challenge for continuing programmes is their ability to reach the high proportion of nurses employed part-time; 47% of surveys participants were employed part-time. Identified barriers to continuing education such as lack of time, limited access, resistance to change and pressure to conform to ritualistic practices (Veeramah 2004) must also be considered in programme design. Cost-effectiveness is a major consideration in today's climate. Programmes producing short-term changes are financially ineffective, long term change needs to be evaluated particularly in light of the scrutiny and rationalisation that continuing education programmes are subjected to (Levett-Jones 2005). This highlights the need for ongoing programme evaluation to establish programme effectiveness and sustainability of change.

Recently reported continuing education methods include a programme based on Bandura's (1977) self-efficacy theory (Barta & Stacy 2005) which enhanced self-efficacy evidenced through behaviour change; a knowledge based programme enhanced knowledge (Mujuru & Niezen 2004), and a ward-based brief information exposure programme, although not evaluated, was well received (Williams & Jones 2004). Other methods, suggested from the education field, for future continuing education include peer coaching which facilitates transfer of new knowledge and skills into practice and fosters empowerment (Waddell 2005) and online continuing education (Phillips 2005).

There is a need for theoretically based education programmes facilitating information transfer to all nurses practicing in the targeted area to be developed and trialled. The inclusion of peer education, support and consultation enable knowledge and skill transfer and stimulate peer discussion to address outdated ritualistic practices. The current study did facilitate information transfer and discussion of current myths and misconceptions through posters displaying session content and the necessary double checking of paediatric medications. Through these processes nurses not attending PEP sessions had similar opportunities to receive session content as those attending PEP sessions. Nurses attending the PEP reported discussing session content with between one and nine peers and stimulation of peer-peer, medical officer-nurse and parent-nurse discussions by posters.

Limitations

Findings from this study should be considered within the following limitations that could limit their generalisability to other settings. The study was conducted in medical wards at the two metropolitan paediatric hospitals in Brisbane limiting and controlling potential samples. Group change was explored; translation of findings to the individual level could perhaps be inappropriate. Sample size was influenced by available and interested nurses therefore positive findings could be biased.

CONCLUSIONS AND RECOMMENDATIONS

Findings highlight the effectiveness of a theoretically based educational programme to correct ritualistic, irrational, everyday nursing practices in fever management. Organisational group changes support the inclusion of peer support and education as effective tools in facilitating and maintaining practice change. As many parents learn to manage fever from health professionals (eg., Impicciatore *et al*. 1998 , Al-Eissa *et al*. 2000, Crocetti *et al*. 2001) it is imperative they have competent role models to promote evidence-based childhood fever management. Parents' fever management continues to be based on irrational beliefs and fears; antipyretic use has increased significantly since 1980 (Schmitt 1980) with an associated trebling in antipyretic overdosing (Walsh & Edwards 2006). Fever management is a universal occurrence for nurses providing care for children irrespective of setting or country. Although long-term effectiveness needs to be evaluated the PEP, adaptable to other settings and cultures, provides a template for not only fever management but is adaptable to other nursing practices where negotiation with either patients, family or health professionals is a necessary aspect of practice. The authors recommend long-term evaluation of the programme and replication with larger cohorts of nurses comparing individual and group changes to explore relationships between individual and group changes.

4984 words

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Table 1: Demographic details of survey participants

Demographic		*Pre-test*		*Post-test*[a]		*Latency-test*[b]	
AGE		***Mean (SD)***		***Mean (SD)***		***Mean (SD)***	
Experimental		32.0 (9.1)		33.7 (9.3)		32.9 (9.4)	
Control		28.5 (6.9)		29.4 (7.5)		28.0 (5.9)	
GENDER		***N***	***%***	***N***	***%***	***N***	***%***
Experimental	Female	40	97.5	49	95.9	45	93.9
	Male		2.5		4.1		6.7
Control	Female	20	95.0	16	93.8	18	100.0
	Male		5.0		6.3		0.0
MARITAL STATUS							
Experimental	Single	40	47.5	47	34.0	43	30.2
	Married/defacto		45.0		61.7		62.8
	Separated/divorced		2.5		4.3		7.0
Control	Single	20	50.0	16	31.3	18	50.0
	Married/defacto		45.0		56.3		44.4
	Separated/divorced		5.0		12.5		5.6
EMPLOYEMNT STATUS							
Experimental	Full-time	40	70.0	49	44.9	45	55.6
	Part-time		30.0		55.1		44.4
Control	Full-time	20	55.5	16	43.8	18	50.0
	Part-time		45.0		56.3		50.0
PAEDIATRIC EXPERIENCE		***Mean (SD)***		***Mean (SD)***		***Mean (SD)***	
Experimental		2.79 (1.3)		3.02 (1.3)		2.89 (1.3)	
Control		2.35 (0.9)		2.19 (1.0)		2.17 (0.9)	
HIGHEST ACADEMIC QUALIFICATION		***N***	***%***	***N***	***%***	***N***	***%***
Experimental	Non-tertiary	*40*	15.0	*49*	24.5	*45*	11.1
	Diploma/Degree		67.5		59.2		64.4
	Post-Graduate		17.5		16.3		24.4
Control	Non-Tertiary	*20*	15.0	*16*	18.8	*18*	16.7
	Diploma/Degree		80.0		75.0		66.6
	Post-Graduate		5.0		6.2		16.7
PAEDIATRIC CERTIFICATE							
Experimental	Yes	*40*	32.5	*49*	36.7	*44*	38.6
	No		67.5		63.3		61.4
Control	Yes	*20*	55.0	*16*	31.3	*18*	27.8
	No		45.0		68.7		72.2
LEVEL OF EMPLOYMENT							
Experimental	Level 1	*40*	67.5	*49*	75.5	*45*	77.8
	Level 2		32.5		24.5		22.2
Control	Level 1	*20*	80.0	*16*	93.8	*18*	83.3
	Level 2		20.0		6.2		16.7
TIME IN CURRENT POSITION							
Experimental	1-6 months	*40*	30.0	*49*	12.2	*45*	17.8
	7-11 months		17.5		24.5		11.1

	1-4 years		30.0		36.8		48.9
	5+ years		22.5		26.5		22.2
Control	1-6 months	*18*	10.0	*16*	0.0	*18*	22.2
	7-11 months		20.0		31.3		11.1
	1-4 years		50.0		56.2		55.6
	5+ years		20.0		12.5		11.1

[a] one month post PEP
[b] four months post PEP

Table 2: Nurses' knowledge about the physiology of fever, general fever management principles and antipyretic use in fever management determined by the FMK

	Pre-Test			Post-Test[a]			Latency[b]		
	n	**Mean**	**SEM[c]**	**n**	**Mean**	**SEM**	**n**	**Mean**	**SEM**
Overall Knowledge Score (24 items)									
Experiment	35	13.23	0.43	47	14.49	0.37	42	15.64	0.39
Control	20	13.35	0.56	16	12.38	0.63	18	12.72	0.59
Knowledge of the Physiology of Fever (10 items)									
Experiment	40	5.80	0.24	46	6.54	0.22	40	6.63	0.24
Control	20	6.40	0.34	14	4.79	0.40	16	5.38	0.38
Knowledge of General Fever Management Principles (7 items)									
Experiment	40	2.98	0.19	49	3.43	0.17	45	4.00	0.18
Control	20	2.95	0.27	16	3.19	0.30	18	3.11	0.28
Knowledge of Antipyretic Medications (7 items)									
Experiment	40	3.93	0.21	49	4.14	0.19	45	4.31	0.20
Control	20	4.00	0.29	16	3.88	0.33	18	3.83	0.31

[a] one month post PEP
[b] four months post PEP
[c] standard error of the mean

Table 3: Attitudinal differences depicted by groups over time determined by the FMA

	Pre-Test			Post-Test[a]			Latency-Test[b]		
	N	**Mean**	**SEM[c]**	**N**	**Mean**	**SEM**	**n**	**Mean**	**SEM**
Attitude toward evidence-based fever management (potential range 0 – 50)									
Experimental	40	37.25	0.85	49	42.96	0.77	45	41.60	0.81
Control	20	36.05	1.21	16	35.63	1.35	18	36.11	1.27

[a] one month post PEP

[b] four months post PEP

[c] standard error of the mean

Figure 1: Overall Knowledge about Fever and Fever Management N = 24

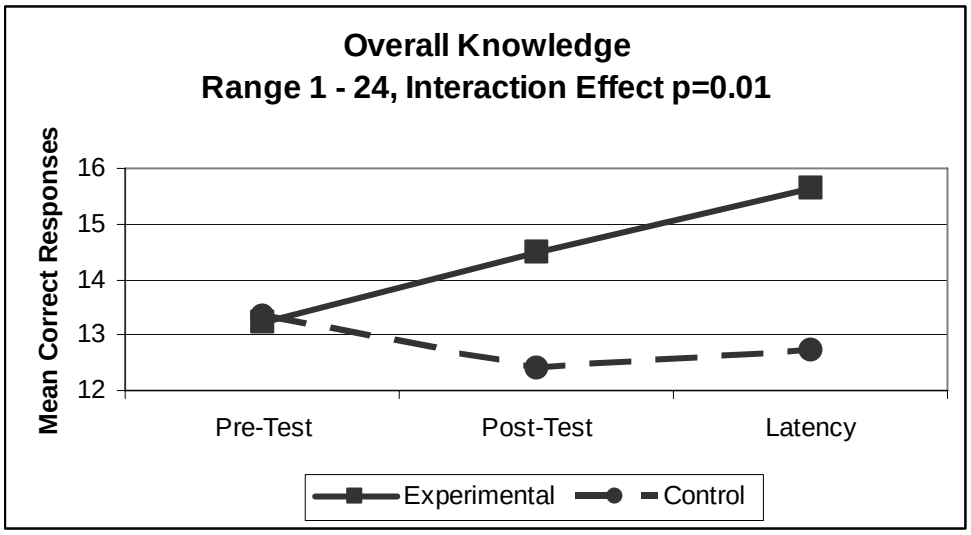

Figure 2: Knowledge of the Physiology of Fever N = 10

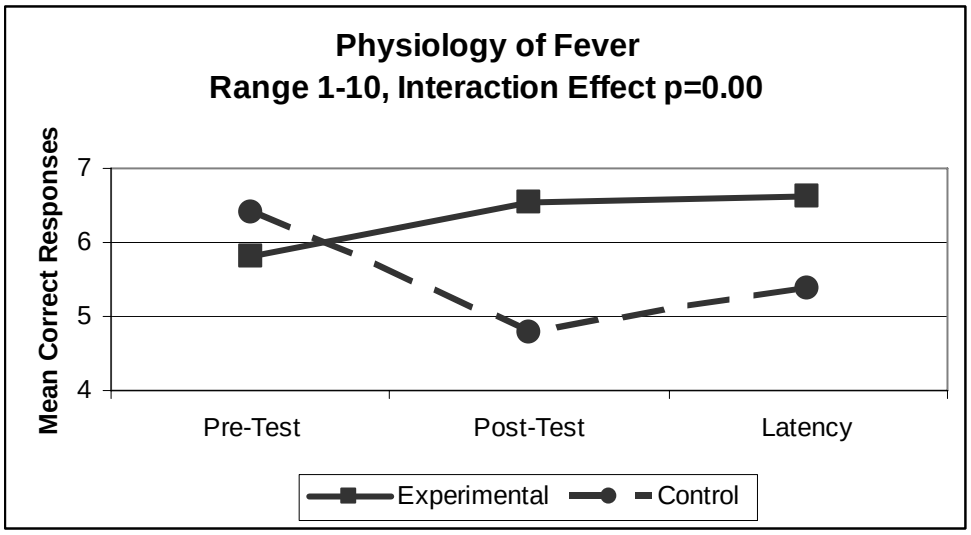

Figure 3: Attitudes toward Evidence-Based Fever Management N = 10

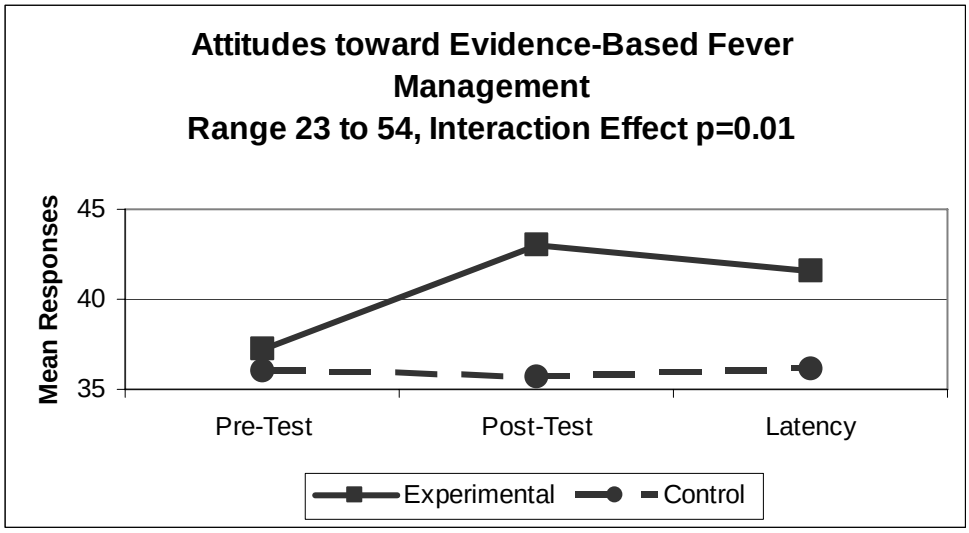

Table 4: Items in the attitude toward evidence-based fever management scale $\alpha = 0.76$

Temperature, in children, is often unrelated to the severity of illness
Fevers below 40° C may not be harmful to children
It is normal for a child's temperature to fluctuate more than 1°C during any 24 hour period
Regular administration of antipyretic medication (paracetamol/ibuprofen) may mask a fever indicative of a progressive infective process
Temperature alone is an indication for the administration of antipyretics (RS)*
Antipyretic medication (paracetamol/ibuprofen) should be administered to all children with a temperature of 38.5° C or higher (RS)
You would waken a sleeping child with a temperature of 38.5°C or higher, to administer an antipyretic (RS)
In all children, it is important to treat fever aggressively with antipyretics to prevent febrile convulsions (RS)
It is important to treat fever aggressively in children with a history of febrile convulsions (RS)
Neurological damage is common in a child who has had a febrile convulsion (RS)
Antipyretic treatments have minimal effect in the prevention of recurring febrile convulsions (RS)*

A higher response to these items indicates a negative attitude. Item scores were reversed prior to analysis