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Registered nurses' reflections on bioscience courses during the undergraduate nursing program: an exploratory study

ABSTRACT

Aims and objectives

To explore new graduate registered nurses' reflections of bioscience courses during their nursing program, and the relationship between bioscience content and their clinical practice.

Background

Undergraduate nursing students internationally find bioscience courses challenging, which may be due to the volume of content and level of difficulty of these courses. Such challenges may be exacerbated by insufficient integration between bioscience theory and nursing clinical practice.

Design

A descriptive, cross-sectional mixed methods study was conducted.

Methods

A 30-item questionnaire with five written response questions which explored recently registered nurses' reflections on bioscience courses during their nursing degree was employed. Descriptive analyses were reported for individual items. Thematic analysis of qualitative responses were grouped to reveal emerging themes.

Results

Registered nurses' ($n=22$) reflections revealed that bioscience courses were a significant challenge during their undergraduate program, and they lacked confidence explaining the biological basis of nursing. Participants would like improved knowledge of the relevant bioscience for nursing, and agreed that bioscience courses should be extended into the undergraduate final year. The importance of relating bioscience content to nursing practice was elaborated extensively throughout written responses.

Conclusions

Although registered nurses reflected that bioscience courses were difficult with large volumes of content, having more bioscience with greater relevance to nursing applications was considered important in their current clinical practice. It is suggested that bioscience academics develop greater contextual links between bioscience content and clinical practice relevant to nursing.

Relevance to clinical practice

After working as a registered nurse, there was appreciation of bioscience relevance for clinical practice, and the nurses believed they would have benefitted from more nursing-related bioscience during their undergraduate program. Focussed integration of bioscience with clinical nursing courses should be driven by academics, nurse educators and clinical nurses to provide a biological basis for patient care to nursing students.

KEYWORDS: registered nurses, nursing education, bioscience, clinical practice, undergraduate courses

WHAT DOES THIS PAPER CONTRIBUTE TO THE WIDER GLOBAL COMMUNITY?

- Registered nurses need to make connections between bioscience knowledge and patient care. Bioscience in nursing degrees needs to be integrated with nursing clinical practice to enhance contextual links between biological constructs and patient care.
- Focussing and refining bioscience content during undergraduate programs may allow nursing students to better appreciate the relevance of bioscience, which could better inform their subsequent clinical practice as registered nurses.

INTRODUCTION

It has been well recognised that nursing students in Australia and internationally find bioscience courses a challenge compared with other components of their nursing undergraduate program, especially clinical-based courses. Bioscience courses are units of study within the nursing

curriculum, and mainly consist of anatomy, physiology, pathophysiology and pharmacology, and in Australia these are usually taught by science academics. Issues related to the volume of content, the level of difficulty, lack of prior science knowledge, increased anxiety, and a tendency to adopt surface-approaches to learning have all been attributed to the difficulties that nursing students may experience during their studies of bioscience within the nursing curriculum (McKee 2002, Lindblom-Ylane *et al.* 2006, Craft *et al.* 2013, Salamonson *et al.* 2013).

To date, the majority of studies have examined the experiences of nursing students either during their program, or the reflections of nursing graduates who have completed their program many years previously. Whilst current nursing students may provide insights into bioscience courses within the curriculum, we sought to investigate registered nurses' experiences of bioscience, particularly during the critical transition period since graduating and entering the workplace. By capturing nurses' experiences within this time, they would have gained some valuable clinical experience and had an opportunity to identify any individual need for further bioscience knowledge, yet this time was also recent enough to recall their bioscience learning in their undergraduate program.

The aims of this study were to explore new graduate registered nurses' reflections of bioscience courses during their nursing program, and its relationship with their current clinical practice. In examining the reflections of registered nurses, we were particularly interested in three aspects of bioscience during their nursing program, namely: a) the volume of bioscience learning especially related to other nursing courses; b) how bioscience was related to clinical practice; and c) at what stage in their program did they believe bioscience courses should have been taught – recent graduates reflections on the appropriate timing of bioscience courses within their study program have not previously been reported. In this way, we may have identified learning needs that are directly related to clinical practice requirements of the new registered nurse.

BACKGROUND

Nursing students' perspectives of bioscience courses

Nursing students' difficulties with bioscience courses are exacerbated by a lack of integration between bioscience theory and nursing clinical practice, thus making bioscience a struggle for nursing students to contextualise (Davies *et al.* 2000, Choi-Kwon *et al.* 2002, Craft *et al.* 2013). Nursing students have identified the importance of the academics in making the links between bioscience theory and nursing clinical practice more apparent (Wilkes & Batts 1998, Latter *et al.* 2001, Kyriacos *et al.* 2005, Logan & Angel 2011), as well the necessity to be embedded within the curriculum and assessment for students to appreciate the relevance for their future clinical practice (Lim & Honey 2006). However, science academics may not have sufficient clinically-relevant experience to integrate nursing clinical practice into their bioscience teaching, and students are often unable to see the relevance of bioscience for nursing until after they have been on clinical placement within their program (Mowforth *et al.* 2005). Nonetheless, an overwhelming majority of students perceive that bioscience will be important for their subsequent clinical practice, and would like an improved knowledge of bioscience (Friedel & Treagust 2005, Craft *et al.* 2013). Nurses knowledge of bioscience is important in their abilities to recognise patient needs (Smales 2010), and nurses with sufficient bioscience knowledge have a positive impact on the clinical outcomes for patients (Prowse & Heath 2005, Sturgeon 2008). Therefore, it is imperative that students learn adequate bioscience to effectively inform their clinical practice as registered nurses.

Registered nurses' perspectives of bioscience content and clinical relevance

After completion of undergraduate nursing programs, additional courses containing bioscience have been successful in improving nurses' practice, with most of these nurses believing that their knowledge of applied physiology was strongly related to patient care (Jordan 1998), and

such courses also decrease their anxiety (McMillan *et al.* 2007). This indicates that after completion of undergraduate programs, additional bioscience learning and application may assist nurses in their clinical practice. In a study of graduates from USA within a short period (8-24 months) since completing their programs, most felt that the program had prepared them to begin as registered nurses, but more than one quarter of the participants reported concerns about course content, such as needing a greater understanding of bioscience and physiology (Kemsley *et al.* 2011). In addition, a small group of nurses interviewed in Sweden one year after graduating indicated that they lacked confidence in their bioscience knowledge, such as anatomy and pharmacology (Andersson & Edberg 2010). Together, this indicates that within a relatively short time since commencing work, registered nurses lacked confidence in bioscience understanding.

Studies of registered nurses working for approximately five years in the UK revealed issues relating to confidence and application of bioscience in clinical practice. For example, nurses were very confident of their bioscience knowledge, yet had only moderate confidence in their ability to explain it to patients (Clancy *et al.* 2000). This contrasts with their understanding of bioscience, as on average, nurses failed basic bioscience tests that included biology, physiology and pharmacology (Campbell & Leathard 2000). Other nurses self-rated as having weak bioscience knowledge, yet indicated that they had only really gained this limited knowledge after their program when they made connections with clinical practice (McVicar *et al.* 2010). Similar results were found elsewhere, as nurses in Korea reported deficiencies in their bioscience knowledge (Choi-Kwon *et al.* 2002). Indeed, these issues with bioscience are also revealed in nurses who had been in the workplace for longer than 15 years. For example, only one-fifth of nurses surveyed in the UK felt that the bioscience in their undergraduate programs had prepared them well for clinical practice (Davis 2010). Similarly, in South Africa, whilst just over half felt that they had adequate understanding of anatomy and physiology, 20% said that they had only a superficial knowledge of pharmacology (Kyriacos *et al.* 2005).

METHODS

Participants

Recent nursing graduates (Bachelor of Nursing and nursing double-degrees) from an Australian university were mailed a questionnaire approximately 16 months after graduation. This time period was selected to allow recent graduates to reflect on their nursing program, and relate this to commencing the work of a registered nurse (working for at least 6 months as a registered nurse). Consent was inferred by the return of the completed questionnaire, and ethics approval was granted by the university Human Research Ethics Committee. Questionnaires were anonymous, with no identifying information, to preserve student identity.

A total of 22 registered nurses completed the questionnaire, forming a convenience sample for this exploratory study. Seventeen registered nurses (77.3%) had graduated from the larger metropolitan campus, with the remaining from a satellite campus. Participant characteristics are listed in Table 1. The majority of participants were female, with an average age of 33.6 years. Most participants had studied science in secondary school, with half of all participants having studied biology. More than two-thirds of respondents had not studied at a tertiary level prior to their nursing program. Upon working as a registered nurse, just over one-third of respondents worked in acute medical-surgical wards of tertiary hospitals, and another third worked in critical-care areas, such as intensive care or emergency departments. Two nurses were working in aged care, and another two were working in the community in general practice settings. The distribution of clinical areas that the registered nurses worked in was representative of the nursing industry in Australia.

Questionnaire design

The questionnaire used a Likert scale with extended written response (see Creswell, 2014) which allowed participants to elaborate on reflections of their bioscience courses during their program. The first part of the questionnaire (quantitative) consisted of statements related to the participants' undergraduate bioscience courses, and was grouped into five themes: i) their expectations of bioscience courses, items 1-6; ii) the bioscience content, items 7-12; iii) their approaches to learning bioscience content as students, items 13-18; iv) learning for assessment, items 19-24; and v) the relevance of bioscience courses for their current clinical practice, items 25-30. These statements were answered using a five-point Likert scale (1=strongly disagree to 5=strongly agree). This was an adaptation of Craft *et al.* (2013) questionnaire which examined first-year nursing student's perceptions of bioscience. The psychometric properties of the original tool were found to be reliable and valid. Craft *et al.* (2013) used Kaiser-Meyer Olkin (KMO) measure of sampling adequacy and Bartlett's test of Sphericity. Both measures were considered acceptable. Cronbach alpha scores were acceptable for three of the four factors, that is, students' learning of bioscience content (0.85), students' difficulty with bioscience (0.77), and the relationship of bioscience to nursing practice (0.71). However, the Cronbach alpha score for the fourth factor (approaches to bioscience learning) was 0.48 which is < 0.70 and individual items were analysed in this factor (Streiner & Norman 2003).

The second part of the questionnaire (qualitative) explored newly-registered nurses' reflections on their bioscience experiences during their nursing program by presenting free-text questions, viz: 1) What challenges did you experience about learning bioscience?; 2) Why were these challenges for you?; 3) Were you able to learn enough bioscience required to work as a registered nurse?; and 4) Can you remember enough of the bioscience taught at university? In addition, a yes/no response was asked for question 5) Do you think that bioscience should be taught into the third year at this university? Although questions 3 and 4 could be considered closed questions that could be answered with a yes/no response, the answer spaces were provided as free-

text to encourage participants to provide more elaborate responses; question 5 asked students to select yes or no, as well also asking for an explanation for their answer.

Data analysis

Quantitative responses were entered into Microsoft Excel and analysed with SPSS version 20 for Windows. Means (M), standard deviations (SD) and frequency distributions were reported for individual items. The number of respondents who agreed and strongly agreed were added to provide a percentage who agreed (similarly for disagreed). This study was exploratory in nature and we reported descriptive level data only as statistical significant differences were not deemed highly conclusive due to the sample size. There was unlikely to be sufficient power and we used descriptive data primarily to elucidate trends which could be explored further in the qualitative responses. Qualitative responses were transcribed into Microsoft Word, and were grouped using thematic analysis to reveal emerging themes. Using this research design, the qualitative comments were intended to provide insight into quantitative responses and, hence, were integrated with quantitative responses during analysis (Ostlund *et al.* 2011).

RESULTS

Results are organised into broad issues, and quantitative and qualitative results are incorporated accordingly. First, general responses to reflections on bioscience courses are detailed, consisting mainly of quantitative data and having appropriate qualitative comments integrated. Second, qualitative responses focusing on the structure of bioscience are presented. Finally, responses to issues relating bioscience with working as a registered nurse are provided, which contains mainly qualitative explanations, which relating to quantitative items.

Registered nurses reflections on their undergraduate bioscience courses

Recently registered nurses' responses to the quantitative items are shown in Table 2, with responses to qualitative statements summarised in Table 3. Quantitative questions relating to expectations of bioscience courses and bioscience content related to items 1 to 12. Almost two thirds (59%, $n=13$) of these registered nurses agreed that bioscience courses were the most difficult that they had studied during their course. Specifically, two thirds (64%, $n=14$) of participants reflected that bioscience courses were harder than nursing courses, which was consistent with their responses to bioscience being the most difficult in their course. Whilst more than half of participants (59%, $n=13$) agreed that they were comfortable with the level of detail taught in bioscience, the majority (82%, $n=18$) agreed that there was more content in bioscience than in nursing courses. In this explanatory questionnaire, the extended written response questions regarding the challenges they had experienced in their bioscience courses provided insights into the quantitative data. The two main emerging themes from qualitative data were the large volume of content in a small amount of time, and the nature of science content (including lack of prior science knowledge and science terminology; Table 3). For example: *"Such a large content of information given to learn in a short amount of time"* and *"Enjoyed bioscience but with so much info in a short amount of time it was hard to retain post exams"*. This respondent indicated that the volume of bioscience content in a small amount of time was at the detriment of other courses: *"Not enough time to absorb material, too much content, I could only focus on bio [bioscience]. My other subjects suffered, was not on a nursing level"*. Insufficient or forgotten prior science knowledge was also explained: *"Didn't have time to learn all of the content while trying to complete my other assignments along with work commitments"* (e.g. *"Too long since studying biology at school"*).

Recently-registered nurses' reflections on approaches to learning bioscience are shown in Table 2, items 13 to 18. Most participants did not agree that they could learn bioscience by memorising without needing to understand. Only a minority of students (36%, $n=8$) agreed that bioscience concepts were difficult to visualise. Also, a small percentage (27%, $n=6$) agreed with

the quantitative question that they have learnt body organ systems, but have not yet understood well how they are integrated; this may indicate that these registered nurses believed that they understood organ system integration. Qualitative responses to questions about why bioscience was a challenge reflected concerns about time restrictions leading to the need to memorise in order to get through, which then led to inability to understand: *“Very hard to memorise especially for exam”* and *“I thought one semester was too short to comprehensively cover the content of each unit and to fully understand the content”*.

Participant responses to quantitative comments on the theme of learning for assessment are shown in Table 2, items 19 to 24. Most of the respondents (82%, $n=18$) indicated that they spent more time on bioscience than nursing courses; despite this time commitment, almost every respondent agreed that they would like to have better bioscience knowledge. Interestingly, this question had the highest percentage agreeing out of the entire questionnaire (95%, $n=21$), and a mean of 4.32, and no participants disagreed. This was supported by only just over half of all respondents giving agreement that they are confident in their ability to explain the biological basis of nursing decisions. Qualitative responses regarding not being able to learn enough bioscience required to work as a registered nurse included: *“...I felt and now feel I learnt enough to get through my exams and then [then] moved onto the next bioscience subject. I wish I could of [have] retained more knowledge”*.

Undergraduate curriculum design reflection

When asked whether bioscience should be taught into the third (final) year at university (Table 3), most nurses (82%, $n=18$) answered yes. Themes into which the supporting comments emerged included that it would assist with relating bioscience to both nursing courses and nursing clinical practice, as well as issues which again may relate to the large volume of content with insufficient time. Explanations about being better able to relate to nursing if bioscience were

studied in the third year include this insight: *“I feel that I did not realise the relevance of the content to my degree. Now I do and sometimes feel I would benefit from re-doing some of my subjects!”*. Also, this reflection by a nurse about the timing of the bioscience content towards the start of their course: *“I think I felt like I just learnt bio and it didn’t relate to nursing in the beginning of my degree. Would of [have] worked better if it combined and built on nursing subjects...”*. This registered nurse working in emergency added: *“[The Bachelor of Nursing]...does not incorporate enough science subjects for nursing practice in acute areas and bioscience should be taught for the entire nursing course from start to finish”* and this nurse working in aged care commented that *“Bioscience should be taught right to the end including end stages of diseases”*. Four participants did not think that bioscience should be taught into the third year of this degree. Reasons provided included that bioscience takes away too much from other courses, and that by the third year students needed to be connecting the information and putting it into practice.

Despite most of these nurses indicating that they thought bioscience should be taught into the third year, just over half of all respondents (59%, $n=13$) agreed that they could remember enough of the bioscience taught at university (Table 2). Interestingly, five of these elaborated by commenting that they are constantly learning, whilst another one said that they can only remember what is directly relevant to their current working, and another said that there was not enough time to comprehend it all. Of the nine respondents who did not believe they could remember enough bioscience from university, two stated it was too much content delivered in too short a time, whilst one stated that they do not use that information.

Undergraduate bioscience preparation for working as a registered nurse

The registered nurses who participated had strong consensus about the relevance of their bioscience courses for clinical practice (Table 2, items 25 to 30). It was interesting to note that this theme attracted the strongest agreements, with five out of the six items having means above four.

Almost all nurses agreed that it was easy to relate bioscience to nursing, as well as being able to see the importance of bioscience to the workplace (91% for both questions, $n=20$). Reflections on their time at university also gave very strong support that bioscience lecturers should relate more to clinical practice, and that nursing lecturers should relate more to bioscience (82% for both questions, $n=18$), both of which would improve the bioscience-nursing nexus.

Although 18 respondents answered that they were able to learn enough bioscience to work as a registered nurse (Table 3), several provided explanation that they still would have liked more, such as: *“Yes. I feel sometimes like I would like to know more about the physiology”* or *“Yes, but I did a lot of rogue [rote] learning with bioscience so a lot is forgotten”*. One neutral response indicated that they did not use bioscience in their employment: *“it doesn’t really come into my practice as an RN too often”*, and a participant who had not felt that enough bioscience was learned for working as a registered nurse indicated: *“No, I’m constantly referring to my textbooks for a better understanding”*.

Those important links between bioscience theory and nursing practice featured in the qualitative comments by the registered nurses, where invited to make further comments. In particular, responses were made regarding the importance of linking bioscience with nursing more effectively, during the time of studying bioscience. For example: *“...I feel like it would have been more use if I had already been in a hospital when studying this.”* and *“There needs to be more integration on bioscience and nursing. It is almost like they are disconnected whereas they are indeed connected and links to bioscience should have been made more in nursing subjects. This will make for better nurses.”* This registered nurse added: *“Bio-science should be more interesting related and have different assessments rather than just exams.”*

Registered nurses gave additional insight by commenting on the need for bioscience for nursing practise, such as:

“Without strong bioscience nurses cannot meet the requirements of their registration or indeed, meet their responsibilities to themselves, their colleagues or most importantly to their patients. If we don’t want to go back to being blind, obedient handmaids, we are required to have a sound knowledge of bioscience and pharmacology. Would you give a drug whose action you didn’t understand for a condition you don’t understand?”

This nurse was capable of clearly linking bioscience with obligations as a registered nurse in clinical practice, and emphasised that application of knowledge is an important role of registered nurses. Another participant was particularly inclined to provide lengthy evidence of the importance of bioscience, by providing a detailed example of a workplace scenario. This nurse was female, had not studied biology in school and had been working as a registered nurse in acute and emergency settings. Interestingly, this participant disagreed strongly that nursing lecturers should have taught bioscience instead of science lecturers, and also strongly disagreed that bioscience courses were harder than nursing courses. The full explanation provided by this nurse is shown in Figure 1, and details how appropriate bioscience knowledge guided her thought processes that led to a previously undiagnosed patient issue. In paragraph 1, she lists her underlying knowledge of bioscience in the context of this patient. She then moved on to develop a plan for how to care for this patient, and specifically, how to obtain broader information about the patient’s pain, and from this drew important conclusions about the positional nature of the pain (paragraph 3). She concludes by reflecting that registered nurses should be able to provide doctors with appropriate information to guide their investigations and treatment (paragraph 5), which had a positive outcome for tailoring patient care in this case. This is a clear example of the relevance of bioscience in informing clinical practice.

DISCUSSION

Reflections on undergraduate bioscience

The recently graduated registered nurses within this study provided strong consensus that bioscience courses were more difficult and had more content than nursing courses, and most confirmed that they had spent more time on bioscience than nursing courses. The main difficulties elaborated qualitatively by these registered nurses' reflections were the volume of content in insufficient time, as well as the terminology, depth of content and lack of sufficient prior knowledge in science. These findings are consistent with those reported in other cohorts, including commencing nursing students, through to those who had been in the workplace for many years (Friedel & Treagust 2005, Kyriacos *et al.* 2005, Craft *et al.* 2013).

Despite the participants identifying issues with bioscience difficulty, almost every respondent indicated that they would like to have improved understanding of bioscience, and only approximately half of the participants were confident in being able to explain the biological basis of nursing decisions. Hence, although bioscience was problematic for them during their program, upon reaching the clinical setting they could clearly see its importance and acknowledged the need to learn more. These registered nurses indicated that they required better understanding of bioscience, which has synergies with other studies on those with years of clinical practice (Choi-Kwon *et al.* 2002, Clancy *et al.* 2000, Friedel & Treagust 2005). Our findings also reflect work from Europe, whereby participants ($n=8$) one year since graduating reported that during their education, they focused on the details of bioscience, yet now could appreciate that specific details were of lesser importance than broad bioscience concepts forming a basis on which to build new knowledge (Andersson & Edberg 2010). Similar results have also been revealed in a smaller number of participants from the UK who were qualified for short periods up to five years ($n=4$; Campbell & Leathard 2000). Our participants also self-identified lacking in confidence, which has also been reported by experienced nurses' perceptions of new graduates working in their area (Baumberger-Henry 2012). Together, the results of this study indicate that within a short time

period of working as a registered nurse, our participants identified a need for enhanced bioscience knowledge to inform their clinical practice. Importantly, our participants emphasized that bioscience must be nursing-relevant, and hence bioscience content should be prioritized during the undergraduate program according to its potential usage for registered nurses.

Curriculum design reflection

Our study of registered nurses found that 82% ($n=18$) of students thought that bioscience should be taught into the third year at this Australian university. This is more than when the same question was asked of those still studying their degree, where two-thirds of nursing students felt that bioscience should be taught into year three of their program in New Zealand (Friedel & Treagust 2005). Importantly, most undergraduate students indicated that more bioscience is required, and it needs to be related to nursing context (Wilkes & Batts 1998, Friedel & Treagust 2005). This concept was also strongly supported in the current study, as our participants indicated that bioscience should be in the third year, but must be related to nursing; our qualitative comments repeatedly emphasized the need to relate bioscience to nursing courses and nursing practice.

Preparation for role as registered nurses

The quantitative responses to items on the relevance of bioscience for clinical practice were those of highest agreement throughout all questionnaire items. Despite various concerns expressed about the volume of content, difficulty, and lack of confidence in explaining the biological basis of nursing decisions, these registered nurses identified the importance of bioscience in the nursing clinical setting; however, they clearly explained that bioscience content must be focused on aspects which were relevant to nursing. With the continually increasing body of scientific knowledge, bioscience academics need to refine and focus bioscience content towards that which has greatest clinical significance to nurses. Bioscience academics also need to make apparent links with nursing clinical practice. Although a similarly high percentage of agreement on relevance of bioscience for

clinical practice has been previously reported for undergraduate students and for experienced nurses (Friedel & Treagust 2005), in our work we can confirm that this clinical importance of bioscience understanding has been identified by registered nurses soon after graduating.

Registered nurses who had worked for an average of 15 years also indicated insufficient bioscience knowledge. For example, nurses in the UK that bioscience in their curriculum had not adequately prepared them for their roles upon registration (Davis 2010). Also, some of the nurses studied in South Africa had adequate knowledge in anatomy and physiology, others stated that they had only limited knowledge of pharmacology (Kyriacos *et al.* 2005).

The insight elaborated by the registered nurse in Figure 1 shows various steps through the thought process of providing good patient care, and how this was achieved by the registered nurse combining bioscience knowledge with attention to the varying symptoms experienced by the patient. This respondent also gave insight into how the bioscience knowledge contrasted with other nursing approaches, which were explained as dismissive in that the patient shouldn't be smoking, or was lying to obtain morphine; seemingly, there was no investigation in the relationship between pain and smoking by other nurses (Figure 1, paragraph 4). Our participant expressed dissatisfaction with this approach by other nurses (Figure 1, paragraph 5). In contrast, the application of bioscience knowledge in influencing clinical practice in this case led to further investigations that revealed a significant yet previously unidentified patient issue. Although this vignette was only provided by one respondent, it is an example of how insufficient bioscience knowledge or bioscience application in nurses may have contributed to further delays in this secondary diagnosis in this patient, and hence less-satisfactory patient care. Furthermore, it highlights that although this registered nurse was not able to authorise further investigations or interventions, her identification of the patient experience using bioscience knowledge gave clear information to the medical staff, and provided direction for moving forward that ultimately influenced the patient outcomes. The

example provided by this respondent reflects the critical importance of nurses' bioscience understanding. Nurses' foundational bioscience knowledge can equip nurses to be "knowledge brokers" in advocating for patients (Logan & Angel 2011), provides nurses with sufficient information to recognise and respond to issues relating to safety (Smales 2010), and nurses' bioscience knowledge facilitates the appropriate language and clinical rationale to influence medical decisions (Sturgeon 2008). Furthermore, nurses' bioscience knowledge can have a positive impact on influencing patient outcomes (Jordan & Reid 1997, Prowse & Heath 2005). This is consistent with our study, where bioscience knowledge provided an insight into the ability to influence a patient's outcome, despite working as a registered nurse for less than one year (Figure 1).

CONCLUSION

The registered nurses in our study reflected that bioscience courses had been challenging during their undergraduate program. After having spent time working as registered nurses, their responses also indicated that they would like greater bioscience knowledge, and improved confidence in explaining the relevance of bioscience theory in nursing decisions. This may in part be achieved by extending bioscience courses into the third year at this university, as almost all participants felt that more bioscience was required; however, the suggestion for additional bioscience was heavily conditional upon a necessary nursing focus. Despite their concerns relating to the challenges of bioscience, these registered nurses saw strong relevance of bioscience theory to the nursing workplace. Future changes to the nursing curriculum need to take into great account how the registered nurses view their bioscience learning after having had experience in the workplace. After being in the position of needing to draw on this knowledge, when working as registered nurses, the relevance of bioscience knowledge in the undergraduate program can be fully appreciated.

STUDY LIMITATIONS

This study was conducted at one Australian institution, and may not represent findings of other university graduates. Nonetheless, comparisons with national and international literature have found that issues related to bioscience courses for nursing students are widespread, and our results support the limited number of published studies on recent nursing graduates. Although we had a modest number of participants in this exploratory study, the qualitative findings strengthened the study findings and were used to extrapolate meaning from the quantitative data.

RELEVANCE TO CLINICAL PRACTICE

Registered nurses who participated in our study could clearly see the relevance of bioscience theory for their clinical practice. Participants provided clear examples of applications in the workplace when bioscience knowledge was critical. Overall, these recently registered nurses reflected that the bioscience courses in their undergraduate program had more content than nursing courses, yet upon reaching the workplace they clearly required more bioscience understanding; however, they were explicit in the condition that bioscience must be focussed on nursing-relevant content. In particular, bioscience could be taught into the final year of their program, when typically consolidation of clinical practice occurs, provided that it be applied and linked more closely with clinical practice. It is only when bioscience is targeted to the needs of registered nurses that it can have the greatest impact on student learning, and ultimately on improving the quality of patient care. Further, the integration of bioscience with clinical nursing courses needs to be driven by academics, nurse educators and clinical nurses to provide a biological basis for patient care to nursing students.

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Table 1. Registered nurse participant demographics ($n=22$)

Variable	Number of participants (frequency %)
Age in years: M (SD and range)	33.6 (10.5, 22-53)
20-30 years	12 (55%)
>30 years	10 (45%)
Female	19 (86%)
Male	3 (14%)
<i>Secondary school science studied</i>	
Biology	8 (36%)
Biology, physics and chemistry	3 (14%)
Any science subject other than biology	7 (32%)
No science	4 (18%)
<i>Prior tertiary education</i>	
Certificate or diploma level	4 (18%)
Completed or partial bachelor	3 (14%)
No prior tertiary education	15 (68%)
<i>Clinical area of practice</i>	
Medical and surgical wards	8 (36%)
Critical care: intensive care, emergency, theatre	8 (36%)
Aged care	2 (9%)
Oncology	2 (9%)
General practice medical centre	2 (9%)

Table 2. Registered nurses' reflections on university bioscience ($n=22$)

Descriptor	Number of respondents					M (SD)
	SD	D	N	A	SA	
1. I was not expecting to study that amount of bioscience when I enrolled in nursing.	4	8	2	4	4	2.82 (1.44)
2. The bioscience subjects were the most difficult that I undertook during my course.	0	4	5	7	6	3.68 (1.09)
3. Students without any secondary school science should study bioscience before semester 1.	1	8	4	8	1	3.00 (1.07)
4. Nursing lecturers should have taught the bioscience subjects (rather than science lecturers).	3	6	7	4	2	2.82 (1.18)
5. I had expected that most of my grades would come from exams in bioscience subjects.	1	6	4	7	4	3.32 (1.21)
6. I was concerned about passing bioscience, as it may have delayed my course completion.	1	5	1	7	8	3.73 (1.32)
7. Bioscience subjects were harder than my nursing subjects.	1	3	4	5	9	3.82 (1.26)
8. The language of bioscience made it easy to learn.	3	7	7	5	0	2.64 (1.00)
9. The topics taught within bioscience should have been taught in nursing in the same week.	0	1	3	10	8	4.14 (0.83)
10. The teaching style used in bioscience subjects made them easy to learn.	1	6	6	8	1	3.09 (1.02)
11. There was more content required for bioscience compared with nursing subjects.	0	2	2	10	8	4.09 (0.92)
12. I am comfortable with the level of detail that was taught in bioscience subjects.	0	3	6	9	4	3.64 (0.95)
13. I could learn bioscience by memorising, without needing to understand.	4	12	1	2	3	2.45 (1.30)
14. Online slides and recordings were more valuable for learning than lecture attendance.	3	11	2	3	3	2.64 (1.29)
15. Bioscience consisted of mathematics, making it difficult to understand.	3	14	4	0	1	2.18 (0.85)
16. I think there was adequate university support to allow me to do well in bioscience subjects.	1	7	3	9	2	3.18 (1.14)
17. I've learnt body organ systems, but haven't yet understood well how they are integrated.	4	4	8	5	1	2.77 (1.15)
18. Bioscience concepts were difficult to visualize.	3	5	6	6	2	2.95 (1.21)
19. Exam-based assessments are more difficult than other assessment types.	6	4	5	5	2	2.68 (1.36)
20. The time I spent studying bioscience was more than I spent on nursing subjects.	1	2	1	10	8	4.00 (1.11)
21. I would like to have a better knowledge of bioscience than I have at present.	0	0	1	13	8	4.32 (0.57)
22. I related bioscience to nursing practice to gain a better understanding for assessment	0	1	8	10	3	3.68 (0.78)
23. I thought about bioscience as organ systems rather than general concepts when studying.	1	4	6	11	0	3.23 (0.92)
24. I am confident in my ability explain the biological basis of nursing decisions.	0	5	5	9	3	3.45 (1.01)
25. It is easy to see how bioscience subjects relate to my current nursing practice.	0	0	2	8	12	4.45 (0.67)
26. It would have assisted my understanding if bioscience lecturers had related more to clinical practice.	0	1	3	9	9	4.18 (0.85)
27. It is hard to combine bioscience knowledge to make sense of what is wrong with patients	2	8	7	4	1	2.73 (1.03)
28. An understanding of bioscience forms the foundation of nursing practice.	0	2	1	13	6	4.05 (0.84)
29. Now that I am working, I am able to see why bioscience is important to nursing.	0	1	1	10	10	4.32 (0.78)
30. It would have assisted my understanding if nursing lecturers related more to bioscience.	0	1	3	10	8	4.14 (0.83)

SD, strongly disagree, D, disagree, N, neutral, A, agree, SA, strongly agree

Table 3. Registered nurses' qualitative responses on university bioscience (*n*=22)

Qualitative responses	Number of comments
1. What challenges did you experience about learning bioscience?	
Volume of content and limited amount of time	9
Nature of content (depth of topics, terminology, insufficient prior knowledge)	7
Non-English speaking background	2
2. Why were these challenges for you?	
Insufficient prior knowledge	4
Time restrictions	4
Memorising information	3
3. Were you able to learn enough bioscience required to work as a registered nurse?	
Yes; however 5 of these would have liked more	18
No	2
Neutral	2
4. Can you remember enough of the bioscience taught at university?	
Yes	13
No	9
5. Do you think that bioscience should be taught into the third year at this university?	
Yes	18
Would assist with relating bioscience to nursing subjects or nursing practice	8
Would assist with remembering content	3
To spread the units out	2
No	4

Figure 1. One registered nurse's workplace scenario of application of bioscience knowledge; a vignette.

[Paragraph 1] Just in the last week there was a man in the acute ward with abdominal pain. The pain was described as 8/10 or more at its worst, was not sharp but “wringing” and not limited to an identifiable focal area. Morphine and bed rest would take the pain down to almost nothing, but it would still come and go. Nurses on handover stated that when he went out for a cigarette (which was reasonably often) he came back in saying his pain was back at its worst. Bioscience told me a few things:

- Pain fibres being stimulated were not in the muscle or skin
- Peristalsis could account for pain that comes and goes
- Pain associated with smoking could be related to ischaemia
- Soft abdomen, good Hb [haemoglobin], stable BP [blood pressure] and pulse, no fever; ruled out immediate life threatening bleeding or infection.

[Paragraph 2] I administered pain relief shortly after receiving handover as the patient had been outside for a smoke just before I came on. I asked the patient to call me before he wanted to go out for a smoke next time. My plan was to take him for a bit of a stroll before going out to smoke. I was hoping to use mild movement to differentiate peristaltic vs [versus] ischaemic pain. When he called I asked how his pain was (he was lying down), he said it was really good. I asked him to sit on the edge of the bed before getting up and just chat a minute. After maybe 15 seconds he started explaining that the pain was at its worst when he was sitting and it was a little better when he stood, so I suggested he stand. We continued to talk and he explained that the pain was better than sitting but still increasing. I got him to lay back at this point and recommended as much bed rest as possible (urinal, nicotine patches etc) until MO [medical officer] review.

[Paragraph 3] This was positional pain, indicating gravity (or direction of it) was the key.

Understanding the anatomy I was picturing structures in the abdomen that could cause pain on position change. I'm thinking mesentery (blood supply as well as support structure) or stable-ish abdominal aortic aneurism – but didn't feel any pulsations where they shouldn't be. But they don't pay me the big bucks so I called the MO for more pain relief and mentioned the positional nature of the pain.

[Paragraph 4] It turns out that a lumbar x-ray revealed a protruding disc. The person was still being sent away for CT [computerised tomography] scan to rule out other things, but having an understanding of anatomy and physiology I was able to relay important clues to the MO. The nursing response to this patient up to now was that he shouldn't be going out and smoking because this was causing him pain, or that he was a chronic liar that just wanted morphine. Not how or why the pain was related to smoking, just that pain relief should be withheld.

[Paragraph 5] As far as I'm concerned not enough nurses have enough science knowledge to ask the how and why questions. We don't have to have the answers, that's what we pay doctors the big bucks for, but we need to be able to give the doctors good information, not just that the pain had 5 episodes of 8/10 pain during the shift which required morphine.