Antimicrobial stewardship and pre-registration student nurses: Evaluation of teaching

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Abstract

Background: Antimicrobial resistance (AMR) is a global health concern. It is therefore imperative that healthcare professionals receive ongoing and relevant education and training to ensure they are competent in contributing to antimicrobial stewardship (AMS). At present, few undergraduate nursing programmes include AMS within their curriculum.

Objective: The aim of the evaluation was to determine the relevancy of AMS within the undergraduate nursing programme through the perceptions of student nurses.

Methods: A survey questionnaire was used to obtain undergraduate perceptions of AMS and the relevance to them and their clinical practice.

Results: Our evaluation of this educational programme demonstrated that providing AMS education to undergraduate student nurses raises awareness of current challenges around AMR and reinforces the vital role nurses play in enhancing AMS and infection prevention and control.

Discussion: This evaluation and current literature demonstrate a necessity for AMS to be embedded throughout undergraduate nursing education. Additionally, there is also a requirement to develop clear educational pathways in AMS to ensure continued professional development and contribute towards the advancement of the nursing role in AMS. By doing so, we will continue to build capacity and capability for the future delivery of healthcare.

Keywords

Antimicrobial stewardship, nursing, students, education, competence

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Introduction

The use of antimicrobials has revolutionised modern medicine, not only in the context of managing and preventing infections, but also by supporting many surgical procedures and chemotherapy treatment. Without them, the risk of mortality will increase significantly. However, since their discovery, antimicrobials have been misused and overused, which has resulted in the development of multidrug-resistant organisms. This poses a serious threat to global health and wellbeing (Bartlett et al., 2013; Dellit et al., 2007). It is estimated that by the year 2050, one patient will die every 3 s due to a resistant organism infection, and antimicrobial resistance (AMR) will cost \$100 trillion per annum (O’Neil, 2014, 2016).

The introduction of antimicrobial stewardship (AMS) programmes aims to improve the treatment of patients with

infection while minimising the associated collateral damage, such as AMR and *Clostridium difficile* infection (Bartlett et al., 2013; Owens et al., 2008). AMS has largely been defined as the optimal drug selection, dosage, duration and timely de-escalation of antimicrobial treatment (Dellit et al., 2007). However, such a definition focuses upon medical models highlighting the active and reactive process to AMS, and are not inclusive of the wider multidisciplinary team (MDT) approach. As a result, AMS

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programmes have traditionally been aimed at physicians and pharmacists, and have failed to consider and acknowledge the vital role the nursing profession can have (Mostaghim et al., 2017). To ensure that antimicrobials remain effective for future generations, nurses must be integral to robust multifaceted and multidisciplinary AMS programmes (Edwards et al., 2011; Gillespie et al., 2013; Ladenheim et al., 2013; Olans et al., 2016). Additionally, effective preventative and proactive infection prevention approaches within clinical practice must also be embedded within AMS programmes to avert the transmission and/or development of infection. Such infection prevention practices are integral to the role of the nurse.

Within the healthcare setting, nurses account for the greatest proportion of the workforce. They are central to the delivery of daily patient care and therefore directly involved in the administration, management and monitoring of antimicrobials, assessing patient suitability for outpatient antimicrobial management, engaging with multidisciplinary staff about microbiology results in conjunction with patient clinical assessment, and providing appropriate education for patients and other healthcare workers (Olans et al., 2015). Consequently, nurses are also most likely to identify and intercept errors in a timely manner (Hughes, 2008). However, research demonstrates that they do not do this knowingly under the auspices of AMS (McGregor et al., 2015). Considering the concerted efforts that have been made over the past decade to enhance AMS globally, there is little mention or consideration of the role of the nurse in guidelines for the development of AMS programmes (Mostaghim et al., 2017). Additionally, studies have shown previous initiatives have failed to acknowledge the vital influential role nurses can have in driving forward change and improvement in relation to AMS (Olans et al., 2016).

Given the limited focus on the role of the nurse in AMS, it is unsurprising that there is little empirical evidence to draw upon which explores the nurses understanding, knowledge and/or experiences of AMS. One mixed methods study using a paper-based survey and face-to-face questionnaire across nursing and midwifery in 14 NHS regions in Scotland explored understanding of AMS among nurses and midwives (McGregor et al., 2015). A total of 901 qualified nurses and midwives completed either the paper-based or face-to-face questionnaire, around half of whom worked in an acute setting and half in a community setting. Perhaps most surprisingly, 79% had not heard of the term AMS, and those who did believed that their role in AMS was about ensuring appropriate antimicrobial use. Additionally, 29% thought their role should be about having good knowledge of antimicrobials/antimicrobial guidance and keeping knowledge up-to-date. Only 36% stated that they thought they had good knowledge of antibiotics and 22% thought their role was about educating colleagues and/or patients about antimicrobial use. However, 75% believed AMS should be taught to nursing and midwifery students. Challenges around the implementation of AMS

into the nurses' role, included time constraints, workload, changing practice and poor attitudes. Although the response rate for this study was low, and not all questions were responded to, these findings and anecdotal evidence demonstrate that nurses' knowledge and understanding of AMS within the context of their role are very limited. If we are to achieve a true multidisciplinary approach to AMS, of which nurses are integral, then healthcare and academic organisations need to invest considerable time, resources and educational strategies to address this.

In another study, Castro-Sanchez et al. (2016), examined the teaching of AMS in undergraduate degree programmes within university settings. Using a cross-sectional online survey, they collected information from nursing, dentistry, pharmacy, human and veterinary medicine schools in universities in the UK about AMS teaching within their programmes. They found that out of 58 higher education institutes, less than 13% included all principles of AMS in their pre-registration programmes. It is disappointing to find that nursing schools provided the least AMS teaching. This study identifies significant shortfalls around AMS education within universities, which needs to be addressed by ensuring the key principles of AMS are embedded within pre-registration programmes.

Antimicrobial stewardship teaching

The University of Dundee, School of Nursing and Health Sciences is one of the first universities in the UK to fully embrace the role of the nurse in AMS and embed this within the pre-registration curriculum; thus, integrating it into an already established infection prevention and control teaching programme for pre-registration student nurses. This enables the consolidation of prior theory and practice learning, and contextualisation of the principles of AMS.

Targeted AMS education was delivered to third year nursing students at the University of Dundee, School of Nursing and Health Sciences during their final module. This was felt to be the most appropriate time within the programme to deliver this education as students were thought to be capable of applying practical knowledge, acquired from a wide range of clinical placements, to the related AMS theory. Additionally, delivering the education session at this point within the curriculum would contribute towards ensuring that students were adequately prepared for clinical practice as newly qualified practitioners.

A blended teaching method was used for the 2-h teaching session including PowerPoint presentation, video and clinical scenarios where the students were actively encouraged to participate in discussion and engage with each other. To provide structure to the session and to enable outcome evaluation, student learning objectives were set as detailed below:

1. Understand what AMS means
2. Understand why AMS is important

Table 1. Nursing influence in AMS.

Medicines Management	Nursing Management
Prescribing in line with recommended guidelines –non medical prescribers	Adherence to infection prevention and control standards both national and local
Monitor duration of therapy	Provision of essential nursing care including nutrition, hydration and prevention of pressure ulcers
Promote appropriate route of administration	Appropriate sampling
Timing of antimicrobial administration	Review microbiology results
Participation in therapeutic drug monitoring	Nursing assessment
Check allergy status	Health promotion
Contribute to preparing patient for Out-patient parenteral antimicrobial therapy (OPAT)	Discharge planning

Adapted from Edwards et al., 2011.

3. Understand the logic behind empiric therapy
4. Identify nursing roles within the MDT approach to AMS

The educational content included AMR, AMS definition, the importance of AMS, why AMS is required, classification of bacteria, principles of empirical therapy and the areas of nursing influence. The areas of nursing influence have been adapted from the Edwards et al. (2011) criteria (Table 1). Within the session, each of the areas of nursing influence were discussed, rationalised and examples provided of how these could be incorporated into clinical practice. These were also incorporated into the clinical scenarios to highlight the patient-associated risk when not applied appropriately. An education overview is detailed within the lesson plan (Table 2).

Evaluation methodology

Several weeks following the delivery of the AMS education, an evaluation was undertaken to explore the student's understanding of AMS, establish the students' perspective of the relevance of AMS to their pre-registration programme and to gain an insight into perceptions and experience of AMS within clinical practice. A post-test evaluation questionnaire was developed, which was informed by the literature, content of the education, and advice from infection prevention and control academics. The questionnaire consisted of ten questions and three statements to allow for free text comments (Table 3). The questionnaire was piloted and minor modifications made. Student demographics were not collected as it was felt that this information would not supplement the evaluation; therefore, the questionnaires were anonymous.

All third-year student nurses were included in the evaluation. Student nurses at this point within their studies will

have had exposure to a variety of both community and acute placements gaining clinical experience in diverse clinical settings which will enable and inform student questionnaire response. Questionnaires were distributed to students during their team meetings with their personal tutors and were completed at the end of the meeting. All students were happy to complete the evaluation and no student refused to participate. This significantly enhanced the return rate. Advice was sought from the University Ethics committee, but as this was an evaluation of learning, no ethical approval was required. All students agreed that the data generated could be used for publication purposes.

Results were entered into an excel database which allowed for quantitative analysis. Descriptive analyses using percentages was used to analyse the responses. Thematic analysis identified themes from the qualitative element of the questionnaire which identifies commonalities and differences between students (Silverman, 2010).

Results

A total of 167 student nurses completed the evaluation. Three predominant themes inductively emerged from the evaluation: knowledge and understanding; application to clinical practice; and relevance to pre-registration programme.

Knowledge and understanding

Before attending the lecture, only 15% ($n = 26$) of nursing students had heard of the term AMS. After having attended the lecture, the number of student nurses who stated they now knew what AMS was significantly increased to 79% ($n = 132$). Some students who stated they had more knowledge and understanding of AMS following the lecture said that

Table 2. AMS lesson plan.

Content	Description	Linked to objectives	Material used
Introduction to AMS	Introduce the concept of AMS and establish what, why, who and where	1 2 4	PowerPoint presentation Evidence-based articles News page headlines TED video Student engagement
<i>C. difficile</i> infection (CDI)	Highlight the relationship between antimicrobial therapy and CDI	1 2 4	PowerPoint presentation National enquiry report News page headlines Student engagement
Microbiology	Bacterial classification, likely location of endogenous organisms and types of infection likely to cause	3 4	PowerPoint presentation Visual aids to highlight differences in bacterial structure Human map of organism habitat
Principles of empiric antimicrobial therapy	Define the underpinning theory of empiric therapy, highlighting the nursing role in clinical assessment, sample collection, MDT communication and continued clinical review	3 4	PowerPoint presentation Clinical examples
Areas of nursing influence	Areas of nursing influence divided in to Medicines and Nursing management roles; descriptors and clinical examples provided for all 15 areas of nursing influence	1 2 4	PowerPoint presentation Clinical examples National decision aids and toolkits Student engagement
AMS clinical scenario	Integration of acquired theory into mock clinical practice scenarios highlighting associated risk factors and ability to optimise patient safety; promote student engagement, interaction and critical analysis	1 2 3 4	Student engagement PowerPoint presentation Summary of best practice points National decision aids

they had more insight into the principles of AMS and the link between good infection prevention practice and the necessity of judicious antimicrobial use. One student commented that nurses and students have the most time to spend with patients and are therefore a key factor in patient education. Others also commented that it was important for nurses to be knowledgeable and aware of policies and new therapies.

One student, however, indicated that awareness does not influence practice by stating: *'Awareness is good, but as a nurse, there is not a huge amount we can do. It's down to the person prescribing to be aware of the patient's antibiotic history'*. Another student stated that although students may have an awareness of AMS, they are not in a position to challenge a prescriber.

Application to clinical practice

When asked if they believed nurses had an important role to play in good antimicrobial management, 92% (n = 154) said yes and 71% (n = 119) stated they could identify where they could contribute to antimicrobial and infection management. This included promoting good infection prevention and control practice, particularly hand hygiene,

communicating up-to-date information to healthcare staff and patients, questioning why patients are prescribed antibiotics, assessing the length of time patients are on antibiotics, continual assessment of patients' health, which therefore have a positive impact on patient outcomes and patient-centred care. One student also stated that nurses could also contribute to AMS education to other nurses and medical staff. Despite this, however, 38% (n = 63) of students were unsure if being aware of AMS has changed their practice although this could be explained by the fact that the students had not yet been on clinical placement following the session. Indeed, not all students thought that they could contribute to antimicrobial and infection management and thought that it was only relevant to the prescriber or the medical staff. One commented: *'I don't know much about prescribing antibiotics, so wouldn't question why a patient would need them'*.

Relevance to pre-registration programme

The majority of student nurses felt that AMS was relevant to their pre-registration nursing education and that the content was relevant for their clinical development (84%, n = 140).

Table 3. Evaluation questionnaire.

Question	Response format
I knew what antimicrobial stewardship was before the lecture.	<ul style="list-style-type: none"> • Yes • No • Unsure
I now know what antimicrobial stewardship is about.	<ul style="list-style-type: none"> • Yes • No • Unsure
Nurses have an important role to play in good antimicrobial management.	<ul style="list-style-type: none"> • Yes • No • Unsure
I can identify areas where I can contribute to antimicrobial stewardship and infection management.	<ul style="list-style-type: none"> • Yes • No • Unsure
Being aware of antimicrobial stewardship has changed my practice.	<ul style="list-style-type: none"> • Yes • No • Unsure
Antimicrobial stewardship is relevant to undergraduate nursing education.	<ul style="list-style-type: none"> • Yes • No • Unsure
The content of the lecture was relevant to me.	<ul style="list-style-type: none"> • Yes • No • Unsure
I have sufficient knowledge of antibiotics to ask about antimicrobial prescriptions.	<ul style="list-style-type: none"> • Yes • No • Unsure
I have, or would ask questions about a patient's antibiotic prescription in my clinical setting following this lecture.	<ul style="list-style-type: none"> • Yes • No • Unsure
I am aware of where to access the antibiotic policy relevant to my area of work when on placement.	<ul style="list-style-type: none"> • Yes • No • Unsure

Additionally, 83% (n = 139) felt that the content of the education session was relevant to them. The majority of students also stated that they would or have asked questions about a patient's antibiotic prescription in their placement (73%, n = 121). Some student nurses stated that they believed that AMS is a contemporary healthcare issue where they have clear roles and responsibilities. Others felt that it made them feel confident about asking questions in their clinical placements about antibiotics and infection prevention practice and requested for AMS to feature more within their pre-registration programme. Some also stated that it would help them with patient communication and education in that they would be able to respond better to questions asked. A number of students stated that AMS awareness and education is very relevant to them and some requested it to be introduced early on in their pre-registration programme. There were some students, however, who still believed, even after they had received the education

session, that although this raised awareness for them, they are not in a position to challenge others so they cannot act upon anything. Additionally, 32% (n = 53) were still unsure if they had sufficient knowledge of antibiotics to ask about antimicrobial prescriptions.

Discussion

Nurses are a constant factor in the delivery of healthcare and are already participating in key AMS activities; however, the nursing knowledge, understanding and context behind these are not yet fully acknowledged and are perhaps not completely considered under the auspices of AMS. To date, the limited literature around the nursing role in AMS has focused on the probable and potential impact nurses can have in the optimisation of antimicrobials and infection management (Edwards et al., 2011; Gillespie et al., 2013; Ladenheim et al., 2013; Olans et al., 2016). The nursing profession therefore needs to address this and actively contribute to and participate in the reduction of AMR as part of the wider MDT to fully understand the influential potential of the profession.

Nursing education, awareness and role clarity are required to define the nursing contribution to AMS activities and programmes (Olans et al., 2016). Our evaluation found that most students agreed that AMS is relevant to pre-registration nursing education and believed that the content covered in the education session was relevant to them as nursing students. This therefore complements the view of registered nurses that AMS knowledge and understanding should be incorporated into undergraduate nursing programmes (McGregor et al., 2015). There is evidence to suggest that there is untapped potential in engaging nurses and nursing students in AMS education; however, despite this very few institutes seem to have included this within their curriculum (Castro-Sanchez et al., 2016; Olans et al., 2015).

Due to the lack of nursing participation in AMS programmes, it is no wonder that a large proportion of nurses are not familiar with AMS terminology, but can postulate that it is centred around antimicrobial knowledge and guideline awareness (McGregor et al., 2015). In stark comparison, our evaluation showed that following their lecture, student nurses clearly recognised and understood that AMS is much wider than prescribing, in that it is about acknowledging the relationship between AMS and infection prevention and control practice. A small proportion of students, however, still believed that AMS programmes were aimed at prescribers and the act of prescribing antimicrobials. Perhaps the misconception that AMS is solely concerned with prescribing stems from the intended target audience of doctors and pharmacists at programme inception (Fishman, 2006; Gould and Jappy, 2000; Paskavoty et al., 2005; Shlaes et al., 1997) and it is only now that these fallacies are being dispelled.

The educational session delivered to student nurses at the University of Dundee is contemporary and evidenced-based. It can be incorporated into wider healthcare delivery as student nurses are considered essential to the development and implementation of key measures in clinical areas, and are instrumental in sharing and disseminating evidence based practice (Houghton et al., 2012). As student nurses tend to spend a considerable amount of time with patients and their families they are also influential in health promotion and education (Proctor-Childs, 2016; Rossman et al., 2012; Santa Maria et al., 2016). Our evaluation found that students identified themselves as being key contributors in the continual assessment of health, which was truly patient-centred, and felt that this impacted positively on patient outcomes in infection prevention.

The areas of nursing influence were built upon the roles and responsibilities which epitomise the art of nursing and are instrumental in the nursing role within AMS. These were developed at local level and were informed by the evidence available from the literature on the role of the nurse within AMS (Edwards et al., 2011; Gillespie et al., 2013; Ladenheim et al., 2013). They are therefore central to the education delivered to nursing students as they encompassed both theoretical and scenario-based learning. Although most nursing students in our evaluation identified themselves as having a role to play in antimicrobial management, fewer could specify where they and the nursing profession could contribute in AMS. This perhaps reinforces that there is a need for role recognition and clarity at national level. Currently, only one of the four national AMR strategy documents (Department of Health, Social Services and Public Safety, 2012; National Health Services Scotland, 2014; National Health Services Wales, 2016; Public Health England, 2015) within the UK clearly specifies the role and responsibilities of the registered nurse within AMS (National Health Services Scotland, 2014). To enable the nursing profession to move forward with enhancing AMS, these need to be translated and incorporated into local, national, educational and professional strategy documents to define nursing scope of practice within stewardship. By bringing clarity and definition to the nursing role would enable students to feel more empowered to question, challenge, engage and participate in antimicrobial management if it were deemed to be within their professional scope of practice.

Our evaluation has identified student nurses' perceptions of AMS and explored their understanding and experiences of their role in AMS. We do however recognise limitations of our evaluation and acknowledge that a pre-test/post-test study design would have given greater insight into the student knowledge acquisition and perceptions of their role in AMS and the suitability and relevance of AMR within their pre-registration curriculum. Additionally, the evaluation could have been further enhanced by distributing the questionnaire once students had returned from

clinical placement so as to obtain a greater understanding of impact on practice.

With an impending global health crisis and the associated burden AMR infections have on healthcare systems and wider society, it is imperative that the nursing students are adequately prepared for clinical practice as they make the transition to registered practitioners. Incorporating AMS education into undergraduate nursing programmes and threading this through existing curriculum such as infection prevention and control, will provide a foundation for newly qualified practitioners entering healthcare to build on evidence in the areas of nursing influence and realise the impact the profession can have in reducing AMR.

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