

Testing nursing staff competencies using an online education module

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Abstract

Background Since the introduction of an annual skill assessment in 2000, the mandatory completion of assessments has provided staff with ongoing professional development and has reinforced knowledge of organisational policy and procedure. Whilst staff have consistently achieved the target of 100% successful completion, growth of the service and workforce has increased the demands on educators. An increased trend to part-time work called for more flexibility from both educators and staff to deliver and complete assessments. The educators took on the challenge of introducing an online skill assessment with the objective of reducing the time required of educators to conduct the assessment and to improve accessibility for staff.

Method Internet-based, open-source education software was used to create an online assessment package. A bank of 100 questions was formulated relating to organisation and departmental policies, drug and fluid calculations and dialysis specific medications. The questions were reviewed for relevance and ambiguity. Individual assessments comprised 20 selected questions. The time taken in the delivery, processing and completion of assessments was reviewed.

Results The online tool has made for easier delivery of education. There was a substantial improvement in time required for delivery, assessment and feedback. Staff response to the assessment method was positive.

Conclusion As a result of the improvement in efficiency of education delivery and the positive response of staff, this tool will be used for future skill assessments, and will be able to include a wider network of regional staff.

Keywords

Competency, dialysis, education, skill assessment, nursing.

Background

Maintaining clinical competencies is essential to operating a safe and efficient health service. Although a definition of the term competency is itself not without controversy (Cowan, Norman, & Coopamah, 2005; Scott Tilley, 2008; Burns & Poster, 2008; Le Deist & Winterton, 2005), it is generally accepted that competency is a demonstrable skill, or observable behaviour (Hoffman, 1999). Importantly it encompasses more than just knowledge itself, and includes values, attitudes and skills which incorporate intellectual, interactive and psychomotor components (White & Evan, 1991). The National Competency Standards for the Registered Nurse (ANMC, 2006) underpin these broad and principles-based performances. The Australian Nursing & Midwifery Council (ANMC) defines competence as “the combination of skills, knowledge, attitudes, values and abilities that underpin effective and/or superior performance in a profession/occupational area” (p. 14, 2006).

The dialysis service introduced skill assessments in 2000 as a means of ensuring all staff possess and maintain the requisite skills to perform dialysis. This skill assessment is delivered on a three-year cycle where year one is a comprehensive assessment of basic dialysis procedures via a practical and theoretical module. Years two and three are various advanced learning modules and include diabetes, renal osteodystrophy, blood pressure complications in dialysis patients, dialysis and the ageing population, and medication and calculations.

All staff complete year one either within three months of commencing with the service, or on the three-year cycle, with years two and three being completed by all staff on the alternative years. For successful completion of assessments, staff are required to achieve 100% for the basic module and in most cases 85% for the advanced modules. The Medication and Calculation Competency was the exception, requiring 100% accuracy.

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Whilst staff have consistently achieved the skill assessment targets, increased staff numbers has increased demands on the educators. The two educators in the service work part-time during weekdays, making it difficult to meet with the many staff who work part-time or on evenings or weekends only.

When considering a skill assessment for 2011, the educators were keen to minimise the time spent administering assessments and to improve their ability to monitor submissions. Other considerations were to provide staff with a package that was easily accessible during their work day, gave access to all the relevant resource material, and prompt feedback after submission. The aim was to introduce an online skill assessment that could meet these considerations.

Materials and methods

Advances in technology have led to innovative tools in both clinical education (Pilcher & Bedford, 2011) and competency testing (Rebholz, 2006). There is a range of learning management systems (LMS) available as either free (open-source) or at a cost (paid-for) (Eckstein, 2010). These advances come with challenges both for educators setting up the e-learning module and for staff accessing the education. Educators need to devote time to learn how to use the LMS software (Billings, 2007), be cognisant that it can be resource-intensive to develop, and be aware that poor design may impair learning (Davids, Chikte, & Halperin, 2011). Principles of learning need to be adhered to rather than just “the technical procedures of how to conduct E-learning” (Al-Shehri, 2010, p. 149). Educators also need to consider constructing packages which are compatible with the download speed and modes of internet access used by the students (Sinclair, Schoch, Black & Blackman, 2011). Challenges faced by students include availability of computer access, time needed to complete the module(s) (Billings, 2007) and limited computer capability.

To set up the online skill assessment, the internet-based open-source learning management software *Modular Object-Oriented Dynamic Learning Environment* (Moodle™) was chosen. There were a number of reasons that this software was selected. These included its availability as freeware and absence of any licence fee; courses for both administrators and teachers were run locally; Moodle.org (Moodle, 2011) has an extensive website which provides a demonstration site, documentation, support forums, and a large range of free optional modules designed for specific tasks; and the ability to develop courses that include a range of resources and activities.

A programme was commenced using the Medication and Calculation Competency as an initial advanced module for implementation. The online Medication and Calculation Competency for dialysis staff consisted of several linked resources. These included links to the hospital policy and procedure intranet, the dialysis service policy and procedure intranet, MIMS online and drug calculations. MIMS online is a web-based version of the MIMS manual, which contains references to medication and product information. The drug calculations site is from Flinders University in South Australia

(Basic Drug Calculations, n.d.) and contains examples of how to calculate tablets, mixtures and solutions and intravenous rates. For the quiz, a bank of 100 questions relating to organisational and service policy, drug and fluid calculations and renal specific medications was developed by the educators. A group comprising a nephrologist, renal pharmacist and representatives from each of the clinical areas reviewed the questions for accuracy, relevance of content and ambiguity. Sample questions are shown in Table 1.

The questions were grouped into specific categories from which Moodle™ was set to randomly pick a nominated number of questions. The question order and answer options were shuffled so that no two quiz attempts were likely to be the same. Using the question bank categories, quizzes of 20 questions were set up for each of the staff groups, enabling the educators to tailor the quizzes to suit the different clinical areas.

A pilot programme was undertaken using a single centre. The purpose of this was to identify ambiguity of questions, ease of completing the assessment, length of time to complete and monitoring the feedback from Moodle™. This allowed the educators to modify or remove ambiguous questions and to change the type of question to allow for a variety of answers; for example, an answer of ½ could have been written as 0.5, ½, half or half a tablet and if the answer in Moodle™ was ½ all the other ways of writing the answer would have been marked as incorrect by Moodle™, thus requiring the educators to change the question format from a numerical question to a short-answer question to allow for the different ways of answering the question.

Following the pilot programme, questions were modified or removed and the module was rolled out across all metropolitan dialysis units in the service. Staff accessed the online assessment the same way they log onto the organisations intranet. For successful completion, 106 staff were required to correctly answer all 20 questions. No time limit was set for completion and the quiz could be saved and continued at a later time. Once submitted, the quiz could not be modified and Moodle™ then provided an instant feedback grade to students. If 100% was not achieved, the assessment could not be reattempted for 12 hours; and staff would be issued with another set of 20 questions, not just the questions that were answered incorrectly.

Staff were allowed a maximum of three attempts to achieve 100%. Executive management clearly defined the consequence for staff if they were unsuccessful in completing their competency; that they were to cease administering all drugs until further remedial education and assessment were completed.

Grade reports were automatically generated in Moodle™; these allowed educators to view both overall results and individual staff results to see which questions were answered incorrectly.

Staff evaluation

An online evaluation tool was used to gain some insight into what staff thought about both the competency itself and the delivery system that was used. Staff were given eight statements

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Table 1. Sample questions.

| Info | Results | Preview | Edit |
|--|--|--|---|
| Preview Medication and Calculation Competency | | | |
| Start again | | | |
| 1 | The doctor delivering a verbal or telephone order must state: Choose one answer | <input type="radio"/> a The name of the patient and the generic name of the drug | <input type="radio"/> b The route of administration and the time the drug is to be given |
| | | <input type="radio"/> c The strength of the drug and the dosage | <input type="radio"/> d All of these options are required |
| 2 | Intravenous dextrose (50%) should only be administered to patients during haemodialysis when: Choose one answer | <input type="radio"/> a The patient is either unconscious but unable to tolerate oral intake of glucose and serum glucose is measured at less than 3.5mmol/L | <input type="radio"/> b The patient is conscious and serum glucose remains less than 3.5mmol/L |
| | | <input type="radio"/> c The patient is unconscious and serum glucose is measured at less than 3.5mmol/L | <input type="radio"/> d The patient is unconscious and serum glucose is measured at less than 3.5mmol/L |
| 3 | 2 grams of a drug has been added to 1 litre of 0.9% sodium chloride. Calculate the amount of drug (mg) per ml in this infusion Choose one answer | <input type="radio"/> a 1.5 mg/ml | <input type="radio"/> b 2 mg/ml |
| | | <input type="radio"/> c 1 mg/ml | <input type="radio"/> d 0.5 mg/ml |
| 10 | A patient is receiving 30mL/hour of an infusion of 500mL of 0.9% sodium chloride (normal saline) containing 100mg morphine. How many mg of morphine will the patient be receiving an hour? Choose one answer | <input type="radio"/> a 2 mg | <input type="radio"/> b 6 mg |
| | | <input type="radio"/> c 5 mg | <input type="radio"/> d 4 mg |
| 11 | The major risk associated with heparin therapy is: Choose one answer | <input type="radio"/> a Osteoporosis | <input type="radio"/> b Haemorrhage |
| | | <input type="radio"/> c Itching and burning | <input type="radio"/> d Hypersensitivity reactions with chills, fever and urticaria |
| 12 | A patient presents to HDS with peritonitis and is ordered intra-peritoneal (IP) antibiotics. The patient is on CAPD and has 2 litre exchanges. The antibiotic order is for Gentamicin 30mg IP daily. Stock strength of Gentamicin ampoules is 80 mg / 2 ml. Calculate the required dose in ml you will need to administer. Answer | <input type="text"/> | |
| 13 | A test dose of iron must be administered: Choose one answer | <input type="radio"/> a Where emergency resuscitation equipment is readily available | <input type="radio"/> b All of these options |
| | | <input type="radio"/> c If the patient has not previously had intravenous (IV) iron | <input type="radio"/> d Where medical officers can attend |

describing responses to the module. In each case they were asked if they agreed, disagreed or were unsure.

Results

Participation rates

In previous years, it has typically taken eight to 10 months to achieve 75% participation and completion of a skill assessment. In comparison, it took three months to achieve 75% participation with online competency testing (Figure 1).

Fifty-two per cent of staff achieved 100% on the first attempt, 34% on the second attempt, whilst 14% required three attempts to complete the assessment successfully. No staff member was unsuccessful after three attempts.

Staff evaluation

Results of the staff evaluation tool are shown in Table 2. Fifty-one per cent completed the evaluation. Survey results indicated that staff preferred to do the assessment online; found it easy to navigate and were comfortable completing it at the workstation. Even though most were unable to complete the assessment in a single sitting, this was not considered a problem.

The improvement in completion rates suggested to the educators that the speed of completion was due to the novelty factor of completing the Medication and Calculation Competency online. However, only 44% of staff agreed that this was an important factor (Table 2)

Forty-six per cent of staff thought the questions on "medication administration" were relevant to their practice; whilst 47% thought the questions on "drug/fluid calculations" were relevant

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to their practice. Staff were asked to rate their knowledge, confidence and safety prior to completing the Medication and Calculation Competency and post-completion. Interestingly, 70% of staff perceived themselves to be knowledgeable, 74% confident, and 68% safe in relation to medication administration and drug/fluid calculations; this increased slightly to 72%, 82% and 74% respectively post-completion.

It was of concern that 73% found ambiguity in the questions. Although it was not possible from the evaluation to determine exactly what staff considered ambiguous, some of the questions were found to be poorly worded, despite being reviewed. It

Figure 1. Percentage (%) year-to-date (YTD) completion of online competency testing compared to target completion.



was also clear from results that a limitation of Moodle™ is that calculated answers are marked as incorrect when text is included in a numerical answer. For example, a correct answer of 5 entered as 5 ml was marked incorrect; when this occurred the answer was retrospectively marked as correct by the educators.

Although 42% felt anxious completing the assessment, it was unclear whether the anxiety was related to the consequences of not being able to administer medications, the ambiguity of some questions or completing the task online.

Twenty seven staff (57%) who completed the evaluation felt there was an impact on them not being able to administer medications if they were not successful in completing the assessment.

Discussion

This paper has described an experience with an online skill assessment tool used to measure Medication and Calculation Competency. Online assessment offers an efficient and effective way of measuring staff competencies, and offers advantages to both staff and educators. Cunningham and Roche (2001) undertook a study using Web CT to determine competency in medication dosage calculations and found similar results noting that the online module not only provided immediate feedback but also “saved faculty time in the grading and analysis of the quizzes” (p. 165).

Safe medication administration and drug calculations rely on the ability of clinical staff to have a basic knowledge, skill and understanding of mathematical calculations; with obvious potential harm to patients if this is not achieved. Several studies have found that staff completing a drug calculation competency test did not achieve 100% (Santamaria *et al.*, 1997; Deans, 2005; Glaister, 2007; Hamner & Morgan, 1999). Santamaria *et al.* (1997) found staff had difficulties with conversion of drug dosages from milligrams to micrograms and simple divisions necessary to calculate the correct dose of a drug. Deans (2005) found that the most common errors reported were administering a medication at the wrong time and missing a dose of medication. Human factors that contributed to medication errors as reported by staff were stress and high workload (25.3%) and fatigue or lack of sleep (16.5%). It has also been reported that anxiety related to mathematics and/or assessments plays a role (Santamaria *et al.*, 1997; Glaister, 2007; Hamner & Morgan, 1999).

Although 74% of staff perceived themselves as confident in relation to medication administration and drug and fluid calculations prior to the assessment, it was of some concern to the educators. The small increase in confidence gained by doing the assessment may compound with familiarity if the assessment was to be completed annually. These results are better than what is reported in the literature. A training needs analysis by Lee (2008) looked at the confidence levels of nurses in calculating infusion rates. Of 190 nurses, 41% felt they were not confident or unable to calculate a drip-rate, whilst 61% felt they lacked the ability or confidence to answer a drug calculation. Jones (2009) suggests that “confidence may therefore be a key factor that underpins competence in mathematics” (p. 42).

Despite modifying and adapting questions after the pilot programme, a high percentage of staff still found the questions ambiguous and, upon further review, the authors found some questions were still poorly worded. The educators’ perception of the ambiguity of questions fell into two categories: poorly worded questions and the structure of the question. Making

Table 2. Results of staff evaluation.

| | Agree | Unsure | Disagree |
|---|-------|--------|----------|
| I enjoyed completing the assessment because on-line was a novelty. | 44% | 30% | 26% |
| I would prefer to do the assessment on-line rather than on paper. | 80% | 8% | 12% |
| It was easy to find a computer to complete the on-line assessment. | 92% | 2% | 6% |
| The on-line assessment was easy to navigate. | 90% | 4% | 6% |
| I did not feel comfortable performing the assessment at the workstation/ nurses station. | 20% | 10% | 68% |
| I found some of the questions ambiguous. | 73% | 13% | 15% |
| I felt anxious completing the Medication and Calculation Competency. | 42% | 15% | 44% |
| The consequences of “not being able to administer medications” had an impact for me when completing the on-line assessment. | 57% | 22% | 22% |

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the educators more aware of the possible misinterpretation of questions will make them more critical of the way the questions are worded for future assessments but the poorly worded questions got through a number of review groups, so in future there could be some questions that fall through this loop. The ones with structural problems where the answer can be written as 0.5, ½ or half have been addressed by changing the question format.

Almost half of the staff who completed the evaluation felt anxious completing the assessment; this was not expanded on in the evaluation but should be followed up in the future. A study undertaken by Glaister (2007) looked at mathematical and computer anxiety in nursing students and it was found that 14% experienced mathematical testing anxiety and 12% reported computer anxiety. Computer anxiety can be related to experience and confidence with using IT, with the less experienced having greater anxiety (Currie, Biggam, Palmer, & Corcoran, 2011).

Remedial education was provided for staff after the second quiz attempt. The area focused on during remedial education depended on the type of question that was answered incorrectly by the staff member. For most staff, remedial education was done on an individual basis. Staff felt not being able to administer medications would impact on the dynamics of the dialysis unit by placing an unfair workload on colleagues who were successful and thought there could have been potential safety concerns for the patients by the increased workload of colleagues. "Protections against academic dishonesty were provided by password management" in Cunningham & Roche's study (2001, p. 165.) Similarly, staff were required to use their hospital log-on and password to enable them to access the quiz, which was a barrier to dishonesty. The educators did not envisage that any staff member reattempting a quiz may be dishonest and ask a colleague to complete the quiz, having the threat of being unable to administer medications hanging over them. However, this would be no different to a colleague completing a paper-based quiz in previous years.

Administering medications is a daily occurrence in dialysis units, thus staff need to be competent in all aspects of drug and fluid calculations and administering medication. It is suggested by Sulosaari, Suhonen and Leino-Kilpi (2010) that "medication competence is not achieved once and for all" (p. 475) and this should be an ongoing event. They go on to say that medication competence is not only drug calculations, but should include decision making, theoretical and practical competence. This notion is supported by Choo, Hutchinson and Bucknall (2010) who suggest that nurses need to integrate pharmacology and medication knowledge into clinical practice.

Health professionals as a whole have shown clear willingness to learn with a variety of technological tools (Pilcher & Bedford, 2011). Benefits of LMS include: flexible delivery; being able to deliver the content online saves time spent in multiple in-service sessions at multiple sites; collaborative learning; cost-effective once set up; and less travel. Barriers to online learning include

slow internet access, interruptions within the workplace, access to computers within the workplace. Some of these barriers may have been overcome if the service allowed for staff to access the assessment outside the workplace.

The LMS used marked and collated the results and provided instant feedback to staff, saving time and paperwork. Moodle™ grade reports allow educators immediate identification of incorrect questions to feed back to staff in a timely manner.

There were both immediate and long-term specific benefits for the educators. The online system made it easy to track when assessments were commenced and completed. This was in comparison to persistent emails and phone calls to management and staff in the final weeks of the previous financial years, requesting completion of outstanding assessments.

Limitations

Although in general it is believed that this mode of delivery is an improvement, it is not without limitations. The LMS chosen required that each answer exactly matched the answer in the database; otherwise the software marked it as incorrect. Choosing short-answer questions would have prevented this; however, it would have required manual marking by educators.

A further limitation was questions that related to policies were not revised or removed from the question bank in a timely manner if policies had been updated, thus causing staff utilising the policy resource to answer incorrectly.

Conclusion

In conclusion, although the initial set-up of the question bank was time-consuming in the first year, there is now a foundation for building future assessments. Question banks and resources can be adapted to develop future tools and to accommodate the wider network of regional staff. Future assessments can be developed with more interactive learning and clinical-based scenarios to engage learners and facilitate learning. Implementing assessments online has been successful, both in staff access and decreasing the workload of the educators.

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