Forecasting Informatics Competencies for Nurses in the Future of Connected Health
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Nursing Informatics Competencies for Entry to Practice: The Perspective of Six Countries

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Abstract. Internationally, countries are challenged to prepare nurses for a future that has ever increasing use of technology and where information management is a central part of professional nursing practice. There has been a growing trend to move nursing to competency-based education, especially for those students undertaking their first nursing qualification. This first nursing qualification may be linked to pre-registration, pre-licensure or undergraduate education; the term used depending on the country. The authors are drawn from the International Medical Informatics Association special interest group, Nursing Informatics (IMIA-NI) Education Working Group and represent New Zealand, the United States of America, England, Australia, Finland and Canada.

Keywords. Nursing education; undergraduate; pre-licensure

1. Introduction

Every country faces the challenge of preparing nurses for entry to practice in a changing world where an ageing population, shortage of qualified nurses, increased longevity and incidence of long term conditions occurs alongside technological developments and opportunities for effective use of information and communication technologies to support nursing care. The use of competency based nurse education is seen as a move to ensure future nurses are prepared to be active participants in complex health care systems. Each country struggles to satisfy demand within an environment of reduced funds and resources. With the requirement to maximize effectiveness the focus is drawn to effective information management and the use of technology to become part of daily nursing practice.

The initial educational preparation of nurses varies between countries in relation to the length of the course or programme of education, place of education and the mix of theory and clinical within the curriculum. Additionally, the initial nursing education is known by different terms depending on the location and country. For example, the United States uses the terms pre-licensure and baccalaureate, where New Zealand uses

the terms undergraduate. While the terms may vary, the focus is on the early education that allows for entry to practice that culminates in becoming a registered nurse.

Competency-based education has attracted renewed attention and is a growing trend internationally. It is defined as "education that derives a curriculum from an analysis of a prospective or actual role in modern society and that attempts to certify student progress on the bases of demonstrated performance in some or all of the aspects of that role" [1]. The Quality and Safety Education for Nurses (QSEN) project describes competencies as including knowledge, skills, and attitudes that are necessary to continuously improve the quality and safety of the healthcare systems within which they work [2]. Nursing informatics competencies are explicitly described in some countries curricula [3, 4], while others are less clearly stated [5].

The authors are drawn from members of the International Medical Informatics Association special interest group, Nursing Informatics (IMIA-NI) Education Working Group and presents a global view as each briefly describes their representative country's status on the development and use of informatics competencies in their education of student nurses.

2. New Zealand

New Zealand is a small country with 4.7 million people and nearly 50,000 registered nurses [5]. In New Zealand there are 17 schools offering three year Bachelor of Nursing programmes and these are accredited by the national nursing statutory and regulatory body, Nursing Council of New Zealand [5]. At the undergraduate level nursing informatics has been recognised as important since the early 1990s when Jan Hausman wrote the national nursing informatics curriculum [6]. The current competencies identified by the Nursing Council are broadly stated as "Demonstrate the skills needed to acquire, understand and assess information from a range of sources" and "the use of information technology and health information management" [7]. However, the way these competencies are incorporated into each school's nursing curriculum varies, with some being more explicit than others, with an integrated curricula approach being more common. Evidence based practice is seen as a fundamental attribute of a Registered Nurse, and resources to support evidence based practice are accessible through schools of nursing, clinical intranets and the internet. Additionally, each School of Nursing provides a description of the profile of their graduate and information literacy is commonly identified as a degree programme core competency.

A more pressing concern in New Zealand has been nurses developing informatics knowledge and skills post registration. Health Informatics New Zealand (HiNZ), as the independent national health informatics organization, established a working group who, drawing on international guidelines and experience, developed a list of health informatics competencies for New Zealand health professionals [8]. Core competences identified were: health domain knowledge, social/ethics/legal aspects of health information technology (HIT), basic computer science, basic data management, clinical information systems (IS), basic health IS/IT management and health informatics concepts [8, 9]. Free introductory health informatics workshops for clinicians, sponsored by the government, and conducted by HINZ, have been offered around the country with the aim of raising awareness of the importance of the field of health

informatics, the competencies involved and the requirements and opportunities for upskilling or advancing learning in this area.

3. United States of America

As of 2016, there were over 3.1 million registered nurses active in the workforce [10]. Most recent estimates, there are approximately 150,000 new registered nurse graduates per year [11]. Approximately 55% of the nursing population hold baccalaureate degrees or higher [12]. Associate degree nurses represent the remaining percentage [12]. The US has set a goal that 80% of all registered nurses will have a baccalaureate degree by 2020. Yet, in 2014 close to 69,000 suitably qualified potential students were turned away from nursing baccalaureate and graduate programs due to faculty shortage, lack of clinical sites and preceptors [13].

Nursing informatics competencies have evolved since the early days of computer literacy. Although there were several studies identifying the necessary knowledge and skills needed by nurses there was very little momentum to incorporate these into nursing education. Several driving forces helped to facilitate the adoption of informatics competencies in the nursing curriculum. An Institute of Medicine report [14] documented the need for all health care professionals to have the following five core competencies to practice in today's health care system: provide patient-centered care, work in interdisciplinary teams, employ evidence based practice, apply quality improvement and utilize informatics. In this report, informatics tools are considered essential for communication, management of information and knowledge, mitigation of error, support for decision-making and health care interventions.

In 2004, the establishment of the federal Office of the National Coordinator of Health IT, created the "decade of Health IT" in the United Sates. This initiative to promote the widespread adoption of Electronic Health Records, foster health information exchanges and advance consumer engagement in their health care served as a foundation for the development of the Technology Informatics Guiding Education Reform (TIGER) initiative [15]. The goal of TIGER is to ensure that all nurses, in current practice as well as the next generation, will have the necessary knowledge and skills to fully engage in the unfolding digital era of health care [16]. A corresponding initiative funded by Robert Wood Johnson was The Quality and Safety Education for Nurses (QSEN) project [2]. Both the TIGER and QSEN initiatives paved the way for professional nursing organizations, such as the National League for Nursing and the of American College of Nursing, to examine the necessary knowledge and skills needed for the preparation of future nurses. The National League for Nursing released a position statement, Preparing the next generation of Nurses to Practice in a Technology-Rich Environment: An Informatics Agenda [17], calling upon educators to incorporate the necessary informatics knowledge and skills within nursing curricula. To do this, it was important to prepare faculty to gain competencies in informatics. To this end, the Division of Nursing, Department of Health and Human Services, funded nine Faculty Development Collaboratives to prepare faculty to incorporate technologies into their curriculum including informatics and telehealth.

The American Association of Colleges of Nursing (AACN) sets standards for nursing education and informatics criteria is written for all levels including Baccalaureate, Master's and Doctorate of Nursing Practice (DNP). For those preparing at the prelicensure level, the Essentials of Baccalaureate Education for Professional

Nursing Practice [3] delineates competencies related to the use of patient care technologies to support care, the use of decision support systems to guide practice, understand and use standardized terminologies to reflect nursing's unique contribute to patient outcomes, and to ethically manage and process data, information and knowledge to support safe and quality patient care. As a standard for pre-licensure competencies, this document serves as one of the foundational component of accreditation of a nursing education program.

4. England

The United Kingdom (UK) is divided into four countries, England, Wales, Scotland and Northern Ireland. England is the largest of the four countries with a population of more than 60 million. There are around 308,000 nurses (including midwives and health visitors) in England [18]; student nurses attend a three year undergraduate programme at one of the 56 accredited universities, annually there are around 30,000 undergraduate student nurses. The UK Nursing and Midwifery Council (NMC) is the statutory and regulatory body which sets pre-registration (undergraduate) competences required to be met to register as a nurse in the UK; the most recent competency requirements are set out in the NMC Standards for pre-registration nursing education [19]. Two relevant core competencies are highlighted in the standards: those around record keeping and information governance, with the latter mandatory from 2014. In addition, the use of appropriate evidence to support practice is widely included. By December 2016 it is expected that there will be the introduction of a new information, data and technology knowledge and skills framework which will be aimed at all levels of the health, care and social care workforce to enable enhanced use of digital technologies to commission, deliver, support, evaluate and audit health and social care [20].

In May 2016 a framework for nursing, midwifery and care staff was published by NHS England titled 'Leading Change, Adding Value' [21]. Within the framework there are ten commitments and one of these identifies the need for nurses, midwives and care staff to "champion the use of technology and informatics to improve practice". There are also associated education measures to support this commitment, namely:

- Provide learning that enables staff to maximize the benefits of innovations in technology and informatics;
- Construct training and education to build the knowledge and confidence to utilize technology;
- Raise awareness of the benefits that telehealth, telecare and information management can bring to improve effectiveness; and to
- Consider developing new roles in the leadership of informatics such as a career pathway for nurse informaticians leading to chief nurse information officer roles.

The framework provides a national strategic direction and operational guidance which will enable this commitment to be realised with education, from undergraduate through to continuing professional development, taking a leading role.

5. Australia

The increasing focus on Australia's e-health agenda requires a national approach to the development of competencies in informatics for nurses and the integration of these into nursing curricula. With an estimated 344,190 registered nurses in Australia [22], nursing is the largest single group of health professionals who directly influence the quality and outcomes of health services. A study of Australian nurses and information technology reported that nurses generally are poorly prepared to engage with information technology in their practice. The study reported that almost two thirds of nurses had not received any formal training in basic software applications and of the 90% of nurses who used computers or other information technology applications, only one third had any formal training [23]. These outcomes supported the urgent need for nurses to have nursing informatics professional competency standards developed with a project (2009-2011) being funded by the Australian Government Department of Health and Ageing (DOHA) and managed by the Australian Nursing Federation (ANF). Queensland University of Technology (QUT) was contracted to undertake the research and development of the Australian Nursing Informatics Competency Standards. These Standards were published in 2015 by the Australian Nursing and Midwifery Federation (ANMF) [24].

There are 31 accredited universities offering a three year Bachelor of Nursing degree which are to meet the national accreditation standards of the Australian Nursing and Midwifery Accreditation Council (ANMAC) [25] which is part of the Nursing and Midwifery Board of Australia (NMBA) [26] which is governed by the Australian Health Practitioner Regulation Agency (AHPRA) [27]. Currently in Australia, 'health informatics and health technology' (Standard 4: Program content supports the development and application of knowledge and skills) is the only aspect included as part of the national standards for accreditation by all schools of nursing leading to a Bachelor of Nursing degree. The 2006 national Registered Nurse Standards [28] have been reviewed and the new Registered Nurse Standards come into effect from June 1st 2016. However from the viewpoint of nursing informatics, in the 2006 Registered Nurse Standards there were only two criteria that broadly related back to nursing informatics; a) "accurately uses health care technologies in accordance with manufacturer's specification and organisational policy" and b) "records information systematically in an accessible and retrievable form" [28]. The reviewed Registered Nurse Standards for Practice [29] have no mention of any specific aspects of nursing informatics, hence the critical need for the Australian Nursing Informatics Competency Standards [24] to provide the profession with a set of standards that all registered nurses in Australia must meet. All educational courses in Australia have to meet the Australian Quality Framework (AQF) Standards and Criteria(30] with all Australian Bachelor Degrees meeting AQF Level 7 criteria. Therefore, Bachelor of Nursing degrees have to meet AQF, AHPRA and NMBA standards and criteria for registration as a Registered Nurse in Australia.

6. Finland

Finland has about 5.5 million people and nearly 51,000 registered nurses. There are 23 schools offering three and half year Bachelor of Nursing programmes and these are based both on the statutory and European (EQF) and National Qualification Framework

(NQF). The framework provides an instrument for the classification of qualifications according to a set of criteria for specified levels of learning achieved which aims to integrate and coordinate national qualifications subsystems and improve the transparency, access, progression and quality of qualifications in relation to the labour market. Nursing informatics is included in the Innovation and Working Community Competency. Each nursing school implements nursing informatics studies into sub-competencies and there are variations in curricula. At the bachelor level nursing informatics penetrates the whole nursing curriculum, as themes e.g. information management, documentation, electronic patient records, data security and data protection. There are also practice focused master programmes in nursing informatics and health technology content is included. The Finnish Nursing Association (FNA) aims to increase the standing of the profession of nursing by offering services that help develop professional skills and expertise in the field of nursing informatics and e-Health. The FNA's e-services provide effective tools to carry out evidence-based nursing and access to various databases. In mid-2015 the FNA studied nurses' (n=464) use of and attitudes related to technology use. Over 90% used technology in their work, most commonly within electronic patient records, decision making systems and various medical devices [31]. The newest innovations like games for health, virtual clinics or robotics are gradually coming part of nurse's work. There is a constant need and also a challenge to offer updated education for nurses. The FNA enhances nursing informatics and e-Health by providing the opportunity for nurses with many-sided 'e-health - working experience' to apply for the diploma of Special Qualifications in Nursing Informatics and eHealth [32]. FNA celebrated its 90th anniversary in 2015 and in January 2016, the FNA launched their first National e-Health Strategy for Nurses [32]. Finnish nurses are keen to keep abreast of the times in developing the digitalisation in health. The FNA's eHealth strategy includes informatics competencies. Furthermore, there are three aspects of expertise: knowledge, skills and competence. Nurses' training involves five areas of expertise: learning, ethics, workplace skills, innovations, and internationalisation. The production of eHealth services concerns all these areas. More specifically, workplace skills refer to smooth operations in workplace communications and interaction, as well as the ability to utilise many aspects of Information and Communication Technology (ICT) and networks. Innovation expertise means that nurses are able to develop creative problem solving and work methods, the proficiency to work on diverse programmes and know-how to carry out research and development projects. Nurses also know how to apply existing knowledge and methods in their field and know how to look for financial and client-oriented solutions.

7. Canada

The vast geography of Canada is home to more than 34 million people and more than 360,000 regulated nurses (Registered Nurses, Registered Practical Nurses, and Registered Psychiatric Nurses). Of those regulated nurses, more than 270,000 are registered nurses and graduates of one of 135 schools of nursing. In 2003 less than 30% of all schools reported having any informatics content, theoretical or applied, integrated into their basic entry to practice programs [33]. A decade later, anecdotal evidence suggests that the lack of informatics integration remains relatively the same. In 2011 the development of nursing informatics competencies for new graduates was initiated with the support of the Canadian Association of Schools of Nursing (CASN) and

funding from Canada Health Infoway. Rationale for this included: 1) limited informatics content in existing nursing curricula, 2) the need for entry-to-practice nursing competencies reflecting the skills and knowledge needed to work in Health Information Technology (HIT) enabled practice environments, 3) the lack of shared understanding and consensus among educators on required informatics competencies for entry level practice and 4) the need to better prepare registered nurses to practice in increasingly data, information and technology rich environments. In 2012, CASN published national, consensus-based entry to practice informatics competencies for adoption by all Canadian Schools of Nursing, and followed this with the development of a Faculty Learning Resource and Teaching Toolkit to support the integration of informatics into core curricula [34]. Additional details of these development activities have been described elsewhere [35].

An underlying premise of the competencies is that students entering schools of nursing at the undergraduate level will possess basic computer literacy as it relates to the use of generic applications and devices (e.g., word processing, email, smart phones and computers). The competencies are subsumed by a single over-arching competency statement: *Uses information and communication technologies to support information synthesis in accordance with professional and regulatory standards in the delivery of patient/client care.* The following three competencies have been identified:

1) **Information and knowledge management** - Uses relevant information and knowledge to support the delivery of evidence-informed patient care.,

2) **Professional and regulatory accountability** - Uses ICTs in accordance with professional and regulatory standards and workplace policies.

3) **Information and communication technologies** - Uses information and communication technologies in the delivery of patient/client care.

Each of these competency domains has been further elucidated with specific outcome indicators which can be used to determine whether each competency has been achieved. For example: a) *Performs search and critical appraisal of on-line literature and resources (e.g., scholarly articles, websites, and other appropriate resources) to support clinical judgement, and evidence-informed decision making and b) Demonstrates that professional judgement must prevail in the presence of technologies designed to support clinical assessments, interventions, and evaluation (e.g., monitoring devices, decision support tools, etc.).*

The entry-to-practice informatics competencies for registered nurses and the associated toolkit have been widely disseminated to all Canadian schools of nursing, are available on the CASN web-site for free download [34], and have also been shared as an online resource to subscribers of the TIGER (Technology Informatics Guiding Education Reform) Virtual Learning Environment (VLE).

Efforts to continue the dissemination and integration of the informatics competencies into the undergraduate curricula of Canadian schools of nursing are currently underway. An initiative launched in the winter of 2015 included nursing faculty outreach and mentoring by the designation of ten digital health faculty peer leaders from the east to west coast of Canada. Each faculty peer leader led a variety of educational sessions, webinars, workshops and one-on-one mentoring with nursing faculty. In addition, a faculty resource for the teaching of Consumer Health Solutions was developed, published and disseminated to schools of nursing. Data were gathered from peer leaders and their mentees pre and post-implementation of this initiative and indicate the merits of continuing the peer leader strategy to advance curricula integration of informatics.

8. Discussion

The above description provides an overview of how informatics competencies are addressed in six countries. These examples have the potential to be a useful resource for informatics professionals and nursing curriculum developers as they strive to meet the challenge of including, and then ensuring students meet the nursing informatics competencies in their entry to practice education.

While the reports from six countries shared above indicate variety in how nursing informatics competencies are articulated and implemented in nursing education, it also highlights that despite the differences between the countries there is also a shared concern on how to educate and prepare nurses for a technology rich healthcare environment. The differences in the nursing informatics competencies vary considerably. For example, the American Association of Colleges of Nursing, under the item they identify as Essential IV: Information Management and Application of Patient Care Technology state, "Graduates must have basic competence in technical skills, which includes the use of computers, as well as the application of patient care technologies such as monitors, data gathering devices, and other technological supports for patient care interventions. In addition, baccalaureate graduates must have competence in the use of information technology systems, including decision support systems, to gather evidence to guide practice" [3]. This detailed requirement is in marked contrast to the brief statement from New Zealand regarding nurses needing to be competent in "the use of information technology and health information management" [7]. Both of these differ again with the European Health Information Technology Competencies [36] which under the heading of General Knowledge/System Use have the baseline competency for the nurse of "Being able to use technology appropriate to your role and work environment" and being "aware of the various types and components of health information/eHealth systems". Furthermore, these three examples of competencies are difficult to assess. Some suggest that assessment drives learning [37], and so the challenge is how can educators measure or assess attainment of nursing informatics competencies.

Despite having created, document and shared nursing informatics competencies within a country or region, the competencies may not be fully adopted and taught in all schools of nursing. This issue highlights the need for suitably qualified faculty who will champion nursing informatics as a subject and are available to teach students [38, 39].

An international approach to health is well recognized as important for future developments due to the commonalities in issues such as meeting the increasing demand for health care services and reducing the rising cost of those services [40]. This can be extended to healthcare education, which may also benefit from collaboration with a global approach through sharing insights, educational opportunities and resources [41, 42]. The notion of having an internationalised nursing curriculum has been raised [43, 44], and if this was ever to come to fruition, nursing informatics would ideally be included. The concept that nursing informatics is a concern beyond the borders of any one country has some appeal as having such a standardised approach may help to ensure that nurses throughout the world are prepared to the highest levels, and are well placed to support global health.

9. Conclusion

This chapter presents six country's use of informatics competencies for student nurses and as such shows a range of approaches. The use of international networking, information share and learning among nurses is still in its infancy. What remains clear is that much work remains to achieve full integration of core informatics competencies into nursing curricula. Additionally, the challenge to engage nursing faculty in this work requires multi-faceted approaches to develop the competency and comfort of a majority of nurse educators. The state of nursing informatics within each country varies, and it would seem that no one approach is better than another. Rather the challenge is finding a way forward that fits with local drivers and initiatives to strengthen the early stages of nursing education so that nurses are well prepared for their career which includes making best use of available technology to support their practice.

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