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Informatics Competencies for Nurse Leaders

A Scoping Review

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OBJECTIVE: To consolidate informatics competencies for nurse leaders.

BACKGROUND: Nurses in leadership positions with financial and human resource responsibilities have the capacity to shape how technologies are selected, implemented, and used. Many nurse leaders are not equipped with the essential informatics competencies to do so effectively. There have been efforts to identify a set of standard informatics competencies that should be core to every nurse leader's suite of capabilities; nonetheless, these efforts have yet to be disseminated widely.

METHODS: A scoping review was conducted by: 1) identifying the research questions; 2) identifying relevant studies; 3) selecting studies; 4) extracting collected data; and 5) reporting the results.

RESULTS: Fifteen articles were found, and 11 competency themes related to informatics knowledge, informatics skills, and others were identified.

CONCLUSION: Findings of this review can be used to support nursing leaders in their identification of gaps in their informatics knowledge and skill.

Given the ubiquitous use of information technology (IT) within healthcare settings, there has been a focus on ensuring that nurses have the informatics competencies that enable them to function effectively in direct care roles.[1-4] In the last decade, many have engaged in the identification of "entry-to-practice" nursing informatics competencies,[1,2,4,5] with nursing informatics being described by the American Nurses Association (ANA) and others as incorporating "the science of nursing with information, technological, communication, and analytical sciences to support the integration of data, information, knowledge, and wisdom into the provision of evidence-based nursing care."[6,7]

Despite this focus on developing informatics competencies for nurses entering the profession, nursing interventions and outcomes are often not adequately represented within the electronic health record systems in which direct care nurses document their assessments and care.[8] This may be a result of nursing terminologies not being linked to the various data fields where direct care nurses are required to enter information, often because nurses are either not engaged in system implementation activities or did not have the appropriate informatics knowledge to insist an appropriate terminology be incorporated.[9] As stated by Ponte and colleagues, "Ensuring that standardized, encoded nursing data are captured in electronic health records is critical if nursing is to realize the potential of big data analytics."[9] This need for standardization is also echoed within the American Academy of Nursing's position paper, which calls for a "unified language system," which allows patient-level data to be retrieved for aiding in clinical decision making.[10] Nurses can advocate for the inclusion of key health data within health technology to ensure that the focus of the technology is primarily the patient, and not the organization or insurance provider.[11] The collection of data specific to nursing can also provide insights into the performance of nursing

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practice and be used to measure its direct impact on patient care.[9]

More recently, attention has been directed to the identification of standardized informatics competencies specific to the role of nurse leaders. Nurse leaders, defined as those with human and financial resource management roles (eg, chief nursing officer [CNO], chief nurse executive [CNE], nurse manager [NM], director of nursing [DON]), have the capacity to influence the selection, implementation, use, and evaluation of technologies within healthcare settings.[7] These leaders can ensure that when new systems are implemented, important nursing considerations are taken into account, such as nursing terminologies being embedded in new systems, direct care nurses being engaged in workflow analysis, and that devices selected do not negatively interfere with the nurse-patient therapeutic relationship. The American Organization of Nursing Executives (AONE) has stated that, "Nurses have become key participants in developing the infrastructure for healthcare technology. Nursing informatics performs a critical role in advocating for patients and nurses who are often the key stakeholders and recipients of many technology-based solutions. Nursing informatics professionals are key liaisons to successful interactions between practice, technology, and patients."[12(p1)] Furthermore, AONE describes that nurse leader's involvement in informatics activities is essential for the achievement of improved outcomes as a result of system implementation. Thus, the role of the chief nursing informatics officers has been recently created to play this critical role.[13,14] In Canada, a joint position statement between the Canadian Nursing Informatics Association and the Canadian Nurses Association has highlighted the important role that informatics plays within nursing across the country with numerous implications for nurse leaders.[15] In the United States, however, AONE has developed a position paper describing the importance of nurse leaders acquiring informatics competencies, as well as some of the potential education, credentialing, governance, and reporting structures.[12] The Tri-Council for Nursing (American Association of Colleges of Nursing, ANA, AONE, National League for Nursing) has also called for the improvement in all levels of nursing education due to technological advances in healthcare.[16]

Unfortunately, there is a growing concern that a majority of nurses in leadership roles may not have the requisite informatics competencies to meaningfully participate in making strategic decisions related to the acquisition and use of information and communication technologies (ICTs).[17] Further, a lack of informatics competency and knowledgeable engagement in ICT decision making may result in nurse leaders delegating the responsibility to others, leading to potentially negative consequences for nurses and patients.[18,19]

Core informatics competencies and tools to support self-assessment for nurse leaders must be identified, validated, and disseminated. While several authors have identified relevant competencies for nurse leaders/administrators[18,20,21] and a self-assessment tool,[22] to date there is no known consolidation of this work. This scoping review will provide a synthesis of these efforts. In this review, the term "nurse leader" is used to denote nurses in administrative roles that have operational responsibilities inclusive of human and financial resource management.

Methods

The literature review was completed by applying the scoping review methodology described by Arksey and O'Malley[23] and Levac et al.[24] The following steps were completed: 1) identify the research questions; 2) identify relevant studies; 3) select studies; 4) extract collected data; and 5) report the results. Each of the steps is described below.

Step 1: Identify the Research Questions

The following research questions were applied to the literature: 1) What are the critical nurse leader informatics competencies identified in previous literature? 2) What are the frameworks or theories that have been used to derive/identify nurse leader informatics competencies? 3) What are the instruments that have been developed and used to evaluate nurse leader informatics competencies? 4) What are the psychometric properties of the instruments being used to assess nurse leader informatics competencies?

Step 2: Identify Relevant Studies

A search strategy was developed in consultation with an experienced research librarian based at the Centre for Addiction and Mental Health library (affiliated with the University of Toronto) in Toronto, Ontario, Canada. The following databases were searched: CINAHL, MEDLINE (Ovid interface), Education Resources Information Center, Web of Science, PsycINFO, ProQuest Dissertations and Theses Database, and Theses Canada. A search of the gray literature was completed using Google and the Canadian Agency for Drugs and Technologies in Health search tool. Relevant keywords and combinations of keywords were completed, adding Boolean operators, where applicable. Studies were considered eligible for the review if they were published in English and reported on informatics competencies of relevance to nurse leaders. Nurse leaders were defined as nurses in roles that afforded them human and financial management of resources in healthcare settings (eg, NM, DON, CNO, or CNE). The review was not limited to country, clinical setting, or publication time range.

Step 3: Select Studies

Study selection was completed by 2 independent reviewers using a screening software application called Covidence.[25] All titles and abstracts found during the searches were uploaded into Covidence, and duplicates were identified and removed. The reviewers screened the 1st 100 titles and abstracts by applying the eligibility criteria to each citation. The percentage agreement between the 2 reviewers was subsequently calculated. Since the percentage agreement was greater than 80% (which was determined to be the minimum threshold to continue), the reviewers then proceeded to screen the remaining titles and abstracts. The reviewers then met to review any conflicts and through discussion were able to resolve discrepancies. Next, the reviewers repeated this screening process having reviewed the remaining full-text articles. In 1 case, the 2 reviewers had difficulty determining whether an article should be included; thus, a 3rd member of the research team was consulted.

Step 4: Extract Collected Data

Each article was read in detail, and relevant data were pulled from the articles and used to populate a data extraction table using Excel (Microsoft, Washington, DC). The table comprised the following parts:

1. Information that provided basic information about the article: This included data related to the author, year, type of study, country, objectives, methods, setting, participants, and results.
2. Information related to the research questions: This included data related to the reported informatics leadership competencies for nurse leaders, organization of reported competencies, frameworks or theories used and their application, instruments developed, and psychometric properties of the instruments developed.

One member of the research team was responsible for populating the data extraction table initially. The table was then double checked for accuracy by another member of the research team. The quality of the included articles was assessed using a modified version of the Critical Appraisal Skills Programme (CASP).[26] More specifically, elements of the CASP that were included in the assessment of quality in this review included whether the aim/purpose was clearly defined, whether a framework or theory was used to guide the work, whether a research process was used to guide the competency identification, the number and expertise of the participants, and whether the methods were clearly articulated.

Step 5: Report the Results

The results of this scoping review have been reported both quantitatively (using frequency and percentage) and qualitatively (using themes). A detailed study protocol with additional methodological information has been published.[27] Additionally, the PRISMA extension for scoping reviews checklist (PRISMA-ScR) was used to ensure that all pertinent elements of the scoping review methods were reported.[28]

Results

The search strategy yielded 1041 articles. Once duplicates were removed, and eligibility criteria applied, 15 articles were included in the final review (Supplemental Digital Content 1, http://links.lww.com/NNA/A4).[5,20,22,29-38] Characteristics of the included articles are shown in Supplemental Digital Content 2 (http://links.lww.com/NNA/A5). The following sections report on the relevant competencies that were reported in the included articles, the frameworks/theories used to develop the competency statements, and any instruments identified inclusive of their psychometric properties.

Relevant Competencies Reported

Informatics competencies of relevance to nurse leaders were reported in all of the included articles. The number of competencies reported ranged from 11 to 304. Identified competencies included both those specific to technology and information systems (eg, understanding the consequences of "workarounds")[20] and broader leadership competencies (eg, workforce development)[29] that nurse leaders require to be effective in their roles. Articles that included both technology and information system competencies, in addition to leadership competencies, generally included a larger number of overall competencies. Variation in the specificity and level of detail of the reported competencies was also present. For example, while some articles presented higher-level competencies (eg, understanding the basic "tools" and terminology and have some experience using IT),[21] other article presented more specific competencies (eg, determines reasons for slow system response time).[36] Articles that reported more specific competencies generally reported larger number of competencies, and thus the authors developed various approaches to organize these into domains, categories, and/or levels. The most common approach for organizing competencies was placing them into 3 main categories, consisting of: 1) informatics knowledge; 2) informatics skills; and 3) computer skills. Within these categories were 11 identified themes of competencies, including: 1) data/information management; 2) information systems; 3) education; 4) research; 5) ethical/legal/regulatory; (6) privacy/security; 7) impact; 8) requirements/system selection; 9) implementation; 10) analysis/evaluation; and 11) non–informatics-specific competencies. Despite most of the identified competencies being specifically related to informatics, competencies related to

leadership, management, and administration that would allow nurse leaders to be most effective in their roles were also identified. Table 1 provides an overview of the themes identified in the included articles, in addition to examples of specific competency statements for each of the identified themes. All competencies reported in the articles included in this scoping review are available in Supplemental Digital Content 3 (http://links.lww.com/NNA/A6).

Frameworks/Theories Used

The initial framework that outlined different levels of nursing practice (practicing nurse, nurse administrator, nurse teacher, nurse researcher) was developed by the International Medical Informatics Association task force in 1989.[38] Using this framework as a foundation, 2 seminal articles written in 2001[35] and 2002,[36] described the development of the Information Management Framework (IMF). The IMF classified nursing informatics competencies appropriate for nurses at 4 levels of practice (beginning nurse, experienced nurse, informatics specialist, and informatics innovator) within the following 3 main categories: 1) computer skills; 2) informatics knowledge; and 3) informatics skills.[35,36] In 2008, these competencies were combined with roles of nursing leaders identified by the AONE, to allow for specificity for nurses working in leadership positions.[7] After a Delphi process was completed to gain consensus, competencies for nurse leaders were identified[36] as follows: 92 competencies related to computer skills, 40 competencies related to informatics knowledge, and 28 competencies related to informatics skills. A 2010 study completed using a similar Delphi process applied the IMF's competency list for beginning/newly graduated and experienced nurses as a starting point and identified 49 relevant competencies for NMs.[30]

Several authors[5,31,32,39] categorized competencies based on the Technology Informatics Guiding Education Reform (TIGER) framework,[2] which contains the same 3 parent categories found within the IMF. One study also incorporated competencies from similar

Table 1. *Competency Themes*

Competency Domain	Competency Theme	Examples
Informatics knowledge	1. Data/information management knowledge/standardization	• Effectively manages and shares large amounts of complex data[16] • Recognizes the use and/or importance of nursing data for improving practice[17]
	2. Information systems	• Has knowledge of technological trends, issues, and new developments as they apply to nursing[7]
	3. Education	• Has knowledge of the levels of informatics knowledge by roles[7]
	4. Research	• Has knowledge of the reuse of patient/administrative data for research[7]
	5. Ethical/legal/regulatory	• Understands the ethical issues regarding IT, security, and confidentiality[21]
	6. Privacy/security knowledge	• Describes ways to protect data[18] • Participates in the development and integration of security and data protection protocols for system and personnel files[27]
	7. Impact	• Defines the impact of computerized information management on the role of the nurse[23]
Informatics skills	8. Requirements/system selection	• Has the ability to ensure that nursing values/requirements are represented in health IT selection and evaluation[9]
	9. Implementation	• Develops implementation plans[24] • Has the ability to manage the effect of change because of health IT implementation[26]
	10. Analysis/evaluation	• Participates in the evaluation of information in practice settings[22]
Other (including computer skills)	11. Non–informatics-specific competencies	Subthemes: • Leadership/administration • Operations skills • Interpersonal/soft skills • Industrial/environment • Quality management • Human resource management • Change management • Stakeholder management • Computer skills • Fiscal management • Information literacy • Project management • Competencies specific to direct care nurses, nurse teachers, and nurse researchers

associations across the international stage, including the Global Health Workforce Council,[40] Australian Health Informatics Education Council,[41] and Canada's Health Informatics Association (COACH/Digital Health Canada).[42]

Over time, the original IMF was revised by either adding or removing competencies, often through a Delphi approach. This gave rise to many competency frameworks that were similar to the IMF. Lastly, it was discovered that several studies referenced previously developed informatics models (ie, informatics research organizing),[33] and a collections of theories (ie, competency, organizational, leadership)[29]; however, these models and theories were not specifically applied to the identification of nursing competencies but used more as a guide for data collection and analysis processes.

Instruments and Their Psychometric Properties

One article was identified that reported the development of a relevant instrument, called the Nursing Informatics Competency Assessment for the Nurse Leader.[22] A separate article was published that described the Delphi study that was completed to identify the relevant competencies to be included in the instrument.[20] Using exploratory factor analysis, the final instrument consisted of 26 items, with the following 6 factors: 1) strategic implementation management; 2) advanced information management and education; 3) executive planning; 4) ethical and legal concepts; 5) information system concepts; and 6) requirements and system selection. The authors reported the Cronbach's α of these factors to be .96, .91, .90, .83, .92, and .81, respectively, which suggests that the instrument has acceptable internal consistency.

In 2 additional studies, researchers measured shifts in informatics competency levels among nursing educators[32] and NMs[37] using assessment instruments based on the IMF[35] and the TIGER framework.[2] The nursing educators instrument[32] consisted of the following 4 dimensions: 1) background (6 items); 2) basic computer competencies (33 items); 3) advanced nursing informatics competencies, including information literacy and information management (67 items); and 4) a change-related section (52 items). The instrument was developed to assess nurse educator's competencies before and after they received informatics education. Scores on this instrument improved after the formal education had been received. The NM questionnaire consisted of the following: 1) general characteristics of the respondents (including gender, age, highest level of education, job experience, and years of experience in nursing administration); and 2) NMs' informatics competencies (49 items).[37] The authors reported on the results of NMs' (n = 10) participation in a pretest to ensure validity, with Cronbach's α values higher than .85, suggesting high internal consistency.

Discussion

At present, there is a global need for nurse leaders to be better equipped with informatics knowledge and skills as many healthcare organizations are acquiring and implementing health information systems to support the work of nurses. It is critical that nurse leaders play a role in all aspects of decision making surrounding the strategic direction, procurement, selection, implementation, use, and evaluation of such technologies. This scoping review identified a number of informatics competencies for consideration for nurse leaders. Although informatics frameworks and theories were not explicitly used to inform the identified competencies, in a few seminal articles authors developed frameworks that were drawn upon in subsequent work.[17,35,36] To date, there has been 1 published article reporting on an instrument developed specifically for the self-appraisal of nurse leaders' informatics competencies, and the reported psychometric properties are acceptable.[22]

One of the current challenges in healthcare organizations globally is that many nurse leaders today may not fully appreciate the importance of informatics competencies for nursing practice and administration.[18] Further, these nurse leaders may not wholly appreciate the potential implications of an absent nursing voice at key decision-making tables, particularly related to the acquisition and design of clinical information system solutions. Given this lack of appreciation, it has been difficult to convince nurse leaders that it is important for them to acquire informatics competencies. However, once convinced that informatics competencies are important, the challenge remains as to how nurse leaders go about acquiring the appropriate level and type of informatics competencies to effectively support technology-enabled care environments. Nurse leaders in middle management and executive roles typically have to manage significant demands on their time, extensive human resource and fiscal responsibilities, and numerous competing priorities. Taking formal courses in informatics to address gaps in knowledge and skill is often not always feasible and may not be available in all countries and regions. Therefore, completing a self-assessment (eg, Nursing Informatics Competency Assessment for the Nurse Leader[22]) to identify specific knowledge and skill gaps and subsequently identify formal and/or informal learning opportunities to address these gaps may be more realistic. Thus, having a standardized set of nurse leader informatics competencies would allow for the development of the appropriately focused and type of resources to be developed.

The Future

With the recent emphasis on the development of entry-to-practice informatics competencies for nurses in many parts of the world, it is hopeful that nurse leaders of the future will be equipped with basic informatics competencies before they assume leadership roles. Nurses entering the profession today are likely to have grown up using technology in all elements of their life[41,42] and in many cases will enter the workforce having had informatics education embedded in their entry-to-practice programs.[1,2] In Canada, the United States, and Australia,[1,2,4] efforts to ensure that nursing students develop knowledge and skill in informatics during their entry-to-practice education have been in place for years. Although the degree of informatics education in basic nursing programs may vary for a number of reasons at present (eg, a lack of nurse faculty with expertise in this area), over time graduates of these programs will enter the workforce with some level and type of informatics competencies to work in digital health environments. Nonetheless, while nurses of the future may be informatics savvy, the scope of their competency may not be inclusive of those needed by individuals in senior decision-making positions. Thus, there will likely always be a need for nurse leaders to possess unique nursing informatics competencies specific to their leadership position.

Literature reviews about informatics competencies have been completed for entry-to-practice nursing roles, particularly those providing direct care.[43,44] However, the findings of these reviews differ from the present review in that the informatics competencies required of entry-to-practice and direct care nurses focus more on the use of health information systems within clinical care environments and how to most effectively use these systems during clinical care to enhance the delivery of safe quality care. This may mean that although nurse leaders of the future are informatics savvy in direct care nursing roles, efforts to ensure that nurse leaders have the appropriate level of leadership informatics competency will likely still need to be addressed. Thus, educational strategies and efforts directed at supporting nurse leaders in acquiring the requisite knowledge and skills need to be developed for the long term.

Strengths and Limitations

A strength of this scoping review is that the search strategy was comprehensive because of the assistance of a skilled research librarian. In addition, a rigorous process was used to determine which articles should be included in the final review. However, it should be noted that no articles were excluded from the review due to quality. In addition, the themes presented do not account for the level of specificity in the included articles as all informatics competencies were examined equally despite the presence of categories and subcategories of competencies in some articles.

Conclusion

At present, nurse leaders are likely unaware of the gaps they may have in their knowledge and skill of informatics; however, a recent instrument has been developed to help nurse leaders identify these gaps.[26] Unfortunately, nurse leaders may not know how or where to acquire the knowledge to fill these gaps, and it may not be feasible for them to engage in traditional education to do so. Thus, the results of this scoping review have direct implications for nursing education, particularly at the graduate level and for continuing education. Educational certificates, courses during graduate-level nursing programs, and creative methods (eg, online tutorials) for supporting nurse leaders learning about the subject will need to be developed to address gaps that have been identified during a self-assessment. Once nurse leaders have acquired the knowledge and skill to address these gaps, they are expected to be more effective in their roles related to ICT acquisition and use. Thus, a long-term outcome of nurse leaders being better equipped with specific informatics competencies is that direct care nurses can benefit from having improved guidance on informatics skills as well as technology that is more tailored to nursing care, which could subsequently benefit patient care.

This scoping review also has implications for research. There is a need to assess whether the informatics competencies present in the self-assessment tool are relevant in other countries and regions. As a next step to this scoping review, the research team has gained support from the Canadian Nursing Informatics Association and the Canadian Nurses Association to assess which nurse leader informatics competencies could be used in the country, for example, as a basis to educate nurse leaders.

In conclusion, this literature review used a variety of methods to identify informatics competencies relevant to nurse leaders. Informatics competencies specific to informatics skills, informatics knowledge, and computer skills were identified in the literature as being the most commonly cited domains used to organize the various informatics competencies of relevance to nurse leaders. In addition, 11 themes of competencies were discovered. Ten of these themes were related to informatics-specific competencies, and 1 of the themes was related to non-informatics competencies (eg, administration) that would support nurse leaders in being successful in their roles. Without these core leadership competencies in informatics, nursing will lose opportunities to derive the maximum benefits and mitigate risks in the adoption and use of ICT in all practice settings.

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