Forecasting Informatics Competencies for Nurses in the Future of Connected Health
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Competency Recommendations for Advancing Nursing Informatics in the Next Decade: International Survey Results

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Abstract. The IMIA-NIstudents' and emerging professionals' working group conducted a large international survey in 2015 regarding research trends in nursing informatics. The survey was translated into half-a-dozen languages and distributed through 18 international research collaborators' professional connections. The survey focused on the perspectives of nurse informaticians. A total of 272 participants responded to an open ended question concerning recommendations to advance nursing informatics. Five key areas for action were identified through our thematic content analysis: education, research, practice, visibility and collaboration. This chapter discusses these results with implications for nursing competency development. We propose how components of various competency lists might support the key areas for action. We also identify room to further develop existing competency guidelines to support in-service education for practicing nurses, promote nursing informatics visibility, or improve and facilitate collaboration and integration with other professions.

Keywords. Nursing informatics, future trends, informatics competencies

1. Introduction

Following the 11th International Congress on Nursing Informatics (NI2012) in Montreal, Canada, the International Medical Informatics Association – Nursing Informatics (IMIA-NI) Student and Emerging Professionals (SEP) Working Group was founded. To date, the SEP has been successful in bringing together students in nursing informatics (NI) from around the world to engage in collaborative activities, including research.

The SEP members engaged in 2015 in discussions about the future development of NI as a specialty field. Group members were interested in learning more about the current state of NI and how to best facilitate the advancement of the field. This led to a collaborative international study conducted by the SEP in the Autumn of 2015, which aimed to gather the perspectives of nurse informaticians from around the globe on current trends and future priorities for NI.

In this chapter, we present an overview of the nursing informatics (NI) international trends survey that was focused on the thematic analysis of the question:

"What should be done (at a country or organizational level) to advance nursing informatics in the next 5-10 years?" In our previous study, we identified five key areas for action including research, practice, education, collaboration, and visibility [1]. This chapter discusses these results with implications for nursing competency development. The potential overlap and support for these key areas for action provided by existing national and international NI competency recommendations are also explored. Finally, we offer recommendations on how to achieve the best results in the five key areas for action, supported by various national and international NI competency and education initiatives.

2. Nursing Informatics: a survey of current and future trends

2.1. Study methods

The SEP developed and distributed an international survey, which focused on current and future trends in NI. The questionnaire was created based on contemporary NI literature [2, 3] and recommendations from NI experts in the field. The questionnaire was translated from English into Arabic, Korean, Mandarin, Portuguese, Spanish, and Swedish. The translations were conducted by native speaking nurses with a background in NI. The translations were validated by at least two other NI professionals. The questionnaire had the following demographic questions: city, country, highest degree received, position (clinical or academic), professional background and years of NI experience, and a set of 18 questions regarding the current or future state of NI. This chapter focuses on the open-ended question: "What should be done (at a country or organizational level) to advance nursing informatics in the next 5-10 years?"

The study received a supportive ethical statement from the ethics committee of the University of Turku in Finland, where it was coordinated. The survey was distributed online through Google forms. Any nurse or other allied health professional with experience in NI in the clinical setting or in academia was eligible to respond. We used snowball sampling and 18 SEP members from fourteen countries distributed the survey through their networks. The nurses who translated the original survey question translated the responses to the open-ended question into English for analysis. Data were collected from August to October in 2015.

2.2. Thematic analysis

All responses were saved into an Excel® spreadsheet and each answer was independently analyzed with thematic content analysis by two of the authors (CR, MT). This qualitative descriptive approach was used to identify, analyze, and report themes in qualitative data [4]. Each answer was examined independently by both authors and assigned one or more initial theme. These themes were then discussed by the two authors and a consensus of five major themes was reached. Thereafter, both authors re-examined their analyses based on these identified major themes and they reached agreement regarding each answer [4]. The results were reviewed by two other authors (LP, LMP) for validation.

3. Survey respondents

Out of 402 total survey participants, 272 (67.7%) responded to the question regarding recommendations on the advancement of NI. Responders were from 31 different countries in Asia, Africa, North and Central America, South America, Europe, and Australia. The majority of respondents were nurses (87.8%) with Bachelors (28.25%), Masters (39.75%), and PhD (28.75%) degrees. Clinical roles ranged from staff (33%), middle management (25.8%), upper management (16.4%), or other (24.8%). Training in NI varied: 57.8% of respondents did not receive formal education in NI, 32.9% received formal NI education, and 9.3% were current students or received education in another informatics field. Those identifying with academic roles included students (22.9%), teachers/instructors (16.9%), and professors (36.4%).

4. Study results

Five key themes for action were identified through the thematic analysis: 1) Education and training; 2) Research; 3) Practice; 4) Visibility; and 5) Collaboration and Integration. Figure 1 presents a word cloud of the most common words that appear in responses to the open-ended question on the next steps to advance nursing informatics. A brief summary of the key themes for action is provided in the following sections. For a more detailed discussion of these key themes, please refer to the original paper [1].

Figure 1. Word cloud of the most common words that appear in responses to open-ended question on the next steps to advance nursing informatics.

4.1. Education and training

Survey participants frequently mentioned the need for better training and specialized NI education. There are many strong advocates for incorporating NI education into all levels of nursing learning (Bachelors-Masters-PhD level programs) and professional development training. Inclusion of informatics content was recommended as a required component of undergraduate nursing curriculums, staff nurses' training and continuous education, and for nurses in leadership and administrative roles. Others further

highlighted the need for further development of specialized NI education in nursing for those who wish to pursue advanced NI specializations.

4.2. Research

Participants suggested that further investments should be made to advance NI research as this can generate more evidence on the benefits of NI approaches, e.g., improved patient safety or providing more efficient care. Participants identified significant topic areas as priorities for the future including big data science, standardized terminologies, education and competencies, clinical decision support, mobile health, usability, patient safety, data exchange and interoperability, patient engagement, and clinical quality measures [5]. Participants also recommended increasing NI specific research funding to advance the discipline.

4.3. Practice

Participants suggested that better health care quality and an increased availability of nursing-specific information systems are critically needed across the board, regardless of high or low adoption of health information systems. Participants also emphasized the importance of thinking beyond acute care and keeping patient outcomes at the center, rather than focusing on profession-specific terminology and issues. Usability was another key area identified as needing advancement. Another sub-theme was the need to establish and support specialist health informatics roles across multiple levels within organizations. For instance, the importance of having leadership roles in nursing informatics such as Chief Nursing Information Officers (CNIO) was highlighted as a way of ensuring the inclusion of nursing practice perspectives and considerations in the design and implementation of health information technologies.

4.4. Visibility

Participants pointed to the need to increase the awareness and knowledge of what NI is across practice, organizational, and policy levels, as well as to the public. Responses suggested that an important aspect of improving the understanding and perceptions of NI is demystifying it within the field of nursing as well as other disciplines. The ability to articulate the relevance and advantages provided by NI in health systems is an area for further development, identified by respondents. Many also pointed to the increased efforts that should be invested to ensure NI representation and leadership in high-level decision-making.

4.5. Collaboration and Integration

Participant recommendations centered on establishing a common voice across the field of nursing, with the aim of placing patient outcomes at the center. Others have advocated an integrated approach across all health informatics fields, where nursing informatics is harmonized with medical and other informatics sub-specialties. Overall, these thoughts reflected two key sub-themes around: 1) the integration and inclusion of all health professions as integral components of health information systems; and 2) the need for collaboration across health informatics disciplines in high-level strategic

planning, design, development, implementation, and evaluation of health information systems. Participants also pointed to opportunities for national and international collaboration and facilitating the exchange of expertise, knowledge, and resources across nursing organizations, clinical practice, and academia, as additional key areas for action.

5. Nursing informatics competency recommendations to support the survey results

5.1. Recommendations for NI education

There are numerous historical and recently developed efforts that aim to address the survey recommendations on promoting NI education. So far, the focus on NI capacity building through entry-level nursing education programs seems to be a dominant approach. For example, the Technology Informatics Guiding Educational Reform (TIGER) led to the TIGER Informatics Competencies Collaborative (TICC) model in 2010. The TICC was developed to function as informatics recommendations for all nurses and comprised of basic computer competencies, information literacy and information management (see section B chapter 3 for a more detailed discussion of the TIGER competencies). In agreement with our survey results, TIGER suggests that NI education should span across all levels of nursing learning, from baccalaureate to doctoral level. The TICC model focuses primarily on the competency needs of nursing students, practicing nurses, and advanced and expert skill levels relating primarily to practice. However, we suggest that the development of competency requirements for advanced and highly specialized NI education levels (i.e., doctoral level competencies) are areas for future development, as these are not currently well addressed in established competencies.

Beyond TIGER, there are several other attempts at developing country-level NI education recommendations both for entry-level nursing practice and as continuing education efforts for experienced nurses. For example, the Canadian Association of Schools of Nursing (CASN) Entry to Practice Nursing Informatics Competencies' recommendations target both students and faculty needs related to the use of information technologies [6]. CASN developed the entry-to-practice nursing informatics competencies so that faculty can have a better understanding of what would be expected of the nursing students upon graduation. CASN also developed resources and a toolkit for faculty to support integrating informatics competencies into current nursing education curriculums [7]. The CASN focus on education and knowledge needs not just at the nursing student level but also of nursing faculty (i.e., those who are responsible for ensuring these competencies are met by student nurses) addresses the survey recommendation of incorporating NI as a required component of undergraduate nursing curriculums. Specifically, addressing the needs of faculty ensures that infrastructure is built in order to deliver NI education to students in a way that can be sustainable. Similarly, one goal of the TIGER education and faculty development collaborative [8] is to encourage foundational investment in NI research, curriculum development, NI practice, and IT adoption. Detailed discussions of country-level NI education efforts in Brazil and South America, China and Asia-Pacific, Taiwan, the Netherlands can be found in section B, and in section B chapter 1 for New Zealand, the United States of America, England, Australia, Finland, and Canada.

The final recommendation from the survey relates to the further development of specialized NI education at advanced education and leadership levels, and for those who wish to pursue advanced NI specializations. An initiative led by the AMIA task force on the Knowledge, Education, and Skillset Requirements of Chief Clinical Informatics Officers, addressed this through provision of recommendations for skillsets needed in informatics and different education and training requirements for CNIO roles [9]. The report pointed to the need of a doctorate level training with leadership focus for CNIO positions. Specifically, the report highlighted that doctorate level education should prepare nurses for leadership roles spanning beyond the substantive aspects of NI, such as development and evaluation of programs, advocacy, conducting research, and understanding the financial aspects of NI. An important group that have been identified are nurse leaders and executives, who may not necessarily have NI substantive expertise but are responsible for making decisions around NI infrastructure, technology procurement, and the like. Existing competency recommendations suggest that nurse leaders should ideally have sufficient substantive informatics knowledge to thoughtfully inform decision-making about information systems in institutions. However, they do not necessarily need to be NI specialists themselves (see section D chapter 1 for a detailed discussion of Informatics Competencies for Nurse Leaders). Recognizing this important group, an instrument to assess NI competencies of nurse executives and leaders have been recently developed and is shown to be valid and reliable (see section D chapter 2).

Students at the Masters level are envisioned to become experts in informatics lingo and foundational concepts delineated by the ANA's Nursing Informatics Scope and Standards of Practice [10]. Masters level training can be a foundational first step developing advanced NI leaders, as graduates will be well-positioned to serve as nurse informaticians in clinical analytics, system configuration, IT training, and other tasks around the system development lifecycle, with the potential to build on this expertise towards higher level decision-making positions. Ideally, such educational preparation will initiate the continued development of competencies and capabilities for both CNIO-type roles and other nurse executive roles that oversee information systems decisions to serve on corporate tables and participate in high-level decision-making.

5.2. Recommendations for NI research

To address the survey recommendation of conducting more NI research, continued development of NI researchers with sufficient research skills is a foundational requirement. The research priorities identified by participants highlight the need for continued development in "traditional" quantitative and qualitative research methods, but also point to the need for researchers' development and training in emergent methods. For instance, big data analytics has seen substantial emergence as a key research priority in future years and requires innovative research methodologies and approaches. Specifically, clinical knowledge and multidisciplinary skills on data management and research methods are needed to develop cutting-edge research models where big data science can be incorporated into nursing research (see section C chapter 3 for a more detailed discussion of big data analytics). Another example is natural language processing, which requires the development of new sets of skills and expertise to best make use of narrative nursing data. Development of these methodological skills can also facilitate making use of standardized nursing terminologies in EHRs that can be mined to gain important insights into nursing care

and nursing-specific outcomes. As demonstrated by a recent systematic review, this type of NI research is limited, to date, with only ten of forty-five studies identified to have used of standardized nursing data from EHRs in research and those limited to only two countries (USA and South Korea) [11].

A proposed research agenda for NI in 2008-18 highlight genomic healthcare and the role of environmental factors in health, data visualization, predictive modeling, and development of middle-range NI theories, among other topics as areas where priorities should be focused [12]. Similarly, the most recent international survey examining priorities for research in NI identified two highly ranked areas of importance for research: 1) development of systems to provide real time feedback to nurses; and 2) assessment of the impact of HIT on nursing care and patient outcomes [14]. The diversity and complexity of the topic areas mentioned above further underscore the importance of the development of skills in NI research. The importance of competencies in analytic and research methods appears to be an enduring aspect of NI research, as highlighted in earlier work [13].

The need for skills in NI research is supported by the work of Staggers et al. [14], who divide nurses into four levels: beginning nurses, experienced nurses, informatics specialists, and informatics innovators. They derived a research-based list of 281 competencies for entry-level and experienced informatics nurse specialists. The competencies of experienced nurses, informatics specialists and informatics innovators all include some knowledge of nursing research from using computer applications for nursing research to advanced responsibilities such as developing conceptual frameworks and techniques in NI research. Finally, it is suggested that the highest levels of expertise (i.e. informatics specialists and informatics innovators), should have the skills in obtaining research funding [14]. We did not identify competencies aimed specifically at developing skills that will highlight the benefits of NI approaches and increase NI specific research funding. Further competency development work should examine the necessary skills such as advocating for NI specific research funding and knowledge mobilization or translation science.

5.3. Recommendations for NI practice

The survey findings highlighted the need for better inclusion of nursing practice perspectives in the design and implementation of health information technologies. This finding is underpinned by two key assumptions: 1) that nurses have opportunities to participate; and 2) that nurses will have sufficient understanding of health information systems in order to participate. Staggers et al.'s [14] competency list supports the second assumption related to the need for a foundational understanding of NI in order to participate – it includes nurses' knowledge and skills to take part of system development and implementation processes.

Addressing the second assumption is critical as specific skillsets are needed to implement and adopt evidence based information systems, educate other nurses on clinical technology, transform health care through the use of information technology, and translate policy into practice and delivery towards the aim of improving clinical outcomes. Indeed, this importance is illustrated by the various efforts towards providing continuing education and specialized NI training geared towards practicing nurses, including in Brazil the United States, Finland, Australia, New Zealand, China, and Taiwan (see section B chapters 1 and section B for detailed descriptions). However, it is important to highlight that the goal of increasing practicing nurses' foundational

understanding of NI is only possible by addressing the first assumption that it is reliant on – ensuring nurses' have opportunities to participate and engage with NI in practice. Further, efforts to establish a baseline understanding of NI for all nurses is arguably only possible through advocacy for the need of these specialized efforts and commitment to investment of resources by nurse leaders in health care organizations. One way this can be ensured is through the establishment of specialist health informatics roles across multiple levels in organizations (e.g., CNIO, NI specialists, etc.).

The remaining survey findings around the need to increase nursing-specific information systems, thinking beyond acute care, broadening the focus beyond profession-specific terminology and issues, and issues related to usability of systems appear to have limited overlap with existing competency recommendations. Increasing the development and availability of nursing-specific information systems can arguably benefit from competencies related to advocacy and leadership development among NI professionals, in order to voice the importance of including such systems in health regions. Competency guidelines around working as part of multidisciplinary teams with various perspectives and expertise is another area of development that should be considered, perhaps in future iterations of existing competency recommendations. Finally, skills and knowledge related to NI in the context of public and community health are additional areas that can benefit from further focus and investigation. For instance, initial efforts can be focused on identifying public and community-health specific NI competencies across multiple levels of education and nursing experience, similar to what has been outlined in acute care (e.g., from baccalaureate nursing level to continuing professional nursing education) and identifying unique needs and requirements of nurses in these contexts related to usability.

5.4. Recommendations for increasing NI visibility

As NI visibility varies significantly across institutions and countries, advancing visibility and articulating the value of NI in health care systems relies on competencies related to leadership development and advocacy. Approaches to developing these competencies can, for example, include formal training in well-designed programs, board examinations and certifications, and the development of specialized NI roles [9]. A more detailed discussion of some these approaches in various countries can be found in section B chapter 1 and section B. In line with our survey finding, the need to invest in efforts to promote NI visibility has been acknowledged in the TIGER Leadership Collaborative report [15]. They recommend the development of programs for nurse executives that emphasize the importance of IT and empowers the user of health IT [15].

An important step in demystifying NI and increasing its visibility within nursing can involve targeting nursing students at early stages of education, which is what many of the competency recommendations focused on. Beyond targeting basic nursing education, CASN entry-to-practice competencies touch on the notion of visibility and inclusion of the nursing voice in health IT development, design, and implementation. For example, a CASN competency indicates that users of health information systems should "recognize the importance of nurses' involvement in the design, selection, implementation, and evaluation of applications and systems in health care" [6].

5.5. Recommendations to promote and facilitate collaboration and integration

A clear understanding that the nurse informaticians role is imperative for collaborative work, both inside institutions and across settings and countries. Nurse informaticians collaborate with interdisciplinary teams to promote all aspects of health and develop better models of care for better outcomes. The need for specific competencies at the organizational level exists as nurses' knowledge and skills in NI vary between setting and countries. There are numerous efforts to address NI competency needs through the development of country specific competency guidelines in connection with the TIGER initiative, for example in Germany, Austria, Switzerland [16], Ireland [17], Australia [18], New Zealand [19] and Portugal [20]. Efforts like that, supported by TIGER, are undoubtedly important first steps. However, the focus of TIGER and other competency recommendation efforts focus primarily on NI competencies as related to the acute setting, and more specifically, as related to the use of EHRs. Therefore, there is room for the development of broad, high-level general guidelines to steer NI education and practice at the (inter)national level that could support the development of standardized NI competencies across countries in contexts that are broader than acute care. In terms of broader efforts to promote collaborative working, perhaps one approach is to look at recommendations not limited to NI. For instance, this may include looking to the Interprofessional Education Collaborative Practice (IPEC) [21] competencies, as described in section A chapter 1.

Recommendations to promote cross-organizational collaboration are mentioned by some existing competency recommendations. For example, The TIGER Leadership Collaborative report promotes the sharing of best practices through health IT and promotes alignment of health organizations with the American Nurses Credentialing Centre Magnet Recognition Program®, as a way to demonstrate excellence [15]. However, the skills needed by NI professionals in order to do so are not well described. Identification of these competencies, likely related to multidisciplinary collaboration and organizational dynamics, are areas requiring further development and should be considered in future NI competency recommendations. This can then provide the foundation to address the key recommendations made by the survey participants, namely, enabling the possibility for developing integrated approaches across nursing and the health informatics fields and have a unified voice in high-level strategic planning, design, development, implementation, and evaluation of health information technologies. Perhaps one possibility is drawing from recent efforts toward broadening of the work of TIGER to increase the focus on interprofessional and international issues, with the TIGER International Competency Synthesis Project, currently underway (see section B chapter 3).

6. Limitations

Our study has several limitations. First, the generalizability of our survey results is limited due to small numbers of participants from certain geographic regions (e.g. from African countries). The snowball sampling approach was also limited by the reach of our respective networks and only reached certain organizations and practitioners while others were not included. In addition, we only reviewed some NI competency recommendations and might have missed others.

7. Conclusions

We conducted one of the largest international surveys to identify key areas for action in order to advance the field of NI. Qualitative analysis of the survey themes identified five specific key areas: education and training; research; practice; visibility; and collaboration and integration. In this chapter we suggested how components of various national and international guidelines and competency lists (e.g., TIGER, CASN, etc.) might support the key areas for action. We also identified room for further development of existing competency guidelines to support advancement of several key areas. For example, although several competencies exist to guide the education of nursing students, in-service education for practicing nurses and their competencies remain largely unaddressed. In comparison to efforts aimed at addressing NI education and practice, our search identified the need for further development to identify competencies necessary to promote NI research, NI visibility, or ability to collaborate and integrate with other professions and across institutions and countries. Although our survey results have limitations, we believe that the key areas and our suggestions can be used to evaluate and further develop NI competency efforts.

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