2020

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Recommended Citation

Forman, Tracia M.; Armor, David A.; Miller, Ava S.. A Review of Clinical Informatics Competencies in Nursing to Inform Best Practices in Education and Nurse Faculty Development. Nursing Education Perspectives: 1/2 2020 - Volume 41 - Issue 1 - p E3-E7 doi: 10.1097/01.NEP.0000000000000588

A Review of Clinical Informatics Competencies in Nursing to Inform Best Practices in Education and Nurse Faculty Development

OPEN

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Abstract

AIM The aim of this literature review was to determine the state of the science related to clinical informatics competencies of registered nurses and to determine best practices in educational strategies for both nursing students and faculty.
BACKGROUND Continued emphasis on the provision of evidence-based patient care has implications for requisite informatics-focused competencies to be threaded throughout all levels of nursing educational programs.
METHOD Whittemore and Knalf's five-step integrative review process guided this research. An extensive search yielded 69 publications for critical appraisal.
RESULTS Results suggest nursing educational programs do not adhere to standardized criteria for teaching nursing informatics competencies. Another identified literature gap was the scarcity of research related to informatics training requirements for nurse educators.
CONCLUSION Findings support the need for continued research to provide clear direction about the expected clinical informatics competencies of graduate nurses and what training faculty need to facilitate student learning.

KEY WORDS Clinical Informatics Competencies – Integrative Review – Nursing Informatics – Nursing Faculty Development

Informatics skills required of the registered nurse have substantially increased in complexity over the last decade. This higher skill level is indicative of the need for clarification concerning present-day nursing informatics competencies. To best prepare graduates, nurse educators must be prepared to teach the most current informatics knowledge. The aim of this integrative review study was to determine the state of the science related to clinical informatics competencies of the registered nurse to inform best practices in educational strategies.

BACKGROUND

Patient care decisions should be supported by timely clinical information, reflecting the best evidence possible (Institute of Medicine, 2013). Present and future professional nurses must be able to use informatics and technology to facilitate critical decision-making for optimal patient outcomes (Massachusetts Department of Higher Education Nursing Initiative, 2016). Nursing clinical informatics competencies involve the collection and use of patient data for analysis and dissemination. For graduates to have proficiency in informatics, both effective educational strategies and faculty development are necessary.

Results of a survey deployed by the Quality and Safety Education for Nurses (QSEN) Institute revealed uncertainty among nurse faculty about how to teach informatics to students (Cronenwett et al., 2007). A 2015 National League for Nursing (NLN) publication addressed the need for pedagogical change to enhance graduate readiness to provide high-quality care in today's technology-driven health care environment. Nurse faculty were bidden to improve informatics competencies to benefit student development of technology skills. Still, a lack of effective educational strategies persists, with nurse faculty members still lacking competency.

In a recent national survey, college students reported the use of technology improved their overall academic experience; however, fewer than half the respondents felt faculty appropriately engaged technology to promote attention and encourage critical thinking (Skiba, 2017). This underutilization of technology in the general student population is reflected in health care education. Skiba (2011) reported that meaningful student learning about health care participation must be situated in technology/informatics competence. Yet research has described an ongoing lack of integration of informatics education in nursing curricula (De Gagne, Bisanar, Makowkis, & Nuemann, 2012; Hunter, McGonigle, & Hebda, 2013).

Gaps identified by these studies indicated continued confusion surrounding informatics competencies and how their integration into nursing curricula affects the professional nursing workforce. The purpose of this research was to gather current evidence related to the best

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The authors have declared no conflict of interest.
Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's website (www.neponline.net).

doi: 10.1097/01.NEP.0000000000000588

strategies for the attainment of informatics competencies by both nursing students and faculty through an examination of the literature. Synthesized findings and research recommendations are presented.

METHOD

The Whittemore and Knafl (2005) integrative review research methodology was used in this appraisal of both qualitative and quantitative research. A synthesis of findings from multiple studies should result in better understanding of a phenomenon and thus enhance the contribution to nursing science. This method's five-step process includes problem identification, literature search, data evaluation, data analysis, and presentation. The review process targeted two research questions: 1) What are the educational clinical informatics competencies and strategies that prepare the registered nursing student for practice in the hospital setting? 2) What specific informatics skills must faculty possess to effectively teach these competencies?

Literature Search

A primary search was performed across the CINAHL, OVID, and PUBMED electronic databases using the following keywords: *clinical informatics, competencies, computers, nursing, students,* and *skills.* The date range was from January 2011 to June 2018. Subsequent searches via the Google Scholar, Google, and Bing search engines were also conducted. Additional web-based Boolean searches identified gray literature. The gray literature included five dissertations, one thesis, one teaching toolkit, and one Technology Informatics Guiding Education Reform (TIGER, 2007) e-repository document.

The searches identified a combined total of 1,834 articles. Supplementary hand searching of electronic table of contents from *CIN: Computers, Informatics, Nursing* and the *Online Journal of Informatics Nursing* was also completed. Reference sections of the discovered articles were also reviewed. The manual search processes identified an additional 1,092 articles. After removal of duplicated articles, the total number of records discovered was 2,810.

To refine the results, inclusion criteria included a validation of the need for formal clinical informatics training of nursing students and/or nursing faculty. Exclusion criteria included any research that lacked a relationship to nursing students, new graduate nurses, or nursing faculty. Articles with no relevance to actual computer-based competencies or informatics-related educational strategies were also excluded. A total of 2,712 articles were excluded after abstract reviews. Ninety-eight articles were read in their entirety by the research team, and an additional 29 articles were excluded. A total of 69 articles were critically appraised by the research team. The search processes, parameters, and results were validated by a university librarian. See Supplemental Digital Content at http://links.lww.com/NEP/A170 for a Figure illustrating the search process.

Data Evaluation

The 69 articles were critically appraised with the use of review rubrics created for this study based on Melnyk and Fineout-Overholt's (2015) critical appraisal process. Different rubrics were used to review quantitative versus qualitative research. The qualitative appraisal rubric scored six categories: research design, study importance, sample size, strategy, data analysis, and results. The quantitative appraisal rubric scored seven categories: levels of evidence, study purpose, sampling size, reliability, variability, theoretical framework, and results. Mixed-methods research was scored using the quantitative appraisal rubric. Each article was reviewed and scored independently by the research team. This use of the rubric scoring system was an attempt to decrease researcher bias.

Data Analysis

The goal of the data analysis was to order, code, categorize, and summarize all research findings meeting the inclusion criteria. Whittemore and Knafl (2005) recommend a constant comparison method for this detailed analysis. The basic process of the constant comparative method is associating grouped data with other data to determine similarities and differences (Merriam, 1998). The data analysis was completed in a manner to reduce the amount of information and answer the specific research questions.

RESULTS FOR RESEARCH QUESTION 1

Technology Informatics Guiding Education Reform

Findings related to work based on TIGER nursing informatics competencies consisted of instrument development literature (Hill, McGonigle, Hunter, Sipes, & Hebda, 2014a, 2014b; Hunter et al., 2013; Saratan, Borycki, & Kushniruk, 2015). Hill et al. (2014b) created a reliable, valid online instrument for the self-assessment of perceived nursing informatics competencies based on TIGER competencies that they called the TIGER-based Assessment of Nursing Informatics (TANIC). In a follow-up study, the same research team expanded upon the original TANIC and created a tool to effectively assess graduate-level nursing informatics competencies (Hill et al. 2014a).

In mixed-methods research, Saratan et al. (2015) used the TIGER competencies to determine what information management competencies should be required of a new graduate nurse. Study participants found 62 of the 66 TIGER information management competencies relevant to the new graduate (see TIGER, 2007).

Self-Assessment of Nursing Informatics Competencies Scale

The development of the Self-Assessment of Nursing Informatics Competencies Scale (SANICS) tool was based upon the seminal work of Staggers, Gassert, and Curran (2001). Choi and DeMartinis (2013) used this 30-item tool to compare self-reported informatics competencies of undergraduate, RN-to-BSN, and doctor of nursing practice (DNP) students. Results found students (n = 289) to have higher mean competency scores in three subscales: clinical informatics role, clinical informatics attitude, and wireless device skills. However, survey results indicated students did not perceive themselves to be competent in applied computer skills and the clinical informatics role.

Godsey (2015) completed a psychometric evaluation of the SANICS tool with entry-level nursing students (n = 458). Competencies were measured before and after an educational intervention. Cronbach's alpha results were reported to range from .95 to .97, and nearly half of the factor loadings were .90 or greater following the educational intervention.

Electronic Health Care Record

Use of an electronic health record (EHR) was an educational strategy frequently reported in the literature (Boyd, 2014; Choi, Park, & Lee, 2016; Jansen, 2014; Jones & Donelle, 2011; Kowitlawakul, Chan, Tan, Soong, & Chan, 2015; Miller et al., 2014; Mitchell, 2015; Pobocik, 2014; Warboys, Mok, & Frith, 2014; Wheeler, 2016). Qualitative and quantitative research results indicated a realistic electronic record created an accurate picture of patient care and allowed

students to document real-time nursing interventions in the plan of care (Jansen, 2014; Kowitlawakul et al., 2015; Pobocik, 2014).

In survey research, students (n = 63) reported a need for more hands-on EHR experience (Boyd, 2014). In associated qualitative results, these student participants indicated practice with the EHR guided them to provide safer nursing care. Similarly, surveyed new graduates, in two different studies (n = 222, n = 62), identified EHR system documentation as a primary educational need (Miller et al., 2014; Mitchell, 2015).

Some nursing students learned to use EHR systems at hospitals or other clinical sites during clinical rotations, whereas other EHR system training was school based. Both Open Source and researcher-created EHR software programs were used (Kowitlawakul et al., 2015). Although reported as a difficult skill to learn, survey results indicated both students and faculty felt the use of EHRs to be essential for clinical skills development (Choi et al., 2016). In other research, qualitative results indicated repetition and practice with EHR software improved comfort (Jones & Donelle, 2011). Warboys et al. (2014) reported increased confidence in EHR use was associated with the greater number of times a student accessed the EHR software. In addition, their study revealed increased mean scores in the competency areas of patient safety, documentation, patient needs, prioritization, and nursing process with the use of EHR software.

Information and Communication Technologies Competency Tool

The Canadian Association of Schools of Nursing (2013) developed an information and communication technologies (ICT) competency tool to identify the ICT needs of nursing students and nurse faculty and offer specifics about how to incorporate informatics training throughout nursing educational programs. Another toolkit goal was to address the informatics knowledge level nursing students need prior to graduation (Nagle et al., 2014). The overarching competency theme focuses on ICT to support information integration and deliver professional patient care in accordance with regulatory standards and nursing scope of practice. Researchers indicated the incorporation of these skills into the undergraduate nursing curriculum should result in an alert clinician who is aware of system limitations and understands how to reduce errors at the bedside (Nagle et al., 2014).

A related publication supported use of the ICT competency tool for development of intensive informatics training sessions for Canadian practicing nurses and educators (Kleib, Simpson, & Rhodes, 2016). This work involved achievement of informatics systems competencies through education.

Quality and Safety Education for Nurses

The QSEN Institute's (2018) informatics competencies for prelicensure students include one competency focused on informatics. The focus of this competency is the measurement of the nursing student's ability to use informatics-related skills in actual practice. Published research related to QSEN informatics information includes psychometric analysis of a tool based on the QSEN competencies (Bryant, Whitehead, & Kleier, 2016).

Boyd's (2014) mixed-methods study used the QSEN initiative to assess academic preparedness of recent baccalaureate graduates. Qualitative results indicated the graduates felt QSEN knowledge, skills, and attitudes academic preparation to be very important for daily professional practice. Quantitative survey results reported approximately one third of the participants (n = 63) felt their nursing curriculum should have placed more emphasis on EHR use.

Other Educational Strategies

Many researchers elected to build their own informatics competency lists to measure nursing students' proficiency in informatics. In several instances, these competency lists were based on the seminal work of Staggers et al. (2001). Choi and Zucker (2013) completed a three-year longitudinal study examining the entry-level informatics skills of DNP students (n = 132). The researchers created an 86-item informatics set with 18 competency areas in three categories: computer skills, informatics knowledge, and informatics skills. Results indicated the need for the curricular incorporation of 17 of the 18 competencies, including decision support systems, aids for clinical decision-making, accessing and extracting data from clinical data sets, literature search processes, using RefWorks or other resource files, and statistical data evaluation.

S. Y. Chung and Staggers (2014) psychometrically analyzed the Nursing Informatics Competencies Questionnaire, a tool based on the work of Staggers et al. (2001). This questionnaire included a total of 112 items with 53 competencies for the beginning nurse and 59 competencies for the experienced nurse. Findings, when deployed with a sample of new graduates (n = 228), indicated self-reported above average informatics competency levels.

Other educational strategy research includes Van Houwelingen, Moerman, Ettema, Kort, and ten Cate (2016), who completed a Delphi study to determine competencies needed before practicing telehealth. A panel of 51 experts identified 14 nursing telehealth entrustable professional activities and 52 types of knowledge, skills, and attitudes found to be necessary to provide telehealth nursing care. Mixed-methods research results, seeking to assess the skill, knowledge, and informatics level of associate degree nursing students (n = 90), reported the correlation of a computer training program to increased student satisfaction and improved retention rates (Edwards & O'Connor, 2011).

FINDINGS FOR RESEARCH QUESTION 2

Research suggested the need for organized comprehensive faculty informatics training programs. Nguyen, Zierler, and Nguyen (2011) conducted a faculty needs assessment. The study aim was to describe nursing faculty knowledge and training needs associated with distance learning, simulation, telehealth, and informatics tools. Most faculty respondents (n = 193, 66 percent) considered themselves competent with distance learning and informatics tools, yet 70 percent reported themselves to be novice or advanced beginners with telehealth. In addition, qualitative research results from interviews of nurse faculty (n = 9) described lack of school resources, faculty resistance, and lack of knowledge as barriers to the adoption of academic EHRs in nursing education (J. Chung & Cho, 2017).

The TANIC competency tool was not only used to measure student skill level, it was also used for the development of faculty knowledge and skills in informatics (Hill et al., 2014b). One study queried nurse educators' computer skills before and after a 24-month informatics project. Rajalahti, Heinonen, and Saranto (2014) assessed nurse educator informatics competence development and compared results to other health care workers. Participants, with an average of 15 years of teaching experience, reported a lack of competence in the ability to effectively teach EHR documentation. Survey results indicated nurse educators needed more advanced informatics training.

The study recommended health care organizations support informatics training for nurse educators.

Fulton, Meek, and Walk (2014) examined faculty characteristics regarding informatics adoption by DNP faculty at 114 educational programs in the United States. Only 21 schools reported that at least 50 percent of their faculty knew and understood TIGER competencies. In addition, only 55.4 percent of the schools reported faculty employed with a certification in nursing informatics or graduate-level informatics preparation. In descriptive correlational research, Roney, Westrick, Acri, Aronson, and Rebeschi (2017) surveyed faculty teaching undergraduate nursing students at schools accredited by the Commission on Collegiate Nursing Education about the use of technology and technological self-efficacy. Results showed 86 percent of the faculty (n = 272) reported no TIGER initiative training. More years of teaching experience were reported as nearly significantly correlated with lower levels of technology use in the classroom.

DISCUSSION

Results suggest nursing educational programs do not adhere to standardized criteria for teaching nursing informatics competencies. There was universal agreement about the inclusion of informatics competencies as highly important for nursing curricula, but no discernable agreement about how competency education is best delivered. Another trend was the lack of variance in the identification of informatic competency weaknesses. Most of the competency tools were student self-assessments rather than actual evaluations of students, contributing to a research quality issue. The lack of a valid informatic competency assessment may have increased bias due to students' different interpretations of their own competency levels, made evident by several psychometric analysis studies found in the literature (S. Y. Chung & Staggers, 2014; Godsey, 2015; Hill et al., 2014a, 2014b). The work of Hill et al. (2014a, 2014b) focused on analysis of the TANIC tool for use with undergraduate and graduate nursing student populations. S. Y. Chung and Staggers (2014) confirmed reliability and validity for the Nursing Informatics Competencies Questionnaire, yet their sample population (n = 228) was practicing nurses, not nursing students. Godsey (2015), on the other hand, completed psychometric analysis of the SANICS tool with a large sample (n = 498) of entry-level BSN students.

The literature search revealed innovative techniques for improved educational preparation related to informatics competencies. One study used Google Glass, a hands-free technology that resembles traditional eye glasses, for clinical instruction (Byrne & Senk, 2017). The technology allowed students to access physician orders, the Internet, email, and phone calls while caring for patients. Use of this technology has the potential to improve patient care safety.

E-simulation was another identified innovative technique used to improve informatics competencies. Virtual clinical simulation was demonstrated in a mixed-methods study for a clinical practicum for a master's-level nursing education course (Foronda, Lippincott, & Gattamorta, 2014). A module was designed to provide student educators with an environment to enhance their confidence level when teaching. Although some students reported more confidence after using the e-simulation, others reported initial anxiety and some frustrations with technical difficulties. The researchers recommended future studies should contain a rubric to evaluate the actual student skill and clinical performance concurrently (Foronda et al., 2014).

In other research, use of an electronic medical record (EMR) was considered an effective strategy for teaching nursing students in the clinical setting or using a training EMR in the classroom setting. Practice with EMRs assisted students in prioritization of patient care, provided real-time feedback, and increased confidence in documentation (Warboys et al., 2014). Although research indicated students preferred EMR practice, nursing faculty reported not feeling qualified to provide this kind of instruction (J. Chung & Cho, 2017).

Given the scarcity of research related to informatics training for the nurse educator, no minimal informatics competency levels for nursing faculty have been established. Surveyed nursing faculty (69 percent, n = 193) reported a need for more formal informatics training (Nguyen et al., 2011). Other research discussed faculty resistance as barriers to informatics curriculum improvement (Edwards & O'Connor, 2011; Warboys et al., 2014). Reasons behind faculty resistance is an issue in need of further research.

Although not directly concerned with the assessment of nursing faculty informatics skill or knowledge, certain research offered support to informatics training efforts. Choi and DeMartinis' (2013) study provided general pedagogy tips for the nurse educator. SANICS survey results of undergraduate and graduate nursing students (n = 289) indicated the need for additional student education related to applied computer skills and clinical informatics roles. In addition, informatics training was reported as vital to nursing faculty.

Finally, these study results indicate more research is needed with diverse sample populations. Most of the sample participants included in this research were baccalaureate nursing students. Few studies examined the informatics competency levels of associate degree nursing students and faculty. Although 65 percent of the current RN workforce has obtained a baccalaureate or higher degree, ADN-prepared nurses still comprise a large percentage of US nurses (National Council of State Boards of Nursing, 2015). More research is essential to best determine the educational needs of varied levels of nursing students and faculty.

Whittemore and Knafl (2005) acknowledge that a major limitation of the integrative review methodology is the circumstance of the search being completed primarily using electronic databases. The integrative review methodology has intrinsic problems created by the combination of different research designs. This can lead to lack of rigor, inaccurate interpretations, and potential researcher bias.

CONCLUSION

Although universal agreement exists about the need to teach nursing informatics clinical competencies, research suggests no best practices for teaching clinical informatics have been clearly identified as standard. Tools are available to assist with training for nursing students and nurse educators, and resources are available through various professional organizations, including the NLN and Healthcare Information and Management Systems Society (HIMSS). The NLN website offers extensive information to faculty to incorporate health information technology into courses (NLN, n.d.). In addition, the HIMSS website offers links to multiple training resources that can be used with both nursing students and nursing faculty (HIMSS, 2017). Perhaps the next steps in clinical informatics training of nursing students and nursing faculty should be geared toward measurement of the effectiveness of available tools when incorporated into training opportunities.

REFERENCES

Boyd, T. M. (2014). *New BSN nurse informatics competencies: Perceptions of academic preparedness for practice* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses database (UMI No. 3631548).

Bryant, L., Whitehead, D., & Kleier, J. (2016). Development and testing of an instrument to measure informatics knowledge, skills, and attitudes among entry-level nursing students. *Online Journal of Nursing Informatics*, *20*(2).

Byrne, P. J., & Senk, P. A. (2017). Google glass in nursing education: Accessing knowledge at the point of care. *CIN: Computers, Informatics, Nursing*, *35*(3), 117-120. doi:10.1097/CIN.0000000000000339

Canadian Association of Schools of Nursing. (2013). *Nursing Informatics Teaching Toolkit: Supporting the integration of the CASN Nursing Informatics Competencies into nursing curricula*. Retrieved from https://casn.ca/wp-content/uploads/2014/12/2013ENNursingInformaticsTeachingToolkit.pdf

Choi, J., & De Martinis, J. E. (2013). Nursing informatics competencies: Assessment of undergraduate and graduate nursing students. *Journal of Clinical Nursing*, *22*(13–14), 1970-1976. doi:10.1111/jocn.12188

Choi, J., & Zucker, D. M. (2013). Self-assessment of nursing informatics competencies for doctor of nursing practice students. *Journal of Professional Nursing*, *29*(6), 381. doi:10.1016/j.profnurs.2012.05.014

Choi, M., Park, J. H., & Lee, H. S. (2016). Assessment of the need to integrate academic electronicmedical records into the undergraduate clinical practicum: A focus group interview. *CIN: Computers, Informatics, Nursing*, *34*(6), 259-265. doi:10.1097/CIN.0000000000000244

Chung, J., & Cho, I. (2017). The need for academic electronic health record systems in nurse education. *Nurse Education Today*, *54*, 83-88. doi:10.1016/j.nedt.2017.04.018

Chung, S. Y., & Staggers, N. (2014). Measuring nursing informatics competencies of practicing nurses in Korea: Nursing Informatics Competencies Questionnaire. *CIN: Computers, Informatics, Nursing*, *32*(12), 596-605. doi:10.1097/CIN.0000000000000114

Cronenwett, L., Sherwood, G., Barnsteiner, J., Disch, J., Johnson, J., Mitchell, P., … Warren, J. (2007). Quality and safety education for nurses. *Nursing Outlook*, *55*(3), 122-131. doi:10.1016/j.outlook.2007.02.006

De Gagne, J. C., Bisanar, W. A., Makowski, J. T., & Neumann, J. L. (2012). Integrating informatics into the BSN curriculum: A review of the literature. *Nurse Education Today*, *32*(6), 675. doi:10.1016/j.nedt.2011.09.003

Edwards, J., & O'Connor, P. A. (2011). Improving technological competency in nursing students: The Passport Project. *The Journal of Educators Online*, *8*(2), 1-18.

Foronda, C., Lippincott, C., & Gattamorta, K. (2014). Evaluation of virtual simulation in a master's-level nurse education certificate program. *CIN: Computers, Informatics, Nursing*, *32*(11), 516. doi:10.1097/CIN.0000000000000102

Fulton, C. R., Meek, J. A., & Walker, P. H. (2014). Faculty and organizational characteristics associated with informatics/health information technology adoption in DNP programs. *Journal of Professional Nursing*, *30*(4), 292-299. doi:10.1016/j.profnurs.2014.01.004

Godsey, J. A. (2015). *Towards an informatics competent nursing profession: Validation of the Self-Assessment of Nursing Informatics Competency Scale (SANICS) before and after online informatics training* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses database (UMI No: 3717257).

Healthcare Information and Management Systems Society. (2017, October 6). *The evolution of TIGER competencies and informatics resources*. Retrieved from www.himss.org/library/evolution-tiger-competencies-and-informatics-resources

Hill, T., McGonigle, D., Hunter, K. M., Sipes, C., & Hebda, T. L. (2014a). An instrument for assessing advanced nursing informatics competencies. *Journal of Nursing Education and Practice*, *4*(7), 1-4-112. doi:10.5430/jnep.v4n7p104

Hill, T., McGonigle, D., Hunter, K. M., Sipes, C., & Hebda, T. L. (2014b). *TIGER-based assessment of nursing informatics (TANIC)*. Proceedings of the Nursing Education Research Conference 2014, Virginia Henderson Global Nursing e-Repository. Retrieved from https://www.nursingrepository.org/handle/10755/316870?show=full

Hunter, K. M., McGonigle, D., & Hebda, T. (2013). The integration of informatics content in baccalaureate and graduate nursing education: A status report. *Nurse Educator*, *38*(3), 110-113. doi:10.1097/NNE.0b013e31828dc292

Institute of Medicine. (2013). *Core measurement needs for better care, better health, and lower costs: Counting what counts, workshop summary*. Washington, DC: National Academies Press. doi:10.17226/18333

Jansen, D. A. (2014). Student perceptions of electronic health record use in simulation. *Journal of Nursing Education and Practice*, *4*(9), 163-172. doi:10.5430/jnep.v4n9p163

Jones, S., & Donelle, L. (2011). Assessment of electronic health record usability with undergraduate nursing students. *International Journal of Nursing Education Scholarship*, (8), 28. doi:10.2202/1548-923X.2123

Kleib, M., Simpson, N., & Rhodes, B. (2016). Information and communication technology: Design, delivery, and outcomes from a nursing informatics boot camp. *Online Journal of Issues in Nursing*, *21*(2), 5. doi:10.3912/OJIN.Vol21No02Man05

Kowitlawakul, Y., Chan, S., Pulcini, J., & Wang, W. (2015). Factors influencing nursing students' acceptance of electronic health records for nursing education (EHRNE) software program. *Nurse Education Today*, *35*(1), 189-194. doi:10.1016/j.nedt.2014.05.010

Massachusetts Department of Higher Education Nursing Initiative. (2016). *Massachusetts nursing of the future nursing core competencies*. Retrieved from https://www.mass.edu/nahi/documents/NOFRNCompetencies_updated_March2016.pdf

Melnyk, B. M., & Fineout-Overholt, E. (2015). *Evidence-based practice in nursing & healthcare: A guide to best practice* (3rd ed.). Philadelphia, PA: Wolters Kluwer.

Merriam, S. (1998). *Qualitative research and case study applications in education*. San Francisco, CA: Jossey-Bass.

Miller, L., Stimeley, M., Matheny, P., Pope, M., McAtee, R., & Miller, K. (2014). Novice nurse preparedness to effectively used electronic health records in acute care settings: Critical informatics knowledge and skills gaps. *Online Journal of Nursing Informatics (OJNI)*, *18*(2).

Mitchell, J. (2015). Electronic documentation: Assessment of newly graduated nurses' competency and confidence levels. *Online Journal of Nursing Informatics*, *19*(2).

Nagle, L. M., Crosby, K., Frisch, N., Borycki, E., Donelle, L., Hannah, K., … Shaben, T. (2014). Developing entry-to-practice nursing informatics competencies for registered nurses. *Studies in Health Technology and Informatics*, *201*, 356. doi:10.3233/978-1-61499-415-2-356

National Council of State Boards of Nursing. (2015). *The 2015 National Nursing Workforce Survey*. Retrieved from https://www.ncsbn.org/workforce.htm

National League for Nursing. (2015). *A vision for the changing faculty role: Preparing students for the technological world of health care* [NLN Vision Series]. Retrieved from www.nln.org/docs/default-source/about/nln-vision-series-%28position-statements%29/nlnvision_8.pdf?sfvrsn=4

National League for Nursing. (n.d.) *Faculty resources*. Retrieved from www.nln.org/professional-development-programs/teaching-resources/toolkits/faculty-resources

Nguyen, D. N., Zierler, B., & Nguyen, H. Q. (2011). A survey of nursing faculty needs for training in use of new technologies for education and practice. *Journal of Nursing Education*, *50*(4), 181-189. doi:10.3928/01484834-20101130-06

Pobocik, T. (2014). Using an educational electronic documentation system to help nursing students accurately identify patient data. *International Journal of Nursing Knowledge*, *26*(1).

QSEN Institute. (2018). *QSEN competencies*. Retrieved from http://qsen.org/competencies/

Rajalahti, E., Heinonen, J., & Saranto, K. (2014). Developing nurse educators' computer skills towards proficiency in nursing informatics. *Informatics for Health and Social Care*, *39*(1), 47-66. doi:10.3109/17538157.2013.834344

Roney, L. N., Westrick, S. J., Acri, M. C., Aronson, B. S., & Rebeschi, L. M. (2017). Technology use and technological self-efficacy among undergraduate nursing faculty. *Nursing Education Perspectives*, *38*(3), 113-118. doi:10.1097/01.NEP.0000000000000141

Saratan, C., Borycki, E. M., & Kushniruk, A. W. (2015). Information management competencies for practicing nurses and new graduates. *Knowledge Management & E-Learning*, *7*(3), 378-394.

Skiba, D. J. (2011). Informatics and the learning health care system [Emerging Technologies Center]. *Nursing Education Perspectives*, *32*(5), 334-336.

Skiba, D. J. (2017). Students, technology, and teaching: Findings from the 2016 ECAR report [Emerging Technologies Center]. *Nursing Education Perspectives*, *38*(1). doi:10.1097/01.NEP.0000000000000117

Staggers, N., Gassert, C. A., & Curran, C. (2001). Informatics competencies for nurses at four levels of practice. *Journal of Nursing Education*, *40*(7), 303-316. doi:10.3928/0148-4834-20011001-05

Technology Informatics Guiding Education Reform. (2007). *The TIGER initiative: Evidence and informatics transforming nursing: 3-Year action steps toward a 10-year vision*. Retrieved from www.aacn.nche.edu/education-resources/TIGER.pdf

Van Houwelingen, C. T., Moerman, A. H., Ettema, R. G., Kort, H. S., & ten Cate, O. (2016). Competencies required for nursing telehealth activities: A Delphi study. *Nurse Education Today*, *39*, 50-62. doi:10.1016/j.nedt.2015

Warboys, I., Mok, W. Y., & Frith, K. H. (2014). Electronic medical records in clinical teaching. *Nurse Educator*, *39*(6), 298-301. doi:10.1097/NNE.0000000000000072

Wheeler, B. (2016). *The integration of nursing informatics in Delaware nursing education programs* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses database (10012947).

Whittemore, R., & Knafl, K. (2005). The integrative review: Updated methodology. *Journal of Advanced Nursing*, *52*(5), 546-553.