



Issues for Debate

Educating the nurses of 2025: Technology trends of the next decade



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ABSTRACT

The pace of technological evolution in healthcare is advancing. In this article key technology trends are identified that are likely to influence nursing practice and education over the next decade. The complexity of curricular revision can create challenges in the face of rapid practice change. Nurse educators are encouraged to consider the role of electronic health records (EHRs), wearable technologies, big data and data analytics, and increased patient engagement as key areas for curriculum development. Student nurses, and those already in practice, should be offered ongoing educational opportunities to enhance a wide spectrum of professional informatics skills. The nurses of 2025 will most certainly inhabit a very different practice environment than what exists today and technology will be key in this transformation. Nurse educators must prepare now to lead these practitioners into the future.

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The advancement of information and communication technology (ICT) is one of the most significant factors influencing change in healthcare systems around the world. The rapid pace of technological evolution shows no signs of abatement and has already significantly influenced nursing education curricula. The education of nurses, both students and practitioners, has always required a balance between teaching for present needs while anticipating future demands. What challenges and opportunities await the nurses of 2025? In this article several technology trends are explored that are likely to influence the healthcare transformation of the next decade. A critical reflection on what nursing educators should consider now in order to better support the clinicians of the future is also included with a particular focus on existing informatics curricular supports.

1. The next decade: looking towards 2025

It has been less than a decade since their introduction and yet for many nurses practice without the use of a smart phone or tablet device may already be a distant memory. There are planned, and perhaps yet unimagined, technological innovations that will have a similarly profound influence in the next 10 years. In a recent report for the United Nations, the International Telecommunication Union (ITU) noted a staggering change in global internet use. An expansion from 400 million users in 2000 to 3.5 billion users by the end of 2016, with 2 billion of those in developing countries (ITU, 2016).

In terms of mobile broadband, used to support smartphones and other cellular devices, global penetration is estimated to reach 3.6 billion subscribers by 2017 (ITU, 2016). Yet a significant digital divide still persists in technological uptake. While 80% of households in developed countries are likely to have internet access in 2015 that number is only 34% in developing countries, and will reach only 7% in the least developed countries (ITU, 2015). Equitable access to technology is a key consideration for the nurses of 2025 as health-influencing disparities are sure to persist globally, and along socioeconomic lines within individual countries.

Change is a familiar feature of nursing landscapes but the technological advancements of the next decade may cause greater shifts than have previously been navigated. In North America significant work has been done in providing curricular support for nursing educators in informatics. The Technology Informatics Guiding Education Reform or TIGER initiative in the United States and the Canadian Association of Schools of Nursing (CASN) Entry to Practice Nursing Informatics Competencies and accompanying toolkit have been features of the curricular landscape for several years. However, are educators doing enough to apply and promote these supports? The National League for Nursing (2015) issued a recent call for further action in preparing students for a technological healthcare future highlighting a clear need for nursing education “to teach with and about technology to better inform healthcare interventions that improve healthcare outcomes and prepare the nursing workforce” (p. 4). The need is urgent, as much of what was anticipated as part of a technological future materializes in our present healthcare landscapes.

In addition to significant scientific developments, which are not

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the focus of this article, such as nanotechnology and genomic research, central tenets of patient care related to diagnosis, planning, and intervention are undergoing substantial change. There are four areas in healthcare technology trends that nursing educators can plan for now: 1) Expanded electronic health record (EHR) use and interoperability; 2) Increased influence of technology wearables for both patients and practitioners; 3) Big data and data analytics; and 4) Patient engagement in directing and managing care.

2. EHRs, interoperability and the cloud

Future clinicians in countries around the world will most certainly be required to utilize EHRs and/or electronic medical records (EMRs) in their practice. Despite the widespread dissemination of this technology, integration of EHRs into healthcare systems remains a global challenge (Luchenski et al., 2013). In the United States legislation has further directed the development of EHRs to meet stringent meaningful use standards (Kuhn et al., 2015; Shea et al., 2014) and by 2016 demonstrate improved patient outcomes (Krist, 2015).

Ongoing challenges with EHR systems are often related to technical issues such as access speeds, content lag, and the inevitable interruptions related to malfunction. Researchers have also found that although EHRs are a means to strengthen communication between healthcare providers (Krist, 2015; O'Malley et al., 2015), more work needs to be done in improving functionality. Nurses should be equipped to advocate for improvement in "areas of integrated practice registries, care management software integration, whole-person orientated care plans, and longitudinal tracking of individual patients" (O'Malley et al., 2015, p.433).

As uptake has increased, many EHRs and EMRs have become overwhelming data reservoirs. Future clinicians will need enhanced data management skills to meet demands associated with this upsurge. Specific data extraction applications are being pursued through targeted interface or dashboard systems to aid practitioners in accessing needed data quickly and efficiently (Ellsworth et al., 2014). There should be a strong nursing presence in the creation and further expansion of these data dashboards. Nursing education institutes would be ideal locations for the development and testing of these tools. Future practitioners required to use these interfaces to access data quickly, and perhaps educate patients to do the same, must be equipped with a sound foundation of informatics skill. These skills must go beyond efficient operation of data systems and tools and include skills to support effective advocacy for user needs, both patient and practitioner.

As patient and clinician data accumulates in multiple systems the demands for interoperability, or integration of systems and data are intensified. One solution to this need for improved interconnectivity is the use of cloud computing and data storage. Cloud-based systems can offer care teams working to provide real-time integrated care improved collaborative access to data but there are accompanying cautions related to security, workability, privacy, and ultimately user acceptance and use (Hsieh, 2015; Lustgarten, 2015). Securing and storing the data of the next decade will be a significant aspect of how nurses and other healthcare providers access, collaborate, and contribute to the patient data collective. Future practitioners will need to be well versed in health information legislation such as the Health Insurance Portability and Accountability Act (HIPAA), or the equivalent privacy and protective laws that govern health data interactions in their country. The location of the stored data and whether it will leave the country of its origin is another key privacy issue. Nursing curriculums should include detailed digital best practice content covering these legal, and additional ethical, concerns. However, a current lack of

consensus and specificity in managing these issues in a digitized healthcare environment (Lustgarten, 2015) creates ongoing curricular challenges.

Improved access and quality of patient data is supporting additional technological advancements such as electronic integrated care planning (Hayward-Rowse and Whittle, 2006) and the increased availability of clinical decision aids for both patients and providers (Kuhn et al., 2015; Liao et al., 2015; Moss and Berner, 2015; Murphy, 2014). There are recognized benefits to these particular technological advances such as improved care plan data quality (Nunes et al., 2014; Yusof, 2015) and improved connection of interdisciplinary team members (Hayward-Rowse and Whittle, 2006). The ready access to evidence-based clinical practice decision tools shows promise in supporting improved patient outcomes however there are still barriers to be overcome (Murphy, 2014; Ricciardi et al., 2013). Ongoing challenges with these technologies include underutilization, language standardization (Byrne and Lang, 2013; Nunes et al., 2014), and lack of flexibility in system design (Moss and Berner, 2015). Still the next decade will see these particular technologies advance. Trials embedding practitioner decision support tools into EHRs (Kuhn et al., 2015) and the use of artificial intelligence (AI) in decision support tools are already underway (Liao et al., 2015). There are significant steps nursing educators should consider now to prepare clinicians whose future interprofessional teams may include AI or robotic members (Sharts-Hopko, 2014).

3. Wearable technology

Moving beyond patients equipped with static barcodes, the future of wearable devices will potentially alter long-standing assessment tools and practices (Rodgers et al., 2015). In their every day lives people are already collecting a myriad of electronic data such as heart rate, blood pressure, weight, activity level, blood glucose, sleep patterns and calorie intake (Williamson, 2015). The use of similar monitoring devices in acute care settings is not new, but the ability to aggregate and deliver key data to both patients and practitioners from them is evolving (Rodgers et al., 2015). Nurse educators must be prepared to support students in a future practice that may include numerous biometric sensor types and data delivery mechanisms. Existing adhesive sensors are being used for patient data collection in some care settings and these technologies will continue to expand. Contact lenses, and other body implants are additional future monitoring possibilities along with sensor imbedded fabric that could conceivably feature in the hospital gowns of 2025. The future of google glass in health education and practice is another wearable technology under review as a prospective tool to aid in clinical practice (Sultan, 2015).

Nurses will likely be equipped with their own wearable technology in future practice and serve as primary instigators of technological connection and data transfer between patients and clinicians. Consider what new assessment techniques may need to be developed for environments where data flows automatically between electronic devices. Existing use of algorithms to organize and focus data will most certainly expand to include automatic clinical alerts for practitioners (Rodgers et al., 2015). How algorithms are used to shape data and what influence the results may have on patient and practitioner decisions (Williamson, 2015) is an urgent curricular priority. It seems increasingly likely that nurses will need to become astute data analysts as opposed to primary data collectors as the use of these technologies advances.

4. Big data

The use of big data in healthcare continues to generate intense

interest. Just how big is healthcare big data? One measure from 2012 equated the data amount at around 500 petabytes or, in paper terms, enough data to fill 10 billion four-drawer file cabinets (Roski et al., 2014). “The emergence of ‘big data’ offers unprecedented opportunities for not only accelerating scientific advances, but also enabling new modes of discovery” (Honavar, 2014, p. 329). There is much speculation about the prospects of pairing massive data reservoirs with predictive analytic tools and identifying healthcare crises before they even begin. Data mining and predictive analytics are presented as opportunities to forecast patient demand for service, such as emergency department visits (Ekstrom et al., 2015); to tailor diagnosis and patient interventions (Krumholz, 2014; Roski et al., 2014); to discover patterns that may have otherwise gone unnoticed in particular patient populations (Roski et al., 2014); or potentially in epidemic situations (Grossglauser and Saner, 2014); and in tracking and providing automated responses to collected patient data to their care providers.

Further specialization of predictive analytics can also support medical decision and triage of care, although ethical concerns abound in these applications, with calls for additional research and training in this area (Cohen et al., 2014). Consideration should be given to establishing or expanding dedicated informatics courses in nursing curriculums to manage these specific learning needs. A broad approach to health informatics that includes the critical importance of social justice and patient centered approaches to technological use and development should frame these opportunities. The ever-present issue of patient privacy and data security must also be considered (Amarasingham et al., 2014; Roski et al., 2014). Future demands aside, there are urgent current needs for additional healthcare personnel with specific data management or analytic skills (Krumholz, 2014) as well as further collaborations between informed clinicians and computer science teams (Honavar, 2014).

5. Patient engagement and empowerment

The issue of patient engagement, from a technology perspective, has largely been tied to opportunities for patients to access and contribute to their own healthcare data (Chuncho et al., 2012; Giardina et al., 2014; Goldzweig et al., 2013). Patient EHR portals, PHRs, one-note or other shared provider patient data collection, and increased e-visits or other electronic communication with healthcare team members have all been presented as ways to increase sense of ownership for patients with the hopes that improved outcomes will follow. There is considerable research to support patient desire to have improved access to their healthcare data, be it through EHRs or other technology applications (Chuncho et al., 2012; Giardina et al., 2014; Goldzweig et al., 2013). Patients will present with great differences in digital literacy and even basic computer skills and nurses should take the lead in either providing the needed patient education or making referrals to community resources that will allow all patients to get connected, digitally speaking.

This surge of patient involvement is also heavily driven by the use of social media (SM) tools (Lee and Whitley, 2014; Prybutok and Ryan, 2015; Tse et al., 2015). Formal and informal online patient networks are plentiful and the use of tools, such as hashtags, provides streamlined opportunities to share experiences, questions, and concerns. Patients are also increasingly using SM as a health information tool (Fernandez-Luque and Bau, 2015), a development that will have significant implications for nursing practice. Nurses must have an in-depth understanding of how information is aggregated and distributed through SM (Risling, 2016). Current patient education skills related to accessing health information online should be expanded to allow for further assessment of patients’

digital literacy skills and networked connections. Future clinicians can collaborate with patients to minimize risk related to erroneous information circulated through SM and connect patients into reliable networks to enhance positive support mechanisms.

Patients are not the only ones who can benefit from SM. Nurses should be well versed in the professional benefits of these tools (Risling, 2016), such as the creation of personal learning networks (PLNs) (Farrelly, 2014). Already there are concerns about digital overload and burnout in relation to our technology driven environments and this is only likely to intensify. PLNs and other tools for filtering internet information can support nurses in retrieving the best evidence and information available. Nursing organizations, healthcare and academic institutions, publishers, non-profits, and a host of other healthcare agencies are already engaged in the use of SM. Although the ongoing importance of these networks remains to be seen, it seems very likely that SM will emerge as significant factor in nursing practice in the coming years.

6. Curricular supports for a nursing future

Each of these trends requires a shift in how nursing prepares future generations of practitioners and these are only a few areas where technological change is imminent. However, a technology infused healthcare future does not require a complete transformation of nursing education practices. Nursing has always required competencies that are essential to supporting sound technology based practice such as clinical knowledge and skills, therapeutic communication, patience (van Houwelingen et al., 2016), and foundational critical thinking and problem solving abilities. In their recent research, van Houwelingen et al. (2016) also identified several unique technological competencies that should be demonstrable by nursing graduates today. Many of these skills align with key informatics competencies identified by groups such as TIGER and CASN (2015) and include a basic familiarity with a host of varying digital tools and information formats. The use of computers and smart devices (phones or tablets), electronic communication, multimedia presentations such as podcasts or blogs, computer software for creating and sharing professional documents, and an understanding of social networking applications such as Twitter and LinkedIn have all been identified as vital for future nursing professionals (CASN, 2015).

Nurse educators, both in practice and education, will be essential in leading a successful technological evolution for nursing. Educators may need to increase their own comfort and knowledge of technology, however even this learning is an opportunity to role model the critical importance of embracing this change. Tim Porter-O’Grady an American nursing expert and longtime advocate for the expanding presence of nursing practice has urged nurses to take their place as leaders in this technological revolution (Jaimet, 2016). However, as technology aids nurses in meeting patients where they are and contributes to the ongoing shift from institutional to community based care, there will likely be resistance from nursing professionals themselves (Jaimet, 2016). Fear not, says Porter-O’Grady “technology is what frees us to be able to fully practice our profession, as we idealize it, rather than simply being functionaries in a much more limited system” (Jaimet, 2016, p. 21). Now the question remains, he cautions, do we have the language, the skills, and the courage to step forward (Jaimet, 2016).

7. Summary: educating the nurses of 2025

Much of the preparation for the next decade of nursing practice must be done without the benefit of certainty. More than ever before we must support nurses already in practice, and the next generation of practitioners, for technological advancements and

challenges that do not yet exist. Educators should engage in future-casting about the potential evolution of nursing and not be limited by current practice paradigms. Curricular revision is often a complex and time-consuming process and there will be inherent challenges in matching the pace of technology trends. Stand-alone health informatics courses may allow for more flexibility and responsive ongoing revision in nursing programs. Existence of such courses should not preclude pursuit of a comprehensive increase to informatics competencies throughout nursing curricular content supported by well-developed frameworks such as those provided by TIGER or CASN. The TIGER group is currently leading an International Competency Synthesis Project with 21 countries around the world (HIMSS, 2016). When complete the project will provide a comprehensive list of informatics competency recommendations.

There are many foundational nursing skills that will serve future practitioners well as they advance their technological knowledge. Nurses will continue to move into practice with strong critical thinking and self-reflection abilities. These traits will not only allow for future problem solving acumen they will help create practitioners open to new ideas and transformative ways of practice. In reviewing global technology trends, the ITU has acknowledged an existing digital divide and called for the expansion of a truly inclusive information society with the ability to connect all (ITU, 2015). Advanced understanding of principles such as social justice will equip nurses to uniquely assess and support patients at risk of disparity due to technological inequity. Access to technology and digital literacy skills will have significant influence on the determinants of health for future populations. Concerns related to human interaction and caring presence will be also be paramount in the years to come and nurses will require the skills needed to balance human need with technological advancement.

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References

- Amarasingham, R., Patzer, R.E., Huesch, M., Nguyen, N.Q., Xie, B., 2014. Implementing electronic health care predictive analytics, electronic health care predictive analytics: considerations and challenges. *Health Aff.* 33, 1148–1154.
- Byrne, M.D., Lang, N., 2013. Examination of nursing data elements from evidence-based recommendations for clinical decision support. *Comput. Inf. Nurs.* 31, 605–614.
- Canadian Association of Schools of Nursing, CASN, 2015. *Nursing Informatics: Entry-to-practice Competencies for Registered Nurses* (Toronto, ON).
- Chunchu, K., Mauksch, L., Charles, C., Ross, V., Pauwels, J., 2012. A patient centered care plan in the EHR: improving collaboration and engagement. *Fam. Syst. Health* 30, 199–209.
- Cohen, I.G., Amarasingham, R., Shah, A., Xie, B., Lo, B., 2014. The legal and ethical concerns that arise from using complex predictive analytics in health care. *Health Aff.* 33, 1139–1147.
- Ekstrom, A., Kurland, L., Farrokhnia, N., Castren, M., Nordberg, M., 2015. Forecasting emergency department visits using internet data. *Ann. Emerg. Med.* 65, 436–442.
- Ellsworth, M.A., Lang, T.R., Pickering, B.W., Herasevich, V., 2014. Clinical data needs in the neonatal intensive care unit electronic medical record. *BMC Med. Inf. Decis. Mak.* 14.
- Farrelly, R., 2014. Nurses and social media. *Br. J. Nurs.* 23, 343, 343.
- Fernandez-Luque, L., Bau, T., 2015. Health and social media: perfect storm of information. *Healthc. Inf. Res.* 21, 67–73.
- Giardina, T.D., Menon, S., Parrish, D.E., Sittig, D.F., Singh, H., 2014. Patient access to medical records and healthcare outcomes: a systematic review. *J. Am. Med. Inf. Assoc.* 21, 737–741.
- Goldzweig, C.L., Orshansky, G., Paige, N.M., Towfigh, A.A., Haggstrom, D.A., Miakel-Lye, I., Beroes, J.M., Shekelle, P.G., 2013. Electronic patient portals: evidence on health outcomes, satisfaction, efficiency, and attitudes. *Ann. Intern. Med.* 159, 677–687.
- Grossglauer, M., Saner, H., 2014. Data-driven healthcare: from patterns to actions. *Eur. J. Prev. Cardiol.* 21, 14–17.
- Hayward-Rowse, L., Whittle, T., 2006. A pilot project to design, implement and evaluate an electronic integrated care pathway. *J. Nurs. Manag.* 14, 564–571.
- HIMSS, 2016. *TIGER Expands Integration of Technology and Informatics with International Competency Synthesis Project* (Chicago, IL).
- Honavar, V.G., 2014. The promise and potential of big data: a case for discovery informatics. *Rev. Policy Res.* 31, 326–330.
- Hsieh, P.J., 2015. Healthcare professionals' use of health clouds: integrating technology acceptance and status quo bias perspectives. *Int. J. Med. Inf.* 84, 512–523.
- International Telecommunication Union, I.T.U., 2015. *ICT Facts and Figures: the World in 2015* (Geneva, CH).
- International Telecommunication Union, I.T.U., 2016. *ICT Facts and Figures 2016* (Geneva, CH).
- Jaimet, K., 2016. Ready to embrace the future? *Can. Nurse* 112, 20–21.
- Krist, A.H., 2015. Electronic health record innovations for healthier patients and happier doctors. *J. Am. Board Fam. Med.* 28, 299–302.
- Krumholz, H.M., 2014. Big data and new knowledge in medicine: the thinking, training, and tools needed for a learning health system. *Health Aff.* 33, 1163–1170.
- Kuhn, L., Reeves, K., Taylor, Y., Tapp, H., McWilliams, A., Gunter, A., Cleveland, J., Dulin, M., 2015. Planning for action: the impact of an asthma action plan decision support tool integrated into an electronic health record (EHR) at a large health care system. *J. Am. Board Fam. Med.* 28, 382–393.
- Lee, R., Whitley, H.P., 2014. Use of social media to support patients with diabetes mellitus. *Consult. Pharm.* 29, 53–57.
- Liao, P.H., Hsu, P.T., Chu, W., Chu, W.C., 2015. Applying artificial intelligence technology to support decision-making in nursing: a case study in Taiwan. *Health Inf. J.* 21, 137–148.
- Luchenski, S.A., Reed, J.E., Marston, C., Papoutsis, C., Majeed, A., Bell, D., 2013. Patient and public views on electronic health records and their uses in the United Kingdom: cross-sectional survey. *J. Med. Internet Res.* 15.
- Lustgarten, S.D., 2015. Emerging ethical threats to client privacy in cloud communication and data storage. *Prof. Psychology-Research Pract.* 46, 154–160.
- Moss, J., Berner, E.S., 2015. Evaluating clinical decision support tools for medication administration safety in a simulated environment. *Int. J. Med. Inf.* 84, 308–318.
- Murphy, E.V., 2014. Clinical decision support: effectiveness in improving quality processes and clinical outcomes and factors that may influence success. *Yale J. Biol. Med.* 87, 187–197.
- National League for Nursing, 2015. *A VISION for Changing Faculty Role: Preparing Students for the Technological World of Health Care* (Washington, DC).
- Nunes, S.R.T., Rego, G., Nunes, R., 2014. The experience of an information system for nursing practice the importance of nursing records in the management of a care plan. *Comput. Inf. Nurs.* 32, 322–332.
- O'Malley, A.S., Draper, K., Gourevitch, R., Cross, D.A., Scholle, S.H., 2015. Electronic health records and support for primary care teamwork. *J. Am. Med. Inf. Assoc.* 22, 426–434.
- Prybutok, G., Ryan, S., 2015. Social media the key to health information access for 18- to 30-year-old college students. *Comput. Inf. Nurs.* 33, 132–141.
- Ricciardi, L., Mostashari, F., Murphy, J., Daniel, J.G., Siminerio, E.P., 2013. A national action plan to support consumer engagement via e-health. *Health Aff.* 32, 376–384.
- Risling, T., 2016. Social media and nursing leadership: unifying professional voice and presence. *Can. J. Nurs. Lead.* 28, 48–60.
- Rodgers, M.M., Pai, V.M., Conroy, R.S., 2015. Recent advances in wearable sensors for health monitoring. *IEEE Sensors J.* 15, 3119–3126.
- Roski, J., Bo-Linn, G.W., Andrews, T.A., 2014. Creating value in health care through big data: opportunities and policy implications. *Health Aff.* 33, 1115–1122.
- Sharts-Hopko, N.C., 2014. The coming revolution in personal care robotics: what does it mean for nurses? *Nurs. Adm. Q.* 38, 5–12.
- Shea, C.M., Malone, R., Weinberger, M., Reiter, K.L., Thornhill, J., Lord, J., Nguyen, N.G., Weiner, B.J., 2014. Assessing organizational capacity for achieving meaningful use of electronic health records. *Health Care Manag. Rev.* 39, 124–133.
- Sultan, N., 2015. Reflective thoughts on the potential and challenges of wearable technology for healthcare provision and medical education. *Int. J. Inf. Manag.* 35, 521–526.
- Tse, C.K.W., Bridges, S.M., Srinivasan, D.P., Cheng, B.S.S., 2015. Social media in adolescent health literacy education: a pilot study. *J. Med. Internet Res.* 17.
- van Houwelingen, C.T.M., Moerman, A.H., Ettema, R.G.A., Kort, H.S.M., Cate, O.T., 2016. Competencies required for nursing telehealth activities: a dephi-study. *Nurse Educ. Today* 39, 50–62.
- Williamson, B., 2015. Algorithmic skin: health-tracking technologies, personal analytics and the biopedagogies of digitized health and physical education. *Sport Educ. Soc.* 20, 133–151.
- Yusof, M.M., 2015. A case study evaluation of a critical care information system adoption using the socio-technical and fit approach. *Int. J. Med. Inf.* 84, 486–499.