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ORIGINAL ARTICLE

The Impact of Technology on Nursing Care

Esther Sudhir Joseph

Nursing Superintendent, Govt. Medical College and Hospital, Nagpur, Maharashtra 440003, India.

Abstract

While myriad forces are changing the face of contemporary healthcare, one could argue that nothing will change the way nursing is practiced more than current advances in technology. Indeed, technology is changing the world at warp speed and nowhere is this more evident than in healthcare settings. This article identifies seven emerging technologies that will change the practice of nursing; three skill sets nurses will need to develop to acquire, use, and integrate these emerging technologies; and four challenges nurse leaders will face in integrating this new technology. The role of technology in delivering cost-effective solutions through technology and eHealth services has been encouraged and health groups have been urged to identify and evaluate suitable eHealth solutions as part of an overall strategy for developing quality care services While increased demand for health care alongside budget constraints are challenging the delivery of health care services.

Keywords: Change; Future; Technology; eHealth; Telehealth; Telecare; Telehealthcare; Genetics; Genomics; Human Genome; 3-D Printing; Robotics; Nanomedicine; Nanotechnology; Biomechatronics; Kansei; Biometrics; Electronic Healthcare Records; Computerized Physician/ Provider Order Entry; Clinical Decision Support; Nursing Leadership; Informatics; Training; Education.

Introduction

The changing health care landscape For all health care practitioners delivering health care services, the changes in our ageing population are presenting challenges but also creating new opportunities for transforming patient care [1].

People are now working beyond the age of 65. And, while life expectancy has been rising, so has the number of years we can expect to live with a long-term condition or disability that limits our lifestyle. Public policy groups have acknowledged the need for health providers to understand how these demographic changes will affect their patients, carers, clinicians and practitioners. They have also recognised the need for greater invention in supporting the needs of an older population and the importance of home-based care to reduce costs and help improve the quality of life [1,2].

Better access to technology, and particularly to the internet is opening up the way for innovative approaches to health and homecare delivery. eHealth services–such as telephone health advice, text messaging, web-based support and remote monitoring of patients' vital signs – are facilitating individuals, families and communities to improve their health and wellbeing through information communication technology (ICT). eHealth is helping to improve patients' selfmanagement, preventing the deterioration of health, and decreasing the need for

Reprint Request: Esther Sudhir Joseph, Nursing Superintendent, Govt. Medical College and Hospital, Nagpur, Maharashtra 440003, India.
E-mail: sudhirjoseph@ymail.com

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surgery consultations and hospital admissions [2].

eHealth eHealth means promoting, empowering and facilitating health and wellbeing with individuals, families and communities and enhancing professional practice through the use of information management and information and communication technology (ICT) [3].

ICT ICT (information and communications technology) is an umbrella term that includes any communication device or application. For example: radio; television; mobile phones; computer and network hardware and software; and services such as videoconferencing and distance learning.

Telehealth Telehealth refers to the provision of care from a distance using a range of electronic technologies. Examples of telehealth include video consultations to support diagnosis and management, clinical networks and health professional education. Telehealth programmes are often established by health care organisations, such as the NHS or general practice.

Telecare Telecare is the provision of technology to enable a patient or client to live more safely and with greater independence in their own home. For example, pendant alarms or smoke and heat sensors, and alarms to summon help in an emergency. Telecare programmes, on the other hand, are often led by social care organisations, such as local authorities.

Telehealthcare Telehealthcare is the convergence of telecare and telehealth to provide a technology-enabled and integrated approached to the delivery of effective, high-quality health and care services. It can be used to describe a range of care options available remotely by telephone, mobile, broadband and video conferencing [3-4].

Types of information Information management includes electronic and physical information that is delivered through multiple channels that may include mobile phones and the internet. For example: data; paper documents; electronic documents; audio; and video.

Emerging Technologies That Will Change the Practice of Nursing

There are many emerging technologies that will change the practice of nursing in the coming decade. Seven are discussed here; genetics and genomics; less invasive and more accurate tools for diagnosis and treatment; 3-D printing; robotics; biometrics; electronic health records; and computerized physician/provider order entry and clinical decision support (See Table 1 for a discussion of the benefits and challenges of each)[4,5].

Table 1: Seven Emerging Technologies that Are Changing the Practice of Nursing

Technology	Benefits	Challenges
Genetics and Genomics	The majority of disease risk, health conditions and the therapies used to treat those conditions have a genetic and/or genomic element influenced by environmental, lifestyle, and other factors therefore impacting the entire nursing profession (Calzone et. al, 2010).	Many nurses currently in practice know little about genetics and genomics and lack the competence needed to effectively counsel and teach patients in this regard.
Less Invasive and More Accurate Tools for Diagnostics and Treatment	Non-invasive and minimally invasive tools for diagnostics and treatment generally result in lower patient risk and cost.	The rate at which noninvasive and minimally invasive tools are being introduced makes ongoing competency regarding their use a challenge for nurses.
3-D Printing	Bioprinters, using a "bio-ink" made of living cell mixtures can build a 3D structure of cells, layer by layer, to form human tissue and eventually human organs for replacement (Thompson, 2012).	Healthcare is just beginning to explore the limits of this technology. There are limits to the materials which can be used for printing and materials science is a laggard in 3D printing (Nusca, 2012).
Robotics	Robotics can provide improved diagnostic abilities; a less invasive and more comfortable experience for the patient; and the ability to do smaller and more precise interventions (Newell, n.d). In addition, robots can be used as adjunct care providers for some physical and mental health care provision.	More research is needed on comparative effectiveness of robotics and human care providers. Many healthcare providers have expressed concern about the lack of emotion in robots, suggesting that this is the element that will never replace human caregivers.

Biometrics	Biometrics increase the security of confidential healthcare information and eliminate the costs of managing lost passwords.	The measurement of biometric markers may occur in less than ideal situations in healthcare settings and in a rapidly changing workforce, cost may become an issue.
Electronic Healthcare Records (EHR)	Healthcare providers have access to critical patient information from multiple providers, literally 24 hours a day, 7 days a week, allowing for better coordinated care.	Implementation costs, getting computers to talk to each other and debates about who "owns" the data in the EHR continue to challenge its required implementation.
Computerized Physician/Provider Order; Entry (CPOE) and Clinical Decision Support	CPOE and clinical decision support fundamentally change the ordering process resulting in lower costs, reduced medical errors, and more interventions based on evidence and best practices.	The introduction of CPOE and clinical decision support requires providers to alter their practice. Resistance is common due to the time spent on order entry. Implementation and training costs are often significant.

Nursing Skill Sets Needed to Appropriately Respond to Emerging Technologies

The capacity to manage human knowledge, and to convert it into useful products and services, is fast becoming the "critical" leader skill of the age (National Defense University, n.d.).

Leadership skills that will be required of nurses to appropriately respond to emerging technologies include being able to use technology to facilitate mobility, communication and relationships; having expertise in knowledge information, acquisition, and distribution; and understanding and using genetics and genomics in nursing (see Table 2 for select examples of these skill sets) [5,6,7].

Nursing Leadership Challenges in Integrating New Technology

What leadership challenges will nurses face in integrating new technology with the caring part of nursing? Who will determine what cost-benefit ratio justifies the development and use of expensive technological innovations? Who will be charged with overseeing the initial training of a technology enabled nursing workforce and for assuring continuing competence in technology aided practice? Finally, what role will nurses play in helping to establish the ethical parameters of technology in healthcare? This section discuses four nursing leadership challenges (Table 3) that exist in integrating new technology in nursing and healthcare [6,7].

Table 2: Three Nursing Skill Sets Needed to Appropriately Respond to Emerging Technologies

Nursing Skill Set	Select Examples
Being able to use technology to facilitate mobility, communication, and relationships	Email, telehealth and telemedicine, internet, cellular technology, text messaging, video conferencing, smart phones, 3-dimensional printing, high fidelity simulation, virtual realities such as Second Life Virtual World, social media networking, embedded sensor networks, global positioning systems, bio-electronics
Having expertise in knowledge information, acquisition, and distribution	Information literacy, evidence-based practice, clinical decision support, sensemaking, commercially purchased expert networks, distributed expertise, boundary spanning knowledge management, knowledge engineering, standardized guidelines, fuzzy case-based reasoning, understanding of cognitive science theory and complex adaptive systems theory
Understanding and using genomics in nursing	Understanding of the Human Genome Project, genetic sequencing, service delivery models that promote safe, efficient, and effective utilization of genetic/genomic information in care decisions (First Genetics, 2008); ethical issues related to genomics encountered throughout the life continuum and around the world (First Genetics, 2008); ethno-cultural beliefs and practices for utilization of genomic-based care; and resources available to arm nurses with information to learn about and teach genetics (First Genetics, 2008).

Table 3: Four Nursing Leadership Challenges in Integrating New Technology

Balancing the Human Element with Technology
Balancing Cost and Benefits
Training a Technology Enabled Nursing Workforce and Assuring Ongoing Competency
Assuring that Technology Use is Ethical

Balancing the Human Element with Technology

What does all this expanding technology mean for nurses? Many things, but perhaps most importantly, nurses need to make sure that the human element is not lost in the race to expand technology. The human connection is the art of nursing and nurses need to be actively involved in determining how best to use technology to supplement, not eliminate, human resources. One of the most significant challenges nurse leaders will face then in the coming decade then will be to find that balance between maximizing the benefits of using the technology which exists, while not devaluing the human element [6,7].

Balancing Cost and Benefits

There are other leadership challenges that nurses must address in conjunction with a health care system so driven by technology, such as cost. The U.S. health care system is already the most expensive healthcare system in the world and technology is one of the leading cost drivers. These technologies are without a doubt saving lives and improving the quality of life for millions, but sometimes technology development comes first and then a need is created simply because the technology exists. In addition, access to technology is often dependent on a person's ability to pay for that technology; many healthcare disparities still exist in this regard [6,7].

Training a Technology Enabled Nursing Workforce and Assuring Ongoing Competency

Judy Murphy, deputy national coordinator for Programs and Policy at the Office of the National Coordinator (ONC) for Health Information Technology, Department of Health and Human Services, in Washington, DC stated that "I used to think we [nurses] provide healthcare first, and that the need for health information was secondary" (Take 5 with a Nurse, 2012, para. 8). But, Murphy now argues that nurses cannot provide good care without having the right information to make the right decisions when caring for individual patients (Take 5 with a Nurse, 2012). She concludes then that nursing is an information-based profession that provides health care, and that it is technology that helps us bring all that information to the point of care [6,7].

Who is going to train all the healthcare professionals who will work with new emerging technologies? More importantly, who will need to be responsible for assuring *ongoing competency* in a digital era where half of what someone knows is obsolete in three years? Cipriano (2011) suggests that as technology and computing become ubiquitous, all nurses will have to demonstrate competencies to maintain cutting-edge practices and that the call to lead this change will likely fall to nurse informaticians. These leaders with expertise in informatics will be critical to bridging the divide between clinicians and technology as well as leading delivery model transformation through application of health IT (Cipriano, 2011) [7,8].

Assuring that Technology Use is Ethical

Finally, nurse leaders must increasingly ask "how" and "why" technology should be implemented. What parameters need to be put into place to determine its ethical use? Just because something can be done does not mean that it should be done. In fact, the problems faced by organizational leaders regarding technology will increasingly be what is called "*wicked*"- meaning that they have many causes, they are tough to describe, and there is no right answer.

In a recent speech, Thomas Baldwin, a professor of philosophy at Britain's York University, suggested that new technologies bring significant hopes of curing terrible diseases as well as fears about the consequences of trying to enhance human capability beyond what is normally possible (Kelland, 2012). Baldwin concluded that the blurring of the line between man and machine will continue to pose concerns about the ethics of emerging technologies in medicine and other fields. It is important for nurses to be a part of conversations to address these ethical concerns [9,10].

Conclusion

Clearly, planning for the future is difficult even when environments are relatively static. When they are as dynamic as healthcare and technology, the challenges multiply exponentially. National Defense University (n.d.) agrees, suggesting that:

As the future is uncertain, the only thing relatively clear is that much of what we will experience in the future will be different from the past. We must understand it is not information or even technology that will produce this unprecedented change, but the impact of technology on all aspects of human life; not computers or even bits and bytes, but the ability to apply and integrate rapid technological change [10,11].

The Future of Nursing, suggested that it is nurses who will be called up to fill expanding roles and to master technological tools and information systems while collaborating and coordinating care across teams of health professionals. Nurse leaders must begin thinking now about how emerging technologies will change the practice of nursing and proactively create the educational models and leadership development programs necessary to assure that nurses will have the competencies they need to address these emerging technologies. It must be nurses who are at the forefront in planning for and preparing for these challenges. Nursing as a profession must not be reactive and allow others to assume this leadership role [9,10,11].

Barriers can be an Asset

1. Depending on a client's need, recommend everything from budgeting software to interactive programs.
2. Technology can be developed to improve the entire family's health related factors in an easy way.
3. Technology can streamline processes and create default options that promote speedy, sensible health decisions, educate clients and the general public on matters pertaining to health.
4. A company can use this technology, for example, to build a barrier to entry, to build in switching costs, and even, sometimes, to completely change the basis of competition To solve customer service problems, a major distributor installs an on-line network to its key customers so that they can directly enter orders into its computer.
5. The hospital management integrated system in India is able to manage the OPD based system, in hospital based system, supportive system, the biometric system etc. The reports can even be traced at Mantralayas, and necessary corrections can be done if necessary.
6. The nursing applications are found very useful for the patient care which is cost effective, saves the time, useful for the management in the wards, and beneficial in all avenues.Thus this technology is very useful to all once it is dedicatedly implemented. Only little on the job training on how to use it and an attitude for proper implementation will help the society at large.[12]

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