

New Technology in Nursing Education and Practice

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Abstract: Technology is changing the world at warp speed and nowhere is this clearer than in health care settings. In an increasingly crowded world, people rightly expect health care to meet their needs quickly and, where possible, tailored to their needs. Technology helps to deliver these elements, putting the power back in the hands of the patient. Health care is growing increasingly complex, and most clinical research focuses on new approaches to diagnosis and treatment. In contrast, relatively little effort has been targeted at the perfection of operational systems, which are partly responsible for the well-documented problems with medical safety. If medicine is to achieve major gains in quality, it must be transformed, and information technology will play a key part, especially with respect to safety. Technological innovation in health care is an important driver of cost growth. Doctors, nurses, and patients often embrace new modes of treatment before their merits and weaknesses are fully understood. These technologies can lead to increases in costs, either because they are simply more expensive than previous treatments or because their introduction leads to an expansion in the types and numbers of patients treated. 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. The role of technology in delivering cost-effective solutions through technology and e-Health services has been encouraged and health groups have been urged to identify and evaluate suitable e-Health solutions as part of an overall strategy for developing quality care services.

Keywords: Technology, Nursing education, Nursing practice

Abbreviations: *eHealth*; electronic Health. *ICT*; Information and Communication Technology. *IT*; Information Technology. *PRS*; Personal Response System. *HPS*; Human Patient Simulation. *3D*; 3Dimensional. *EHR*; Electronic Healthcare Record. *CPOE*; Computerized Physician/Provider Order Entry. *HIM*; Health Information Management. *TEFT*; Testing Experience and Functional Tools. *DCM*; Detailed Clinical Model. *EMR*; Electronic Medical Record. *BCMA*; Bar-Code Medication Administration.

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I. Introduction

The use of technology in nursing is too earlier, in fact nurses have become capable of utilizing and familiarizing complex technology into caring nursing practice for years, at least since the time of Florence Nightingale in the United Kingdom and even past, when Jeanne Mance (1606-1673) founded the first hospital in Montreal, Canada in 1642. Various procedures of machinery such as ventilators and physiological monitors were first used in intensive and critical care settings, and are now presently used in adapting form in less acute areas, even in home care [1].

1.1. eHealth services

The use of information and communication technologies (ICTs) for health, referred to as eHealth represents a means to support health care delivery. These technologies change how nurses plan, deliver, document, and review clinical care; this will only continue as technology advances. The process whereby nurses receive and review diagnostic information, make clinical decisions, communicate and socialize with patients and their relatives, and implement clinical interventions will be fundamentally modified with further integration of ICTs into nursing practice [2].

There are many different forms that eHealth can take. It can involve: A telephone consultation between patient and a health care provider to triage symptoms, deliver instruction, monitor vital signs and provide guidance on the use of medication telephone or text on health promotion advice and management or appointment reminders patient-submitted health information using a mobile device for example, a mobile phone or hand-held computer applications resulting in A referral or consultation appointment a remote consultation between a patient and doctor using video conferencing patient started interaction with practitioners local internet based support group with a chat room, blog or social network for sharing information with other users [3].

1.2. Technology in nursing education

Working with trajectories: The role of digital technology in higher education teaching and learning over the near term. Working with trajectories is an admission that we cannot predict the unexpected factors and developments that might affect the trajectory, quickening it or maybe derailing the trajectory entirely. Digital technology is the very fabric of nearly everything associated with teaching and learning. A core trajectory of digital technology in higher education is the shift away from thinking of it as Information Technology (IT) infrastructure and toward conceiving it as a digital learning engagement environment [4].

1.3. Technology and its Impact on Nursing Education

Nursing educators have to prepare clinicians to promote health and increase wellbeing, but the basics of nursing education need to be redesigned in many countries as technology, science, and the demands of the public for effective and responsive health care, become more complex. In some countries and regions nursing curricula are outdated, not preparing nurses for further practice. The technology has many benefits, but there are huge gaps in technology access and training in nurse education and health settings, and challenges regarding the nature, cost, and high turnover of technology used in teaching-learning spheres. Other challenges include understandings about how technology influences on the well being of patients, clinicians, learners, and educators. Technological innovation and improved globalization are closely interlinked, and nursing education has to respond in a measured and carefully executed way, if it is to be relevant [5].

1.4. The technological challenges for nursing education

With the health care system in a state of flux, nursing education faces many challenges. Nursing faculty must design a dynamic curriculum that deals with the explosion of information, the complexity of the healthcare system, and optimal patient outcomes while addressing the diverse expectations of learners. Inclusion of information management and interactive technology facilitates learner engagement, promoting critical thinking and improving clinical judgment. Fundamental to inclusion of technology in nursing education is information literacy and informatics. To prepare nurses for the challenge of the complex, dynamic healthcare environment, the faculty envisioned curricula infused with technological innovations. Multiple interactive technologies such as personal response systems (PRS), human patient simulation (HPS) personal digital assistants, web conferencing, podcasting, and course management systems were integrated within the curriculum [6].

II. The Impact of Emerging Technology on Nursing Care

There are many emerging technologies that will change the practice of nursing in the coming decade.

2.1 Genetics and Genomics

The American Cancer Society (2011) suggests that genetic testing is already being used for many reasons. Future applications of genetics and genomics will transform the health care system even further. Carroll (2011) suggests that by the year 2020 the health care system will have transitioned from one which fixed people after they were sick with one of preventive, diagnostic, genomic-based medicine where patients will be treated for conditions we know they are likely to develop. Despite these concerns, there is no doubt that Geno-typing and genetic sequencing will continue to significantly improve diagnostic and Interventional medicine. Gene therapy is expected to make significant inroads in curing cancer and preventing birth defects within the next two decades [7].

2.2 3-Dimensional (3D) 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 [8]. 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 [9].

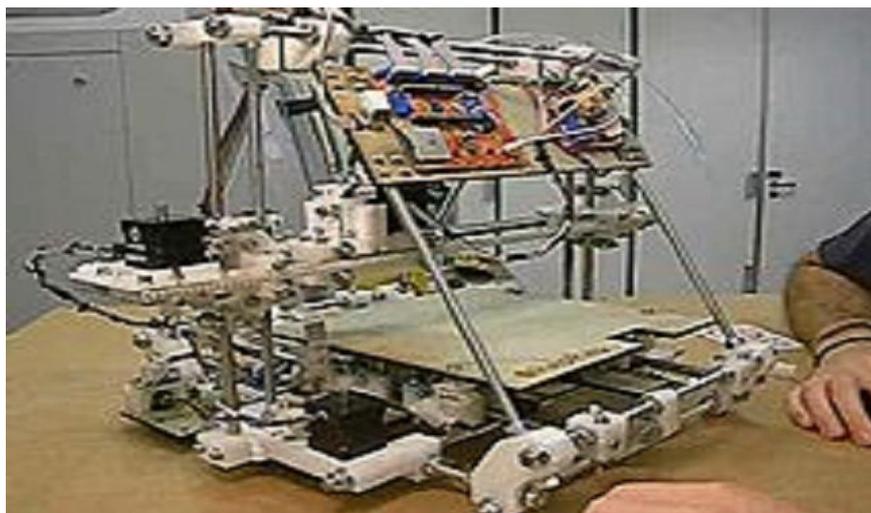


Fig 1:Typical 3-Dimensional Printing [10].

2.3 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. In addition, robots can be used as adjunct care providers for some physical and mental health care provision [11].



Fig 2: Robotic [12].

2.4 Less Invasive and More Accurate Tools for Diagnosis

There are several different types of less invasive meters being developed for monitoring blood glucose. One of these includes a sort of nano-tattoo, and Symphony® CGM System. It was developed by a medical device company with expertise in advanced skin permeation technology.



Fig 3: Symphony® CGM System [13]

2.5 Biometrics

Biometrics is the automated recognition of individuals based on their behavioral and biological characteristics. It is a tool for establishing confidence that one is dealing with individuals who are already known (or not known) and consequently that they belong to a group with certain rights (or to a group to be denied certain privileges) [14].

2.6 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 [15].

2.7 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 [15].

2.8 Nursing Skill Sets Needed to Appropriately Respond to Emerging Technologies

- Being able to use technology to facilitate mobility, communication, and relationships
- Having expertise in knowledge, information, acquisition, and distribution
- Understanding and using genomics in nursing [15].

III. Impact of technology on nursing practice

Information and communication technologies (ICTs) embody all digital technologies that support the electronic capture, storage, processing, and exchange of information in order to promote health, prevent illness, treat disease, manage chronic illness, and so on. In the health sector ICTs refers to a set of projects or services that allow for remote nursing care (Tele-health), interdisciplinary clinical support, as well as knowledge transfer [16].

IV. Technologies that changed nursing forever

4.1 Electronic IV monitors

Drip detects sensor AS introtek's optical technology, non-invasive designed sensor measures the instantaneous drip rate by accurately outputting a pulse for each drop of liquid, the drip detects sensor is designed to be utilized as a technique for monitoring media flow rate during patient Iv infusion. The sensor can be used to enhance and improve processes in the following applications.

- IV infusion administration system
- Liquid dispensing
- Pharmaceutical manufacturing
- Clinical laboratory [17].



Fig 4: A Baxter International Colleague CX infusion pump [18]

4.2 The Sphygmomanometer

The accurate measurement and control of blood pressure are key elements in the prevention of cardiovascular disease and stroke. Mercury Sphygmomanometers, first developed over 100 years ago and largely unchanged since, are used in both hospital and ambulatory settings. They have been considered the gold standard' blood pressure measuring devices from which treatment guidelines are developed [19].

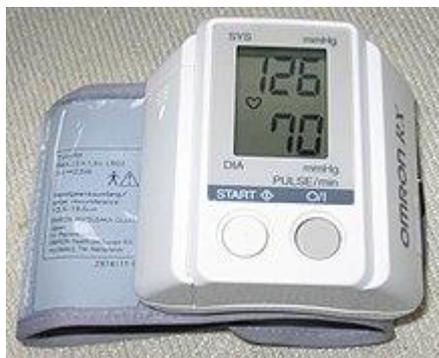


Fig 5: BP 126/70 mmHg as result of electronic sphygmomanometer [20]

4.3 Information management

The health information management (HIM) profession is dedicated to the effective management of the patient information and health care data needed to deliver quality treatment and care to the public. The basic duties of the him professional continue to evolve over time, as patient records become less paper-based and increasingly electronic. HIM professionals play a critical role in the successful implementation of electronic health records and ensure that providers, healthcare organizations and patients have access to the right health information when and where it is needed while maintaining the highest standards of confidentiality and security [21].

4.4 The portable defibrillator

Electrical defibrillation is the only effective therapy for cardiac arrest caused by ventricular fibrillation or pulseless ventricular tachycardia. Scientific evidence to support early defibrillation is overwhelming, being delayed from collapse to delivery of the first shock the single most important determinant of survival. If defibrillation is delivered promptly, survival rates as high as 75% have been reported. The chance of a favorable outcome decline at a rate of about 10% for each minute cardiac defibrillation is delayed [22].



Fig 6: Portable defibrillator [23]

4.5 Readily accessible base of information

A common thread woven through the Testing Experience and Functional Tools (TEFT) demonstration objectives is the use of technology to enhance person-centered health care. The health care industry has experienced rapid expansion in the use of electronic health records (EHRs), personal health records (PHRs) and other health information technology (HIT). This growth has created a culture that encourages everyone in the care continuum to be involved with individual decision-making processes. HIT enables individuals and their caregiver(s) to take an active role in the management of their care. The federal government has been a key driver in the movement toward person centered care, and that movement continues to gain momentum. Ultimately, these health care advances drive improvements in the individual's experience and quality of care and reduced service fees [24].

4.6 The sonogram/ultrasound

As nurses, midwives, nurse practitioners, and physician assistants take on more responsibility in providing first-line care to women, the need to incorporate sophisticated technology as an adjunct to clinical assessment has become greater. These same clinicians are often the first to provide bedside assessment of maternal and fetal conditions. In the case of an advanced nurse practitioner (ANP), he or she may be the only clinician evaluating and treating a woman from adolescence through the post-menopausal years. As a result gaining knowledge and acquiring skill with advanced technologies such as sonography has become paramount [25].



Fig 7: Ultrasound Machine [26]

4.7 Local wireless telephone networks

Computer-aided Design (ALCAD) is a nursing communication and management system using IP technology that can be used for both wired and wireless connections. The features of this system make it ideal for use in hospitals, homes, supervised apartments and day centers. The room post controls the push buttons, lights, and sensors in a room; it sends alarms and establishes communication with the nursing staff. It is a versatile and flexible element that allows for future adaptations and extensions [27].

4.8 Hands-free communication devices

Hands free communication devices (HFCDs) are an information and communication technology comprised of wearable “badges” and server-based software. The technology is distinguishable by three traits: 1. It utilizes Voice-over Internet Protocol (VoIP) and wireless local area networks (WLANs), 2. The communication devices are wearable, and 3. The technology possesses voice control capability. HFCDs are increasingly used in clinical care settings, particularly among nursing staff [28].

4.9 Communications options

Communication can be defined as a process during which information is shared through the exchange of verbal and non-verbal messages, and where people create a relationship by interacting with each other. Communication is integral to the nurse-patient relationship and is one of the six fundamental values of nursing identified in the government’s strategy to deliver high-quality, compassionate care for patients department of health. The policy document compassion in practice states that communication is central to successful, caring relationships and to effective team working [29].

4.10 Patient remote monitoring

Remote monitoring is extremely important and probably in the forefront of mobile technologies now because of its potential importance in decreasing hospital readmission rates, which are a big headline because they are responsible for penalties that the centers for Medicare and Medicaid services (CMS) is now imposing on hospitals that have readmissions within 30 days for certain diagnoses. Whether the goal is preventing readmissions or maintaining medical stability among the chronically ill, what remote monitoring does is it keeps the patient more in touch with the physician over a period of time outside of the acute-care setting, such that you don’t have to wait for disasters to happen” to bring the deteriorating condition to a provider’s attention [30].



Fig 7: Patient Remote Monitoring [31]

4.11 RFID technologies

Radio frequency identification (RFID) technology is having a major impact on the health care industry. By attaching radio frequency tags to different entities people and objects, (RFID) technology can provide identification, tracking, location, security and other capabilities. RFID technology can be used to reduce medical mistakes, improve patient safety and enhance the quality of medical service in hospitals. RFID is now generating significant interest in the marketplace because of its robust application capabilities. Thus, RFID systems are becoming popular in logistics operations, inventory and materials management, and industrial automation, replacing optical identification technologies such as bar codes. But RFID technology can provide a number of benefits to the healthcare industry, improving overall safety and operational efficiency because it operates without line-of-sight while providing read/write capabilities [32].

4.12 Compact, portable medical devices

As medical devices have become more compact and portable, it has become possible to conduct a variety of medical treatments in the home. Home use devices can provide significant benefits to care recipients. Quality-of-life improvements, home health care offers more comfort and convenience to care recipients than hospital-based care. Technological advancements have allowed care recipients to remain ambulatory and independent. For example, tele-medicine and wireless monitoring devices have made it possible for healthcare providers to observe and communicate with home care recipients remotely. Advances in robotics and electronics have allowed for more automated delivery of care, with less need for the intervention of a medical professional. Cost savings, the use of medical devices in the home can also generate a cost savings for care recipients and the health care system [33].

4.13 Learning technologies

Student access to technology is no longer a privilege: it is a prerequisite for full participation in high-quality education opportunities. Increasingly, important learning resources used by students and teachers are digital, making access to the internet as basic as access to a library. Technology access also enables students to find and enroll in educational opportunities, such as summer enrichment programs and college scholarship programs, and is increasingly fundamental for participation in college itself. Modern technology tools that enable design, media production, self-expression, research, analysis, communication, collaboration, and computer programming are commonplace in various professions and disciplines, and facility with these tools is an essential part of becoming ready for college and careers. Interacting with digital learning environments that support the development of deeper learning skills such as problem solving, critical thinking, and inquiry is also crucial. Furthermore, goals for improved educational achievement and increased participation in science, technology, engineering, and mathematics (STEM) learning and careers will not be reached without the integral use of technology [34].



Fig 8: Teaching and learning online S[35]

4.14 Video conferencing

In a healthcare environment that is technology oriented, providers and patients are recognizing the benefits of video conferencing. With the constant pressure to increase the quality of patient care and the desire to provide new services, while at the same time controlling costs, healthcare providers are leveraging the power of video networks to link patients, specialists, and clinicians, thus extending the reach of healthcare. Telemedicine systems bring medical expertise to patients and providers, regardless of location. The use of telemedicine increases revenues for health care facilities by allowing hospitals to tap the expertise of individuals across the country or the globe. Patients get the care they need, regardless of their location, and often faster and at a reduced cost. [36].

V. Nursing and implementation of modern technology

The application of modern technologies is an essential factor required for the advancement of nursing. Health care itself and continuous monitoring of patients requires use of the information-communication system. However, the information -communication system is essential for efficient implementation of nursing documentation and effective providing of health care. Information technology in health care involves the processing and application of information and easier access to the patient's history of care. Data entry, data conversion into useful information, and the application of data affecting the health care system are the factors included in this process. Nurses who provide direct health care are among other specialists, registered nurses with advanced practice, coordinators of care, visiting nurses, and health promoters and so on. In short, they are everywhere where nurses work [37].

VI. Informatics and technology in professional nursing practice

Technology has increased rapidly over the past four decades, and has become an integral part of health care. Nurses have participated in the purchase, design, and implementation of information technology in health care. The knowledge required for the field of nursing informatics has expanded and it is now a recognized specialty in the profession. Nursing informatics are considered both a science and a system, including process and data. The term "nursing informatics" was initially seen in literature in the 1980s, including a definition of combining nursing, information, and computer sciences for managing and processing data into knowledge for using in nursing practice [38]. Since the digitization of nursing records began in the late 1980s, a vast amount of data has been accumulated in electronic nursing records (ENR) systems, and there has been a heightened interest in collecting, sharing, and reusing patient information generated during nursing care. To effectively share and reuse data of ENR systems, ensuring semantic interoperability is a key factor. To ensure full semantic interoperability, one approach is to document nursing records using a data model, such as a detailed clinical model (DCM) [39]. As the use of information technology in healthcare increases, the demand for healthcare professionals equipped with the necessary knowledge and skills for utilizing and managing information also increases. The Institute of Medicine specified the use of information technology as one of the top five abilities that healthcare professionals needed, and also emphasized the importance of information technology in ensuring patient safety and the quality of healthcare. Nurses are no exception to this. The multidisciplinary field that uses health information technology to improve health care is called health informatics. Nursing informatics is a sub-component of health informatics pertaining to nurses and nursing care. The increasing use of information and communications technology (ICT) and Electronic Medical Records (EMRs) at the point of care has led to a consensus that nurses need to understand technology, as well as there is a greater demand for nursing informatics education [40].

6.1 . *Electronic Nursing Record System*

The benefits of electronic nursing record (ENR) systems include reduced errors, improved quality of care, and lowered cost. These benefits can be maximized by using a standard nursing terminology, which improves data quality, data sharing, and decision support [41].

6.2. *Barriers to information access*

- Workload
- Access to computers
- Technical support
- Information technology knowledge
- Age
- Lack of training
- Consultation;
- Geographic location
- Level of employment
- Sector of employment
- Recognition of the value of information technology in nursing [42].

6.3 . *Nurses resisting information technology*

Resistance in the workplace, by nurses, has not been extensively studied from a sociological perspective. In this paper, nurses' resistance to the implementation and use of computer systems is described and analyzed, on the basis of semi structured interviews with 31 nurses in three UK NHS hospitals. While the resistance was not 'successful', in that it did not prevent the implementation of the systems, it nonetheless persisted. Resistance took a wide variety of forms, including attempts to minimize or 'put off' use of the systems, and extensive criticism of the systems, though outright refusal to use them was very rare. Resistance was as much about the ideas and ways of working that the systems embodied as it was about the actual technology being used. The patterns of resistance can best be summed up by the phrase 'resistive compliance' [43].

6.4. *Technology can reduce errors*

Effect of Bar-Code Technology on the Safety of Medication Administration: Bar code medication administration (BCMA) systems (also referred to as bar code enabled point of care) (BPOC) technology, is now adopted by the majority (65.5%) of American hospitals to allow patient identity verification and electronic checking of orders. The nurse scans a bar code on their identification tag, the patient's wristband, and the medication to be administered. The BCMA is believed to enable the verification of the 5 rights of medication management (and so prevent wrong-patient, wrong-dose, wrong-time, wrong-drug and wrong-route errors). The system also ensures accurate and complete documentation of the medication administration process. The BCMA implementation requires all medication packaging to contain bar codes that can be read by BCMA scanners and all ordered medications to be listed in an eMAR [44].

6.5 *Mobile technology use for continuing professional development in nursing profession*

The rapid growth of health technology and informatics, mobile learning platforms and software applications in healthcare has enabled an increased and diverse range of additional opportunities for learning and teaching in the workplace than previously available, with implications at the individual and systems levels in the planning and delivery of care and for supporting lifelong learning in healthcare settings [45].

VII. Conclusion

The use of technologies in nursing is not recent, these technologies change how nurses plan, deliver, document, and review clinical care; this will only continue as technology advances. The technology has many benefits, but there are huge gaps in technology access and training in nurse education and health settings, and challenges regarding the nature, cost, and high turnover of technology used in teaching-learning spheres. To prepare nurses for the challenge of the complex, dynamic healthcare environment, the faculty envisioned curricula infused with technological innovations.

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