Chapter 3
Nursing Informatics: A Core Competency for the Profession

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Abstract This chapter provides the reader with a summary of nursing informatics, considering how it has evolved over a 50-year timeframe to become a core competency for the profession of nursing in twenty-first century healthcare. In this chapter we describe the background and context of nursing informatics and why it is a critical enabler for the advancement of the profession. Drawing on nursing theory and historical milestones on development of informatics within health and social care service delivery. This chapter uses an adaptation of the CARE acronym with four core concepts namely Connected health, Administration, Research, and Education to present the evidence and provide insights on key influences shaping the development and advancement of digital within the profession. Specifically this chapter focuses on introducing the reader to critical factors are which driving the practice of nursing informatics in order to impact upon patient outcomes, and deliver a quality orientated global health and social care service over time. This chapter therefore acts as a primer for chapters which follow in this fifth edition, and presents the fundamental concepts of nursing informatics in context. It provides an introductory and summative chapter for those who do not have a background in this topic and who wish to understand how nursing informatics is emerging as a core competency for the profession.

Keywords Health informatics · Nursing informatics · eHealth · Connected health · Nursing role · Digital health

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Key Concepts
Health Informatics
Nursing Informatics
Nursing Role

Learning Objectives for the Chapter
1. Understand how nursing information can be used efficiently and responsibly to make nursing care evident in documentation of patient care through the use of digital data.
2. Understand the importance of nursing informatics competencies and digital literacy in professional practice of nursing.
3. Gain a deeper understanding of historical roots of nursing informatics and its association with nursing theory over the lifecycle of electronic health care delivery.
4. Appreciate the Impact of digital transformation on the profession of nursing especially in regards to connected health.

In Chap. 2, we explained the seismic shift in care design transitioning to new models of care underpinned by digital health. We considered how global leaders are looking to information and communications technology (ICT) as an enabler to support health care professionals and assist individuals to age well in place. In this chapter, we focus on the changing landscape of healthcare and consider what it means for the profession of nursing. The increasing use of digital and technology integration in the domain of health means that nursing leaders must adopt a proactive approach on the digital transformation within both health and social care. Specifically we argue the case that nursing informatics specialists can provide a much-needed scaffold for the profession to build stronger evidence based infrastructure and guidance supporting nursing education, research, and practice. We demonstrate how nursing informatics is a core nursing competency and critical to the practice of the profession in the delivery of twenty-first century health care. Projected figures on the need for nursing leadership to engage with informatics specialists to advance eHealth and digital health are noteworthy. The American Medical Informatics Association estimates that as many as 70,000 nursing informatics specialists or analysts will be needed in the next 5 years (Spring 2020, p. 12). Focused nursing informatics activities and associated deliverables are influencing patient outcomes. This is a core message that needs to be amplified so that a wider audience can understand it. The scope and influence of clinicians with advanced informatics knowledge and analytics expertise is poorly understood, not only in the profession, but also in the wider context of care delivery (Peltonen et al. 2019). As a means of background and context, this chapter provides an overview of the journey of informatics theory. Using the CARE acronym as outlined in Chap. 1, we use this CARE acronym (see Fig. 1.1) to discuss key concepts, which underpin the material presented in this chapter. In this edition, CARE is presented as an acronym for Connected Health, Administration, Research and Education.
Key definitions of nursing informatics are included in addition to insights from the evidence base on the nursing contribution to and role of informatics within practice. This chapter is structured in three sections. Firstly, this introduction, then Sect. 3.1 provides an historical view of informatics and its origins. This section also includes the nursing contribution within informatics and how the nature of nursing influences and informs the field of informatics over the past 50 years. Section 3.2 reviews the CARE acronym in the context of Nursing Informatics considering Connected Health, Administration and Research and Education from the perspective of related evidence to inform nursing agendas. The chapter concludes with a final discussion on critical factors that situate nursing informatics as a core competency for the profession.

3.1 Historical Overview of Informatics

Francois Gremy of France is widely credited with coining the term informatique medical, which was translated into English as medical informatics. Early on, the term medical informatics was used to describe “those collected informational technologies which concern themselves with the patient care, medical decision making process”) (Greenburg 1975). Another early definition, in the first issue of the Journal of Medical Informatics, proposed that medical informatics was “the complex processing of data by a computer to produce new kinds of information” (Anderson 1976). As our understanding of this discipline developed, Greens and Shortliffe (Greens and Shortliffe 1990) redefined medical informatics as “the field that concerns itself with the cognitive, information processing and communication tasks of medical practice, education, and research, including the information science and the technology to support these tasks. An intrinsically interdisciplinary field … [with] an applied focus, … [addressing] a number of fundamental research problems as well as planning and policy issues.” Shortliffe et al. (2001) also defined medical informatics as “the scientific field that deals with biomedical information, data, and knowledge—their storage, retrieval and optimal use for problem-solving and decision-making.”

One question consistently arose: “Does the word medical refer only to physicians, or does it refer to all healthcare professions?” In the first edition of this book, the premise was that medical referred to all healthcare professions and that a parallel definition of medical informatics might be “those collected informational technologies that concern themselves with the patient care decision-making process performed by healthcare practitioners.” Thus, because nurses are healthcare practitioners who are involved in the patient care and the decision-making process that uses information captured by and extracted from the information technologies, there clearly was a place for nursing in medical informatics. Increasingly, as research was conducted and medical informatics evolved, nurses realized there was a discrete body of knowledge related to nursing and the use of informatics. During the early 1990s, other health professions began to explore the use of informatics in their
disciplines. Mandil (1989) coined the phrase “health informatics,” which he defined as the use of information technology (including both hardware and software) in combination with information management concepts and methods to support the delivery of healthcare. Thus, health informatics has become the umbrella term encompassing medical, nursing, dental, and pharmacy informatics among others. Health informatics focuses attention on the recipient of care rather than on the discipline of the caregiver. The evolution of technology supporting health and professional nursing practice can be illustrated in Fig. 3.1, which demonstrates the steady progression of innovation with technology. From the 1970s onwards, there is an acceleration of technology to support practice and improve patient outcomes across the context of health care, including how the use of ICT for distance activities related to health. One example being the introduction of telehealth facilities for remote access to diagnostic and therapeutic support resources to enhance quality of care. Telehealth services provided scope to reduce geographical limits and accommodate access to population and mobile health services. Core over this time line is the integration of computers and technology originally as two separate entities they have today become one. This is well articulated by Time Magazine brief history of the computer (Time Magazine 2020) and the Computer History Museum Timeline of Computer History (CHM 2020).

Within healthcare, the progressive deployment of electronic health records (EHR) evolved. Hospital administrators became more aware of the possibilities of
automating health care activities beyond business office procedures. Health care professionals began to develop patient care applications and vendors began to realise the potential of the market in healthcare. The stages of EHR cycle in terms of capability and integration over time are illustrated in Fig. 3.2 which is adapted from Nagle and Catford (2008).

Originally published in 2008, Fig. 3.2 presented above depicts the various stages of electronic health record cycles over time is still very much relevant in 2020. Sensmeier (2017) describes health care as one of the most data rich industries driven by digital health image capture and widespread EHR adoption. Between the various EHRs in existence, the average person will leave a trail of more than one million gigabytes of health related data in their lifetime.

On review of the early literature on nursing and informatics. The nurse’s early role in medical informatics was that of a consumer. The literature clearly shows the contributions of medical informatics to the practice of nursing and patient care. Early developments in medical informatics and their advantages to nursing have been thoroughly documented by Hannah (1976). These initial developments were fragmented and generally restricted to automating existing functions or activities such as automated charting of nurses’ notes, automated nursing care plans, automated patient monitoring, automated personnel time assignment, and the gathering of epidemiological and administrative statistics. Subsequently, an integrated approach to medical informatics resulted in the development and marketing of sophisticated hospital information systems that included nursing applications or modules. Pioneers from this time include Maureen Scholes from the United Kingdom who was involved in the London Hospital Real Time Computer Project in 1967, and Harriet Werley from the USA who from the 1960s worked with the American Nurses Association on communication and decision making in nursing.

**Fig. 3.2** EHR lifecycle adapted from Nagle and Catford (2008)
Harriet Werley was also involved in the 1980s in the development of Nursing Minimum Dataset with Norma Lang (Scholes et al. 2000).

Dr. Marion Ball introduced the term nursing informatics (NI) initially at the 1983 International Medical Informatics Association (IMIA) Conference in Amsterdam. Nursing informatics as then originally defined by Hannah, in 1984, (Ball et al. 2000, p. 181), referred to the use of information technologies in relation to those functions within the purview of nursing carried out by nurses when performing their duties. We include here two additional definitions of nursing informatics from the American Nursing Association and the International Medical Informatics Association Special Interest Group for Nursing in Box 3.1.

Today, we see there is a further evolution of related definitions that encompasses core concepts relating to informatics, Digital Health and Connected Health under an umbrella of Digitally Connected Health. Both of these terms are briefly described here and will be expanded upon further in Sects. 3.2 and 3.3.

Digital Health is patient centred and emphasizes the use of information and ICT to enable people to better track, manage, and improve their own and their family’s health. (Adapted from Topol (2016).) Digital Health is the use of patient centred ICT solutions “to improve health, transform quality and reduce health system costs” (Canada Health Infoway 2020).

Connected Health encompasses terms such as wireless, digital, electronic, mobile and tele-health and refers to a conceptual model for health management where devices, services or interventions are designed around the patient’s needs, and health related data is shared in such a way that the patient can receive care in the most proactive and efficient manner possible (Caulfield and Donnelly 2013, p. 704).

Box 3.1 Definitions of Nursing Informatics (Harrington 2015; Newbold 2016)

Nursing informatics (NI) is the specialty that integrates nursing science with multiple information and analytical sciences to identify, define, manage and communicate data, information, knowledge and wisdom in nursing practice. ANA 2015 (Harrington 2015).

Nursing Informatics science and practice integrates nursing, its information, knowledge, and their management with information and communication technologies to promote the health of people, families and communities worldwide. IMIA NI SIG 2009 (Newbold 2016).
3.2 **Nursing Informatics CARE**

### 3.2.1 **Connected Health**

Considering the impact of digital transformation in connected health, it is evident from the literature that almost every country claims to have a digital transformation initiative in progress. Digitally Connected Health is the broadest term and encompasses the use of information and ICT that will empower nurses and assist healthcare systems in achieving a Primary Health Care focus. Evolving from the convergence of the digital and genomic revolutions with health and wellness, healthcare, living, and society. Digitally Connected Health includes Social Networking, Information and Communication Technology, Interoperability (both functional and semantic), Infrastructure and Processes, Solutions and Applications. Digitally Connected Health also includes the use of best practice guidelines/pathways, electronic order sets, smartphone apps (e.g., drug manuals, calculators), point of care documentation tools (e.g., bar-code readers), and access to internet resources which can all facilitate and support evidence-informed practice as well as patient generated data such as exercise, diet, vital signs.

The International Telecommunication Union (ITU) suggest at its core digital transformation in connected health is about creating a vision. Putting an emphasis on how digital services and connected health applications will change and “transform” citizen’s experience and how improvement in quality of life and wellbeing and the attainment of Sustainable Development Goals can be achieved. Sustainable Development Goals (SDG) were discussed in detail in Chap. 2, often described as global goals, they were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030 (Saha 2019; Sustainable Development 2020).

A thematic report published on digital transformation in 2019 by the ITU offers some principle insights relating to connected health (Saha 2019). ITU in this report identify six fundamental attributes of services that classify a transformation as digital. For example digital services need to be personalised, paperless, cashless, presence less, integrated and consent based to be transformational. Three of these attributes are of interest to connected health and nursing related activity and are therefore listed for consideration.

- Personalised services are designed and delivered to suit the specific requirements of those who consume them. Personalisation is generally achieved by way of giving citizens a great experience that meets their needs and expectations.
- Paperless services are automated by adopting widespread automation. Paperless services are a consequence of extensive business process reengineering and significant fundamental rethinking.
• Consent-based services refer to security and data privacy, two imperatives that have to be focused on with utmost priority. In the digital era, people share huge amounts of information, citizen consent has a hugely significant impact on the effectiveness of digital services. People must know what data is being collected, who is collecting it, and for what purposes is it going to be used.

Nowadays, countries and organizations need to develop specific capabilities to be able to deliver connected health digital services for effective transformation. ITU describe this as the value chain and propose organisations consider some key questions incrementally over the life course of any transformational programme. They suggest organisations follow a high-level process and address some core issues iteratively throughout the programme of change. These issues are illustrated as questions in Fig. 3.3.

Considering Fig. 3.3 from a clinical perspective, digitally connected health offers potential for a value chain in the area of integrated care. Effective transitioning of care delivery mechanisms across services i.e. from a primary to secondary care, and then back to primary care in a coordinated fashion underpins the vision and ambition for integrated care. To achieve integrated care effectively access to quality data is needed. Quality data is considered as information that are relevant, accurate and reliable. Key features relating to quality data are presented in Fig. 3.4 that describes core components of a data quality framework.

Underpinning a quality data framework is the need to use agreed and shared vocabularies. From a nursing informatics perspective, agreed vocabularies for patient assessment tools need to be embedded in electronic health records and digital devices linked to performance indicators for monitoring of interventions and

Fig. 3.3 ITU report adapted (Saha 2019)
symptom management. This is a core requirement discussed in Chaps. 2, 5 and 6 from a computer science and standards perspective. Here, however we provide some examples of systems interfaces and processes that can assist with advancing data quality from connected health and integrated care initiatives.

A large-scale programme entitled C-HOBIC full title being the Canadian Health Outcomes for Better Information and Care. This dataset introduces a common, structured terminology for use in patient assessment and in electronic health record (EHR) documentation in acute care, complex continuing care, long-term care and home care. This data set includes terminology in the following areas:

- Functional status and continence
- Symptoms: pain, nausea, fatigue, labored breathing
- Safety outcomes: falls, pressure ulcers
- Readiness for discharge

This dataset is now entering its third phase of deployment in Canada and is integrated into the core National Nursing Data Standards (NNDS) with the goal of optimising the nursing contribution to care delivery (White 2020).

Table 3.1 provides a summary of the process of workflow engagement for C Hobic in health care services and describes how the impact of nursing is made evident in client or patient outcomes across different points in service delivery.

Integrating programmes such as C-HOBIC requires detailed workflow to be completed as outlined in Table 3.1 to optimise workflow mapping the Healthcare

Fig. 3.4 HIQA key components for a data quality framework (Flynn 2018)
Information and Management Systems (HIMSS 2019) recommend some initial key steps:

- Conduct an analysis of existing workflow practices
- Explore the end user input regarding specific roles in current paper record workflows
- Review and finalise documentation of current workflow
- Identify waste and opportunities on the current workflow diagrams, and then redesign workflow practices.
- Identify and implement the electronic health record system and the new agreed workflow process in practice
- Analyse new electronic health records workflow and refine the process as needed (HIMSS 2019) (Fennelly 2019, p. 21)

Workflow is critical to ensure that there is good alignment between the existing systems of paper workflows and the new automated workflows using technology for data entry of health records. Poor alignment from “as is” infrastructure to the “to be” planned new workflow can have a number of negative outcomes. Reports from the United States provide examples such as issues with technology-induced errors that impact on patient safety and nursing practice. Technology-induced errors is a new category of errors identified with the introduction of electronic health records in the United States. These errors occur at the interaction between the information technology interface and the health care providers during clinical use. As a consequence focused interventions are now in place across the US to develop pre-emptive activities involving new workflow processes to detect such technology errors in EHR before they occur (Spring 2020).

Figure 3.5 provides an illustrative workflow completed by nursing informaticians on bed management and referral of a patient to facilitate integrated care delivery.

As the largest stakeholder group in health care delivery, nursing can provide insights on patient safety in regards to technology induced errors. Defining detailed workflow on medication management processes and patient safety checks for example can assist in minimising negative impacts on transition from paper to electronic prescribing systems. In the following section, we provide some screen shots of

| Table 3.1 C-HOBIC CIHI (White 2020) |
|-------------------------------------|
| Direct health care programs and services | Health research | Health care system |
| C-HOBIC data informs and evaluates operational decisions and resource allocation, helps set industry benchmarks and provides real-time information to support clinical practice | C-HOBIC provides standardized clinical data to answer research questions about the impact of practice on clinical outcomes and to support research on new approaches to clinical practice | C-HOBIC empowers Better health system Management decision making, offers deeper Insight into how Facilities manage clinical Outcomes and follows Patients across the Health care continuum |

| C-HOBIC | CIHI (White 2020) |
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electronic health records from secondary care services that offer examples of care planning and patient summary record systems. Such systems are routinely now used by nurses and implemented across Europe and Canada (Figs. 3.6 and 3.7).

Referral Patient with Chest Infection

Fig. 3.5 Workflow of care transition for patient with chest infection

Fig. 3.6 Example 1 of patient summary module in electronic record system
From the primary care setting, Chap. 2 provides a detailed summary of Davra personal monitoring suite that can be used to provide supporting data on assisted care delivery processes. The interaction and associated workflow issues often encountered between the information technology, transitional care and the associated system interface of data access is highlighted in 2019 Report by Shultz and Fry in the Fortune Report Case Studies. These issues are illustrated in Figure 3.8 and summarised Box 3.2.
Box 3.2 Case Study Detail on Transitional Care

Reports of progress on connected health of electronic health records and integrated care are variable. In the United States, for example the Health Information Technology for Economic and Clinical Health Act (HITECH) was signed into law in 2009 to deliver meaningful use for interoperable electronic health care records. Ten years after this initiative was signed into law, Obama Care and the Meaningful Use programme has been implemented nationally, a controversial report by Schulte and Fry published in Fortune magazine indicate the results are often lacking in terms of anticipated benefits. Costing over 36 billion dollars a wide review of the impact of deployment of Meaningful Use described at the flagship programme to deploy electronic health records across the United States provides concerning results. Rather than an electronic ecosystem of information, the authors suggest that the nation’s thousands of EHRs largely remain fragmented and in a number of initiatives disconnected. The authors of this specific report spoke with more than 100 physicians, patients, IT experts and administrators, health policy leaders, attorneys, top government officials and representatives at more than a half-dozen EHR vendors, including the CEOs of two of the companies. Describing the interviews in this report the authors maintain that they reveal a tragic and missed opportunity (Fortune FS Erika Fry 2019), key findings suggest six core factors, which are impeding anticipated benefits. They include,

1. Poor integration of health systems and use of closed rather than open systems. The benefits of open systems are provided in Chap. 5 integrating the Health Care Enterprise.
2. Access to health records across and between health services and to individual patients.
3. Poor interface design, the strategic fit between the systems deployed and the needs of the user of this system to complete their role-increased time to do routine tasks using the technology and systems deployed than previous operation of routine tasks.
4. Spiraling costs the authors indicated that in interviews users of the systems and the service administrator had gagging orders enforced upon them.  
   
   **EHR vendors often impose contractual “gag clauses” that discourage buyers from speaking out about safety issues and disastrous software installations—though some customers have taken to the courts to air their grievances** (Fortune FS Erika Fry 2019).
5. Accuracy and quality of data was noted as a concern, the report indicated that the process of linking the correct medical record to the correct patient, even when made by the same EHR vendor, often failed. This finding is also evident in other reports. For example the Kaiser Foundation tracking poll reports nearly half of those with EHRs have concerns about errors in their records (40% of total), one in five overall (21%) say that they or a family
Anecdotal discussions with scholars from the US who have drafted Chap. 14 suggest that incremental improvements are emerging in different care service providers. Enhancements include revisions of existing systems and provide changes on how care is being provided to advance integrated care. For example, the patient portal is impacting on citizen access to their records in a positive way. [https://www.dmc.org/portal](https://www.dmc.org/portal) (TH Medical 2016–2020). The implications of this comprehensive report by Fortune Magazine however suggest that the nursing informatics contribution for large-scale deployment is clearly warranted. Nursing has a core role to play particularly in designing and addressing patient safety and participating in detailed workflow mapping to optimise quality of care in transitioning to electronic health records. Examples where nursing engagement influences direct and indirect patient care increasingly will include the use of digital in the domain of connected health and supporting activated patients to manage their own care.

3.2.2 Administration and Research

In Chap. 9, the authors provide a comprehensive overview of administration systems and their increasing use in nursing and research. Here in Sect. 3.2.2, we provide some introductory background on the topic of nature of nursing and practice based evidence that contributes to progress nursing as a profession over time.

Research by Matney et al. (2011) recognises nurses as knowledge workers who translate data to information, information to knowledge and knowledge to wisdom. While nursing has a rich history of theoretical thinkers, who explore the knowledge of nursing, with advances in artificial intelligence and machine learning there are increased opportunities to advance nursing knowledge accelerating the research of practice theory. This is often articulated as a quest for a theoretical basis for the practice of the profession, and will be expanded upon further in the Chaps. 12–14 of this text (McQueen and Kickbush 2007; Saba and McCormack 1986).
It is not only the concept of practice theory that is important to consider to advance informatics, seminal work on the nature of nursing is also important. Virginia Henderson has in 1964 for example explored the Nature of Nursing and argued the case that an occupation especially a profession such as nursing that affects human life must clearly define its function (Flynn 2018). Today this notion is translated into terms such as evidence based practice and nursing scholarship as described by AACN published in 2018.

Nursing scholarship is the generation, synthesis, translation, application and dissemination of knowledge that aims to improve health hand transform health care. Scholarship is the communication of knowledge generated through multiple forms of inquiry that inform clinical practice nursing education policy and healthcare delivery (American Association of Colleges of Nursing (AACN) 1999, p. 2).

Schlodfeldt and Cody (1989) described the two criteria for a profession as a social mission and a calling for examiners to assist in knowledge generation to support advancement of practice. In the context of twenty-first century, health care Nursing’s social mission is as important today as it has ever been. Nursing theory continues to evolve at an accelerated rate with the proliferation of digital data in society and access to such large volumes of data will challenge the boundaries of conventional thinking not only in the profession of nursing but at the interface of inter-professional working relationships.

Inter-professional clinical models are important and models such as Bonnie Wesorick Clinical Practice Model (CPM) are useful to reference in this context. The CPM framework is designed to assist practitioners to focus on practice priorities, evidence based clinical decision support, and practice expertise to ensure improved patient outcomes, compliance with national patient safety standards, and inter-professional staff collaboration satisfaction is achieved. This CPM framework also includes a health informatics model with evidence based clinical practice guidelines to support professional scope of practice and care processes (Troseth et al. 2017). Underpinned by core beliefs, principles, and theories and clinical practice models, the CPM Framework includes the following concepts: Health and healing care, Partnership and culture, Interdisciplinary integration, International consortiums, Health informatics, Applied evidence based practice, and central to the framework, the patient family and community care giver. Further information on the CPM framework is available from the following website https://www.elsevier.com/solutions/care-planning/professional-practice-services (Professional Practice Services 2020), that is to appraise and assist human beings in their quest to optimize their health status, health assets, and health potential” (Schlodfeldt and Cody 1989, p. 17).

In 2010, the International Council of Nursing defined nursing as:

\textit{Nursing encompasses autonomous and collaborative care of individuals of all ages, families, groups and communities, sick or well and in all settings. Nursing includes the promotion of health, prevention of illness, and the care of ill, disabled and dying people. Advocacy, promotion of a safe environment, research, participation in shaping health policy and in patient and health systems management, and education are also key nursing roles (International Council of Nurses (ICN) 2020).}
More recent publications from Royal College of Nursing provide eight key principles relating to nursing practice describing what citizens can expect from the profession of nursing. These eight principles are

1. Principle A: Nurses and nursing staff treat everyone in their care with dignity and humanity; they understand their individual needs, show compassion and sensitivity, and provide care in a way that respects all people equally.
2. Principle B: Nurses and nursing staff take responsibility for the care they provide and answer for their own judgments and actions—they carry out these actions in a way that is agreed with their patients, and the families and carers of their patients, and in a way, that meets the requirements of their professional bodies and the law.
3. Principle C: Nurses and nursing staff manage risk, are vigilant about risk, and help to keep everyone safe in the places they receive healthcare.
4. Principle D: Nurses and nursing staff provide and promote care that puts people at the centre, involves patients, service users, their families and their carers in decisions and helps them make informed choices about their treatment and care.
5. Principle E: Nurses and nursing staff are at the heart of the communication process: they assess, record and report on treatment and care, handle information sensitively and confidentially, deal with complaints effectively, and are conscientious in reporting the things they are concerned about.
6. Principle F: Nurses and nursing staff have up-to-date knowledge and skills, and use these with intelligence, insight and understanding in line with the needs of each individual in their care.
7. Principle G: Nurses and nursing staff work closely with their own team and with other professionals, making sure patients’ care and treatment is coordinated, is of a high standard and has the best possible outcome.
8. Principle H: Nurses and nursing staff lead by example, develop themselves and other staff, and influence the way care is given in a manner that is open and responds to individual needs (Royal College of Nursing 2019).

Each of the eight principles identified by RCN and listed above can be linked with nursing informatics knowledge skills and competencies. Principle B recommends nursing taking responsibility for care provision in accordance with patient’s families and the law or Principle D recommends promoting patient centered care designed to aid decision making across the continuum of care. Principle E, F, G and H include concepts such as communications, confidentiality, acquired knowledge and skills and provision of coordinated care for all.

The implications on the above definitions and principles of nursing practice on the specialty of informatics are increasingly evident. It is important to stress that nursing functions include both delegated tasks as illustrated in the CPM inter-professional framework in addition to autonomous nursing activities, all of which have a direct bearing on the design and use of information systems for integrated care in practice. By nursing performing a dual role, the focus for nursing activity can be identified both as an independent practitioner and as part of an inter-professional team. As nursing is one of the largest stakeholder groups in most countries engaged
in direct and indirect patient care, their voice within the specialty of Health informatics needs to be a strong one.

The ever-expanding impact of informatics on clinical nursing practice is therefore inevitable. It is therefore not surprising that institutions such as the National Academy of Medicine have consequently developed a dedicated committee to address technology roles in nursing, providing a series of focused sessions to inform practice and advance equity for use of digital. As technology increases in daily nursing practice, they consider nurses wellbeing and the impact of technology on patients and caregivers important factors to take into consideration (Spring 2020; Troseth et al. 2017). In the United Kingdom the Royal College of Nursing in 2019 launched its programme entitled Every Nurse an eNurse (Royal College of Nursing 2019).

The first report on this initiative is entitled Improving Digital Literacy (RCN NHS Health Education 2017) and the executive summary stresses that nursing is in the midst of a technological revolution and digitalisation is developing at an incredible speed. It will continue to impact on many aspects of our lives and has the potential to transform the art and science of healthcare creating many opportunities for the population and those who care for them (RCN NHS Health Education 2017, p. 3).

This report stresses the need to rethink the nurse patient and nurse citizen relationship and provides key definition for digital literacy as

*Definition: Digital literacies are the capabilities, which fit someone for living, learning, and working, participating and thriving in a digital society.*

To become a digitally-literate person the report suggests involving and developing specific functional skills, plus attitudes, values and behaviors’ that can be categorised under the following domains:

- Digital identity, wellbeing, safety and security
- Communication, collaboration and participation
- Teaching, learning and personal/professional development
- Technical proficiency
- Information, data and media literacies
- Creation, innovation and scholarship. (RCN NHS Health Education 2017)

Jo and Ha (2019) sought to develop and validate an instrument to measure nursing information literacy competency. Reviewing information theoretical conceptual competency frameworks for education by RCN, ACRL Nurse and Tiger (Royal College of Nursing 2011; Phelps 2013; O’Connor et al. 2017). Through conducting a quantitative study using factor analysis 27 items in total were agreed for selection in the final scale. The authors suggest the results provide a basic direction for developing a nursing information literacy programme. The items are summarised as follows:

1. Competency for identifying a problem for example selecting key concepts or topics to find the information needed to solve the nursing care problem.
2. Competency for potential sources for information for example selection of the most appropriate information source to solve the nursing problem.
3. Competency for searching fine information for example checking of clinical information systems nursing records or test results in order to solve the nursing problem.
4. Competency for evaluating information for example identifying whether the retrieved information is valid reliable accurate and current.
5. Competency for acquiescing and managing of information for example extracting the core content needed to sort the nursing problem from various sources of data and information material.
6. Competency for using the information ethically for example the collected information is legally available to use and if required transfer, there has been no abuse of use of information access use of password or ID in an electronic health record.
7. Competency for integrating new information for example the main content of the collected information to use as a basis to resolve the nursing problem is appropriate Ref. Jo and Ha (2019, p. 32).

This section provides some initial detail on how to use data to develop a plan of care, we suggest there is a need to expand further the use of data through the nursing process and use digital competencies for patient assessment intervention and evaluation for a one to one action and the use of data for population health.

The ubiquitous nature of smart and mobile devices in the twenty-first century provides new opportunities for nursing informatics, particularly to enhance professional influence and empower the profession to tackle health challenges. Examples of global initiatives, which situate nursing at the core of global policy, include the Nursing Now campaign. This initiative focuses on raising the profile and status of nursing (ICN 2020). It seeks to disseminate to wider audiences the triple impact of nursing which includes better health, greater gender equality and stronger economies. Reports from the Nursing Now campaign unpack core elements of the value of the nursing contribution. Examples include intimate hands on care, professional knowledge and person centered humanitarian values (Crisp et al. 2018, p. 4).

Nursing Now as a campaign, has created five programme areas to enable the profession to achieve campaign goal of improving global health by raising the profile and status of nursing worldwide. Briefly, we expand on the programmes in Table 3.2 and further information and resources are available from the Nursing Now Website (ICN 2020) https://www.nursingnow.org/join-the-campaign/.

It is evident from the literature and policy reviewed that the profession of nursing globally is at a crossroads and nursing informatics is critical in preparing the profession to practice in a digitally enabled society. Some of our existing models of care are evolving. There is a growing need for nursing as a profession to engage with community based interventions that support home and integrated care service. Underpinning such services are systems that can provide disease prevention, health promotion and self-management support interventions. Skiba et al. (2016) reports that deployment of Meaningful use and adoption of EHRs presents a fundamental change in how nurses plan, deliver, document, and review clinical care. For the academic community it suggests a change is needed in how we educate and train
next generation nurses Chap. 15 by Prof Diane Skiba will discuss technology enabled learning in nursing, the final section on education in this chapter uses a framework from Skiba et al. (2016) to illustrate critical factors for digitally connected care. This final section explores core concepts to underpin educational and training requirements for practicing nurses.

### 3.2.3 Education

As illustrated earlier in this chapter, nursing and global policy recommends that nursing as a profession is expected to use a variety of technological tools and complex information management systems. This will require skills in analysis and synthesis of information to improve the quality and effectiveness of care delivery. Skiba et al. (2016) in a paper discusses preparation for next generation nursing on connected care. Identifying critical factors where nursing influences can align to achieve optimal results for care delivery. Under the theme of education, the concepts on this Framework for Nursing Informatics and Digitally Connected Care are adapted to present the evidence on next generation nursing informatics in context (Skiba et al. 2016) (Fig. 3.9).
An Inter-Professional Team

For inter-professional team engagement, nurses globally are working across disciplinary fields providing leadership and insights on deployment of electronic health systems. Recent reports from Ireland that provide nursing leadership in inter-professional team engagement and report on what the profession considers as key factors for successful deployment in electronic health records. Working as part of an interdisciplinary group team three core strands and themes are identified relating to organisational factors human factors and technological factors for successful electronic health care record deployment nationally.

These factors are listed below in Table 3.3.

Examples of educational inter-professional team programmes on digital transformation in eHealth have been introduced in Ireland. For example in January 2020, a
new interdisciplinary programme on digital health transformation was introduced with a number of different academic institutions across the country. This innovative programme is working collaboratively to fully operationalise the concept of inter-professional collaboration in practice the goal of this innovative programme is preparation of leaders to implement large-scale change involving digital health technologies, to accelerate active participation where all disciplines are working in a harmonised and connected health fashion to advance innovations based on citizens needs (McElligot 2019). In the United States, the advanced practice nursing roles are expanding through certified nurse practitioner programmes to deliver primary care health services by 2025. Focusing on ability to attain skills, which support the healthcare organization to deliver clinical, leadership, and informatics skills across the care continuum. These initiatives will be discussed further in Chap. 16.

**Interoperability**

The theory underpinning Interoperability and investigating why interoperability is an important priority to grow capacity on with health care professionals is discussed in detail Chaps. 2, 5 and 6 of this text. It will therefore not be expanded upon further in this chapter other than to say that interoperability is increasingly described as the missing jigsaw piece in delivery of integrated care services (Blobel and Giacomini 2019; Blobel and Interoperable 2018; Blobel 2019). It is critically important therefore that nursing informatics education include related theory and evidence underpinning this important topic into educational syllabus. In this fifth edition the adoption and wide use of standards is discussed from different viewpoints with examples by authors across a number of chapters. As it is considered a critically important topic for nurses to understand and promote in their associated practice. Chapter. 2 that discusses new models of care as defined by global leaders emphasizes the need to connect systems and devices as a priority to address the fragmentation of care. Without the integration of standards within large scale national programmes of eHealth and digital, there is little chance of achieving the anticipated benefits of accessing quality information across and between systems. Indirectly this also can have an impact on patient safety and outcomes. Further information on standards for integrated care is available in Chap. 5 and a full chapter introducing standards is available as Chap. 6.

**Patient Engagement**

The third trend that requires focused attention in nursing informatics education is the rise of patient engagement and their uptake and use of digital tools. The engagement of patients, families, caregivers and consumer in their health care is an important component of the transformation of health care. Leonard Kish refers to Patient Engagement “as the blockbuster drug of the century (Skiba et al. 2016).
If as already indicated in Sect. 3.2, the profession of nursing’s mission is to appraise and assist human beings in their quest to optimize their health status, health assets, and health potential. The nurse patient relationship is at the heart of our professional scope of practice. As new inter professional working roles emerge, and some of traditional models of care delivery are revised, the people patient involvement agenda (PPI) becomes a critical driver to include in nursing informatics education. Understanding what the benefits for patients are with digital, the notion of empowerment and choice of services are just some of the key instigators within connected health. Underpinning this is the need to recognise the importance of design science and the fit of systems for their specific purpose to address patient need. This is best achieved by placing patients at the heart of health innovation within informatics. Ensuring patients are the driving force, informed through co-participatory methods of engagement in order to translate their needs into planned service delivery using digital and connected health (IPPOSI 2020).

Learning Health System

A Learning Healthcare System is defined, by the Institute of Medicine in 2015 (IoM)), as a system in which, “science, informatics, incentives, and culture are aligned for continuous improvement and innovation, with best practices seamlessly embedded in the delivery process and new knowledge captured as an integral by-product of the delivery experience” (McLachlan et al. 2019).

Learning health systems (LHS) were developed as a vehicle to advance clinical safety and health research and improve patient-centered care. Learning systems are closely aligned with the progression of Electronic Health Records (EHR) and share similar barriers and facilitators with implementation of EHR particularly from a human factors perspective. Learning health systems are possible by advancements in integrating patient data into care, knowledge management, data analytics and documentation practices underpinned with legal ethical and data privacy agendas. Core to the adoption of a learning health system is the constant generation and use of new clinical knowledge and evidence based practice collated from digital data streams informing public policy. Such data presents new opportunities to provide benefits in care delivery efficiencies and inform quality and safety and patient outcomes (Friedman et al. 2015). Addressed in the future chapters critical questions that may be addressed by a learning health system may include how can the financial and emotional costs of care to patients be reduced? Alternatively, what is the impact of dashboards on nursing clinical decision making on patient outcomes?

For access to health, systems in progress see the following link, http://www.learninghealthcareproject.org/section/background/learning-healthcare-system (Foley 2020).
Digital Tools

The advancement and uptake of digital tools is increasingly mainstream in society today. In the United States for example, over 80% of citizen’s use a smart phone or tablet to access social media, the use of email and text is now the preferred choice of communication rather than face-to-face communications. In the text The Patient Will See You Now published in 2015, Topol argues the case that individuals are increasingly expecting more from technology and less from each other (Topol 2016, p. 43). At the time of drafting, this chapter there is 3.50 billion smart phones in the world. Statistics reviewed in February 2020, including both smart and feature phones, the current number of mobile phone users is 4.78 billion, which makes 61.62% of people in the world a cell phone owner. Feature phones are the basic cell phones without apps and complex OS systems, are more prominent in developing countries. (Source: statista 2019.) We therefore are conditioned to engage with digital tools and Artificial Intelligence in our daily social and professional lives. For example, we use the Internet of Things (IoT); assistive devices such as the Amazon Alexa in the home to check weather listen to music or schedule our diaries. We see AI integrated in the clinical practice setting with devices such as infusion pumps. Such devices are underpinned with algorithms that include sequential instructions to complete a task in a sequenced order. Such algorithms provide assistance in managing the patient safety agenda, they are underpinned by a set of well-constructed rules for conformance such as checking an infusion rate is correct or setting a warning, that it has exceeded the pre-programmed limits. Driven by the global workforce decline of nurses, robotics has experienced a steady growth in the use of nursing particularly in aging population and in countries like Japan (Maalouf et al. 2018, p. 590). They define the use of robotics in nursing as into two distinct types assistive to support physical care including service and monitoring tasks and social assistive focused on the cognitive and emotional well-being of patients in need of companionship (Glauser 2017).

Spring identifies three key levels in which digital and technology is integrated into nursing practice

1. Use of digital device system and products including ICT used in daily routine working practices.
2. The act of using the technology for example pushing a button to turn on a device.
3. Technology as a service or purpose using the device and systems to deliver a function. For example, decrease in medication errors by using a bar coded medication administration system. (Spring 2020, p. 11).

It is essential to understand that such digital tools do not in any way replace nursing judgements and as required health care professionals can overwrite such tools as necessary (Spring 2020, p. 10). Stressing the importance of considering the legal and ethical dimension in the uptake and use of digital in practice setting, Jo and Ha (2019) deliberate on what impact the ever-increasing volume of accumulated data is on the practice of the profession.
The scale of digital information across healthcare organisations is ever increasing. It is therefore necessary to understand nursing information literacy from the perspective of nurses’ ability to focus on what key information they need. This is achievable by fully understanding a nursing related problem in context, searching for the necessary information to address the identified problem. Having the ability to evaluate selected information and to use the accurate information to address the identified problem (Fortune FS Erika Fry 2019; Jo and Ha 2019). Other authors stress the need for educationalists to ensure that the skills associated with nursing informatics competencies are aligned with different roles and contexts within nursing and across different levels of health system delivery. This is best achieved by allocating better supports for the development of NI education, practice and research globally (Peltonen et al. 2019).

Clinical Transformation

Publications on clinical transformation and adoption of a comprehensive electronic health record EHR are associated with more positive usability ratings and higher quality of care within the profession. For example, in recent studies by Kutney-Lee et al. (2019) findings suggest that at the EHR adoption level, the hospital work environment plays a significant role in how nurses evaluate EHR usability and whether EHRs have their intended effects on improving quality and safety of care. Evaluation studies completed in Taiwan on the Implementation of a Mobile Nursing Information System (MNIS) found that the domain relationship of registered nurses years and managers’ support for the use of the MNIS were positively related. Listing quality of care and user satisfaction as the most powerful predictor in both behavioral intention and actual use of the MNIS, this study also reported upon Managers’ support as having a significant impact on implementation of digital systems in clinical setting (Cheng et al. 2019).

A core reason for user satisfaction being unmet relates to human factors and the fit of the system in to organisations.

Managing clinical transformation presents nursing with a number of challenges, all of which require important change management and implementation processes.

For clinical transformation change, literature suggests that altering practice involves two key implementation process firstly change processes and secondly transition processes. (McLean 2011). Both of these concepts can be distinguished as follows; change can be described as observable things that happen or are done differently usually involving alteration of structural processes on work practice routines. While transition processes relate more to the emotional aspects around what people feel, experience, or consider important in their practice. Early recognition that both concepts are required for successful implementation of national eHealth programmes is important (Hewitt-Taylor 2013). Failure to address change management processes can be a costly business and it therefore important to include the topic in nursing informatics educational programmes.
Change management theory emphasise the importance of establishing both frameworks and models to facilitate sharing and collaborating on the transition process in order to ensure a smooth translation from paper based records to electronic records is achieved. Bridging the gap between what we know and what we do in order to maximise the translation of evidence into practice requires effective and focused communication (Thompson et al. 2013, p. 20). The importance and complexity of communication within the change management/transition process is well illustrated in the following quote:

*eHealth program is best conceptualised not as a blueprint and implementation plan for a state of the art technical system but as a series of overlapping, conflicting, and mutually misunderstood language games that combine to produce a situation of ambiguity, paradox, incompleteness and confusion.* (Greenhalgh et al. 2011, p. 534)

Identifying the need for change with practitioners and devising strong leadership with clear aims and objectives are critical levers for success (Hewitt-Taylor 2013). Other key requisites for change include realisation and communicating a vision (Kotter 1995; Alonso 2013). Change management programmes need to be rooted in practitioner’s wisdom (Greenhalgh et al. 2011, p. 7). Advancing clinical transformation and eHealth agendas therefore requires change management programmes, not only to succeed in single organisations structures, but at the wider cross-institutional boundaries to facilitate patient centered connected care. The consequences of such innovations affect health care professionals working practices and organisation need to invest significant effort on acquiring new skills on security measures, training on routine documenting and referral practices whilst concurrently managing patient care to avoid adverse outcomes. Clarity on realisable benefits or incentives not just for the organisation but for the individual practitioners involved by identifying why they should make such a time investment needs to clearly articulated (Peppard et al. 2007).

### 3.3 Conclusion

This chapter has summarised nursing informatics in the context of contemporary health and social care, considering how it has evolved over the past 50 years. Chapter 3 highlights, that the field of informatics is increasingly considered a core professional competency for nursing. Using an adaptation of the CARE acronym namely connected health, administration, research, and education Chap. 3 has sought to present the evidence and provide the reader with insights on the critical factors which are driving the practice of informatics within the profession. Programme initiatives such as the Nursing Now campaign are critical to migrate key values from the nature and scope of nursing activities in twenty-first century health and social care. As the needs of our patients change so too does the clinical specialist and advanced practice roles within nursing. Effectively communicating the value of nursing informatics to a wider audience in health and social care policy is
essential, and we would argue critical for the profession at this time. The need for robust and rigoursly designed nursing informatics infrastructure to enhance the use of ICT and digital across the different levels of care delivery to support nursing workforce and patient outcomes has never been greater. A poorly designed and implemented Electronic health record can make nursing practice harder to deliver, and in the longer term potentially compromise patient care and outcomes. This explains why we consider that different informatics roles are needed across the care environment ensuring that nursing informaticians are involved from the outset on any planned digital transformation. Specifically nursing engagement in procurement, selection of technologies, enhanced equipment deployment and software design. At the time of writing this chapter, the world is in the midst of fighting a global pandemic Covid-19. Nurses globally are practicing 24 h a day 7 days a week on the front line to care for citizens, many of whom will not survive. Never before has there been such as need to accelerate innovation and advance knowledge skills and competencies in the field of nursing and health informatics to assist in care delivery.

Clinical Pearls
Nursing informatics skills are now considered a critical competency in delivery of health and social care and global policy agendas for new models of care.

The nursing contribution in the development of eHealth and digital is critical to optimise the value proposition specifically in regards to efficiency effectiveness and sustainability of electronic health records in the future.

The expanding and new roles within the profession are underpinned with connected digital health solutions, attaining digital competencies are therefore increasingly considered a priority skill set for nurses.

3.4 Review Questions

3.4.1 Questions

1. Having reviewed this chapter, list what you consider are the critical factors that require careful consideration in the context of your own health care context to advance connected digital health.
2. Access the website and publications on the Nursing Now campaign from the following link (ICN 2020) https://www.nursingnow.org/join-the-campaign/
3. One of the nursing now initiatives is the Nightingale Challenge established for the Year of the Nurse 2020. A total of 27,295 nurses and midwives from 719 employers in 71 countries have accepted the Nightingale Challenge. Review the associated links and select an example of one initiative which uses nursing informatics to demonstrate empowerment of nurses and midwives as leaders, practitioners and advocates in health.
3.4.2 Answers

1. The response to question one should include reference to Sect. 3.2.3 specifically material relating to Interoperability, Patient Engagement, Learning Health System, Digital tools and Clinical Transformation. The response should demonstrate contextual material from the participants professional practice context or experiences.

2. The response to question two should reference publications from the Nursing Now Resources homepage and specifically the Toolkit which has structured resources on social media, advocacy materials and Nursing Now guidelines and slides.

3. The response to question three should provide a selected example and list detail of how this example incorporates nursing informatics as detailed in this chapter.

Glossary

Careflow A mapping activity of the healthcare encounter or service delivery process between health care professionals and patients, which describes the health and social care service activity through one to many service and data flow points

C-HOBIC Canadian Health Outcomes for Better Information and Care

CIHI Canadian Institute for Health Information

Cloud computing A term used to describe a new form computing, “cloud” computing relates to remote based computing, instead of storing and processing all of your information locally, all computation and storage is done remotely on the “cloud” which is an external server or network of servers

Co-production Co-production is about care that is delivered in an equal and reciprocal relationship between clinical and non-clinical professionals and the individuals using care services, their families, carers and communities. Co-production therefore goes beyond models of engagement, since it implies a long-term relationship between people, providers and health systems where information, decision-making and service delivery become shared

CPM Clinical Practice Model

CPOE Computerised provider order entry system

DHC Digital Health Canada

Digital Health Digital Health is used as an umbrella term for areas including eHealth, telehealth, mHealth and more. Digital Health is the integration of all information and knowledge sources involved in the delivery of healthcare via information technology (IT)-based systems. This includes information created by caregivers, often within electronic health record systems at a hospital or GP practice, and information created by patients using apps, monitoring devices and wearable sensors. Digital health information also includes management and
administrative information needed to co-ordinate and manage activities within the healthcare system

eHealth eHealth is the use of information and communication technologies (ICT) for health (WHO 2005)

Empowerment Empowerment is about supporting people and communities to take control of their own health needs resulting, for example, in the uptake of healthier behaviours, the ability of people to self-manage their own illnesses and changes in people’s living environments

EMR Electronic medical system

Engagement Engagement is about people and communities being involved in the design, planning and delivery of health services, enabling them to make choices about care and treatment options or to participate in strategic decision-making on how, where and on what health resources should be spent. Engagement is also related to the community’s capacity to self-organize and generate changes in their living environments

FHIR Fast Healthcare Interoperability Resources Specification is a set of standards that guides how systems code, transmit, and receive data using smart and mobile devices

Health Health as a state of complete physical, mental and social wellbeing, and not merely the absence of disease and infirmity (WHO 1948)

Interoperability Interoperability is the ability of two or more systems or components to exchange information and to use information that has been exchanged

ITU International Telecommunication Union

mHealth A term for medical and public health practice supported by mobile devices such as mobile phones, patient monitoring devices, and other wireless devices

NNDS National Nursing Data Standards

PAHO Pan American Health Organisation

Personalization Services designed specifically for individuals and their unique healthcare needs

Telehealth The delivery of health services using ICTs, specifically where distance is a barrier to health care

Workarounds A strategy for working around a software misfit in order to solve the problems that the poorly designed software fails to address

Workflow Depiction of actual sequence of the operations or actions taken in a process Ref Systems of Concepts for Continuity of Care ISO 13940

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