

An Overview of Nursing Informatics (NI) as a Profession: How we Evolved Over the Years

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Keywords: Nursing Informatics (NI), Definition, History, Role, Competencies, Career Path, Challenges, Opportunities, Future Direction for Research.

Abstract: Nursing informatics is a relatively new and expanding field. The evolutionary journey it has, that started more than thirty years ago, marks its rich history. Accordingly, its definition, role, education, competencies and the career path of its practitioners changed significantly through the years. Also, due to its unique nature, different issues emerged as challenges that need to be dealt with. On the other hand, some would view these issues as opportunities which we can benefit from. Nevertheless, the discipline of nursing informatics continues to evolve and progress rapidly over the years, as a result of the efforts and initiatives of its practitioners, scholars and organizations. This paper attempts to shed some light on this unique discipline by briefly examining how it evolved around the world over the past four decades. Yet, some challenges such as the lack of global NI literature could be considered as the main limitation of the scope of this review as there are plenty of resources in some parts of the world, while almost the opposite can be seen in some other regions. Therefore, a comprehensive review of the international historical development of the discipline of Nursing Informatics is beyond the scope of this paper.

1 INTRODUCTION

“Nursing informatics is a 21st century science with great potential for improving the quality, safety, and efficiency of health care” (McCartney, 2004). Simply put, nursing informatics is viewed as the combination of the concepts of three sciences i.e. cognitive science, information science, and computer science with an overall focus on nursing science (Sackett et al., 2004). The collective efforts of many scholars have contributed to the increased exploration and understanding of the field of Nursing Informatics. The importance of Nursing Informatics stems from the fact that, as estimated, nurses spend about 50% of their time in the “gathering, coordinated, and documenting of information” (Meadows, 2002). Hence, Nursing Informatics provides an excellent chance to obtain the full potential of an organized and well-managed information by nursing personnel. This paper attempts to shed light on the definition of nursing informatics, its history, the role, education and competencies of its practitioners, their career path, and the challenges that face it along with the

opportunities available out there for the field to flourish.

2 THE DEFINITION OF NURSING INFORMATICS

When it comes to the discipline of Nursing Informatics, the term itself was proposed in 1976 as Scholes and Barber elaborated on the computer technology potentialities for a practice discipline such as nursing and how it can contribute to the nursing field in terms of education, service, and research (Scholes and Barber, 1976). Moreover, it was further used and defined by Scholes and Barber again in 1980 in the MEDINFO conference at the same year in Tokyo (Scholes and Barber, 1980; Hannah et al., 1999). Yet, Ozbolt and Saba (2008) tracked the early beginning of NI back to the days of Florence Nightingale with her vision of "standardized clinical records that could be analyzed to assess and improve care processes and patient outcomes" (Ozbolt and Saba, 2008). However, even though nurses have done informatics tasks for more

than thirty years now, the term “nursing informatics” was not used in the literature until 1984 as indicated by Guenther (2006) (Guenther, 2006). Furthermore, the definition of nursing Informatics itself has evolved over the years. For instance, in 1985, nursing informatics was defined by Hannah as the “use of information technologies in relation to those functions, within the purview of nursing that are carried out by nurses when performing their duties” (Hannah et al., 1985). These duties mentioned in the definition include all aspects of the information technology that are used by nurses either related to the patient care, nursing practice, health care administration, or nursing education. (Guenther, 2006). Furthermore, Grobe provided another description of NI in 1988, where he defined it as “the application of the principles of information science and theory to the study, scientific analysis, and management of nursing information for purposes of establishing a body of nursing knowledge” (Grobe, 1988). Additionally, in 1989, another definition by Graves and Corcoran for nursing informatics was suggested. They define it as “a combination of computer science, information science and nursing science designed to assist in the management and processing of nursing data, information and knowledge to support the practice of nursing and the delivery of nursing care” (Graves and Corcoran, 1989). In 1994, the ANA (the American Nurses Association) published the *Scope of Practice in Nursing Informatics* as a pamphlet, which defined nursing informatics as “the specialty that integrates nursing science, computer science and information science in identifying, collecting, processing and managing data and information to support nursing practice, administration, education, research and the expansion of nursing knowledge” (American Nurses Association, 1994). Furthermore, in 1995, the ANA published another pamphlet called *Nursing Informatics Standards of Practice*. This publication mainly portrayed “a generalist level of practice and performance for nursing informatics that is applied to nurses qualified by experience or education to practice at that level” (American Nurses Association, 1995; Guenther, 2006). Ultimately, in October 2001, the ANA combined these two pamphlets into one document, which it called the *Scope and Standards of Nursing Informatics*, which was updated in 2008. Nursing informatics was defined in this publication as “a specialty that integrates nursing science, computer science and information science to manage and communicate data, knowledge and nursing practice” (American Nurses Association, 2001). Yet, in 1999,

Rognehaugh suggested an additional definition to nursing informatics which defines it as “the use of any computer and information technologies that support any nursing function carried out by nurses in the performance of their duties” (Rognehaugh, 1999). Moreover, Guenther (2006) indicates that it is commonly accepted today to have an understanding of nursing informatics as an “electronic information combined with nursing and any aspect of clinical practice, administration, research, or education” (Guenther, 2006). Nevertheless, nursing informatics (NI) is considered as one of the subspecialties of health informatics and simultaneously nursing. This can explain why, with substantial efforts, many definitions and characterizations emerged over time to describe its unique nature (Staggers et al., 1998; Turley, 1996). For this reason and after reviewing the literature, staggers and Thompson (2002) tried to develop an overarching definition, that combines critical concepts from the previous work and attempt as well to add some components such as patients, information structures, information communication and decision making that were, and still to some extent, absent at the time. Therefore, according to staggers and Thompson (2002), nursing informatics is defined as “a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, and knowledge in nursing practice. Nursing informatics facilitates the integration of data, information, and knowledge to support patients, nurses, and other providers in their decision making in all roles and settings. This support is accomplished through the use of information structures, information processes, and information technology” (Staggers and Thompson, 2002). Additionally, Staggers and Thompson (2002) highlighted how the definition of nursing informatics was three themes-oriented. These themes are; Information Technology-oriented, Conceptually-oriented, and Role-oriented definitions. However, a more recent definition of nursing informatics is offered by *IMIA Special Interest Group on Nursing Informatics* i.e. IMIA-NI, 2009 which defines nursing informatics as “science and practice (that) integrates nursing, its information and knowledge, with management of information and communication technologies to promote the health of people, families, and communities worldwide.” (IMIA-NI, 2009). Other agencies and bodies such as the Division of Nursing in the Department of Health and Human Services and the National Institute for Nursing Research have provided other definitions for the discipline that

added to the previous definitions of Nursing informatics that were published by the American Nursing Association (ANA) in 1994, 2001, and in 2008. This clearly reflects how the definition of this discipline and the role of its practitioners rapidly changed and evolved over the years. Accordingly, we can say that, this evolution moved from the technology-focused orientation in the early 80s to be more information-focused in 1989 and end up to be a combination of the four sciences of technology, information, cognitive and nursing in 1996 (Thede and Sewell, 2010). It also integrated the hierarchy of information i.e. from data, information, knowledge up to wisdom in the 2008 which is demonstrated by the ANA 2008 definition, and the international multifaceted aspects i.e. “to promote the health of people, families, and communities worldwide” it has in *IMIA Special Interest Group on Nursing Informatics* in 2009 definition.

3 THE HISTORY OF NURSING INFORMATICS

The term “nursing informatics” was firstly proposed by Scholes and Barber in 1976 (Scholes and Barber, 1976). Since then, nursing informatics has become one of the cornerstones of the field of health informatics. The terms continued to be used in the 80s (Ball and Hannah, 1984; Hannah, 1985; Grobe, 1988) and still is used today by many scholars. Furthermore, Nursing Informatics was approved as a nursing specialty by the American Nurses Association (ANA) in 1992 (American Nurses Association, 1995). On the other hand, when it comes to the history of nursing informatics, the American Medical Informatics Association working group of nursing informatics (AMIA NI-WG) has formed a large project in order to preserve and document the nursing informatics history. This project consists of three constructs;

- Documenting the pioneers and their experience in nursing informatics. The organizations have been encouraged to preserve their related materials in a national library of medicine archive which was started in 1997 by Dr. Saba.
- The AMIA’s website has also maintained the history of nursing informatics by videotaping the nursing informatics pioneers' stories and made them available. These videos include different themes that describe the journey and the various topics

that shaped the field of nursing informatics over the years.

- The informatics evolution as a specialty in nursing is planned to be documented as a part of historical research. Use cases are also incorporated in this project.

Additionally, in her article in 2010, Murphy explained how the pioneers of nursing informatics joined the profession. According to Murphy, most of the nurses, who had a varied age, titles, roles, experience, and responsibility, got into Nursing Informatics accidentally due to different reasons such as being “good clinicians, were involved in IT projects as educators or project team members, or were just technically curious and willing to try new things” (Murphy, 2010). However, this doesn’t mean that some of the pioneers didn’t get into the field purposefully. On the other hand, in 1982, the International Medical Informatics Association (IMIA) recognized the importance of nursing informatics by establishing Working Group 8 (WG8) in order to represent the nursing interest in the field. This was followed by a further step of recognition i.e. transforming this working group into a Nursing Informatics Special Interest Group that’s known as the International Medical Informatics Association – Nursing Informatics (IMIA-NI) in 1994 (Scholes et al., 2000). Nevertheless, globally, the NI field has and still is going through a constant process of development in a varied pace around the world. This section briefly reviews its continuous international growth by having a concise description of the evolution of NI discipline in each continent/region along with providing random examples as possible from each region. However, due to the lack of NI literature in some parts of the world, the author will instead give a brief introduction about the state of healthcare information technology in general in that area because the development of nursing informatics is tightly connected to the overall progress achieved in the domain of healthcare information technology and health informatics. Its worth noting that the following sections are not intended to be an exhaustive review of the field historical evolution and progression.

3.1 NI History in Asia

It wasn’t until the 1970s that the computers were introduced for the first time to the Asian countries’ healthcare sector such as South Korea, China, Japan, Taiwan, and Thailand. The main use of computers back then was concerned with the aspects of billing,

administration, and insurance. Now, these countries are in the process of implementing a paperless electronic health record, yet in a variable rate (Policarpio, 2014). For instance, in Taiwan, regardless of the fact that 27% of the hospitals did implement information systems, 9% are in the development phase of such process while 24% of these hospitals are planning to do so, 40% of them were not planning to invest in any nursing information systems. However, this doesn't mean that Taiwan is not interested in nursing informatics. Such interest can be evident since 1986 in how the Taiwanese ministry of education developed specific instruction programs, i.e. computer- assisted, for nursing vocational programs (Policarpio, 2014). In addition, the first formal NI academic association was founded in 2004, i.e. when the Taiwan Medical Informatics Association, which was established in 1991, formed a Nursing Informatics working group. Furthermore, on the behalf of the IMIA-NI i.e. IMIA Special Interest Group in Nursing Informatics and under the theme 'eSmart', the Taiwan Nursing Informatics Association (TNIA) along with other organizations, organized the 12th International Congress on Nursing Informatics NI2014 in 2014. When it comes to China, the late 70s of the last century witnessed the beginning of the development of the nursing information management systems that were first used late in 1987. NI is used in the Chinese clinical practice in the form of nursing management systems such as nursing information management, nursing quality management, as well as staff nurses' training on clinical skills. NI is also applied in clinical systems like patient management, nursing records, pharmacy management etc..(Shi, 2010). Yet, the main weakness the nursing information management systems face is the insufficiency of national standards along with the low level of informatics skills and computer literacy among the nursing professionals (Li et al., 2008). Nevertheless, even though there is a lack of any official statistics about it, many Chinese hospitals have made progress in the Nursing informatics implementation as a healthcare standard as many other of their Asian counterparts did and are using information systems for the discipline of nursing nowadays (Jiang et al. , 2002).

3.2 NI History in the Middle East

When examining the environment of health informatics in general and nursing informatics in particular in the middle east, one can notice that there is a variable rate of the adoption of healthcare

technology in this part of the world as well as a lack of resources of information in general about these disciplines. We can say that to a certain extent, little is known about the development of nursing informatics in the middle east. However, the Middle East Association for Health Informatics (MEAHI) was founded in 2002, and approved officially by IMIA in 2009 as the newest region of IMIA and as a sign of the increasing interest the health informatics field is gaining in this area of the world. In its 4th Conference that was held in April 2013, MEAHI had an inaugural meeting that included MEAHI-Nursing Informatics (MEAHI-NI) activities since that it was one of the conference tracks. Additionally, the second meeting of MEAHI-NI is planned to be conducted in Kuwait during MEAHI-STC (MEAHI Special Topic Conference) in December 2015. Moreover, this Middle Eastern varied adoption rate might be due to the fact that the implementation of technology in healthcare in the region is still in its early stages for many countries here. However, there are some countries that achieved a remarkable progress in the area of healthcare technology adoption such as the case of King Faisal Specialist Hospital & Research Center (KFSH&RC) in Saudi Arabia, which become in 2015 the first health system to attain Ambulatory HIMSS Stage 7 Adoption Model (EMRAMSM) that is provided by HIMSS Analytics, outside North America. It took KFSH&RC more than thirteen years to achieve this level of adoption. Nevertheless, many hospitals within Saudi Arabia are still struggling when it comes to the implementation of healthcare information systems. This example can clearly show how varied is the state of adopting such technology within the same country in some cases not to mention between the different countries in the region. This could be the result of not having a national strategy for implementing healthcare technology in many of these countries, even though having national healthcare information systems is one of the strategic goals in many of them, and leaving such enormous task to the diligence and discretion of the different sectors that are responsible for providing healthcare in each country. However, the Middle East has many opportunities that can promote the adoption of healthcare technology adoption. According to Dr. Suzan Ahmad "The strength of the Middle East region in terms of informatics lies in its recognition of the importance of implementing state-of-the-art information solutions in healthcare. Many initiatives are underway to promote Health Informatics in governmental and non- governmental organizations

that will upgrade the entire healthcare system” (Ahmad, 2015). Conversely, the indecisiveness that results from the lack of understanding represents a major drawback to the adoption of healthcare information Technology within the region. Such disadvantage has slowed the adoption of IT and shown the necessity of a special education about the benefits as well as the disadvantages of healthcare technology, which is a fundamental requirement of a successful adoption of EHR technologies (Simpson and Stewart, 2010). When viewing Turkey as an example, Erdemir (2010) illustrates the remarkable progress Turkey has made in the healthcare information and management systems arena, which is largely represented in the Turkish e-Health Project. Yet, it is noteworthy that even with the efforts of different disciplines and/or units in Turkey, the progress in the field of healthcare information and management systems is still limited (Erdemir, 2010). Furthermore, since the beginning of the 1990s, information systems and the electronic health record have secured a place in the healthcare agenda in Turkey as well. When it comes to nurses contribution to this process, Erdemir (2010) mentions that Turkish executives and policymakers must recognize the pivotal role of the nursing profession in the strategic planning of the Electronic Health Records (EHRs) and information systems in both their own organization and within the national Turkish organizations. On the other hand, in Lebanon for instance, “the use of computer technology in all sectors including healthcare is still in its infancy. One of the top hospitals in the country is planning to implement a fully integrated, networked hospital information system (HIS) over the next three years. There are stand-alone systems for the laboratory, radiology, and billing departments. However, point-of-service systems, the computer-based patient record, and other NI applications are not yet available” (Marini, 2000). Until the year of 2000, Marini indicated that except for the American University of Beirut-School of Nursing (AUB-SON), NI nor computer literacy has being taught in any program of nursing in Lebanon. This incorporation of NI in AUB-SON curriculum was a subsequent of the recent Lebanese initiatives to implement Health Information Systems and computer technology in the healthcare sector within the country.

3.3 NI History in Africa

In Africa, the association of Health Informatics in Africa (HELINA) was created in 1993. In 2010, Cape town in South Africa hosted the first ever

African MEDINFO i.e. the Confernece on Health Informatics of IMIA. HELINA include almost ten countries as a full members such as Malawi, Nigeria..etc, while a number of countries are considered as corresponding member countries such as Algeria and Tanzania. When reviewing the literature about the implementation of healthcare technology in these countries, it can be clearly seen that many national healthcare strategies (such as in South Africa and Ghana for example) have been influenced in one way or another by the 2005 eHealth project’s definition and aims of the 58th World health Asssembly of the World Health Organisation (WHO) in Geneva, which suggested incorporating the Information and Communication Technologies (ICT) into the global healthcare systems to help reach communities like vulnerable groups (Sarfo and Asiedu, 2013; Department of Health in the Republic of South Africa, 2012). When it comes to NI, there are similarities to a certain extent in the current view of the field of nursing informatics between the African and the Middle Eastern visions. We can say that NI is still largely viewed as a synonym to health informatics, or in the best cases, as an integral division of it. The importance of NI as a distinctive discipline has not yet been understood and realized by many clinicians. This does not mean that individual efforts are not being made to help shape the structure and the body of knowledge of this discipline in these parts of the world. Nevertheless, in Egypt, technology is increasingly becoming an integral part of the healthcare system. The Egyptian Hospitals have gone through the process of trials and efforts in order to develop the discipline of nursing informatics within the country. Some of the difficulties that faced these efforts are the varied levels of education for nurses, the low ratio of nurse to patient, resistance to change and not really involving nurses in the different phases of the implementation (Ebrahim et al., 2014). On the other hand, Nigeria’s history with health informatics began in the late 80s with a collaborative research project that was initiated between the Finnish University of Kuopiom Computer Center and the Nigerian Obafemi Awolowo University, and Obafemi Awolowo University teaching Hospital (OAUTHC) (Idowu, et al., 2003a) as a part of a long-term research project on the development of Informatics for Health in Africa, i.e INDEHELA (Idowu et al., 2008). The result of this joint project was the production of a very rudimentary hospital information system (HIS) which was running on a stand-alone PC that was in use at OAUTHC at that

time i.e. 1991 and is based on the Admission, Discharge, and Transfer of the Veterans Administration (VA) (Idowu et al., 2008; Daini et al., 1992). Afterwards, the group organized the 1st International Working Conference on Health Informatics in Africa that was held at Ile-Ife, Nigeria between the 19-23 of April, 1993 (HELINA, 1993). Furthermore, Idowu and colleagues (2008) identify several obstacles that hinder the implementation of health Informatics and the use Information and Communication Technology (ICT) in Nigeria such as government's attitude, cost of ICT peripherals, resistance to new technology..etc. These obstacles are the result of three factors, namely, people, government and ICT infrastructure as indicated by and Idowu and colleagues (2008). When it comes to nurses' knowledge of nursing informatics in Nigeria, a study in 2014 by Olajubu, Irinoye, & Olowokere revealed that the knowledge of NI in this sample of nurses in primary, secondary, and tertiary healthcare facilities was just fair, and the majority described themselves as 'not competent' when it comes to the use of NI. The limited computer access was the most perceived barrier among the thirteen barriers that were identified by the same study (Olajubu et al., 2014).

3.4 NI History in Australia and New Zealand

When tracing back the nursing informatics' early beginnings in New Zealand, it can be seen that the early 1980s witnesses the early inception of the discipline, even though it took New Zealand about ten years to establish the first national organization in 1991 (Appleton et al., 2000). In 1989, the New Zealand government funded Jan Hausman to develop a national curriculum of nursing informatics. Nursing informatics competencies were identified by this curriculum along with the associated attitudes, skills, and knowledge which still currently relevant for the most part (Honey and Baker, 2004). Each school of nursing in New Zealand is being supplied with a NI curriculum document along with a set of teaching resources and packages. However, a great variation in the introduction of nursing informatics is present (Honey, & Westbrooke, 2012). Additionally, Nursing Informatics New Zealand (NINZ), which was the first informatics group for health professional formed in New Zealand, hosted in 2000 the 7th International Nursing Informatics Conference

(NI'2000) in Auckland, New Zealand (Honey and Westbrooke, 2012). In Australia, at the 7th National Conference of the College of Nursing Australia which had a theme of 'Information Processing: Challenges and Choices for Nurses', a nursing group was founded in 1985 'to promote improvement in nursing care through the use of information technology and to provide a forum for sharing knowledge and experiences'" (Griffin, 1989). Late in the same year of 1985, the Nursing Computer Group Victoria was established. Two years later in 1987, the group won the bid to host IMIA's WG8, which is known now as IMIA-NI, 4th International Conference on Nurses' use of Information Science and Computers that was held in Melbourne in 1991 (Hovenga, 1997). After this successful conference, the Nursing Computer Group Victoria changed its name in order to mirror its growing national membership to become the Australian Nursing Informatics Association. About the same time in other Australian states, other similar groups were created. All these groups decided in 1994 to work together by forming the Australian Nursing Informatics Council (ANIC), with a representative and territory group from each state.

3.5 NI History in Europe

In 1993, EuroMISE i.e. European Education in Medical Informatics, Statistics and Epidemiology, a joint European project was started under the aegis of the European TEMPUS-PHARE programme. The idea of this project was to teach health informatics to teachers in among others. The programme involved Faculty from various European countries while students came from countries in the central and eastern European (Zvarova, 1998). Furthermore, the outcomes of other European funded projects such as EDUCTRA, the EuroMISE, the ERASMUS MSc Programme, etc.. were the starting point of the Information Technologies EDUCation and TRAINing project known as IT EDUCTRA which was approved in the 4th EU Framework programme in 1995 (Hasman, 1998). The IT EDUCTRA programme main goal was "to create a training program for healthcare professionals in the basics of information technology and IT medical applications" while the ultimate production of this program was "a CD-ROM containing the teaching materials and tools and used new information technologies for the dissemination of knowledge and skills required for

new health care systems” (Hasman et al., 2014). When specifically tracking the NI education in Europe, a 1997 survey which included five European countries revealed that NI education differs widely within and between these countries nursing curricula in terms of intensity, length and equipment used. Furthermore, the results of the questionnaire revealed that there are NI identifiable course in 59% of these nursing schools. Nevertheless, there are numerous initiatives in Europe that promote the education of NI such as the project of NIGHTINGALE EU (Nursing Informatics Generic High-level Training in Informatics for Learning & Education), another EU-Financed project that was approved in 1995 (Mantas, 1997). The main goal of the NIGHTINGALE project was to “bring to the surface, by means of a series of workshops, the user needs of the nursing profession with respect to telematics, to develop a nursing informatics curriculum for European nurses, and to develop educational tools and software assisting the educational process in nursing informatics” (Hasman et al., 2014). This project was considered extremely important and fundamental for planning and therefore implementing a strategy to train the nursing professionals in using and applying healthcare information systems. Moreover, the project was grounded on the previous experiences that were obtained in the Telenursing AIM project as well as on the EDUCTRA Concerted Action that partially touched the subject of the education of the nursing professionals and their training. A number of Health Telematics Education in European conferences were organized and a ‘health informatics for nurses’ textbook was compiled as a result (Mantas and Hasman, 2002). Additionally, another distinctive movement towards developing the discipline in Europe is manifested by the creation of the European Federation of Medical Informatics EFMI WG5 of nursing informatics in Europe which is known as NURSIE in EFMI Council meeting at MIE’88 in Oslo, Norway. Moreover, the 13th International Congress in Nursing Informatics (NI2016) will be held in Geneva, Switzerland.

3.6 NI History in North America

When reviewing the history of NI in North America, it can be seen that the discipline is better documented, especially in the States, than in other parts of the globe. Ozbolt and Saba (2008) pointed out how in the late 1950s, Werley was one of the few who were consulted about the possible computer

uses in healthcare by IBM as “the first designated nurse researcher at the Walter Reed Army Research Institute” (Ozbolt and Saba, 2008). In turn, Werley was also able to convince the committee appointed by the American Nurses’ Association in 1960 “to include a focus on nurses’ use of information in communicating and decision-making” (Ozbolt and Saba, 2008; ANA Committee on Research and Studies, 1962). Additionally, the first computer applications in the nursing profession reports appeared in the literature both scholarly and professionally in the early 1970’s. In the 70s, nursing informatics was supported by the development of some of the early HIS by many agencies/parties in the US. These HIS included nursing care planning and documentation. Furthermore, nurses were involved in these interdisciplinary efforts which aimed at developing and implementing applications that support health care. Through the 80’s, NI practice, education, and scholarship flourished and grew in the US. For instance, in 1981, the National Institutes of Health Clinical Center hosted its first national conference on Computer Technology and Nursing, with the TRIMIS project of the Department of Defense and the Division of Nursing of HRSA as co-sponsors. Nursing schools and professional associations also organized conferences and offered workshops. Furthermore, in the schools of nursing, NI leaders were introducing informatics courses. In 1984 and 1985 respectively, a Council and a Forum on Computer Applications in Nursing were established by the American Nurses Association and the National League for Nursing. Furthermore, In 1988, the first NI graduate education program was opened at the University of Maryland. The field gained more recognition and many advancement have been achieved through the 90s in the States such as, but not limited to, the publications of the American Nurses Association, the basic nursing informatics certification established by the American Nurses Credentialing Center, additional NI graduate programs etc.. The 2000s were largely revolving around developing the standards needed for achieving interoperability as well as nursing Terminology models by many American parties such as the American Health Information Community (AHIC) and the Nursing Terminology Summit Conference. Research was conducted to distinguish the informatics competencies’ different levels needed for all nurses and from those who are identified as informatics nurses. On the other hand, during the early to mid 1980’s in Canada, hospitals began implementing HIS i.e. Hospital Information

Systems, which included clinical applications such as entering order and reporting results in which nurses were expected to use. Accordingly, the Canadian Information Systems Departments realized that implementing such systems can not be done without some kind of knowledge of the clinical operations and input from its practitioners/users and consequently started hiring nurses to bridge this clinical-technical gap. Many titles described the job of these nurses such as “Nurse Analyst”, “Nursing Systems Coordinator,” and “Nursing Coordinator-Computer Project” (National NI Project Discussion Paper, 2007). On the other hand, the Canadian Nursing Informatics Association (CNIA) received in 2001 the status of emerging group from the Canadian Nursing Association (CAN) and afterward the affiliate status in 2003. Now, the CNIA has full associate status with the CNA. In addition, since 2003, there has been a noticeable increase in the Canadian nursing informatics courses at both graduate and undergraduate levels in nursing schools. When it comes to education, in 2012, CASN i.e. the Canadian Association of Schools of Nursing, and Canada Health Infoway created and developed Nursing Informatics Competencies for Registered Nurses at Entry-to-practice level (Nagle et al., 2012) along with learning resources and tools that can help faculty in teaching undergraduate students in nursing informatics. Additionally, CASN is also “actively involved in supporting faculty in a peer to peer network to help faculty master nursing informatics competencies and integrate them into nursing curricula across the country. Peer leaders are engaging nursing faculty across the country” (Madsen et al., 2015; CASN, 2015). Moreover, in 2012, the 11th International Congress on Nursing Informatics was held in Montreal, Canada.

3.7 NI History in Latin America and Caribbean

As indicated by Jhon (n.d.), the activities of individuals have been viewed and considered as the base of NI in South America more than governmental policies or any national efforts. Additionally, in each South American country, there is a variation rates and levels of development and implementation of technological resources (Jhon, n.d.). Jhon also mentioned that the growth in information technology in the region of Latin America and the Caribbean has been consistently reported as the world highest for the past 20 years. Moreover, the countries of Latin America and the Caribbean are rank third in information technology

expenditure (Panis, 2015). Consequently, guidelines and protocols have been published by the Pan American Health Organization (PAHO) to orient and guide the development and deployment of ICT within the region. When speaking about the motives behind starting NI initiatives in South America, Jhon says that administrative and financial concerns were the initial motivation for developing computer systems in the area of healthcare. Countries like Mexico, Brazil, Argentina, Chile, Colombia, and Paraguay have clinical information systems in hospitals/health institutes. He also indicates that “National and International software become more represented in South America health care workers(Jhon, n.d.). Furthermore, workshops, conferences, congresses, education and training programs are being arranged in order to share NI experiences in these countries. Accordingly, in order to meet the education and training need of the nursing workforce, programs have been initiated by nursing schools and hospitals to prepare nurses on how to use computers. For instance, the *Federal University of São Paulo* started the first center to offer the specialization degree certificate in NI in South America i.e. *Nucleo de Informatica em Enfermagem*. Jhon concluded that NI is considered as an integral part of healthcare that result from the advancement achieved in the entire health informatics sector. Additionally, the NI development is carried out on a case by case basis that take into account each region-specific needs and requirements (Jhon, n.d.). On the other hand, ongoing discussions at many levels, including federal, about implementing computer systems for managing health information are noticed in a number of these countries such as in Brazil (National Education Council (BR). n.d.; Sanches et al., 2011). Sanches, Jensen, Monteiro, and Lopes (2011) indicated that Brazilian public initiatives are supporting the notion of implementing and integrating such systems to be used at various levels of healthcare. As a result, the Unified Health System (SUS) National Information and Health Informatics Policy (PNIIS) was proposed (Sanches et al., 2011). Furthermore, Sanches and colleagues identified in their study about the teaching of Informatics in undergraduate nursing programs at Brazilian public institutions that “in Brazil, only 35 undergraduate nursing programs at federal and state higher education institutions offered informatics-related subjects in their curriculum, available on the Internet, in 2010” (Sanches et al., 2011).

4 THE EDUCATION AND COMPETENCIES OF NURSING INFORMATICS

The education of NI witnessed a somehow slow start as only two graduate-level programs were established in the late 80s in the United States of America (Heller et al., 1989; Graves et al., 1995). Nevertheless, with a proper funding that is started in 1998, a steady increase in the number of the NI programs continues and result in a numerous programs in the States alone, even though a shortage in the informatics faculty was reported as an obstacle to the proliferation of these programs (Murphy, 2010). Another paper, however, identified the earliest NI curriculum initiatives that occurred in 1977 in a nursing program by Ronald and Skiba at the state University of New York at Buffalo (Sackett and Erdley, 2002). During the late 70s and through the 80s of the last century, courses were mainly focused on three components; “computer basics, informatics related to the research process, and software applications related to education, administration, and clinical practice” (Sackett et al., 2004). When it comes to the standardization of the NI competencies at different levels of education, many scholars have contributed to these efforts such as Stagers et al. (2001) and (2002) who tried to provide a framework that divide the NI personnel according to their competencies into levels from novice to expert practitioners. Other researchers defined particular competencies that are needed for nurses once joining the nursing workforce (McCannon and O’Neal, 2003). Nevertheless, even though many scientific publications of NI competencies began in the late 80s and continued until our current times, “the first master list of discrete NI competencies” was only published in 2002 (Goncalves et al., 2012; Stagers et al., 2002). An analysis of the latest research in this regard was provided by Goncalves and colleagues in 2012.

5 THE ROLE AND CAREER PATH OF NURSE INFORMATICIANS

Only in 1992, NI was recognized as a distinguished specialty in the US by the American Nurses Association as one of its newest specialties. This might explain why different specification for the NI role exists, even though the general description

always include information organizing, managing and providing nurses’ input into the implementation process. However, an informatics nurse specialists role specification was provided by Stagers and Thompson (2002) (Stagers and Thompson, 2002). They describe the nurse informatics role specification as “to employ informatics theories, concepts, methods, and tools to analyze information and information system requirements; design, select, implement, and evaluate information systems, data structures, and decision-support mechanisms that support patients, nurses, and their human-computer interactions within health care contexts; and to facilitate the creation of new nursing knowledge”. This role for NI was the result of the successive advances in information technology arena. For nurse informaticians, the career path typically starts when the hospital come to a decision to implement a clinical information system. A nurse will be hired to bridge the gap between the nurses and the implementation team and to bring a nursing perspective to the table. They also ensure that the nurses’ needs are considered when designing and purchasing an automated system. The career options expand as the nurse informatician’s knowledge, skills, and experience grow. Some of them may join a consulting firm, information systems vendor (Rosen and Routon, 1998), or pursue further education in the discipline and turn to academia while the rest may continue working as a nurse informatics specialist in hospital settings.

6 NURSING INFORMATICS CHALLENGES AND OPPORTUNITIES

Over the years, the NI profession has witnessed many challenges as well as opportunities, and still is, to evolve to the current state that we see it in today. This progression has been in different rates and patterns around the world. The background of those involved in this profession that is varied as well might contribute to these issues. The unique nature of NI itself might also be one of the reasons of all of these challenges and opportunities. Nevertheless, many issues have been considered as challenges that could be turned into opportunities in the field of NI. These matters include accessibility of information, lack of privacy, and freedom of use vs. security of information (Baker, 2012). Designing and implementing nursing information systems that can improve patient care efficiency and effectiveness

and, simultaneously, track patient outcomes and preparing the nursing workforce to manage the challenges that might accompany this process is also viewed as one of the most significant challenges that faces nurse informaticians (NagelKerk et al., 1998). Another study in 1994 identified six fundamental factors that affect nurses during a computerized process implementation. These factors include established time frame, strong leadership, carefully planned training, effective communication, proper choice of software, and planned change process with leadership as the most important factor among all (Adaskin et al., 1994). The low number of NI staff could also be considered as another obstacle. Furthermore, in terms of education, many obstacles still face the incorporation of core informatics courses into the curricula of nursing schools. The lack of well-prepared faculties to teach these courses is considered as another drawback that hinder the accomplishment of this goal. On the other hand, there are many associations/ unions around the world that act as an umbrella for nursing informaticians in different countries such as the Alliance for Nursing Informatics (ANI), American Nursing Informatics Association (ANIA), Canadian Nursing Informatics Association (CNIA), and the International Medical Informatics Association Nursing Informatics Special Interest Group (AMIA NI). This can be seen as a significant advantage that has the potential to help better shape and professionalize the discipline. Have an established accreditation system in the states for the nurse informaticians can also greatly serve this cause if transferred to other countries for instance. Also, a number of initiatives that have the same goal such as Technology Informatics Guiding Educational Reform (TIGER), the Health Information Technology for Economic and Clinical Health (HITECH) Act, and the Quality and Safety Education for Nurses (QSEN) have also positively contributed to these efforts.

7 CONCLUSION, RECOMMENDATIONS AND FUTURE DIRECTION FOR RESEARCH IN NI

NI is one of the newest specialties in the nursing profession and is as well a distinctive subspecialty of the interdisciplinary field of health informatics. Its unique nature significantly contributed to its evolution in different aspects in terms of its

definition, history, and its practitioner role, education and competencies. Nevertheless, thanks to the efforts of many scholars and associations in the field, NI continues to steadily expand and grow around the world. Globally though, it can be seen that remarkable advancement has been achieved in some countries or even in some parts of the same country, while other regions/countries are still lagging behind in this aspect of healthcare. Carefully creating and clearly defining the body of knowledge for the discipline of NI is imperative because nurses constitute the majority of healthcare professional and are already using technology in healthcare education, practice, and research. More research is indeed still needed to clearly develop the education, competencies, and job description of NI professionals. An active international body that act as an umbrella that regulates NI activities around the world can help properly utilize the lessons of the past and benefit from the valuable experience of the NI pioneers who can be an active participants in achieving the aforementioned goals. From a clinical practice point of view, the role of nurses in all the phases of the HIT implementation should be clearly defined to encourage more nurses to confidently participate in the implementation process by supplying them with the needed resources and materials to facilitate such involvement. In order to do that, more research is certainly needed to identify what core skills should be incorporated in the future basic nursing education and training curricula and the best way to integrate them in the nursing schools. In addition, with the emergence of concepts such as telehealth, telemedicine and telenursing, more research is needed to assess these processes and identify their pros and cons in terms of patient care, clinical practice and education. (Vernic, 2012).

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