

**ASSESSMENT OF NURSING INFORMATICS
COMPETENCY LEVEL AMONG BEDSIDE
NURSES IN PRINCE MOHAMMED BIN ABDUL-
AZIZ HOSPITAL, RIYADH, SAUDI ARABIA**

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UNIVERSITI SAINS MALAYSIA

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AZIZ HOSPITAL, RIYADH, SAUDI ARABIA**

by

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Master of Science**

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿يَرْفَعُ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ ۚ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ﴾ {11} سورة المجادلة

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LIST OF ABBREVIATIONS

NI	Nursing Informatics
NIC	Nursing Informatics Competency
NICAT	Nursing Informatics Competency Assessment Tool
HIS	Health Information System
TIGER	Technology Informatics Guiding Educational Reform
PMAH	Prince Mohammed bin Abdul-Aziz Hospital
HIT	Health Information Technology
HCW	Health Care Worker
ANA	American Nurses Association
IMIA-NI	The International Medical Informatics Association
EMR	Electronic Medical Record
HER	Electronic Health Record
USM	Universiti Sains Malaysia
NCSBN	The National Council for State Boards of Nursing
APM	Airborne particulate matter
BBB	blood-brain barrier
BMU	Best Matching Unit
CMB	Chemical Mass Balance
CPCA	Consensus PCA
CSI	Class Separation Indices
CSM	Class Sample Matrix
CSV	Class Sample Vector
CWM	Class Weight Matrix
CWV	Class Weight Vector
EDC	Euclidean Distance to Centroids
IPS	Institut Pengajian Siswazah
USM	Universiti Sains Malaysia

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**PENTAKSIRAN TAHAP KOMPETENSI INFORMATIK
KEJURURAWATAN DALAM KALANGAN JURURAWAT DI HOSPITAL
PRINCE MOHAMMED BIN ABDUL- AZIZ, RIYADH, ARAB SAUDI**

ABSTRAK

Penggunaan teknologi klinikal yang canggih semakin meluas di kalangan jururawat dalam persekitaran penjagaan kesihatan masa kini, yang memerlukan pengetahuan dan kemahiran informatik yang mencukupi. Kecekapan kejururawatan dalam bidang ini kini penting, memandangkan kira penekanan yang semakin meningkat terhadap keselamatan pesakit dan kualiti penjagaan melalui informatik. Tujuan penyelidikan ini adalah untuk menilai tahap Kecekapan Informatik Kejururawatan (NI) dan menentukan faktor-faktor yang mempengaruhi kecekapan ini di kalangan jururawat di katil di Hospital Prince Mohammed bin Abdul-Aziz (PMAH). Kajian ini mengambil pendekatan deskriptif, korelasi, rentas-seksyen melibatkan 196 jururawat di PMAH. Dengan menggunakan Alat Penilaian Kecekapan Informatik Kejururawatan (NICAT) yang dibangunkan oleh Alphonsa Rahman pada tahun 2015, penyelidikan menilai kecekapan informatik kejururawatan jururawat di katil. Selain itu, soal selidik mengumpul data demografi. Data dimasukkan ke dalam perisian SPSS 25, dan analisis korelasi dijalankan. Tahap kecekapan purata dalam semua kategori adalah signifikan condong ke arah 'Kompeten, Sangat Kompeten, dan Pakar' (74%), dengan peratus yang jauh lebih rendah dalam 'Novis atau Pemula Mahir' (26%). Tahap pendidikan dikenalpasti sebagai berkorelasi secara signifikan dengan tahap kecekapan informatik kejururawatan (NIC) ($P = 0.047$). Walau bagaimanapun, umur, jantina, tahun pengalaman kejururawatan, dan penggunaan sistem maklumat kesihatan tidak menunjukkan korelasi yang signifikan dengan tahap NIC.

**ASSESSMENT OF NURSING INFORMATICS COMPETENCY LEVEL
AMONG BEDSIDE NURSES IN PRINCE MOHAMMED BIN ABDUL-AZIZ
HOSPITAL, RIYADH, SAUDI ARABIA**

ABSTRACT

Advanced clinical technology is widely used by nurses in today's healthcare settings, requiring the possession of sufficient informatics knowledge and skills. Nursing competency in this field is now essential, considering the increasing focus on patient safety and care quality through informatics. The purpose of this research is to evaluate the level of Nursing Informatics (NI) competency and determine the factors influencing this competency among bedside nurses in Prince Mohammed bin Abdul-Aziz Hospital (PMAH). The study adopts a descriptive, correlational, cross-sectional approach involving 196 nurses at PMAH. Utilizing the Nursing Informatics Competency Assessment Tool (NICAT), developed by Alphonsa Rahman in 2015, the research assesses bedside nurses' informatics competency. Additionally, the questionnaire gathers demographic data. The data was entered into SPSS 25 software, and correlation analysis was carried out. The average level of competency across all categories was significantly tilted toward 'Competent, Very Competent, and Expert' (74%), with a substantially lower percent in 'Novice or Advanced Beginner' (26%). Educational level was identified as significantly correlated with the level of nursing informatics competency (NIC) ($P = 0.047$). However, age, gender, years of nursing experience, and use of the health information system showed no significant correlation with NIC level. These findings underscore the significance of nursing informatics competency within healthcare organizations, as it determines nurses' ability to

effectively utilize available health information systems, thereby enhancing healthcare quality and improve patient safety.

CHAPTER 1

INTRODUCTION

1.1 Overview

In today's healthcare settings, nurses utilize complex clinical technology, requiring strong informatics skills and knowledge. Competency in informatics has become essential for nurses to fulfil their professional responsibilities, as patient safety and care quality are elevated through informatics (Khezri & Abdekhoda, 2019).

Nursing informatics (NI) has become integral to the nursing profession and practice with the rapid evolution of health information systems. Implementing modern NI competencies that assess nurses' informatics skills and knowledge will enhance their use of health information systems and help identify the educational programs needed to improve these skills. Furthermore, enhancing NI skills and knowledge for bedside nurses will positively impact the quality of nursing care and patient safety (Jouparinejad et al., 2020).

This study will involve a self-assessment of NI competency for bedside nurses at Prince Mohammed bin Abdul-Aziz Hospital (PMAH) in Riyadh, Saudi Arabia, using the Nursing Informatics Competency Assessment Tool (NICAT). Additionally, the study will explore any correlation between the level of Nursing Informatics Competency (NIC) among bedside nurses and various sociodemographic variables. The self-assessment questionnaire was effective in identifying areas where nurses needed further education and training, improving their overall competency level. This underscores the importance of ongoing education and training for nurses to stay abreast of the rapidly evolving field of nursing informatics.

1.2 Significance Of the Study

This was the first study in a Prince Mohammed bin Abdul-Aziz Hospital to focus on determining the level of bedside nurses regarding the use of available health information systems, their computer and informatics skills, and their perceived nursing informatics competence.

The study's findings will be presented to the nursing service department and nursing education department. The study might encourage nursing administration to design and prepare an educational program to enhance the level of nursing informatics competency for bedside nurses based on the findings of the total level of competency.

Additionally, the findings of the study may motivate researchers in this field to develop a competency model or a comprehensive list of nursing informatics skills to be utilized in nursing education. This model or list might function as a framework for nursing educators to integrate essential informatics skills into their curriculum. Furthermore, it can aid healthcare organizations in identifying and recruiting proficient nursing informatics specialists who possess the required abilities.

1.3 Problem Statements & Study Rationale

The main problem of this research study was the lack of a nursing informatics (NI) competency assessment tool for bedside nurses working at Prince Mohammed bin Abdul-Aziz Hospital (PMAH). Without a NI competency assessment tool, it was difficult to accurately measure the proficiency of bedside nurses in utilizing informatics in their practice.

The novelty of this study is its focus on addressing the absence of a nursing informatics competency assessment tool at Prince Mohammed bin Abdul-Aziz

Hospital (PMAH). This assessment gap made it difficult to accurately gauge nurses' informatics skills and develop targeted training programs.

By implementing a nursing informatics competency assessment tool, this study aims to identify areas for improvement where nurses require additional training or support, allocate resources effectively and enhance patient care by improving nurses' informatics skills, patient care processes will be optimized, medical errors will be reduced, and overall patient outcomes will improve (Najjar, 2022a).

In essence, this study seeks to fill a critical knowledge gap and empower bedside nurses with the necessary skills to effectively utilize technology in their practice, ultimately benefiting both nurses and patients.

Furthermore, understanding how nurses' demographic characteristics (like age, experience, gender, and education) relate to their knowledge and use of HIS is essential. This knowledge helps tailor education and training to specific needs, improve clinical decision-making, promote evidence-based practice, enhance nurse satisfaction, and advance nursing science. Ultimately, this leads to better patient care and a stronger nursing profession (Khezri & Abdekhoda, 2019a).

1.4 Research Questions

The following research questions will be addressed by this study:

1. What is the level of nursing informatics competency among bedside nurses at Prince Mohammed bin Abdul-Aziz Hospital (PMAH)?
2. What is the relationship between sociodemographic factors and the level of nursing informatics competency among bedside nurses at PMAH?

1.5 Research Objectives

1.5.1 General Objective

The purpose of this research study is to assess the level of nursing informatics competency (NIC) and determine the factors affecting NIC among bedside nurses at Prince Mohammed bin Abdul-Aziz Hospital (PMAH).

1.5.2 Specific Objectives:

1. To determine the level of NI competency among bedside nurses at PMAH.
2. To determine the correlation between the level of nursing informatics competency and sociodemographic factors of bedside nurses, such as gender, age, educational level, years of nursing experience, and time of using health information systems.

1.6 Conceptual And Operational Definition of Terms

Table 1.1 Definition of Terms.

Term	Definition
Nursing-Informatics (NI)	A specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge, and wisdom in nursing practice” (American Nurses Association, 2008, p. 99). NI enables data integration, information, and knowledge to support patients and the healthcare team in their decision making across the settings and roles.
Nursing informatics competency (NIC)	Defined as adequate knowledge, skills, and abilities for nurses to perform specific information tasks using health information systems. Nursing informatics competencies consist of three basic categories: basic computer skills, informatics knowledge, and informatics skills.
Computer literacy	A list of basic skills that each nurse must have to use a computer in both the software and hardware sections; for example, a nurse will be able to define computer parts and accessories (mouse, keyboard, desktop, and laptop computers, etc.). also be able to have good knowledge of word processing, spreadsheets, presentations, web browsing, and communications through email
Information	The abilities needed to determine when information is needed and how to navigate, use, apply, and evaluate this information appropriately. In the nursing informatics field, information literacy guides nurses to recognize the health information and skills that are required and to use critical thinking in nursing practice.
Information management	literacy is a process consisting of three elements: collecting data, processing data (information), and presenting processed data (knowledge). In nursing practice, information management is done in several ways. The most common and preferred method is to use a health information system (HIS) or electronic health records (EHRs).
Bedside nurses	Are medical practitioners who provide direct care to patients in hospitals, clinics, and other healthcare institutions.
Electronic Health Record (EHR)	The “systematic documentation of a client’s health status and healthcare in a secured digital format meaning that it can be processed, stored, transmitted, and accessed by authorized interdisciplinary professionals for the purpose of supporting efficient, high quality health care across the client’s healthcare continuum.
Health Information Technology (HIT):	Is the hardware, software, integrated technologies or related licenses, intellectual properties, up-grades, or packaged solution sold as services that are designed for or support the use by healthcare entities or patients for the electronic creation, maintenance, access, or exchange of health information”.
The Technology Informatics Guiding Education Reform (TIGER)	A nursing reform initiative set forth at the TIGER Summit in 2006 that established computer literacy, information literacy, and information management as categories of NI competency.

1.7 Organization of the Thesis

The thesis is comprised of 6 chapters and the organization as follows:

Chapter One: This chapter presents the study project, provides a concise background, and outlines the problem statement. Additionally, this chapter includes the importance of the study, the general and specific research objectives.

Chapter Two: present the literature that is relevant to the research topic, both theoretical and empirical.

Chapter Three: provides an overview, justification, and description of the research methodology used.

Chapter Four: Presents the findings of the research.

Chapter Five: Describes and discusses the findings, links them to the literature review, and makes recommendations for future actions.

Chapter six: Includes the conclusions, limitations, and recommendations of the study.

CHAPTER 2

LITERATURE REVIEW

This chapter presents a systematic review of research studies focusing on nursing informatics competency assessment tools for nurses. Additionally, it provides a brief review of the history of nursing informatics, discusses the most used NIC tools by authors to assess competency among bedside nurses, and examines the impact of nursing informatics on nursing practice and healthcare quality. The chapter also delves into determining the sociodemographic factors affecting the level of NIC among bedside nurses.

A systematic review was conducted using online databases, including Google Scholar, PubMed, Academia, and Research Gate. Various keywords such as nursing informatics, nursing informatics competency, health information systems, nursing practice, and quality of care were combined to search for relevant articles. The literature selection process followed specific inclusion criteria: (1) the study focused on nursing informatics, (2) it was published in English, (3) it related to nursing informatics assessment competencies in the study title and abstract, and (4) the study sample consisted of nurses at hospitals. Exclusion criteria were applied to articles that focused on specific competencies unrelated to nursing informatics and studies where the sample included individuals other than nurses.

This chapter is structured as follows: Section 2.1 provides an overview of the study's background. Section 2.2 defines nursing informatics competency, while Section 2.3 defines health information systems. Section 2.4 outlines the scope and purpose of nursing informatics, and Section 2.5 offers a brief historical review of the field and Section 2.6 discusses the most used tools for assessing nursing informatics

competency among bedside nurses. Section 2.7 explores the impact of nursing informatics on nursing practice and healthcare quality. Section 2.8 reviews related works. Section 2.9 presents the conceptual framework of nursing informatics and the chapter concludes with a summary in Section 2.10.

2.1 Background of the Study

The early definition of Nursing informatics initiated by Graves & Corcoran in 1983 (Corn. S., 1983). They defined nursing informatics 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 nursing practice, education, research, and administration”.

Later, the Nursing informatics was defined by American Nurses Association as: “a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge, and wisdom in nursing practice. Nursing informatics facilitates the integration of data, information, knowledge, and wisdom to support patients, nurses, and other providers in their decision-making in all roles and settings. This support is accomplished by using information structures, information processes, and information technology”.

(American Nurses Association, 2022) .

The International Medical Informatics Association (IMIA-NI) adopted the following definition in 2009: “Nursing informatics science and practice integrates nursing, its information and knowledge and their management with information and communication technologies to promote the health of people, families, and communities worldwide”(Mieronkoski et al., 2017).

In 2014, ANA's second edition of *Nursing Informatics: Scope and Standards of Practice* presented an updated definition: Nursing informatics (NI) is a specialty that integrates nursing science with multiple information management and analytical sciences to identify, define, manage, and communicate data, information, knowledge, and wisdom in nursing practice''. Nursing informatics supports consumers, patients, nurses, and other healthcare professionals in their decision-making in all roles and settings to achieve desired outcomes. This support is accomplished using information structures, information processes, and information technology (*ANA NI Scope & Standards of Practice*, 2014)).

Nursing informatics includes a wide variety of definitions(Reid et al., 2021). These definitions demonstrate how information systems are combined with nursing practices in the fields of data collection, analysis, and transformation. This integration is crucial for making decisions using health information systems.

2.2 Nursing Informatics Competency (NIC)

Competency can be defined as the application and administration of proper knowledge, skills, and attitude in settings (Wong, 2020). Generally, competence is based on the following four components:

1. **Knowledge:** refers to the cognitive disciplines of information
2. **Skills:** refers to the ability to perform a task effectively.
3. **Behaviour:** describes an individual's personal attributes.
4. **Judgment:** describes how a task is performed (decision-making or wisdom).

In nursing practice, the National Council for State Boards of Nursing (NCSBN) defines competency as "the application of knowledge and the interpersonal, decision-

making, and psychomotor skills expected for a practice role within the context of public health" (Fukada, 2018). A competent nurse is one who has enough knowledge, skills, personal characteristics (physical, mental, and communication skills), and decision-making abilities to perform nursing care interventions efficiently. This competency level of nurses can be easily assessed and confirmed by passing national exams for graduated nurses before enrolling in nursing practice, which is applicable now worldwide, or by using a checklist of competencies and clinical observation by the nursing administrators (Kavanagh, (2021). Therefore, nursing competencies are very important for nursing practice because it reflects the level of staff performance and nurses' ability to meet the health care needs of patients and the population following standards and policies to provide high quality nursing care (Yamamoto et al., 2021).

Nursing informatics competency can be defined as adequate knowledge, skills, and abilities to perform specific information tasks (Khezri & Abdekhoda, 2019). Nursing informatics competencies consist of three basic categories: **basic computer skills, informatics knowledge, and informatics skills** which will be discussed in detail in chapter 2.

Nursing informatics competency is required for the nursing profession to provide high-quality patient care and safety(Guo et al., 2024). The need for competency evaluation tools is great because nursing informatics technology has advanced significantly in recent years. The significance of these competencies is to assess nurses' proficiency in using health information systems for accurate data collection, analysis, and retrieval, as well as to identify the educational activities required to enhance their competencies(Zareshahi et al., 2022).

2.3 Health Information System (HIS)

Information technology is widely used to manage and control our daily operations, as is well known. Information technology applications increasingly regulate most societal issues, including those involving education, shopping, communications, health care, and other human concerns. One of the key components of integrating information technologies into individual and community health settings is the use of Health Information Technology (HIT) systems. HIT is the electronic systems used by healthcare professionals to manage, store, and share health information Basil et al (2022). HIT systems enable communication between healthcare providers and their patients, support evidence-based practice; allow for better decision-making capabilities; and provide a more efficient system of care delivery(Saeed & Masters, 2021).

Meanwhile, Health Information System (HIS) refer to a set of systems designed to manage health care data. The combination of HIT into health care settings achieved by using Electronic Medical Records (EMR) to collect, store, and manage individuals and community health care data (Epizitone et al., 2023). While HIS used by physicians, nurses, pharmacist, and all other Health Care Workers (HCWs) in primary and central healthcare institutions, HIS used also in research and education purposes(Habboush et al., 2018). To manage patient and population health care activities, a variety of health information system categories are used globally. These health information systems can be divided into several categories such as Electronic Health Records (EHRs), Health Information Systems (HISs), public health surveillance systems, and consumer health informatics(Haule et al., 2022).

Integration of all these systems will help in reducing treatment costs, raising individual and population health literacy, reducing the prevalence of medical errors,

and enhancing and facilitating patient-healthcare provider communication. Furthermore, all categories of health information systems significantly contribute to the main goal of all healthcare facilities to provide high quality of patient care and maintain patient safety.

2.4 Nursing Informatics' Scope and Purpose

Nursing informatics consists of three basic elements: *nursing science*, *computer science*, and *information science* (Kleib ,2022). These components are integrated together to manage, store, retrieve to facilitate communication and the transformation of data, knowledge, information, and lastly decision making within nursing practice.

The main scope of NI is to facilitate the use of health information technology and systems in nursing practice to achieve the following goals:

1. Provide a high quality of patient care.
2. Enhance patient safety.
3. Decrease the incidence of medical errors.
4. Facilitate communication inside health care organizations and facilities.
5. Reduce the cost of treatment for individuals and the population.

Enhance health care education and E-health services such as telenursing and telemedicine, as well as create software and applications for health status monitoring and education.

2.5 History Of Nursing Informatics

The evolution of nursing informatics has led to significant advancements that have greatly impacted modern healthcare practices. This section explores the historical journey of nursing informatics, beginning with its inception and extending to the establishment of standards and competencies.

2.5.1 The Beginnings of Nursing Informatics

The notion of utilizing information to enhance healthcare can be traced back to Florence Nightingale in the 1850s. She recognized the importance of gathering and analysing patient data to make more informed decisions regarding their treatment (Cummins et al., 2016).

2.5.2 Computers Enter the Picture

In the 1960s, healthcare facilities began integrating computers more frequently. Numerous research studies were conducted during this time to assess the potential benefits of technology integration in nursing, particularly by 1966 (Collen & Walker, 2015).

2.5.3 International Collaboration

By the 1970s, nurses and computer experts from around the world were convening to exchange ideas regarding the integration of computer systems into nursing practice. Nursing informatics emerged as a significant topic of discussion during the first MEDINFO conference in 1974 (Ozbolt & Saba, 2008).

2.5.4 Growth and Recognition

Nursing informatics activities saw a significant surge in the 1980s. A distinct organization was established within a prominent medical informatics association, and a journal dedicated to nursing informatics was launched (Hussey & Hannah, 2021).

Furthermore, the first graduate programs in nursing informatics were established in the United States in 1988 at University of Maryland, followed soon after by a University of Utah nursing informatics program (Cummins et al., 2016).

2.5.5 Setting Standards

Nursing informatics-related activities were initiated by the International Council of Nursing (ICN) in 1992. Subsequently, in 1994-1995, the first written scope and standards of nursing informatics practice emerged. These standards underwent revision in 2015 to align with changes in nursing informatics practice and technology (Garcia-Dia, 2021).

2.5.6 Defining the Skills

In the early 2000s, the first set of nursing informatics competencies needed for nurses was defined by Stagger, Gassert, and Curran (Staggers et al., 2002). This helped ensure that nurses had the right knowledge and abilities to use technology effectively in their work. The evolution of nursing informatics is summarized in the following table.

2.6 Nursing informatics competency tools

Nursing informatics competency refers to the sufficient knowledge, skills, and abilities required to carry out specific information-related tasks (Khezri & Abdekhoda, 2019c). These competencies encompass three fundamental categories: ***basic computer skills***, ***informatics knowledge***, and ***informatics skills***. The following section provides a comprehensive discussion of the four competencies that, based on an extensive literature review, are most utilized.

Table 2.1 Evolution of Nursing Informatics.

Year	Evolution of nursing informatics
1850	Florence Nightingale considered the importance of collecting and processing patient data and information to improve medical and nursing protocols.
1960s	The early integration of information technology into nursing practice
1966	more than 50 articles reported about the integration of nursing practice and computers founded in international nursing index
1970	the first conference of nursing and computers practitioners held in the United States.
1974	Nursing informatics paper appeared on international level at MEDINFO in United Kingdom and US
1982	Nursing informatics team established by the international medical informatics association (IMIA).
1983	CIN (Computer, Informatics, Nursing) journal initiated in US
1988	First graduate program in Nursing Informatics was established in united states by Maryland University, followed soon after by university of Utah
1990	Nursing informatics related activities initiated by International Council of Nursing (ICN).
1992	American Nurse Association (ANA) designed specialty in nursing informatics
1994-1995	first written scope and standards of nursing informatics practice appeared. These standards revised in 2015 to reflect changes in nursing informatics practice and technology
2002	Stagger, Gassert and Curran identified a first set of nursing informatics competencies

2.6.1 Stagger, Gassert, and Curran 2002 competency.

The first set of nursing informatics competencies was established by Stagger, Gassert, and Curran in 2002(Staggers et al., 2002). They conducted a research study aimed at identifying informatics competencies for nurses across four levels of nursing practice: *beginning nurses*, *experienced nurses*, *nurse informatics specialists*, and *nurse informatics innovators*.

Staggers et al. categorized the nursing informatics competencies for nurse professionals into the following levels:

1. **Beginner level** nurses possess basic information, skills, and management capabilities.
2. **Experienced level** nurses demonstrate a high proficiency in information management and computer technology skills, including nurse educators and administrators.
3. **Informatics specialists' level** are nurses with additional expertise in integrating computer technology into nursing practice through research, critical thinking tools, data management skills, and the system development life cycle (SDLC).
4. **Innovator's level** represents nurses with advanced knowledge and skills in information management and computer technologies. They are qualified to develop theories, solutions, programs, and software in nursing informatics to enhance nursing informatics skills and knowledge and improve the utilization of health information technologies by nurses.

They established a list of competencies appropriate for each level after three rounds of Delphi research. Participants in this study included nursing educators, nursing administrators, and nursing informatics specialists. The selected participants on the expert panel must hold a master's degree in nursing or higher, have at least five years of experience in nursing practice, or have worked in an informatics organization.

Out of 305 competency items reviewed by experts, 281 were accepted and classified into four levels based on their importance and relevance to the level of nursing practice: Beginning nurse (37 competencies), experienced nurse (32 items), informatics specialist (174 items), and innovator (38 items). These competencies

primarily focus on six categories of informatics competencies: ***basic computer skills, informatics knowledge, informatics skills, research, practice, and education skills.***

The limitations of Gassert et al.'s competency model include its primary focus on informatics specialists and innovator levels of competency, neglecting bedside nurses at beginning and experienced levels. Another limitation is the lack of a mechanism for assessing the level of competency, whether through self-assessment tools for nurses or evaluations by administrators or nursing educators.

2.6.2 Technology Informatics Guiding Educational Reform (TIGER)

In 2007, the Technology Informatics Guiding Educational Reform (TIGER) initiatives were developed to enhance the nursing profession and practice through the integration of health information systems and technology. The TIGER informatics competencies collaborative team (TICCT) focused on improving patient care, safety, and nurses' utilization of health information systems (HIS) by leveraging informatics tools, theories, and principles. Their efforts included developing informatics recommendations for both practicing and graduating nurses, with the primary objective of defining the essential nursing informatics competencies required for effective practice and application within healthcare settings using HIS (Hübner et al., 2018).

After conducting an extensive literature review on nursing informatics competencies, educational references in nursing practice, and research, TICCT categorized nursing informatics competencies into three main categories: basic computer skills, information literacy, and information management. Within each category, they outlined a list of competencies along with the resources that support these competencies.

- 1 **Basic Computer Skills:** his section of competencies includes a range of basic skills that every nurse should possess to effectively use a computer, covering both software and hardware aspects. For instance, nurses should be able to identify computer components and accessories (such as the mouse, keyboard, desktop, and laptop computers). They should also have a good understanding of word processing, spreadsheets, presentations, web browsing, and email communications. The European Computer Driving License Module (ECDL) is the resource utilized to assess these skills. ECDL has been a globally recognized standard for basic computer skills for many years.
- 2 **Information Literacy:** According to the association of colleges and research libraries, literacy refers to "the abilities required to identify when information is needed and how to navigate, use, apply, and evaluate this information appropriately." In the nursing informatics domain, information literacy helps nurses recognize the necessary health information and skills, enabling them to apply critical thinking in nursing practice. The flow of information literacy is elucidated in Figure 2.1. (American Library Association, 2016).

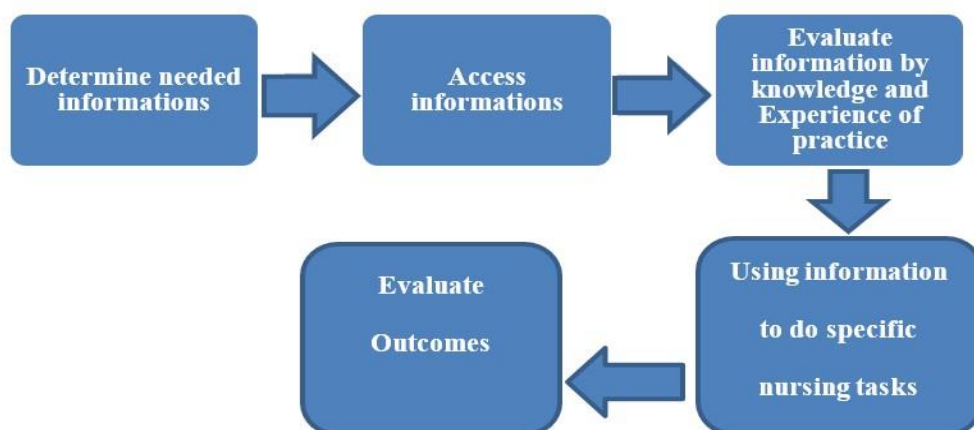


Figure 2.1 The Flow of Information Literacy.

The resource utilized for information literacy competencies is the American Library Association (ALA). ALA provides information literacy competencies for higher educational institutions in the United States (The Association of College and Research Libraries & A division of the American Library Association, 2000). TIGER informatics competencies collaborative team (TICCT) incorporates these competencies into nursing informatics literacy competencies by developing, planning, implementing, and integrating them.

Below are examples of information literacy competencies created by TICCT, aligned with the American Library Association (ALA) competencies. All practicing and graduating nurses will have the ability to have:

- ✓ **Knowledge** to determine the nature and extent of the information needed.
 - ✓ **Access** needed information effectively and efficiently by identifying the availability, types, and online search techniques of information resources.
 - ✓ **Evaluate** information and its sources to integrate this information with knowledge and experience in nursing practice.
 - ✓ **Utilize** information effectively to accomplish specific nursing tasks.
 - ✓ **Evaluate** outcomes by using information effectively.
- 3 **Information Management competency:** The core concepts of information management competency revolve around data, information, and knowledge progression. Information management involves collecting data, processing it into information, and presenting the processed data as knowledge. In nursing practice, information management occurs through various methods, with the most common being the use of health information systems (HIS) or electronic health records (EHRs). TICCT considers the Health Level 7 (HL7) EHR System Functional Module as a resource for applying information management competencies to

nursing practice, published by the HL7 EHR Technical Committee in February 2007 as an American National Standards publication.

TICCT considers that the functional module created by HL7 is insufficient to cover all information management tasks and duties in nursing practice when using health information systems. To address this gap, the TICCT team utilizes the European Computer Driving License for Health (ECDL Health) to translate HL7 information management items into a set of health syllabus statements linked to TICCT's competency statements. The components of the ECDL Health module and the associated TICCT competency statements are detailed in Table 2.2.

Table 2.2 Mapping of HL7 Information Management Items to TICCT Competency Statements Using ECDL Health Components

ECDL Health syllabus	TICCT related competency statement Nurses will.
Concept: Health Information System (HIS)	Verbalize the importance of using health information systems in clinical and administrative sections.
Due care	Assure protection of patient health information, access control, security of health information system used
User Skills	Be able to apply HL7 and ECDL Health skills in navigation, decision making and reporting system.
Policy and Procedures	Have principles of using Health Information System according to their organization's policies.

In Table 2.3, examples of TIGER recommendations for information management competencies are provided, adapted from HL7's EHRs Functional Model. These competencies are widely incorporated into various health information systems used internationally.

Table 2.3 Examples of TIGER Recommendations for Information Management Competencies Adapted from HL7's EHRs Functional Model

Competency statement	Using HIS, Nurse will:
Demographic data	Identify patient demographics and history, Interact with financial and administrative documentation Present AD-HOC view
Consents	Manage all types of consent related to direct patient care, such as general treatment, surgery, procedures, and blood product transfusions.
Medications	Manage medication orders, lists, administration, reporting allergies and adverse drug interactions, and immunization.
Planning of care	implement a plan of care tasks and interventions.
Orders	Manage all non-medication orders, like diagnostic tests, laboratory tests, blood product transfusions, etc.
Documentations	Manage clinical (physicians, nurses, pharmacist) and non-clinical orders (social workers, patient relations, administrative and financial orders).

The TIGER competency elements and their corresponding resources are listed in Table 2.4.

Table 2.4 TIGER Competency Elements and Corresponding Resources

Basic Computer skills	European Computer Driving License (ECDL)
Information Literacy	American Library Association (ALA)
Information Management	Health Level 7(HL7) and ECDL Health

TIGER recommendations for nursing informatics competencies have since become standards and guidelines for most competencies established worldwide(Hübner et al., 2018b). One limitation of the TIGER competency framework is that it lacks a self-assessment component. Competency assessment is typically conducted by administrative nurses, nursing educators, and nursing informatics specialists, requiring significant time and effort to assess all nurses for their informatics skills and knowledge. Therefore, it would be beneficial to have a self-

assessment tool for nursing informatics competency. Such a tool would enable nurses to evaluate their NI skills and knowledge independently, with corresponding nurses reviewing the assessments to determine the necessary educational programs for skill improvement.

2.6.3 Nursing Informatics Competency Assessment Tool (NICAT)

In 2015, Alphonsa A. Rahman developed a new set of self-assessment nursing informatics competencies known as the Nursing Informatics Competency Assessment Tool (NICAT). NICAT was developed based on TIGER's recommendations, the American Nurses Association (ANA) Standards (2008), and Benner's Dreyfus model of skill acquisition (1984) to assess the nursing informatics skills and knowledge of bedside nurses (Alphonsa Rahman, 2015). NICAT assesses NI competency with 30 items in three dimensions:

1. **Computer literacy** (10 items, items 1–10) includes psychomotor skills for using computer tools, as well as knowledge of basic hardware and software functionality, all essential for effective bedside nursing.
2. **Informatics literacy** (13 items, items 11 to 23) refers to nurses' ability to recognize, retrieve, evaluate, and use information for patient care appropriately.
3. **Information management skills** (7 items, items 24–30) involve applying data to support clinical decisions, documentation, data integrity, confidentiality, and security. These skills demonstrate the value of information systems in improving patient safety, quality, and outcomes.

The NICAT is scored on a five-point Likert scale ranging from one to five: not competent (1 point), somewhat competent (2 points), competent (3 points), very competent (4 points), and expert (5 points). The overall score range of the instrument

is 30–150. A total score of 30 points represents a novice nurse; a score between 31 and 59 points represents an advanced beginner; a score between 60 and 89 points indicates a competent nurse; a score from 90 to 119 points represents a proficient nurse, and a score between 120 and 150 is considered an expert.

Table 2.5 presents the scoring methods of NICAT and determines the level of competency based on the total score. Additionally, the level of competency determined using Benner’s model, which outlines nursing skill acquisition from novice to expert, is also presented.

According to Benner’s model, nursing skill acquisition progresses from novice to expert levels. Novice nurses are defined as those who are learning the tools and thinking processes typical of newly graduated nurses. Advanced beginners apply clinical knowledge and judgment in delivering care under supervision. Competent nurses can utilize tools and reason through issues common to their patient population, while proficient nurses can use all tools effectively and recognize and anticipate patient needs. Expert nurses, in addition to the skills, have the ability to assemble and lead teams, look beyond immediate situations, analyse systemic issues, and strive for continuous improvement in practice(Benner, 1984).

Table 2.5 Scoring Methods and Competency Levels in NICAT Assessment Tool, Alongside Benner’s Model of Skill Acquisition.

Benner’s Dreyfus model of skill Acquisition	Novice	Advanced Beginner	Competent	Proficient	Expert
Self-Report of perceived competency level	1-Not competent	2-Somewhat Competent	3-Competent	4-Very competent	5-Expert
NICAT Scoring	30	31-59	60-89	90-119	120-150

2.6.4 Self-Assessment Nursing Informatics Competency (SANIC)

In 2009, Sunmoon Yoon et al. conducted a research study to develop a new nursing informatics competency tool (Yoon et al., 2009). They created a self-assessment nursing informatics competency tool (SANIC tool) based on Stagger et al.'s NI competency tool recommendations for four levels of nurses (2002). However, they focused only on the beginner and experienced levels, excluding the informatics specialist and informatics innovator levels of competencies. This decision was made with the aim of ensuring that newly graduated nurses could efficiently utilize information technology in nursing practice.

This study involved 336 students enrolled in undergraduate and graduate nursing programs and the medical bioinformatics department at Columbia University in the United States. After conducting six steps of principal component analysis on 93 competency items derived from the Stagger et al. competency tool, five main categories containing 30 nursing informatics (NI) items were extracted. Each item was rated on a 5-point Likert scale, ranging from 1 (not competent) to 5 (competent). Table 2.6 displays the elements and competency items of each section of the SANIC tool. Table 2.7 provides a brief comparison between the previously mentioned competencies and determine the strength and limitations of each competency.

Table 2.6 Elements and Competency Items of SANIC Tool Sections

SANIC Category	Number of competency items
Clinical Informatics Role	5 items
Basic computer knowledge and skills	15 items
Applied computer skills	4 items
Clinical informatics attitude	4 items
Wireless device skills	2 items
Total: Five categories	Total: 30 competency items