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Healthcare AI: A Revised Quebec Framework for Nursing Education

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Healthcare AI: A Revised Quebec Framework for Nursing Education

Cover Page Footnote

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Introduction

The Montreal Declaration for a Responsible Development of Artificial Intelligence (Université de Montréal, 2018) defined artificial intelligence (AI) as "the series of techniques which allow a machine to simulate human learning, namely, to learn, predict, make decisions and perceive its surroundings" (p. 18). AI encompasses machine learning and deep learning (Ahmad & Jenkins, 2022, p. 140). The McKinsey Global Institute (Manyika et al., 2017) estimated that automation technologies, including AI and robotics, will result in the creation, change, or replacement of approximately 24% of jobs in Canada, including those in health care (Buchanan et al., 2020).

Since the 2010s, digital health technologies have been used in many ways in health care organizations. AI is projected to be transformative for the nursing profession (Ahmad & Jenkins, 2022; Raymond et al., 2022): "Nursing experience, knowledge, and skills will transition to learning new ways of thinking about and processing information—the nurse will become the information integrator, health coach, and deliverer of human caring, supported by AI technologies, not replaced by them" (Robert, 2019, p. 38). This change will create a need for a review of existing nursing curricula and ongoing skills development for professionals. Nurses, the largest group of health care professionals, will certainly experience the impact of AI health technologies (AIHT) (Ronquillo et al., 2021).

While AI is a much-investigated area—a November 2022 Scopus search resulted in 84,000 articles—only 916 nursing-related documents were identified, 377 of which had been published since 2018. There needs to be more involvement by nurses in the discussions about AI in health care.

von Gerich et al. (2022) found that research on AIHT in nursing focused on predicting, assessing, identifying, or monitoring patient outcomes, triage assessment, and automated reporting and documentation. Data from clinical sources have been used in the development of AIHT (Ahmad & Jenkins, 2022) to predict a variety of outcomes, including patient falls, critical care patient survival, medication adherence, and postoperative symptoms. Nursing management will benefit from the prediction of administrative issues, such as emergency department visits, intensive care admission, nurse turnover and burnout, and risk of death and patient-communication risks (Ahmad & Jenkins, 2022).

A Call for New AI Competencies in Nursing Education

Buchanan et al. (2020) emphasized the need to identify the competencies required to ensure that nurses working with AIHT continue to provide high-quality, safe, and compassionate care. Nursing experts agree that nursing professionals should be equipped with a basic knowledge of AIHT, their impacts on practice, and the ethical and legal requirements of working with these tools (Ahmad & Jenkins, 2022; von Gerich et al., 2022). The Nursing and Artificial Intelligence Leadership (NAIL) Collaborative recommends three priorities: (a) understand the impact of the specific data used by AIHT on outputs and results; (b) engage in all stages of AIHT creation from development to implementation; and (c) create and disseminate knowledge around the practical, social, ethical, and legal implications of using AIHT (Ronquillo et al., 2021). At a strategic level, there are considerations regarding patient empowerment and the ethical input and retrieval of data used in AIHT (Ahmad & Jenkins, 2022).

Project Background

To explore the educational implications of AI integration in nursing practice, the Nursing Department at John Abbott College and Teaching and Learning Services at McGill University received funding from the Montréal Centre for Higher Learning in Artificial Intelligence in 2019 to produce a competency framework for nursing education at the CEGEP[1] and university levels to ensure students are prepared to (a) use AIHT in patient care, (b) educate patients on the benefits and challenges of AIHT, and (c) demonstrate ethical soundness in interpreting and using AI data in patient care. We analyzed the current Quebec nursing informatic competencies (Canadian Association of Schools of Nursing [CASN], 2022) to identify any gaps given the forecasted AI transformation, and then proposed new competencies for the Quebec nursing curricula for the CEGEP's diploma, as well as for the university's undergraduate and graduate levels. These were based on a review of the AI literature relevant to nursing, existing nursing informatics competencies, and consultations with experts in the field of health care AI in Quebec and Canada.

Literature Review

A framework for AIHT in nursing education must consider four aspects to provide a comprehensive approach; these are reviewed below. The *integration of AI into patient care* and the *impact of person-centred care* are specific to the nursing context, while *organizational change* and *change management* apply in any situation with dramatic changes to organizations' and individuals' practice.

Integration of AI Into Patient Care

The integration of AI into the health care system can support enhanced decision-making and automated processes while simultaneously providing cost savings (Robert, 2019) and overall improvements in care (Denney & Evans, 2017). However, Robert (2019) added that it is "essential for nurses to gain experience in interpreting multiple data results and integrating new information into nursing practice" (p. 34). Nurses using AIHT need experience and knowledge to manage patients with complex medical problems and lead diversified teams while maintaining clinical insight into the quality of care (Denney & Evans, 2017). Consequently, nurses not familiar with AIHT will likely find their career advancement possibilities limited (Kelly et al., 2019).

Impact of Person-Centred Care

Integrating AIHT into the health care sector will pose technical and practical challenges. The complexity of health problems and patient care make acting according to predefined patterns difficult (Stinder et al., 2020). A concern with AIHT use is that the complex decision-based algorithms can be opaque for health care practitioners (Lynn, 2019) who will need to use their clinical judgement in combination with AIHT to address particular patient cases and contexts (Pepito & Locsin, 2019). Nurses skilled in interpreting AI data can generate a more complete picture of their patients by combining the AI data with assessments and existing knowledge of the patient. For example, in a hospital setting AIHT can provide instant feedback and reveal additional patient data to supplement the nursing assessment (Challen et al., 2019). AIHT can also impact community care as nurses can use the data to optimize follow-ups. Finally, AIHT can accomplish repetitive and time-consuming tasks, freeing nurses' time.

[1] In Quebec, a CEGEP (*Collège d'enseignement general et professionnel* or general and professional teaching college) is a public school that provides the first level of post-secondary education, leading to an RN diploma.

Organizational Change

To prepare health care professionals to adopt AIHT effectively and safely, Wiljer and Hakim (2019) recommended an approach to managing change based on four pillars: "(1) building awareness and capacity, (2) learning by enabling individuals to innovate and adopt new technologies, (3) creating appropriate and strategic partnerships [at various levels of the organization and with patients], and (4) developing effective knowledge exchange initiatives for its health care professionals" (p. S10). In addition, Kompella (2020) urged businesses to establish an AI ethics practice to promote awareness of any potential negative impacts of AI, particularly in decision-making processes. Wiljer and Hakim (2019) advised organizations to raise awareness of the need for AI ethics and to develop a plan to create, support, and implement the necessary resources.

Change Management

Implementing AIHT will have far-reaching impacts on follow-ups, decision-making for and with patients, personalization of care, performance tracking, and the experience of providing care (Robert, 2019). Ransbotham et al. (2017) identified the lack of managerial support and cultural resistance within units and organizations as the most critical barriers to the adoption of advanced analytics and AI solutions. Barriers such as technophobia, knowledge, or previous experience can be modified by exposure, preparation, and instruction.

Health care organizations must develop the building blocks necessary to fully harness the potential of big data and the insights they provide; this will be critical to ensure the alignment and coordination of service delivery levels. Data literacy can help ensure that all members of an organization can explain the importance of data and how to integrate AI into their decision-making (Wolff et al., 2016). It will be critical for nurses to validate the clinical accuracy of AI algorithms given the random error and biased data generated by AI and machine learning applications (Chin-Yee & Upshur, 2018).

Engineering and Information Science

AI developers most often have engineering and information science backgrounds. The differences in language, knowledge, and values with nursing personnel may lead to communication challenges; however, mutual understanding between nurses and AI developers is vital to promote the development of tools that can be used effectively in practice (Liao et al., 2015). Nurses with basic medical informatics and AI design education will be well placed to work with IT designers to develop systems that meet medical ethics and healthcare practice requirements (Masters, 2019).

Understanding the principles, ethical considerations, and limitations of AI is necessary for nurses to work effectively with AIHT (Gillan et al., 2019; Glasgow et al., 2018). Basic knowledge of a range of topics, including big data, informatics, ethics, privacy, research, and AI algorithms can help nurses reflect on and fully understand the context and limitations of AI. Knowledge of technologies such as expert systems, automation of robotic processes, natural language processing, and machine learning will bring additional benefits (Wiljer & Hakim, 2019).

Ethical and Social Implications of AI for Nursing

Ethical codes and guidelines govern the behaviour of health care professionals and organizations for patient benefit and protection (Luxton, 2014). Ensuring patient safety when providing care is a primary responsibility of health care professionals. The nurses' code of ethics

(*Ordre des infirmières et infirmiers du Québec* [OIIQ], 2015) emphasizes non-maleficence, the principle of not intentionally inflicting harm. To ensure patient safety and compliance with other legal and ethical obligations, the ethical implications of AIHT should be added to existing ethics courses for nurses. To avoid unintended harm from AIHT use, such as incorrect AI predictions resulting from data bias, it is critical for nurses to understand the current limitations of AIHT, as well as how AIHT can perpetuate existing biases and implicit value judgements (Felländer-Tsai, 2020; Kompella, 2020). To guide the future development and use of AIHT, the associated ethical and moral aspects must be fully analyzed.

Methodology

This project makes recommendations for nursing curricula to better prepare student nurses for the challenges posed by the development and implementation of artificial intelligence in the health care environment. Based on a combination of a literature review, workshops, conference presentations, document analyses, and consultations with nurses, both generalists and specialists in the implementation of technology, the research team developed and validated an AI competency framework for Quebec post-secondary nursing curricula. (The McGill Research Ethics Board determined that the data collected as feedback to presentations and workshops were collected in an ethical manner consistent with ethical guidelines.)

The starting question was, "What AI-related competencies would nurses require in the near and foreseeable future?" The project ran from September 2019 to May 2022 and had four phases:

a. a literature review

b. expert validation

c. development of the competency framework

d. validation with experts in AI and health care

Development of the Competency Framework

The research team consisted of two licensed nurses with health care institution work experience who currently teach in college and university settings, and two instructional designers and one educational developer with experience in instructional and curriculum design in post-secondary education.

The initial literature review covered 2015 to 2020 and, although oriented to Quebec, included Canadian and international literature. It focused on current implementations; the repercussions, recommendations, and future predictions for AIHT use in the health care system; and the potential impact on the nursing profession. We reviewed research on nursing informatics and nursing education competencies from Canadian associations, and their recommendations complemented the literature review.

We then used multiple methods to gather a broad range of perspectives from various stakeholders impacted by AIHT implementation in health care settings. We consulted with Quebec nursing experts in nursing informatics, including CEGEP RNs and university nurse clinicians, to understand current and future expectations for AIHT use in nursing. We conducted focus group sessions with professional nursing groups, including the CASN Digital Health Forum, *Association Québécoise des infirmières et infirmiers en systèmes et technologies de l'information*, and the Canadian Nursing Informatics Association. Additional focus groups were held with academic groups such as the Consortium of English-language CEGEPs, Colleges and Universities in

Quebec, the Nursing Department at John Abbott College, the Ingram School of Nursing at McGill University, and the McGill Institute for Health Sciences Education. The feedback helped establish the scope and relevancy of the competency framework and was essential in validating drafted competencies.

Framework Development Process

Based on the literature review, the expert knowledge and experience collected, and the research team's own hermeneutic knowledge, a preliminary competency profile was refined and then expanded based on feedback received. The objectives of the framework development process were (a) identify the central domains related to the nursing informatics competencies published by the CASN (2012) that can be extended to include AIHT; (b) classify the core expectations according to educational level; (c) elaborate and define the skills, knowledge, and attitudes to be developed at the different educational levels; and (d) ensure that the competencies build on the previous level.

Phase 1: Literature Review

The literature review supported the project as the timeliness, emphasis on practical and ethical implications, and importance of understanding how AIHT work were important themes that emerged. The competencies were organized according to the themes identified from the literature review: (a) the timeliness of a review of the Quebec nursing curriculum, (b) an emphasis on the ethical considerations of AIHT implementation in clinical settings, and (c) the importance for nurses to understand how AIHT function and generate results. Learning about AIHT early in nursing studies will benefit students by preparing them to use the tools responsibly and safely in clinical settings (Funk, 2011). The themes were supported by discussions with health care professionals responsible for supporting and implementing AIHT in clinical settings.

Phase 2: Expert Validation

The framework was validated by health care experts with special interest or responsibility in applying AIHT, although we were unsuccessful in recruiting experts from AI science. Hopkins's (2021) academic rounds presentation confirmed the overarching themes once again. Although not specifically about nursing, it helped to clarify the benefits, challenges, and overall impact of AIHT in clinical settings. Additionally, the research team sought expert feedback on the professional competencies required by graduating nurses in a health care environment transitioning to integrating AIHT in decision-making. The outcome of these sessions validated the timeliness of our project. What also emerged was the need to identify specific expectations for each level of study and ensure that competencies be practical and applicable.

Phase 3: Development of Competency Framework

We developed the framework through an iterative process of drafting, consulting, and revising. We first individually identified preliminary domains or areas of knowledge as well as competency levels. After feedback from experts in nursing and education, the number of domains and outcomes was expanded from four to five; their applications to nursing practice are described below.

1. *Introduction to AI health technologies in nursing practice and clinical settings:* Provide nursing students with an overview of AI technology and basic health informatics knowledge and skills. Note that this skill set was raised as a concern as it is not currently formally integrated and addressed in the nursing curricula.

2. *Knowledge of AI data and how the data are created and stored:* Help nurses understand how patient data are generated, used, and stored for clinical decision-making. Nurses will need to gain experience in interpreting multiple results and integrating new information into nursing practice. Nurses should also be able to recognize the strengths and limitations of AIHT.
3. *Communication with health care professionals, patients, and family:* Develop nurses' skills to support AIHT-related communication with multidisciplinary teams, including IT professionals and AI developers, and patient education.
4. *Ethical and social implications:* Understand the ethical and social implications of AIHT in the clinical context while meeting the standards and regulations for safe patient care. This competency prepares nurses to participate in discussions about establishing needed formal clinical standards for AIHT use in nursing.
5. *Engagement in AI as a subject matter expert or end-user:* Support nurses who will actively engage in the development and application of AIHT designed for patient care. The data scientist will determine the data and algorithms to use for AIHT, but nurses will validate and evaluate the systems designed.

Phase 4: Final Validation

The fully developed framework was presented to those consulted previously, as well as educators who would ultimately integrate the competencies within the curricula. This led to a framework that included CEGEP nursing students, undergraduate, masters, and doctoral nursing students' levels and cross-referenced the CASN domains (2014)[2] and Quebec CEGEP 180AO competencies (Cloutier et al., 2009) and 2014 CASN domains—Knowledge; Research, Methodologies, Critical Inquiry & Evidence; Nursing Practice; Communication & Collaboration; Professionalism; and Leadership (the final competencies have been updated to reflect the changes in the 2022 CASN domains). The following competency statements defined the framework:

1. Understand the foundation of informatics and digital health technology prior to working with AIHT.
2. Define AIHT capabilities and their associated risks and limitations.
3. Interpret and effectively communicate AIHT results in terms of patient care.
4. Explain the ethical, social, and legal implications of AIHT.
5. Apply critical thinking to analyze AIHT data.

The competencies were identified as Theory or Application in practice and aligned with the Quebec Ministry of Education format (Cloutier et al., 2009) to present the statement of the competency, elements of the competency, achievement context, performance criteria, and proficiency levels for each education level. This version was shown to professional nursing groups and nursing faculty groups for final validation and feedback. Minor adjustments were made in

[2] At the time the validation was conducted the 2014 CASN framework was available; it was organized into six domains: (1) Knowledge; (2) Research, Methodologies, Critical Inquiry & Evidence; (3) Nursing Practice; (4) Communication & Collaboration; (5) Professionalism; and (6) Leadership. The final competencies have been updated to reflect the changes in the 2022 CASN domains.

response to the feedback and to align with the new CASN framework (2022). The final competency framework is presented in the Results section below.

Results

This project was tailored for Quebec nursing education, encompassing RN, BScN, MSc, and PhD levels, and the Quebec health care system context. Feedback from expert consultants indicated the timeliness of this project. AIHT are rarely seen in any nursing care units in Quebec, and there are currently no AI-specific technology competencies in the Quebec nursing programs (Cloutier et al., 2009; Leprohon et al., 2009). Implementing the proposed framework would prepare nurses for the upcoming integration of AIHT as they become prevalent within the health care sector.

The competencies developed by CASN (2022) and the current Quebec CEGEP 180AO competencies (Cloutier et al., 2009) were cross-referenced with the proposed new competencies. The competencies have been subdivided into *theory* and *application in practice*, and the requirements of the educational levels articulated. Our recommendation is that the following five competencies be integrated within nursing education curricula:

1. (Theory) Students will be able to apply knowledge of informatics and digital health technology to the practice of nursing.
2. (Theory) Students will be able to apply their knowledge of AIHT and their inherent benefits and limitations.
3. (Application in Practice) Students will be able to use AIHT safely and effectively within their nursing practice.
4. (Application in Practice) Students will be able to participate in the development of AIHT guidelines considering ethical, social, and legal implications.
5. (Application in Practice) Students will be able to engage in the development of AIHT training to support continuing nurse education.

Discussion of Competencies

In this section, we describe each competency and accompany it with a corresponding figure. Each figure outlines the competency statement, the context and conditions required for proficiency with corresponding elements, and the performance criteria. Levels of proficiency (i.e., 1 = introduce; 2 = reinforce; 3 = master; 4 = expert) highlight the level of achievement expected for each performance criteria at the post-secondary degree levels. Each competency was cross-referenced with the CASN (2022) and CEGEP 180AO requirements (Cloutier et al., 2009), which served to validate the relevancy of the proposed competencies. Each competency figure illustrates the spectrum of proficiency levels and provides a comprehensive overview of the dimensions and expected mastery of each competency.

Competency 1 (Theory): Students Will Be Able to Apply Knowledge of Informatics and Digital Health Technology to the Practice of Nursing (Figure 1).

A basic knowledge of informatics and digital health technology is necessary before more complex technologies such as AI can be addressed. This competency focuses on acquiring knowledge and expertise in existing AIHT, such as electronic health records, electronic medical records, telehealth, and smart medical devices. Students must be able to (a) summarize the uses of

digital health technology and digitized electronic health records; and (b) explain the fundamentals of telehealth, smart medical devices, and health applications as they impact nursing care.

Figure 1

Competency 1 (Theory)

Statement of the competency	Achievement context [a]
Students will be able to apply knowledge of informatics and digital health technology to the practice of nursing.	• within the legal framework of professional practice • referring to current health policies and concepts • in order to promote and maintain health and prevent illness • in collaboration with health system facilities, associations, organizations or institutions • in conjunction with clients in the health sector and the community • [according to the therapeutic nursing plan, if applicable] • based on: – teaching programs – health programs – PIQ (Québec immunization protocol) – Québec priorities in public health – rules in effect in the health care institution – teaching materials • in accordance with: – the code of ethics – current legislation – approach to primary health care
Elements of the competency	**Performance criteria**
1. Electronic health records 2. Electronic medical records 3. Telehealth 4. Smart medical devices 5. Health applications	A. Summarize the uses of digital health technology and digitized electronic health records. B. Explain the fundamentals of telehealth, smart medical devices, and health applications as they impact nursing care.

Performance criteria	Nursing education levels of proficiency (1 = introduce; 2 = reinforce; 3 = master; 4 = expert)				
	CEGEP	Undergraduate		Graduate	Specialization
	RN	BSc(N)	BNI	Master	PhD
A	1	1–2	2	3	–
B	1	1–2	2	3	–

[a] Quoted from *Nursing: Technical training program, 180.A0*, by C. Cloutier, M. Croteau, and D. Mastrianni, 2009, Ministère de l'Éducation, du Loisir et du Sport (https://numerique.banq.qc.ca/patrimoine/details/52327/1926630).

Competency 2 (Theory): Students Will Be Able to Apply Their Knowledge of AIHT and Their Inherent Benefits and Limitations (Figure 2).

An understanding of how AI works is essential to develop the critical analysis and subsequent decision-making that is part of the nursing process (Levett-Jones, 2018). This competency focuses on incorporating AI within the nursing process, being mindful of the benefits and the potential bias. To achieve this competency, students must be able to (a) describe how AIHT compile data from data sources and generate results, (b) identify potential areas in which data bias can occur, and (c) reflect on how AIHT impact and contribute to the nursing process.

Figure 2

Competency 2 (Theory)

Statement of the competency	Achievement context [a]
Students will be able to apply their understanding of AI applications and their inherent benefits and limitations.	• within the legal framework of professional practice • referring to current health policies and concepts • in order to promote and maintain health and prevent illness • in collaboration with health system facilities, associations, organizations or institutions • in conjunction with clients in the health sector and the community • [according to the therapeutic nursing plan, if applicable] • based on: – teaching programs – health programs – PIQ (Québec immunization protocol) – Québec priorities in public health

	– rules in effect in the health care institution – teaching materials • using: – measurement tools and devices – reference materials • in accordance with: – the code of ethics – current legislation – approach to primary health care

Elements of the competency	Performance criteria
1. Analysis of AIHT-generated information	A. Describe how AIHT compile data from data sources and generate results.
2. How AI technology works	B. Identify potential areas in which data bias can occur.
3. AIHT and the nursing process	C. Reflect on how AIHT impacts and contributes to the nursing process.

Performance criteria	Nursing education levels of proficiency (1 = introduce; 2 = reinforce; 3 = master; 4 = expert)				
	CEGEP	Undergraduate		Graduate	Specialization
	RN	BSc(N)	BNI	Master	PhD
A	1	1–2	2	3	4
B	1	1–2	2	3	4
C	1	1–2	2	3	4

[a] Quoted from *Nursing: Technical training program, 180.A0*, by C. Cloutier, M. Croteau, and D. Mastrianni, 2009, Ministère de l'Éducation, du Loisir et du Sport (https://numerique.banq.qc.ca/patrimoine/details/52327/1926630).

Competency 3 (Application in Practice): Students Will Be Able to Use AIHT Safely and Effectively Within Their Nursing Practice (Figure 3).

It is crucial to emphasize the importance of critical thinking for nurses when integrating AIHT into nursing practice, which follows the clinical reasoning cycle framework (Levett-Jones, 2018). AIHT-derived conclusions or recommendations should not be adopted without nurses critically appraising their validity and applicability to the target situation. To achieve this competency, students must be able to (a) use AIHT within a clinical setting; (b) decide how results will be used to deliver safe patient care following the nursing process and clinical reasoning cycle; (c) discuss

AIHT and results with patients, families, and other health care professionals; and (d) lead the development and integration of AIHT in nursing practice using a multidisciplinary approach.

Figure 3

Competency 3 (Application in Practice)

Statement of the competency	Achievement context [a]
Students will be able to use AIHT safely and effectively within the nursing practice.	• within the legal framework of professional practice • referring to current health policies and concepts • in order to promote and maintain health and prevent illness • in collaboration with health system facilities, associations, organizations or institutions • in conjunction with clients in the health sector and the community • [according to the therapeutic nursing plan, if applicable] • based on: – teaching programs – health programs – PIQ (Québec immunization protocol) – Québec priorities in public health – rules in effect in the health care institution – teaching materials • using: – measurement tools and devices – reference materials • in accordance with: – the code of ethics – current legislation – approach to primary health care • using language suited to the client
Elements of the competency	Performance criteria

1. Application of AI-generated information 2. Patient education 3. Interprofessional communication 4. Nurse education 5. Multidisciplinary collaboration on AI projects within nursing practice.	A. Use AIHT within a clinical setting. B. Decide how results will be used to deliver safe patient care, following the nursing process/clinical reasoning. C. Discuss AIHT tools and results with patient, family, and other health care professionals. D. Lead the development and integration of AI in nursing practice using a multidisciplinary approach.

Performance criteria	Nursing education levels of proficiency (1 = introduce; 2 = reinforce; 3 = master; 4 = expert)				
	CEGEP	Undergraduate		Graduate	Specialization
	RN	BSc(N)	BNI	Master	PhD
A	1	1–2	2	3	–
B	1	1–2	2	3	4
C	1	1–2	2	3	–
D	–	–	–	3 [b]	4

[a] Quoted from *Nursing: Technical training program, 180.A0*, by C. Cloutier, M. Croteau, and D. Mastrianni, 2009, Ministère de l'Éducation, du Loisir et du Sport (https://numerique.banq.qc.ca/patrimoine/details/52327/1926630).

[b] Students will have acquired levels of proficiency 1 and 2 with the prior competencies as part of the nursing curriculum and basic nursing program.

Competency 4 (Application in Practice): Students Will Be Able to Participate in the Development of AIHT Guidelines Considering Ethical, Social, and Legal Implications (Figure 4).

Nurses must be involved in creating the ethical and legal guidelines needed for AIHT. The OIIQ guidelines addressing legal and ethical considerations are incorporated into the proposed framework. Although patient privacy and confidentiality are already part of nursing programs, the specifics of AIHT-related challenges are not. To achieve this competency, students must be able to (a) analyze the ethical, social, and legal challenges of using AIHT in the nursing process; (b) identify potential areas where AIHT guidelines can be further developed; and (c) advocate for stronger nursing involvement in AIHT development.

Figure 4

Competency 4 (Application in Practice)

Statement of the competency	Achievement context [a]
Students will be able to participate in the development of AI guidelines considering ethical, social, and legal implications	• referring to the current organization of the health and social services system • based on laws, regulations, standards and codes currently in effect • based on the: – policies and practice standards set by the OIIQ – nurses' ethical and legal obligations – *Charter of Human Rights and Freedoms* • within the legal framework of professional practice

Elements of the competency	Performance criteria
1. Patient privacy and confidentiality 2. Ethical, social, and legal considerations of AIHT	A. Analyze the ethical, social, and legal challenges of AIHT in terms of privacy and security of patient data. B. Identify potential areas in which AIHT guidelines can be further developed. C. Advocate for stronger nursing involvement in AIHT development.

Performance criteria	Nursing education levels of proficiency (1 = introduce; 2 = reinforce; 3 = master; 4 = expert)				
	CEGEP	Undergraduate		Graduate	Specialization
	RN	BSc(N)	BNI	Master	PhD
A	1	1–2	2	3	4
B	–	1	1	2–3	4
C	–	1–2	1–2	3	4

[a] Quoted from *Nursing: Technical training program, 180.A0*, by C. Cloutier, M. Croteau, and D. Mastrianni, 2009, Ministère de l'Éducation, du Loisir et du Sport (https://numerique.banq.qc.ca/patrimoine/details/52327/1926630).

Competency 5 (Application in Practice): Students Will Be Able to Engage in the Development of AIHT Training to Support Continuing Nurse Education (Figure 5).

This competency addresses the need to continually evolve as the technology evolves. Nurses in the field before the integration of AIHT will require continuing education to be at the

same level as graduating nurses. Therefore, continuing education in AIHT will need to be developed alongside the introduction of AIHT into foundational curricula. Despite the enthusiasm in the health care sector generated by the potential of AIHT to improve the quality, safety, and efficiency of care, significant challenges remain in moving algorithmic systems to the front lines of clinical practice (Petitgand et al., 2020). To achieve this competency, nurses must have acquired the previous competencies to be able to develop AI training materials and activities to support continuing education for nurses.

Figure 5

Competency 5 (Application in Practice)

Statement of the competency	Achievement context [a]
Students will be able to engage in the development of AI training to support continuing nurse education.	• within the current organization of the health and social services system [in Quebec] • taking into account the requirements and development of professional practice • with the help of professional resources, if appropriate • based on laws, regulations, standards, and codes currently in effect • based on information on public or private health institutions • using recent data on the profession

Elements of the competency	Performance criteria
1. Continuing nursing education	A. Develop AI training materials and activities for nurses to support continuing nurse education.

Performance criteria	Nursing education levels of proficiency (1 = introduce; 2 = reinforce; 3 = master; 4 = expert)				
	CEGEP	Undergraduate		Graduate	Specialization
	RN	BSc(N)	BNI	Master	PhD
A	–	–	–	3 [b]	4

[a] Quoted from *Nursing: Technical training program, 180.A0*, by C. Cloutier, M. Croteau, and D. Mastrianni, 2009, Ministère de l'Éducation, du Loisir et du Sport (https://numerique.banq.qc.ca/patrimoine/details/52327/1926630).

[b] Students will have acquired levels of proficiency 1 and 2 within the prior competencies as part of the nursing curriculum and basic nursing program.

Conclusion

To support health care organizations as learning organizations, nursing curricula must include clear recommendations about what nursing competencies should be developed to foster technological adaptability. Mutual understanding with professionals within and outside the health care field around AIHT will be essential. Whether in the developmental, adoption, or evaluation stages of AIHT, nursing professionals will require new competencies to ensure that patient care continues to be provided safely, effectively, and ethically (Ahmad & Jenkins, 2022; Pepito & Locsin, 2019). AIHT that include AI-based clinical decision support systems, machine learning, and other forms of AI are expected to transform current nursing practice, nursing decision-making, and clinical processes (Raymond et al., 2022). Because of its transformative effect and the significant impact of AIHT on the nursing profession and practice, the NAIL Collaborative (Ronquillo et al., 2021) emphasizes the timeliness and importance for the nursing profession to lead and drive conversations around AIHT. Implementing AIHT presents an opportunity for generating new roles in the nursing profession that are critical to the advancement of our health care system (Booth, 2016).

Raymond et al. (2022) called for practising nurses to be involved in research regarding AIHT design, the uses of AIHT in practice, reflection on practice, and the effects on "quality, safety, and availability of care" (p. 6). Pepito and Locsin (2019) strongly urged that nurses be involved in decision-making regarding the implementation of AIHT in nursing practice to ensure that patient care remains compassionate, safe, and ethical. The NAIL Collaborative called for a minimum set of competencies for undergraduate nursing education, and to include at all levels "appropriate integration of AI knowledge to ensure nurses are equipped to practice with the knowledge, skills and judgement required to work in health systems that use AI" (Ronquillo et al., 2021, p. 3711). Ahmad and Jenkins (2022) further argued that professional accreditation boards should facilitate and advocate for the inclusion of an AI-integrated curriculum at the undergraduate and graduate levels of nursing education. These changes will create a fundamental shift in the role of nurses, requiring them to understand tools stemming from the fields of engineering, law, and information science (Rampton et al., 2020) so that they can work responsibly with AIHT in clinical settings. Therefore, identifying and implementing new competencies within the Quebec nursing curricula is essential to ensure that nurses can be fully engaged in the progression of AI in health care in Quebec. We have based the AI competency framework on seminal guidance documents—namely, from CASN—which will ensure that our graduates will be prepared for professional practice on a national level. Our proposed framework may also serve to advance the inclusion of AIHT competencies in nursing curricula nationally and internationally.

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