

INTEGRATING ARTIFICIAL INTELLIGENCE, DIGITAL HEALTH, AND GENOMIC MEDICINE INTO EVIDENCE-BASED NURSING PRACTICE: ADVANCING MENTAL HEALTH, AGED CARE, PUBLIC HEALTH, AND PATIENT SAFETY

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ABSTRACT

AI, digital health and genomic medicine are increasingly transforming evidence-based nursing by augmenting the potential for prediction, ongoing monitoring, personalized intervention and precision-based care. This review examines how these technologies are being integrated into nursing practice across mental health, aged care, public health, and patient safety. Digital health improves nursing practice with telehealth and mobile applications, wearable monitoring, connected care, and digital therapeutics, while AI enhances risk prediction, clinical decision-making, NLP, triage, and care planning. The contribution from genomic medicine includes: Hereditary Risk Assessment, Pharmacogenomics, Biomarker-Informed Care, and Precision Nursing. These technologies can enhance the early detection of patient health conditions, access to health services, surveillance, and care personalization, medication safety, and continuity of care across priority clinical domains. But data quality, interoperability and algorithmic bias are limiting factors, as well as concerns around privacy, transparency, workforce readiness and professional accountability. What is needed next is clinically proven, interoperable, and equitable systems that support, but don't supplant, nursing judgement, and are explainable and human-centred. Clinically robust, ethically sound governance mechanisms and person-centred care combined with technological innovation will play a vital role in the development of safe and evidence-informed precision nursing.

KEYWORDS: artificial intelligence, intelligent robotics, autonomous decision-making, smart manufacturing, Industry 4.0

INTRODUCTION

The foundation of nursing practice is based on the provision of safe, person-centred care that involves using clinical knowledge, professional judgement, interpersonal skills and sensitivity to individual patient needs. Mobility, nutrition, hygiene and elimination activities are key nursing interventions that directly impact patient functioning, recovery and quality of care and thus remain important in this mandate (Taylor et al., 2018; Richards et al., 2018). Yet, the proliferation of health and health care information and digital infrastructure has changed the context within which these longstanding roles are carried out. Research has shown that EBP has gone beyond simply using the best research evidence to a larger model of decision-making that integrates the best evidence, clinical expertise, patient values, and increasingly complex information resources (McMenamin et al., 2019). Digital technologies have therefore emerged as key tools to assist nurses in their work, communication, documentation, monitoring, and care coordination functions in various healthcare settings (Huter et al., 2020).

It is a change that's driven more and more by the intersection of artificial intelligence (AI), digital health and genomic medicine. Beyond the traditional clinical context, a connected system of health technologies can be used to deliver services at a distance, via mobile device apps, and with digitally mediated intervention, but the clinical value requires careful evaluation and validation (Mathews et al., 2019). Machine learning introduces a computational component with the power to recognize patterns in vast and complex datasets that can be used for prediction, risk stratification, clinical decision support and personalization. The increasing use of it in nursing offers a chance to enhance clinical monitoring and decision-making processes while raising questions about reliability, transparency, and ethical responsibilities in nursing practice, as well as questions about how well nurses are prepared for its use of it (Wei et al., 2025). Precision medicine is another development of the shift, tackling the challenge of creating more personalized strategies for prevention, diagnosis and treatment by integrating genomic and other personal information with computational methods (Johnson et al., 2021). Nurses' role is important in this new ecosystem as they constantly create, interpret and use clinical and patient-generated information. Precision health (PH) from the nursing perspective involves taking into account not only genomic variation but also other biological, behavioral, environmental, lifestyle, and contextual factors when designing a prevention/care approach to address them (Fu et al., 2020). This has a special relevance in the context of mental health, aged care, public

health and patient safety, where there are many examples of clinical and psychosocial factors interacting and affecting patient trajectories. For example, mental health care highlights the need for this intersection, as there is an increasing number of medication-related safety issues that need to be systematically evaluated, monitored, communicated and managed across the health care pathway (Roughead et al., 2017). Using genetic information along with intelligent prediction and continuous digital monitoring may help enhance nurses' ability to identify vulnerability sooner and provide a more targeted intervention.

Although technology has advanced at a rapid pace, evidence continues to be scattered throughout the areas of AI, digital health, genomics, precision health, and individual nursing specialities. Most of the literature focuses on the evaluation of these domains separately, giving limited insight into the integration of these domains in evidence-based nursing while maintaining clinical judgment, person-centredness, equity and patient safety. However, issues of implementation readiness, ethical governance, digital competency, genomic competency, interoperability and translation of technology to nursing outcomes are still questions. This review will therefore critically explore how AI, digital health and genomic medicine are now being integrated in evidence-based nursing care, explore the applications and potential contribution of these technologies across mental health, aged care, public health and patient safety and highlight the implementation challenges and future priorities for safe, equitable, person-centred and evidence-driven precision nursing.

2. Artificial Intelligence in Evidence-Based Nursing Practice

AI is changing the way evidence-based nursing can be done by increasing the ability to transform complex clinical data into actionable information at the bedside. AI is now being utilized for predictive analytics, automated monitoring, decision support, documentation, education and personal care planning. While there is evidence of the use of AI for nursing and midwifery, the quality of these studies is inconsistent, and there has been limited real-world testing, so there are variations in evidence to support widespread use of AI (O'Connor et al., 2023). The growing evidence base also suggests that ensuring the competency of AI becomes an increasing priority in the field of nursing education and professional practice, where nurses need to be aware of the strengths and weaknesses of algorithmic systems (El Arab et al., 2025).

Machine learning and clinical decision-support systems based on AI are particularly valuable in helping to combine multiple patient characteristics that might not be easy to understand when assessing and managing patients as part of routine care. They may make timely suggestions, as a result of clinical data, to help with risk assessment, diagnostic thinking, choosing treatment and prioritizing. At present, the impact of AI-supported decision-making systems is limited, with suggestions that these systems could enhance clinical practice and efficiency in certain domains, but their benefits depend on data quality, the validity of the AI models, the ability to integrate AI into clinical workflows, and the effective supervision of the AI system by clinicians (Ouanes & Farhah, 2024). However, predictive modeling is particularly useful for nursing surveillance since machine learning algorithms have the ability to detect patterns related to clinical deterioration before standard thresholds are met. However, the systematic review of the deterioration-prediction models noted significant variability regarding model development, validation, and measures of model performance, as well as the use of different models in practice, underscoring the need for strong external model validation and prospective validation before deployment in the bedside setting (Jahandideh et al., 2023). Unstructured nursing documentation is an important resource for AI-driven nursing practice. Nursing notes include physical signs, functional changes, behavior observations, nursing interventions, and information that may not be recorded in structured EHR data fields. NLP can transform this narrative information into analyzable data, which can facilitate the identification of patient characteristics, nursing problems, clinical outcomes and potential safety risks (Mitha et al., 2023). The potential for further expanding the automated extraction of information from routinely collected clinical data, automated phenotyping, automated risk identification, and automated clinical knowledge generation from these routine care data elements could be further strengthened by the addition of NLP to EHRs (Van Bulck et al., 2025).

With the advent of Generative AI, there are new opportunities to support evidence-based nursing practice such as automated summarization, documentation support, educational content creation, patient communication, and fast retrieval of clinical knowledge. In the recent nursing literature, these applications have been studied, and there have been some attempts to address issues of inaccurately reported values, informativeness, confidentiality, transparency and lack of clinical validation to use these applications independently in high-stakes decisions (Park et al., 2024). Such systems should thus be used as assistive technologies rather than substitutes for professional assessment, especially when recommendations have an impact on diagnosis, treatment or safety-critical interventions. Triage and care planning for individualised care also have some direct impacts of AI. If used in the correct clinical governance structure, algorithm-assisted triage can incorporate clinical signs, physiological monitoring and risk factors to assist with the assessment of acuity and prioritisation of care, which could improve the consistency and timely escalation of care (Abualruz et al., 2025). The application of AI in the care plan could also be used to help incorporate the patients' information and determine nursing priorities for each patient, which poses issues of understanding how the algorithm works, patient confidentiality and the role of the nurse in decision-making (Alotaibi et al., 2024). Therefore, evidence-based adoption calls on nurses to critically evaluate algorithmic recommendations based on clinical evidence, context, patient preference and/or direct evaluation, instead of blindly taking the automation outputs as a final decision.

AI can enhance evidence-based nursing care by better predicting patient conditions, monitoring, information extraction, triage, and individual decision-making. It relies on established algorithms, on accurate data, on transparency of its workings, on its integration into current workflow, and on the human component that gives it meaning; as such, nurses are expected to interpret the information that AI provides in a person-centred approach. The diagram presents the process of how AI can be applied to assist nursing tasks, from the collection and processing of clinical data to clinical application, professional decision-making, and patient outcomes as shown in Figure 1.



Figure 1. Artificial Intelligence Pathway in Evidence-Based Nursing Practice

3. Digital Health and Connected Models of Nursing Care

Digital health is expanding nursing care beyond the traditional bedside visit and facilitating assessment, communication, monitoring and intervention in the physical and virtual space. Virtual nursing models involve the utilization of communication-based technologies to help support patient education, surveillance, discharge preparation and nursing coordination, and the provision of nursing expertise without the need to be physically present at all times. Alterations of this type can support direct care by relocating specific nursing tasks and help to ensure access to professional support, especially if staffing and/or geographical factors affect the provision of care (Schuelke et al., 2019). This model is further extended by the capability of telehealth and remote patient monitoring to enable nurses to assess patients as they move through time, monitor changes between visits, and facilitate chronic disease care in non-clinical environments (Schultz, 2023). mHealth apps offer a more patient-centric approach and enable patients to document their symptoms, provide health information, track their habits, and connect with healthcare providers using their personal devices. They have the ability to engage patients, making them particularly relevant to evidence-based nursing as they can be used to supplement episodic clinical assessment, and to facilitate individual patient education and behavioral interventions based on self-reported and patient-generated information. The link between app adoption, engagement, health behaviour, and health outcomes still relies upon continued adoption, usability, accessibility and the capacity to convert digital engagement into productive modifications in care (Ullah et al., 2024).

Wearable technologies enable ongoing physiological and behavioral measurement to connect with nursing practice. Nurses can have activity, movement, sleep, cardiovascular and other health data collected on devices that can store this data longitudinally over time, which can be hard to gather with intermittent observation. Use of their application can enhance surveillance and can also be used to identify clinically relevant changes earlier in the process, but nursing practice needs to consider measurement validity, interpretation, privacy and the potential for over-collection of data if there is no clear clinical relevance (Wilson, 2017). The Internet of Things (IoT) is an extension of this connectivity, connecting sensors, devices, patients and clinical information systems. When it comes to basic nursing care, connected technologies

can support the monitoring process and even automate parts of data collection, but the value of the produced data is limited if it is not transferred to timely and suitable nursing action (Mieronkoski et al., 2017).

Digital therapeutics expand the scope of technology from detection to intervention. Digitalised care can be structured through software-based therapeutic approaches and provide new opportunities for nurses to recommend, reinforce and assess digitally mediated care. Nurses must evaluate digital interventions using the same criteria as other therapeutic interventions, taking into account evidence of effectiveness, patient suitability, safety, adherence and the potential for interaction with existing pathways of care (Ferguson et al., 2018). Digital competence is more than being used to technology; it is about making critical judgments about the clinical value and meaningful impact of a digital intervention for a specific patient. Connected caring also impacts how nurses deal with evidence. With remote monitoring, patient data streams are created which must be selectively captured, interpreted, contextualized, and tied to clinical decisions. Research with nurses working with remotely monitored patients shows that significant “data-work” is necessary to discover what information is relevant, to correlate digital information with patient-specific conditions and to translate measurements into personalized interventions (Grisot et al., 2019). Interoperable information systems, clinically relevant data presentation and workflows that don't overload the information worker and provide opportunities for professional interpretation are essential for effective connected nursing.

Digital health has the potential to transform nursing from episodic to continuous, connected, and more personalized care delivery. It is not just about gathering more data, but it's about empowering nurses and patients to turn trusted digital information into actionable, timely, and evidence-based practices. The connected digital health pathway in nursing (Figure 2) shows how these concepts are understood and translated by the nurse as virtual care, patient-generated data, continuous monitoring, connected infrastructure, digital intervention, nursing data interpretation, and personalized nursing outcomes.

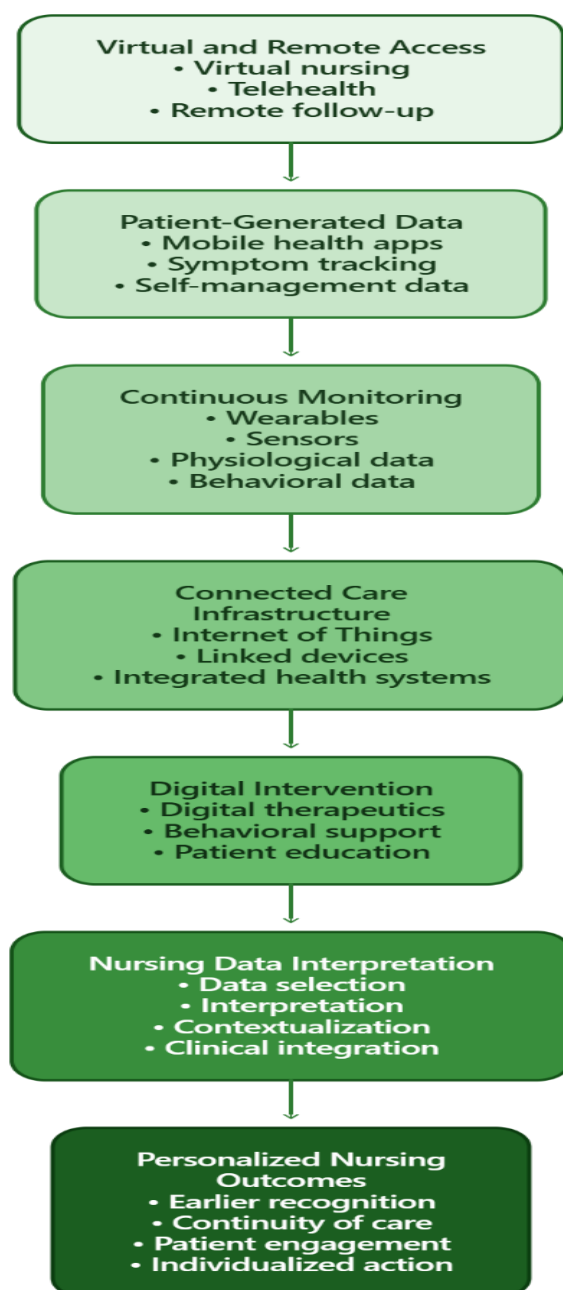


Figure 2. Digital Health and Connected Nursing Care Pathway

4. Genomic Medicine and Precision Nursing

Genomic medicine is moving away from the traditional clinical parameters that are visible on the surface and moving towards a more personal understanding of predisposition to illness, response to treatment and prevention. Nurses are involved in screening, assessment, education, care coordination and long-term follow-up, and the knowledge of genomics has become increasingly important in the day-to-day practice of the nurse. The integration of genomics into nursing practice is not yet uniform and varies across countries in the professional competency, education, and incorporation of genomics into systems of care (Calzone et al., 2018). Thus, building genomic competence among healthcare professionals is integral to interpreting the genetic information, communicating its implications, and using the genetic information appropriately in patient management (Campion et al., 2019). Pharmacogenomics is one of the most actionable aspects of precision nursing. Genomic data can be used to help inform personalized treatment decisions because genetic variation can affect drug metabolism, effectiveness, and risk of side effects. Because advanced practice nurses (APNs) can access and utilize pharmacogenomic evidence in a variety of ways, including therapeutic decisions, response monitoring, and patient education, capacity and utilization rely on knowledge, confidence, access to testing, and integration of genomic evidence into clinical workflows (Fulton et al., 2024). This function is especially important for patient safety, as it can be used alongside traditional medication history, comorbidities, treatment response, and other factors to determine genomic evidence.

Another significant link between genomics and nursing practice is hereditary risk assessment. Nurses are involved with taking family histories, identifying disease patterns, offering education on risk-related issues, and arranging referral to specialised genetic services. Oncology exemplifies this role; nurses are often involved with people and families who have a genetic predisposition to cancer, and they are faced with highly complex decisions regarding testing, prevention, and surveillance. Results from the literature regarding oncology nurses' knowledge, attitudes, and practices reveal ongoing gaps that may impact their capacity for optimal care of patients at high risk for hereditary cancer (Hébert et al., 2022). In addition to the genetic sequence, precision nursing must also have a wider biological lens. Biological factors are important determinants of health trajectories and are part and parcel of nursing science and individualized assessment, as they interact with microbial, metabolic, environmental, behavioural, and physiological processes (Ferranti et al., 2017). The novel molecular candidates and biological relationships that can be explored in silico with the help of advances in computational biology further extend this landscape. Computational molecular approaches for generating candidate-level evidence that can be gleaned for future precision prevention or therapeutic research studies to accelerate research on hospital-based infections, as illustrated in research that identified variants of the antimicrobial peptide against *Helicobacter pylori*-associated gastric cancer (Sahrawat & Sushant, 2026).

Combining genomic data with artificial intelligence and digital clinical data opens up new possibilities for precision nursing. In complex scenarios, intelligent decision support systems can integrate patient information from various sources to help identify risks and manage patients on an individual basis. Intelligent decision-support systems have been investigated in dementia care, where substantial clinical heterogeneity creates opportunities for their use in assessment, diagnosis, monitoring, management, and care support (Andargoli et al., 2024). Such integration is clinically validated and interpretable, and can be applied to other precision-nursing systems in the future, such as using genomic susceptibility and clinical history together with biomarkers, digital phenotypes, and longitudinal observation.

Individual risk assessment, pharmacogenomics, identification of hereditary disease and multidimensional biological information integration are all potential ways genomic medicine can reinforce precision nursing. Advanced genomic skills, proven decision-support tools and a thoughtful approach to the meaning of molecular data in the patient-specific clinical setting are essential to clinical translation. Table 1 provides a summary of the main technologies of AI, digital health and genomics that are significant to evidence-based nursing, with their function in the clinical setting, their nursing value and main limitations.

Table 1. Core Technologies Supporting Evidence-Based Nursing Practice

Technology	Main Nursing Application	Data/Information Used	Nursing Value	Key Limitation
Predictive AI	Risk prediction	Clinical variables	Earlier deterioration detection	Validation variability
Clinical decision support	Assessment and prioritization	EHR and patient data	Faster evidence-informed decisions	Automation dependence
Natural language processing	Nursing-note analysis	Unstructured records	Extracts hidden clinical information	Documentation variability

Generative AI	Documentation and summaries	Clinical knowledge data and	Reduces information burden	Inaccurate outputs
Remote monitoring	Continuous assessment	Wearables sensors and	Longitudinal surveillance	Data overload
Genomic medicine	Precision assessment	Genetic biomarker data and	Individualized risk profiling	Genomic competency gaps
Pharmacogenomics	Medication management	Genotype–drug information	Safer individualized therapy	Limited clinical integration

5. Transforming Mental Health and Aged Care

AI is unlocking new opportunities in mental health nursing by helping to identify issues earlier, monitor them on an ongoing basis and provide more tailored support and paths forward. Current applications encompass symptom classification, diagnostic support, relapse prediction, treatment recommendation and automated tracking of behavioral/clinical changes. There is systematic evidence indicating potential for AI applications in diagnosis, monitoring and intervention; however, there is variability in datasets, validation procedures, and clinical implementation to limit confidence in application in routine use (Cruz-Gonzalez et al., 2025). However, nursing application of AI must not be a substitute for direct assessment, therapeutic communication and contextual understanding of the patient, but rather a complement to it. Digital phenotyping additionally supplements and expands the realm of mental health evaluation, allowing for the assessment of behavioural patterns across mental states through passive or active data gathered from smartphones, wearables and other connected devices. The mobility, sleep, communication behavior, activity, and interacting with devices can offer longitudinal measurements of change that may not be observed at episodic clinical visits. The use of digital phenotyping has been suggested to be useful for the monitoring of heterogeneity of mental disorders, but there are some limitations, including in the approaches to phenotyping, privacy concerns, and the lack of clarity regarding clinical thresholds (Bufano et al., 2023).

Telemental health is an emerging paradigm in the delivery of psychological and psychiatric services that is garnering increasing interest as a means of improving access to services outside of the physical clinic setting. Remote consultation will help to ensure continuity, overcome geographical limitations and support provision of follow-up care where this may be limited for patients. Systematic evidence suggests telemental health can be an effective substitute in certain contexts, especially when enhanced by the proper infrastructure and clinical protocols (Langarizadeh et al., 2017). Digital cognitive behavioral therapy platforms offer a further layer by providing structured psychological treatments, and providing nurse monitoring of adherence, symptoms and progress. Content and nursing follow-up can also be tailored through the use of AI platforms, but the efficacy will depend on clinical supervision, patient engagement, and thorough assessment (Gadda & Paul, 2026).

There is also a parallel need for technologies to be developed that can identify a person's vulnerability before they become vulnerable to significant functional decline, in aged care. The information from wearable sensors of gait, mobility, activity and others that are linked to frailty could be used to support gerontological nursing assessment objectively. In vulnerable older adults, sensor-derived measures have been found to be useful in assessing frailty and could potentially aid in earlier identification of those that need more monitoring or intervention (Razjouyan et al., 2018). These technologies have special applications when traditional assessment methods only capture intermittent functional status changes. Smart-home systems can also be used to make modifications in the living environment to improve its safety and independence for the aging in place person, as well as enhance the accessibility. When designed for older adults, connected sensors and environmental controls, including assistive technologies, can be used to help identify hazards, assist in daily life tasks, and minimize the need for institutional care. Responding to these issues, the evidence on smart-home modification highlights the importance of considering the diversity of functional abilities of ageing people, smart-home autonomy, privacy, and adaptability and usability. (Ma et al., 2022)

The capacity of AI, digital phenotyping, telehealth, wearables and smart-home technologies to enhance mental health and aged-care nursing services can be reinforced by facilitating earlier detection, constant assessment, tailored assistance and accessibility. They are dependent on clinical validation, human relationships, autonomy, and professional nursing judgment, as well as maintaining patient engagement and ethical data usage. The overall contribution of AI and digital technologies to mental health and aged care is summarised in Figure 3 as the technology-assisted assessment, monitoring, and personalised nursing interventions that enable safer and more person-centred mental health and aged care outcomes.

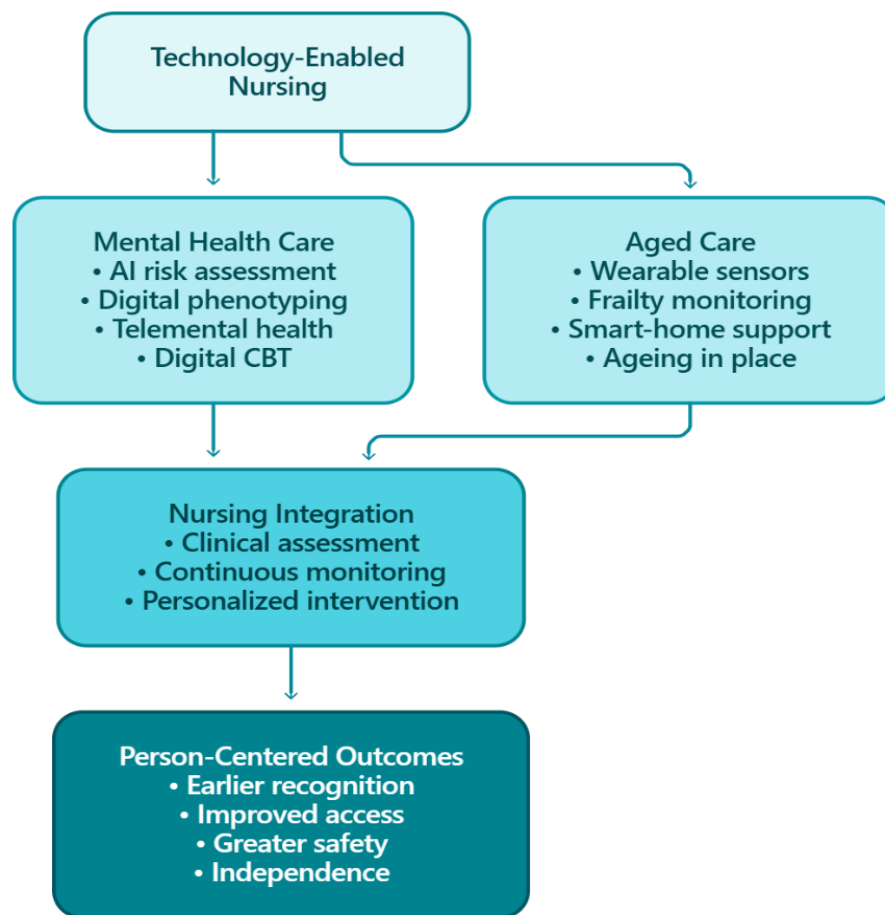


Figure 3. Technology-Enabled Nursing in Mental Health and Aged Care

6. Advancing Public Health and Patient Safety

AI contributes to expanding the analytical ability of public health, enabling prediction and prevention, population stratification, and an increasing form of personalized intervention. It is not just about prediction, prevention, personalization, engagement, precision or public health, it's about the links between them. This integration may facilitate the rapid detection of risks, the allocation of preventive resources and the customization of interventions to the characteristics of the population by keeping connections between individual and community health needs (Khalifa & Hussein, 2026). Perhaps more than any other, an application of epidemic intelligence is the ability of AI-driven early-warning systems to ingest various types of data streams and identify early indicators of infectious disease activity, which could help facilitate timely recognition and response to outbreaks (MacIntyre et al., 2023). Precision approaches can further enhance the public health nursing practice to incorporate genomic information, biomarkers, digital health data and traditional clinical evidence. This multi-dimensional view allows risk assessment to shift from an average across the population to more targeted prevention and interventions. Precision nursing frameworks highlight the value of synthesizing these information sources to guide clinical and preventive strategies, and improve linking of the population-level evidence to the individual health pathway (Harrigan, 2026). These could assist nurses in the better recognition of vulnerable groups and facilitate screening, education, surveillance, and preventive measures for these groups.

Another significant area where digitally enabled evidence can impact on nursing practice is patient safety. Giving medicines involves a knowledge of the correct information, understanding, clinical judgment, and an awareness of patient-specific risks. The use of AI in education is being considered to enhance nurses' skills in medication administration at safe levels, by using adaptive learning, simulation, feedback, and decision-oriented training; however, the evidence regarding their educational effectiveness and impact on clinical practice is emerging (de Oliveira et al., 2026). Translational health informatics fills the gap between these innovations and clinical practice by transforming health data and health informatics knowledge into actionable tools and resources for health services delivery and decision-making (Rissanen et al., 2025). Early-warning systems serve as examples of how data-driven technologies can have an impact at the patient's bedside. These systems combine physiological and clinical signs and symptoms to detect deterioration and trigger escalation before adverse events reach the serious stage. Research investigating the impact of EWS suggests that their implementation can affect both the performance of the nurses and the management of patients with deterioration in their condition in the ward, however, the impact varies depending on the design of the EWS, how the alerts are responded to, staff buy-in and the context in which the alert is being generated (Lee et al, 2020). Therefore, it is important that they are effective not just in terms of knowing what to predict, but also in knowing what to do when they are alerted and responding in an evidence-based way.

The ultimate product of public health and patient safety is a coordinated response to nursing technology. Nursing's role in safety is broad and encompasses surveillance, risk identification and assessment, medication management,

communication, escalation of care, patient education and prevention of avoidable harm. There is a great potential to strengthen these functions with AI and connected information systems, but it is important that such technologies reinforce and do not depend on the safety functions that already exist (Alqhtani et al., 2025). With the use of digital support, it is essential that clinical governance, data quality, interoperability and clear accountability remain in place to ensure that digitized decision-making ultimately results in safer care.

By linking population surveillance with frontline patient-safety practices, AI, precision health, and informatics can help identify risks more early and accurately and work towards preventing them. They can affect the ability to transform consistent data into prompt nursing action via validated systems, successful clinical workflows and accountable human oversight. As seen in Table 2, the same set of technologies can be used to achieve a variety of nursing goals in cross-domain applications, from monitoring behavior to ageing in place, to tracking populations to preventing adverse events.

Table 2. Technology-Enabled Applications Across Priority Nursing Domains

Nursing Domain	Main Technologies	Principal Application	Expected Nursing Benefit	Key Concern
Mental health	AI, digital phenotyping	Diagnosis and symptom monitoring	Earlier risk recognition	Privacy
Mental health	Telehealth, digital CBT	Remote intervention	Improved access and follow-up	Engagement
Aged care	Wearables	Frailty monitoring	Early functional-risk detection	Measurement reliability
Aged care	Smart-home systems	Ageing-in-place support	Greater independence	Autonomy and privacy
Public health	AI surveillance	Epidemic early warning	Faster population response	Data quality
Precision public health	Genomics, biomarkers	Risk stratification	Targeted prevention	Equity
Patient safety	Early-warning systems	Deterioration detection	Timely escalation	Alert burden
Medication safety	AI, pharmacogenomics	Safer medication decisions	Reduced preventable harm	Governance

7. Implementation Challenges, Governance, and Future Directions

Implementation challenges extend beyond algorithmic performance, with AI integration in nursing practice constrained by technological, organizational, ethical, and workforce-related factors. Even at the point of technology showing clinical potential, limited infrastructure, low data interoperability, inconsistent data quality, low AI proficiency, disruption to workflows and questions about professional responsibilities can hinder implementation. Evidence that is nurse-centred also points to issues of organizational readiness, resource availability, trust, and the ability to integrate AI tools into existing care models without adding to the workload or disrupting the clinical workflow (Qutishat & Shakman, 2025). Sustainable adoption, therefore, needs to be mediated by implementation strategies that take into account the technological capability, clinical usability, and the organizational context. Specific governance considerations are crucial as AI-driven nursing decisions can impact patient care, prioritization, and assessment, as well as patient safety. Ethical issues encompass privacy, confidentiality, informed consent, transparency of the algorithm, bias, accountability and unclear responsibility in cases of negative results due to automated suggestions. Nursing management should define and establish governance structures to regulate the use of AI, specifications and responsibilities for oversight, escalation pathways, and methods for evaluating the performance of the system after the implementation of AI (Katebi et al., 2025). The protections are critical to help preserve professional accountability and ensure that the logic of clinically important choices is clear. Nurses' acceptance of AI is influenced by their knowledge of the technology and their beliefs that it is beneficial, effective, and applicable to clinical practice. Favorable factors reported to support the adoption of AI are its potential as a clinical decision support tool, availability of appropriate training, organizational support, and accessibility of technology, while the perception of a decrease in human interaction, resistance to change, and lack of knowledge can act as barriers to its adoption (Ramadan et al., 2024).

In high acuity settings, where decisions are required to be made, incorporating physiological data with rapidly changing clinical circumstances, the human factor becomes particularly important. While AI can enhance surveillance and information processing in critical care environments, over-reliance on automation and lack of integration could lead to a decrease in situational awareness, interpersonal problem-solving, or interpretation. Implementing effectively should not diminish the clinical expertise, empathy and contextual reasoning of the nurse, but rather support professional judgment, using computational tools (Hassan & El-Ashry, 2024). Another challenge of data governance is that AI systems rely on vast amounts of clinical data, which can perpetuate existing inequalities or leave certain groups underrepresented. Data provenance, representativeness, secondary data use, privacy protection, algorithmic fairness and means for identifying discriminatory outputs are important aspects of ethical nursing practice. Nursing practitioners should be represented in governance and data-ethics committees, as they have a significant amount of clinical information and are directly involved in how the algorithms are transformed into a patient care (Dunlap & Michalowski, 2024).

Interoperable platforms need to be developed to merge electronic health records, patient-generated data, wearable measurements, genomic information, biomarkers, and social determinants into clinically interpretable nursing workflows

in the future. Prior to scaling up to high-risk uses, multicenter validation, real-world effectiveness studies, an economic evaluation, and standardized reporting should be priorities. It is highly recommended that AI, data science, digital health, genomics, algorithmic appraisal and ethical reasoning be integrated together as a whole rather than as separate subjects into the nursing curriculum. Future systems need to also be explainable, continuously performing audited, diverse and representative datasets, participatory and involve nurses and patients in design. To conclude, it will be important to use nurse-led research to evaluate the impact of technology on nursing-sensitive outcomes and not just on computation. The long-term vision is to have a learning health system where clinical data continuously improve the evidence and validated evidence increasingly guides the nursing decisions in a personalized manner. As well as technological sophistication, governance, workforce capability, ethical safeguards and clinical integration are crucial to the successful transformation of the technological aspects of nursing. Moving forward, validated, interoperable, equitable, and human-centered systems that will enhance nursing judgment and show a measurable improvement in patient outcomes should be prioritized. Table 3 summarizes the main barriers to technology-enabled nursing, and links each barrier to an implementation need and future research priority.

Table 3. Implementation Priorities for Technology-Enabled Nursing

Challenge	Clinical Risk	Implementation Requirement	Future Priority
Poor interoperability	Fragmented information	Integrated digital systems	Multimodal platforms
Variable data quality	Unreliable outputs	Data governance	Standardized datasets
Algorithmic bias	Unequal care	Fairness assessment	Representative populations
Limited AI literacy	Misinterpretation	Workforce training	AI and data competencies
Privacy concerns	Loss of trust	Secure governance	Ethical data frameworks
Low transparency	Weak accountability	Explainable systems	Explainable AI
Workflow disruption	Reduced usability	Nurse-centered design	Participatory development
Limited validation	Unsafe adoption	Prospective evaluation	Multicenter studies

8. CONCLUSION

Artificial Intelligence, digital health and genomic medicine are working together to transform evidence-based nursing through more predictive, connected and individualised care. Together, they have been demonstrated to benefit mental health, aged care, public health, and patient safety, including when used for early identification of risk, continual tracking, remote care, medication safety, and precision-based decision-making. AI brings analytical and decision support tools, digital health brings care beyond the traditional clinical setting, and genomics brings information about the individual's biology, which can be valuable in the process of assessing risk and designing therapeutic strategies. However, their integration should not be a replacement for professional nursing judgment. It remains essential that data are reliable, algorithms are transparent, they are interoperable, they are governed ethically, workers are competent and that person-centred care remains preserved. Equity is further at the heart of the matter because poorly designed implementation of electronic access and inclusion, genome underrepresentation, and algorithmic bias could exacerbate inequities. Therefore, a focus on validated, explainable, interoperable, and human-centered systems that will enhance clinical reasoning and measurable nursing-sensitive outcomes must be incorporated into future nursing practice. The ultimate goal of the long-term vision is precision nursing using technology intelligence to augment professional skills, patient preferences, and accountable clinical decision-making.

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