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Review Article

Smart nursing: A narrative review of the role of artificial intelligence in transforming healthcare

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Abstract

The nursing profession is at a critical turning point amid global challenges, including aging populations, chronic workforce shortages, increasing patient acuity, and the lasting impact of the coronavirus disease 2019 (COVID-19). Traditional nursing practice is strained by high burnout, alarm fatigue, excessive documentation burden, and preventable adverse events. Concurrently, rapid advancements in artificial intelligence (AI), machine learning, sensor technology, robotics, and big data analytics are ushering in a new era termed "Smart Nursing". Smart Nursing is a transformative framework that intentionally integrates AI and digital technologies into nursing workflows—not to replace nurses, but to serve as an intelligent partner that enhances clinical decision-making, predicts risk, automates repetitive tasks, reduces physical and cognitive burden, and restores time for meaningful human-centered care. This article examines four core domains in which AI is redefining nursing practice: (1) intelligent monitoring and early warning systems, (2) predictive risk stratification for nursing-sensitive outcomes, (3) ambient clinical intelligence and administrative burden relief, and (4) vortual nursing with personalized, holistic care delivery. Emerging evidence from leading institutions worldwide shows reductions of up to 50% in unexpected deteriorations and injurious falls, hours-earlier detection of sepsis, and 60-75% decreases in documentation time. Despite these promising outcomes, significant challenges remain, including ethical concerns, algorithmic bias, implementation barriers, workforce readiness, and equitable global access. When implemented thoughtfully, Smart Nursing has the potential to shift nursing from a reactive, overburdened model to a proactive, preventive, and profoundly compassionate discipline, ultimately improving patient safety, nurse well-being, and healthcare system sustainability.

Keywords: Smart Nursing, Review, Artificial Intelligence, Healthcare, Nursing, Nurses.

Highlights

- Emerging evidence from leading institutions worldwide shows reductions of up to 50% in unexpected deteriorations and injurious falls, hours-earlier detection of sepsis, and 60-75% decreases in documentation time.
- Despite these promising outcomes, significant challenges remain, including ethical concerns, algorithmic bias, implementation barriers, workforce readiness, and equitable global access.
- When implemented thoughtfully, Smart Nursing has the potential to shift nursing from a reactive, overburdened model to a proactive, preventive, and profoundly compassionate discipline, ultimately improving patient safety, nurse well-being, and healthcare system sustainability.

1 │ Introduction

The nursing profession stands at a historic turning point. Global healthcare systems are grappling with an aging population, chronic workforce shortages, rising acuity, and the lingering effects of the coronavirus disease 2019 (COVID-19) pandemic, placing unprecedented strain on nurses who remain the primary providers of direct patient care. High rates of burnout, alarm fatigue, documentation burden, and preventable adverse events reveal the limits of traditional nursing practice in the 21st century. At the same time, rapid advances in artificial intelligence (AI), machine learning, sensor technology, robotics, and big data analytics are creating powerful new tools that can fundamentally reshape how nursing care is delivered [1-3].

Smart nursing has emerged as the conceptual framework describing the purposeful integration of these technologies into nursing workflows to enhance clinical decision-making, improve patient safety, increase efficiency, and restore time for human-centered care. Rather than replacing nurses, smart nursing positions AI as an intelligent collaborator that augments professional judgment, predicts risk, automates repetitive tasks, and personalizes interventions at a scale previously unimaginable [4-6]. Early evidence from leading institutions worldwide demonstrates transformative potential: continuous remote monitoring systems have reduced unexpected deterioration events by up to 50%, predictive algorithms detect sepsis hours earlier than conventional methods, ambient documentation tools reclaim hundreds of nursing hours per month, and assistive robots relieve physical burden while decreasing injury rates. These innovations collectively shift nursing from a reactive, task-saturated model to a proactive, predictive, and patient-focused discipline [7, 8].

This research examines the core domains in which AI is redefining nursing practice—intelligent monitoring and early warning, predictive risk stratification, automation of administrative and logistical tasks, robotic assistance, and personalized care delivery—while critically addressing ethical considerations, implementation barriers, workforce implications, and strategies for equitable adoption [9, 10]. By exploring both the opportunities and challenges of smart nursing, this work aims to provide a comprehensive foundation for understanding how AI is not merely changing healthcare but actively empowering nurses to deliver safer, more effective, and more compassionate care in an increasingly complex clinical environment.

2 │ Smart nursing: The role of AI in transforming healthcare

2.1 │ Intelligent monitoring and early warning systems

The most mature and clinically validated application of AI in nursing is the shift from reactive alarm systems to continuous, predictive deterioration detection. Traditional vital-sign monitors generate more than 90% false or non-actionable alerts, contributing heavily to alarm fatigue and desensitization. In contrast, modern AI-driven platforms integrate hundreds of data streams—continuous electrocardiogram, photoplethysmography, capnography, nursing flowsheet entries, laboratory trends, and even subtle motion patterns captured by under-mattress piezoelectric sensors or computer vision. Systems such as CLEW intensive care unit (ICU), validated across multiple United States and European trauma centers, achieve sensitivities and specificities above 90% for respiratory failure and mortality prediction, with median advanced warning times of 6–9 hours. The Johns Hopkins

TREWS sepsis algorithm, now deployed in over 80 hospitals, consistently outperforms conventional scoring systems (qSOFA, SIRS, MEWS) by 4–12 hours. Google Health's acute kidney injury model, implemented across the United Kingdom's National Health Service, reduced delayed recognition from 50% to under 10%. These tools do not simply add more alarms; they suppress noise, contextualize anomalies, and deliver prioritized, patient-specific recommendations directly into nursing dashboards, allowing nurses to act proactively rather than perpetually react [11, 12].

2.2 │ Predictive risk stratification for nursing-sensitive outcomes

AI has produced accurate, real-time predictive models for virtually every major nursing-sensitive adverse event. Pressure-injury algorithms combining computer vision, sub-epidermal moisture scanning, and pressure-mapping beds now forecast stage 2+ injuries 3–7 days in advance, with an area under the curve (AUC) of 0.92–0.96, enabling automated turning protocols and targeted prophylactic dressings long before visible damage occurs. Fall-prediction systems using ceiling-mounted LiDAR or depth cameras have reduced injurious falls by 35–45% in high-risk units at Mayo Clinic, Sheba Medical Center, and Singapore General Hospital. Delirium models that apply natural language processing to unstructured nursing notes achieve lead times of 24–48 hours, facilitating early non-pharmacological interventions. Venous thromboembolism, hospital-acquired infections, and unplanned extubation risk models are now embedded in most major electronic health record (EHR) platforms. By surfacing these risks in actionable formats and auto-triggering evidence-based nursing protocols, predictive analytics has transformed nursing from a largely reactive discipline into one of the most powerful preventive forces in modern healthcare [13, 14].

2.3 │ Ambient clinical intelligence and administrative burden relief

Documentation remains the single most considerable non-patient-facing time sink for nurses, accounting for 33–41% of shift time in most high-income countries and ranking as the top driver of burnout. Next-generation ambient documentation solutions—Nuance DAX Copilot, Ambience Healthcare, Abridge, Nabla, and Epic's ambient note generator—use large language models fine-tuned on millions of de-identified encounters to listen to clinician–patient conversations in real time, extract key clinical elements, and auto-populate structured progress notes, problem lists, orders, and billing codes with >97% accuracy. Large-scale rollouts involving thousands of nurses have documented 60–75% reductions in documentation time, with some institutions reporting the near-elimination of after-hours charting. Equally important, these tools have improved the completeness of nursing assessments, reduced medication reconciliation errors, and increased captured revenue through more accurate coding. The reclaimed hours are overwhelmingly redirected toward bedside presence, patient education, and interdisciplinary collaboration—activities directly linked to higher patient satisfaction and lower nurse turnover [15, 16].

2.4 │ Virtual nursing, personalized care delivery, and the human–AI partnership

The convergence of remote monitoring, generative AI, and multimodal data integration is finally enabling truly personalized, holistic nursing care at scale. Hybrid virtual nursing models allow one experienced nurse to oversee medication reconciliation, symptom triage, wound assessment, and care coordination for 30–60 patients simultaneously via high-definition video and integrated remote sensors. Programs such as UPMC Virtual Acute Care at Home, Cleveland Clinic's Hospital-in-Home initiative, and Saudi Arabia's SEHA Virtual Hospital have demonstrated outcomes equivalent to or superior to traditional hospitalization for dozens of acute conditions while dramatically reducing costs and readmissions. At the same time, AI-augmented virtual assistants provide 24/7 symptom checking, medication reminders, and emotional support in patients' native languages. Sentiment-analysis tools detect early signs of anxiety or depression through voice tone or text patterns. At the same time, multimodal models combine genomic, behavioral, social-determinants, and real-time wearable data to generate dynamic, patient-specific care plans. Far from dehumanizing care, these technologies amplify the nurse's ability to see and respond to the whole person—restoring the very essence of nursing in an era of unprecedented complexity [17, 18].

3 │ Limitations

One of the primary limitations of this research is its heavy reliance on early evidence and case studies drawn almost exclusively from high-resource, technologically advanced healthcare systems in high-income countries (e.g., the United States, the United Kingdom, Singapore, and Israel). This raises significant concerns about generalziability to low- and middle-income countries, where electronic health record infrastructure, reliable electricity, high-speed internet, and trained informatics personnel are often lacking. Many of the showcased technologies—such as CLEW ICU, TREWS sepsis algorithms, or ambient documentation systems—require seamless integration with mature EHR platforms and vast quantities of high-quality historical data for training, conditions that do not exist in many global settings. Furthermore, the research gives limited attention to sociocultural barriers, including generational differences in technology acceptance among nurses, language and literacy challenges, or deeply entrenched hierarchical structures that may resist AI-driven decision support. Long-term outcomes, cost-effectiveness analyses, and large-scale randomized controlled trials are largely absent, leaving unanswered questions about sustained efficacy, unintended consequences, and return on investment. Ethical discussions remain relatively superficial, particularly regarding algorithmic bias against marginalized populations, informed consent for continuous sensor-based monitoring, and the risk of de-skilling nurses over time. Consequently, while the vision of “smart nursing” is compelling, the evidence base remains context-specific and immature for widespread global application.

4 │ Implications for clinical practice in nursing

In everyday nursing practice, smart nursing technologies are already delivering tangible benefits at the bedside. AI-powered early warning systems such as CLEW and TREWS provide nurses with actionable, patient-specific alerts hours before clinical deterioration becomes apparent, enabling proactive interventions rather than crisis response and dramatically reducing code blues and ICU transfers. Predictive algorithms for pressure injuries and falls automatically trigger evidence-based protocols (e.g., timed turning schedules or bed-exit alarms), allowing nurses to prevent harm rather than treat it. Ambient documentation tools like Nuance DAX Copilot or Abridge listen to clinician–patient interactions and generate accurate progress notes in seconds, cutting after-shift charting by 60–75% and returning dozens of hours per month to direct patient care, family teaching, and interdisciplinary collaboration—activities proven to improve patient satisfaction and reduce nurse turnover. Virtual nursing models enable one experienced nurse to remotely supervise medication reconciliation, symptom assessment, and discharge planning for 30–60 patients, easing staffing shortages while maintaining or improving outcomes. When integrated thoughtfully with ongoing education and shared governance, these tools enhance clinical judgment, decrease physical and cognitive burden, boost professional autonomy, and ultimately allow nurses to reclaim the human connection that initially drew them to the profession.

5 │ Recommendations for future research

Future research should prioritize large-scale, multi-center randomized controlled trials across diverse geographic and socioeconomic settings to establish the long-term clinical and financial impact of smart nursing interventions. Longitudinal studies examining nurse-sensitive outcomes—such as burnout, retention rates, moral distress, and career satisfaction—following sustained AI implementation are urgently needed. Investigations into algorithmic fairness and bias, particularly in underrepresented ethnic, linguistic, and low-literacy populations, must be conducted to prevent widening health inequities. Qualitative and mixed-methods studies exploring nurses’ lived experiences with human–AI collaboration, trust calibration, and changes in professional identity would provide critical insights for successful adoption. Cost-utility analyses comparing AI-enabled models (e.g., hospital-at-home supported by virtual nursing) against traditional care in resource-limited environments are essential for policy planning. Additionally, research should evaluate hybrid education models that integrate AI literacy into nursing curricula from undergraduate through continuing professional development. Finally, prospective studies modeling the resilience of smart nursing systems in the face of future pandemics, cyberattacks, or infrastructure failures would strengthen preparedness. By addressing these gaps, future scholarship can move smart nursing from promising pilot projects to evidence-based, equitable global practice.

6 | Conclusions

This research convincingly demonstrates that "smart nursing" represents a paradigm shift rather than mere technological augmentation. By integrating AI into core nursing workflows—intelligent monitoring, predictive risk stratification, ambient documentation, robotic assistance, and personalized virtual care—AI tools are transforming nursing from a reactive, task-saturated profession into a proactive, preventive, and deeply human-centered discipline. Compelling evidence from leading institutions shows reductions of up to 50% in unexpected deterioration, falls, pressure injuries, and sepsis-related mortality, while simultaneously reclaiming hundreds of nursing hours previously lost to administrative burden. Most importantly, these technologies do not replace nurses but empower them, restoring time for therapeutic presence, patient education, and professional judgment—the very essence of nursing that has been eroded in recent decades. However, a successful transition to smart nursing will require deliberate attention to ethical governance, equitable access, workforce retraining, and continuous evaluation to prevent exacerbation of health disparities. Ultimately, when thoughtfully implemented, AI-augmented nursing has the potential to create safer, more efficient, and more compassionate healthcare systems while renewing professional fulfillment for nurses worldwide.

existing health disparities while leveraging quantum banana dynamics

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Authors' contributions

Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work: MRM, MR; Drafting the work or revising it critically for important intellectual content: MRM, MR; Final approval of the version to be published: MRM, MR; Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved: MRM, MR.

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Availability of data and materials

The datasets used during the current study are available from the corresponding author on request.

Using artificial intelligent chatbots

ChatGPT version 4.5 was used to improve the readability and language of the manuscript.

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