

Nick Nijkamp
MClInNg, GCTE, BN (Dst.), RN,
AFHEA, MACORN
PhD Candidate,
Central Queensland University

Erin Wakefield
MN, Grad Cert Clinical Simulation,
Grad Cert Perioperative Nursing,
RN, MACORN
PhD Candidate, Monash University

The future of artificial intelligence in perioperative nursing

Artificial Intelligence (AI) stands poised at the forefront of health care innovation, promising transformative advances across multiple domains. In the field of perioperative nursing, where precision, efficiency and patient safety are paramount, the integration of AI holds immense potential to revolutionise clinical practice.

Defined as the imitation of human acumen, AI enables computers to perform tasks 'that typically require human intelligence, such as decision-making, problem-solving and learning'¹. This editorial explores the current landscape of AI, future prospects for AI in perioperative nursing and the ethical imperatives that accompany this transformative paradigm shift.

As technology continues to evolve rapidly, perioperative nursing stands to benefit from AI-driven solutions that enhance diagnostic accuracy, optimise patient outcomes and streamline workflows. The possibilities for innovation are vast, from AI-assisted decision-making algorithms to predictive analytics and virtual reality training simulations. However, alongside these opportunities lie challenges that demand careful consideration, including privacy concerns, algorithm biases and the ethical implications of augmenting human expertise with AI.

Current landscape of artificial intelligence

Integration of AI is gaining momentum in the perioperative nursing landscape, albeit at varying degrees across different health care settings. Notably, robotic-assisted surgery has been widely used for some time². Robotic surgical systems, equipped with advanced

imaging and navigation capabilities, enable surgeons to perform minimally invasive procedures with enhanced precision and dexterity. Perioperative nurses play a crucial role in supporting these procedures, ensuring the seamless integration of robotic technology into the surgical workflow and optimising patient outcomes². Other frontiers in robotic surgery include research into and development of autonomous surgical robots³. Some of these use AI models to give them the ability to solve problems, recognise words and objects, and make decisions.

Much work currently being undertaken using AI has significant application in the domain of pre-operative assessment for the identification of patients who are at risk⁴. AI leverages large datasets in predictive analytics and machine learning to provide practical solutions in the provision of proactive, patient-centred care.

'Predictive analytics' is used for forecasting based on previous history. 'Machine learning' is a subfield of AI and one type of modelling used in predictive analytics where engineers 'teach' the computer to associate data with specific outcomes⁵. Algorithms are applied to data and identify patterns that are used to create models that can be used to individualise patient management based on their personal profile⁶. While both

predictive analytics and machine learning have a basis in applied mathematics, predictive analytics is older and more likely to have a reporting purpose while machine learning focusses on modelling and has a wider range of purposes⁷.

Using data such as patient demographics, medical history, diagnostic tests and electronic medical record (EMR) evidence, clinicians are able to make informed decisions and optimise surgical outcomes. Machine learning methods hold the potential for identifying frail patients and patients at risk of complications, mortality and admission to the intensive care unit (ICU)^{8,9}.

Decision support systems powered by AI are being employed to assist perioperative clinicians in real-time clinical decision-making⁵. Machine learning models provide evidence-based recommendations regarding operating decisions, surgical procedures, modifiable risk factors and post-operative care protocols⁵. Further, this technology is being used to predict and prevent medication errors⁶ and even predict prolonged lengths of stay for specific patient cohorts¹⁰. Augmentation of clinicians' expertise with AI-driven insights has the potential to enhance patient safety and streamline care delivery processes such as discharge planning and staffing.

In perioperative nursing education, preparation for rare events has paved the way for AI use across multiple platforms. Skills and knowledge have traditionally been acquired from the written form and supervised practice. Harnessing AI has led to advances such as tablet-based digital simulation for learning surgical instrumentation¹¹. Here in Australia, a virtual reality simulation is in development for experiencing the instrument nurse role during

a ruptured abdominal aortic aneurysm¹². Participating in online simulation using AI-generated virtual patients is already embedded into clinical use. This platform provides an opportunity for immediate feedback to the clinician, as the virtual patient can learn and react to the nurses' decisions in real time¹.

Moving into the tertiary education sector, AI is also used in mannequins for simulation-based learning¹³. Generative AI is used by educators to create realistic patient scenarios¹⁴ and devise novel educational activities. AI platforms such as ChatGPT (Chat Generative Pre-trained Transformer) may also be used by students, for example, if a student requires further information on a specific concept¹⁵. Some students also use AI when writing assignments, and this raises concerns about academic integrity¹⁴.

Future directions

Incorporating AI is poised to revolutionise our profession. For nurses working at the patient-care interface, AI can streamline perioperative workflows allowing nurses to focus on higher-value activities. From administrative duties like scheduling and documentation to clinical tasks such as medication management and wound care, AI-driven automation tools could be developed to enhance efficiency, reduce errors and optimise resource allocation. Let us delve into some future predictions for AI that may impact perioperative nursing.

AI's potential extends to logistical support; for example, robots could retrieve items from Central Sterile Supply Services, eliminating the need for a circulating nurse to leave the operating room if an instrument is dropped¹⁶. Imagine a scenario where surgical setups are automated, and surgeon preference cards are instantly updated to reflect real-

time activities. This could lead to a system with no missing instruments, thanks to micro-level tracking and management of sterile supplies. Such advancements could not only prevent supply service issues with instrumentation, but also eliminate intra-operative delays (such as the wait for a radiographer) and ensure no single-use items are ever 'on backorder'. The questions arise: Could robots assist with restocking? Could AI help triage phone calls for medical colleagues who are scrubbed in?

AI-driven automation tools could be developed to optimise resource allocation. Perioperative staff management could be revolutionised with an equitable request and rostering system, improving efficiency. Imagine an app that could approve a shift swap or annual leave in a matter of seconds¹⁶.

Machine learning could be used to streamline case throughput and team performance, and have positive impact on theatre utilisation, staffing and associated expenditure¹⁷. Imagine a world where delays could be predicated and surgery cancellations do not occur. Imagine a world where all staff finish their shifts on time.

Moreover, AI-assisted diagnostic tools could empower perioperative nurses with real-time insights and predictive analytics. Machine learning models that aid in early detection and intervention may augment nurses' diagnostic capabilities. AI-driven decision support systems will support clinical judgment and enable personalised care plans tailored to each patient's unique needs.

By mainstream use of AI models, educational programs can tailor learning experiences to individual needs, providing personalised content and feedback to nurses. These platforms could enable

adaptive learning pathways across multiple modalities beyond the instrument nurse role, such as crisis resource management, ensuring nurses acquire the skills and knowledge required to excel in the dynamic perioperative environment. Virtual reality may even have a place in pre-registration programs, to lessen the significant gap between the need for exposure to the profession and available opportunities for student perioperative placement.

Challenges and considerations

Embracing AI technologies in perioperative nursing involves certain challenges and must be tempered with care. Patient privacy, data security management and algorithm bias must all be considered and human expertise and autonomy must be augmented by and not undermined by AI. Managing the impact of technology on the workload burden of nursing professionals is exigent¹⁶. Addressing these challenges is essential to harnessing AI's full potential in the perioperative setting and ensuring its ethical, effective and sustainable integration into clinical practice.

As perioperative nursing integrates AI technologies, ensuring patient privacy and data security is paramount¹⁸. Using algorithms on vast amounts of patient data to develop AI models arguably raises concerns about unauthorised access, breaches and misuse. Nurses must adhere to strict confidentiality protocols and system leaders must safeguard patient information with robust data encryption and access controls.

Algorithm bias poses a significant challenge in AI-driven perioperative care. As computer systems learn, biases inherent in their training data can lead to inaccuracies and

disparities in the outputs given by the AI. Perioperative nurses must use their advanced critical thinking skills to evaluate AI outputs and recognise potential biases¹⁹. Human control must be retained over patient care decisions, with AI used to enhance, not supplant, clinical judgment and autonomy. AI cannot build a therapeutic relationship with a patient.

Introducing AI into perioperative nursing can contribute to technology-related stress, enhancing the dichotomy between provision of compassionate nursing care to vulnerable human beings and technical competence²⁰. Nurses may experience anxiety or resistance due to concerns about job displacement, increased workload or fear of technology failures. It's imperative to address these concerns through comprehensive training, ongoing support and fostering a culture of technological literacy and resilience among nursing staff.

Opportunities for collaboration

The integration of AI in perioperative nursing presents a unique opportunity for interdisciplinary collaboration. It fosters partnerships between nurses, technologists, researchers and industry stakeholders to drive innovation and advance patient care.

One avenue for collaboration lies in developing and refining AI-driven technologies tailored specifically to the perioperative environment. By bringing together nurses with expertise in perioperative care, technologists skilled in AI development and researchers well-versed in health care analytics, interdisciplinary teams are well placed to co-design tangible and practical solutions to unique clinical challenges.

Furthermore, collaboration between academia and health care institutions can play a pivotal role in advancing the science and practice of AI in perioperative nursing. Academic institutions can provide the necessary infrastructure, resources and expertise to conduct cutting-edge research in AI-driven health care technologies, while health care institutions can offer real-world clinical insights and data for validation and implementation. By fostering mutually beneficial partnerships, the translation of AI research into clinical practice is accelerated.

Collaboration with regulatory agencies, professional associations and policymakers is critical in establishing the necessary frameworks and guidelines to govern AI's responsible and ethical use in perioperative nursing. Nurses must agitate for policies and regulations that promote transparency, accountability and patient safety in AI-driven health care environments.

In embracing these opportunities for collaboration, perioperative nurses can play a leading role in shaping the future of health care delivery, not only driving innovation but also improving patient outcomes through the responsible integration of AI-driven technologies into clinical practice.

Conclusion

The integration of AI in perioperative nursing represents a transformative paradigm shift with far-reaching implications for patient care, clinical practice and health care delivery. It is imperative to embrace the opportunities, address the challenges and collaborate across disciplines to harness the full potential of AI in shaping the future of perioperative care. As AI and human expertise converge,

perioperative nurses continue to uphold patient-centred care, compassion and professional excellence. Through innovation, collaboration and ethical advocacy, perioperative nurses will continue to advance the field, ensuring best-practice patient care now and into the future.

Conflict of interest declaration and funding statement

The authors of this manuscript declare no conflict of interest or affiliations with any organisation or entity with any financial interest (grants, membership, employment etc.) and non-financial interest in the subject matter or materials discussed herein.

No funding was received for the preparation of this editorial.

References

- Harder N. Advancing healthcare simulation through artificial intelligence and machine learning: Exploring innovations [Internet]. Clin Simul Nurs. 2021[cited 2024 Apr 4];83:101456. DOI: 10.1016/j.ecns.2023.101456
- Muaddi H, El Hafid M, Choi WJ, Lillie E, de Mestral C, Nathans A et al. Clinical outcomes of robotic surgery compared to conventional surgical approaches (laparoscopic or open): A systematic overview of reviews [Internet]. Ann Surg. 2021[cited 2024 Apr 4];273(3):467–73. DOI: 10.1097/sla.0000000000003915
- Duff J. Will robots make good perioperative nurses? [Internet]. JPN. 2020[cited 2024 Apr 4];33(3):e1–e2. DOI: 10.26550/2209-1092.1096
- Maheshwari K, Ruetzler K, Saugel, B. Perioperative intelligence: Applications of artificial intelligence in perioperative medicine [Internet]. J Clin Monit Comput. 2020[cited 2024 Apr 4];34(4):625–28. DOI: 10.1007/s10877-019-00379-9
- Loftus TJ, Tighe PJ, Filiberto AC, Efron PA, Scott CB, Mohr AM et al. Artificial intelligence and surgical decision-making [Internet]. JAMA Surg. 2020[cited 2024 Apr 4];155(2):148–58. DOI: 10.1001/jamasurg.2019.4917
- Ye J. Patient safety of perioperative medication through the lens of digital health and artificial intelligence [Internet]. JMIR Periop Med. 2023[cited 2024 Apr 4];6:e34453. DOI: 10.2196/34453
- Johnson J. Predictive analytics vs machine learning: What's the difference? [Internet]. Houston: BMC; 2020 [cited 2024 Apr 4]. Available from: www.bmc.com/blogs/machine-learning-vs-predictive-analytics/
- Chiew CJ, Liu N, Wong TH, Sim YE, Abdullah HR. Utilizing machine learning methods for preoperative prediction of postsurgical mortality and intensive care unit admission [Internet]. Ann Surg. 2020[cited 2024 Apr 4];272(6):1133–39. DOI: 10.1097/sla.0000000000003297
- Lee SW, Nam JS, Kim YJ, Kim MJ, Choi JH, Lee EH et al. Predictive model for the assessment of preoperative frailty risk in the elderly [Internet]. J Clin Med. 2021[cited 2024 Apr 4];10(19):4612. DOI: 10.3390/jcm10194612
- Klemm C, Tirumala V, Barghi A, Cohen-Levy WB, Robinson MG, Kwon YM. Artificial intelligence algorithms accurately predict prolonged length of stay following revision total knee arthroplasty [Internet]. Knee Surg Sports Traumatol Arthrosc. 2022[cited 2024 Apr 4];30(8):2556–64. DOI: 10.1007/s00167-022-06894-8
- Kryklywy JH, Roach VA, Todd RM. Assessing the efficacy of tablet-based simulations for learning pseudo-surgical instrumentation [Internet]. PloS One. 2021[cited 2024 Apr 4];16(1): e0245330. DOI: 10.1371/journal.pone.0245330
- Kaitu'u MJ, Armour T, Nicholson, P. Determination of skill and knowledge requirements of an instrument nurse working in major vascular surgery for the development of a virtual reality training tool [Internet]. Clin Simul Nurs. 2023[cited 2024 Apr 4];79:40–8. DOI: 10.1016/j.ecns.2023.02.005
- Reifsnider E. Nursing research, practice, education and artificial intelligence: What is our future? [Internet]. Res Nurs Health. 2023[cited 2024 Apr 4];46(6):564–5. DOI: 10.1002/nur.22344
- Topaz M, Peltonen LM, Michalowski M, Stiglic G, Ronquillo C, Pruinelli L et al. The ChatGPT effect: Nursing education and generative artificial intelligence [Internet]. J Nurs Educ. 2024[cited 2024 Apr 4]; Feb:1–4. DOI: 10.3928/01484834-20240126-01
- Liu J, Liu F, Fang J, Liu S. The application of Chat Generative Pre-trained Transformer in nursing education [Internet]. Nurs Outlook. 2023[cited 2024 Apr 4];71(6):102064. DOI: 10.1016/j.outlook.2023.102064
- [No author listed]. Exploring the future of perioperative nursing [Internet]. AORN J. 2023[cited 2024 Apr 4];117(2):123–5. DOI: 10.1002/aorn.13865
- Bellini V, Russo M, Domenichetti T, Panizzi M, Allai S, Bignami EG. Artificial intelligence in operating room management [Internet]. J Med Syst. 2024[cited 2024 Apr 4];48(1):19. DOI: 10.1007/s10916-024-02038-2
- Murdoch B. Privacy and artificial intelligence: challenges for protecting health information in a new era [Internet]. BMC Med Ethics. 2021[cited 2024 Apr 4];22(1):122. DOI: 10.1186/s12910-021-00687-3
- Pruinelli L, Michalowski M. Toward an augmented nursing-artificial intelligence future [Internet]. Comput Inform Nurs. 2021[cited 2024 Apr 4];39(6):296–7. DOI: 10.1097/cin.0000000000000784
- Smith J, Palesy D. Technology stress in perioperative nursing: An ongoing concern [Internet]. JPN. 2018[cited 2024 Apr 4];31(2):25–8. DOI: 10.26550/2209-1092.1028