Applications of artificial intelligence for nursing: has a new era arrived?

Liesbet Van Bulck [a,b,c], Raphaël Couturier [d], Philip Moons [a,e,f]

[a] KU Leuven Department of Public Health and Primary Care, KU Leuven - University of Leuven, Leuven, Belgium

[b] Research Foundation Flanders (FWO), Brussels, Belgium

[c] EA3920, University of Burgundy Franche-Comté, Besançon, France

[d] FEMTO-ST Institute, UMR 6174 CNRS, University of Burgundy Franche-Comté, Belfort, France

[e] Institute of Health and Care Sciences, University of Gothenburg, Gothenburg, Sweden

[f] Department of Paediatrics and Child Health, University of Cape Town, Cape Town, South Africa

Corresponding author:

Philip Moons, KU Leuven – University of Leuven, Kapucijnenvoer 35, Box 7001, B-3000 Leuven, Belgium. Email: philip.moons@kuleuven.be. Twitter: @MoonsPhilip

Funding:

This work is supported by Research Foundation Flanders (grant number 1159522N to LVB) and European Society of Cardiology (Nursing and Allied Professional Training Grant to LVB).

Nowadays, artificial intelligence (AI) is seen as a gamechanger. AI seems to be ready to transform the world and the way people live and work. AI applications are already widely used in modern life. For instance, Google knows what people are looking for based on previous searches, and Grammarly checks the correctness of the writing in its context. In medical and nursing practice, AI health technologies (AIHTs) are also increasingly used. [1,2] This editorial briefly explains what AI is, discusses AIHTs, and highlights opportunities and challenges for the nursing profession.

AI is a generic term for techniques used to teach computers to mimic human-like cognitive functions like reasoning, communicating, learning, and decision-making. Some of the many branches of AI are robotics, machine learning, deep learning and natural language processing (Central illustration). The branch of robotics involves the design, building, processing, and use of robots. An example of robotics for cardiac surgery is the use of robot-assisted coronary artery bypass grafting.[3] Machine learning uses computer algorithms to extract patterns from raw data, learn from these data without human input, and apply this knowledge to numerous tasks. Machine learning algorithms can, for example, independently identify patients with heart failure using electrocardiograms.[4] Deep learning is a type of machine learning that uses multiple layers of neural networks. Compared to basic machine learning models, deep learning models are much more robust for many applications and can better handle large amounts of data such as images and videos. Natural language processing is a type of artificial intelligence that uses machine learning and deep learning and concerns the interactions between the computer and the human language. The technique is used to process and analyze large amounts of natural language data. Using this technology, it is, for example, possible to extract information on the cardiovascular profile of a patient from unstructured discharge letters.[5] It is thanks to natural

language processing and deep learning networks that applications such as virtual health assistants can be developed.

The use of AI for healthcare purposes has been explored for decades. However, it is only recently that AIHTs have been more widely adopted in the medical field due to the improvement of algorithms, computation power, and the rapidly increasing amount of data available for each patient.[6] AIHTs are expected to contribute to the efficiency of healthcare services and significantly reduce costs.[7]

Specifically in the nursing domain, AIHTs have already begun to influence nursing roles, workflows and relationships with patients.[8] Many different types of AI are used, including robotics devices, predictive analytics using machine learning and virtual health assistants.[8] Recently, robots have been developed to take over particular nursing tasks and accompany patients.[8] In Japan, for instance, AI-powered robots are already used to assist older people with activities of daily living in long-term care facilities and in hospital settings.[8,9] Moreover, predictive analytics, for example, can be integrated into smart health technologies to predict health status changes among patients, which enables nurses to intervene proactively.[8] The use of these analytics has been shown to improve decision-making and allow nurses to have more time for patient care.[8] Virtual healthcare assistant apps, so-called 'virtual nurses', also have shown great potential.[8] These virtual assistants can provide information, ask questions, interpret clinical values, and report deviant answers to clinicians. The developers emphasize that AIHTs should not be seen as a replacement for nurses but rather as a partial acquisition of administrative and simple nursing tasks, allowing for the nurses to spend more time on the core nursing tasks.[6]

In cardiovascular nursing, some AIHTs also exist. To date, two studies describing AIHTs have been published in the *European Journal of Cardiovascular Nursing*.[10,11] One is a systematic review describing models used for the prediction of readmission in heart failure patients,

including machine learning models.[10] The second is a paper about the use of wearable cameras to gain insights into the lived experience of patients with cardiovascular conditions.[11] Other AIHTs examples for cardiovascular nursing are the identification of symptoms and substance use from clinical notes in heart failure patients, using Natural Language Processing[12,13], or an algorithm helping the front office to define the appropriate amount of time for a consultation for each cardiovascular patient based on their medical file.[14] It has been stated that AIHTs especially have a lot of potential for the field of cardiology because many diagnostic and treatment decisions are based on digitized and patient-specific data (e.g., echocardiograms), but also, there is a staggering volume of complex data available, such as clinical notes, data of wearables, and imaging.[2,14]

Looking at these examples, it is clear that AIHTs can create opportunities in assisting and enhancing nursing practices and can enhance career development for nurses. However, there are important points of attention to keep in mind while developing these technologies and implementing them in the nursing domain. To ensure that AIHTs are in line with the core nursing values that promote safe, high-quality, and person-centered care for patients and their families, nurses should be involved in the development of AIHTs.[6,8] Currently, in one-third of the studies describing AIHTs for nursing care, no nurses were involved in the set-up of the applications.[6] Ideally, other healthcare professionals, patients and their caregivers are also involved in the development of these applications. Furthermore, before incorporating AIHTs in routine care, new policies concerning the protection of patients as far as failure of technology as well as the privacy of patient information are concerned will have to be developed.[8] Also, further work on the validation and interpretation of AIHTs should be done.[4] For many machine learning models, it is not entirely clear which factors the model relies on when making a prediction. Transparency of a model is important for clinical practice, as healthcare workers are more likely to ignore the recommendation of the model if they do not understand the underlying process.[4] Besides, the

impact of AIHTs on clinical and patient outcomes should be assessed in prospective studies because the benefits of the approaches for patients and healthcare workers often remain theoretical, and the real impact on outcomes remains unknown.[4]

To conclude, a new era seems to have come in which AI applications might greatly influence nursing practices. However, many questions remain and further validation will be needed before AIHTs can be incorporated into routine care. To ensure that this new era aligns with core nursing values and that new applications are relevant to clinical practices, healthcare workers and patients should be put into key positions in the development of AIHTs.

References

1. Robert N. How artificial intelligence is changing nursing. *Nurs Manage.* 2019;50(9).
2. Van den Eynde J, Lachmann M, Laugwitz KL, Manlhiot C, Kutty S. Successfully implemented artificial intelligence and machine learning applications in cardiology: State-of-the-art review. *Trends Cardiovasc Med.* 2022;S1050-1738(22)00012-3. doi: 10.1016/j.tcm.2022.01.010
3. Spanjersberg A, Hoek L, Ottervanger JP, et al. Early home discharge after robot-assisted coronary artery bypass grafting. *Interact Cardiovasc Thorac Surg.* 2022;35(1).
4. Averbuch T, Sullivan K, Sauer A, et al. Applications of artificial intelligence and machine learning in heart failure. *Eur Heart J Digit Health.* 2022;3(2):311-322.
5. Richter-Pechanski P, Geis NA, Kiriakou C, Schwab DM, Dieterich C. Automatic extraction of 12 cardiovascular concepts from German discharge letters using pre-trained language models. *Digit Health.* 2021;7:20552076211057662. doi: 10.1177/20552076211057662
6. von Gerich H, Moen H, Block LJ, et al. Artificial Intelligence -based technologies in nursing: A scoping literature review of the evidence. *Int J Nurs Stud.* 2022;127:104153.
7. Matheny M, Israni ST, Ahmed M, Whicher D. Artificial intelligence in health care: The hope, the hype, the promise, the peril. *Washington, DC: National Academy of Medicine.* 2019.
8. Buchanan C, Howitt ML, Wilson R, Booth RG, Risling T, Bamford M. Predicted Influences of Artificial Intelligence on the Domains of Nursing: Scoping Review. *JMIR Nursing.* 2020;3(1):e23939. doi:10.2196/23939
9. Maalouf N, Sidaoui A, Elhajj IH, Asmar D. Robotics in Nursing: A Scoping Review. *J Nurs Scholarsh.* 2018;50(6):590-600. doi:10.1111/jnu.12424
10. Mahajan SM, Heidenreich P, Abbott B, Newton A, Ward D. Predictive models for identifying risk of readmission after index hospitalization for heart failure: A systematic review. *Eur J Cardiovasc Nurs.* 2018;17(8):675-689.

11. Nourse R, Cartledge S, Tegegne T, Gurrin C, Maddison R. Now you see it! Using wearable cameras to gain insights into the lived experience of cardiovascular conditions. *Eur J Cardiovasc Nurs.* 2022;zvac053. doi: 10.1093/eurjcn/zvac053

12. Yusufov M, Pirl WF, Braun I, Tulsky JA, Lindvall C. Natural language processing for computer-assisted chart review to assess documentation of substance use and psychopathology in heart failure patients awaiting cardiac resynchronization therapy. *J Pain Symptom Manage.* 2022;15:S0885-3924(22)00783-7. doi: 10.1016/j.jpainsymman.2022.06.007

13. Leiter RE, Santus E, Jin Z, et al. Deep Natural Language Processing to Identify Symptom Documentation in Clinical Notes for Patients With Heart Failure Undergoing Cardiac Resynchronization Therapy. *J Pain Symptom Manage.* 2020;60(5):948-958.e3. doi: 10.1016/j.jpainsymman.2020.06.010

14. Quer G, Arnaout R, Henne M, Arnaout R. Machine Learning and the Future of Cardiovascular Care: JACC State-of-the-Art Review. *J Am Coll Cardiol.* 2021;77(3):300-313.

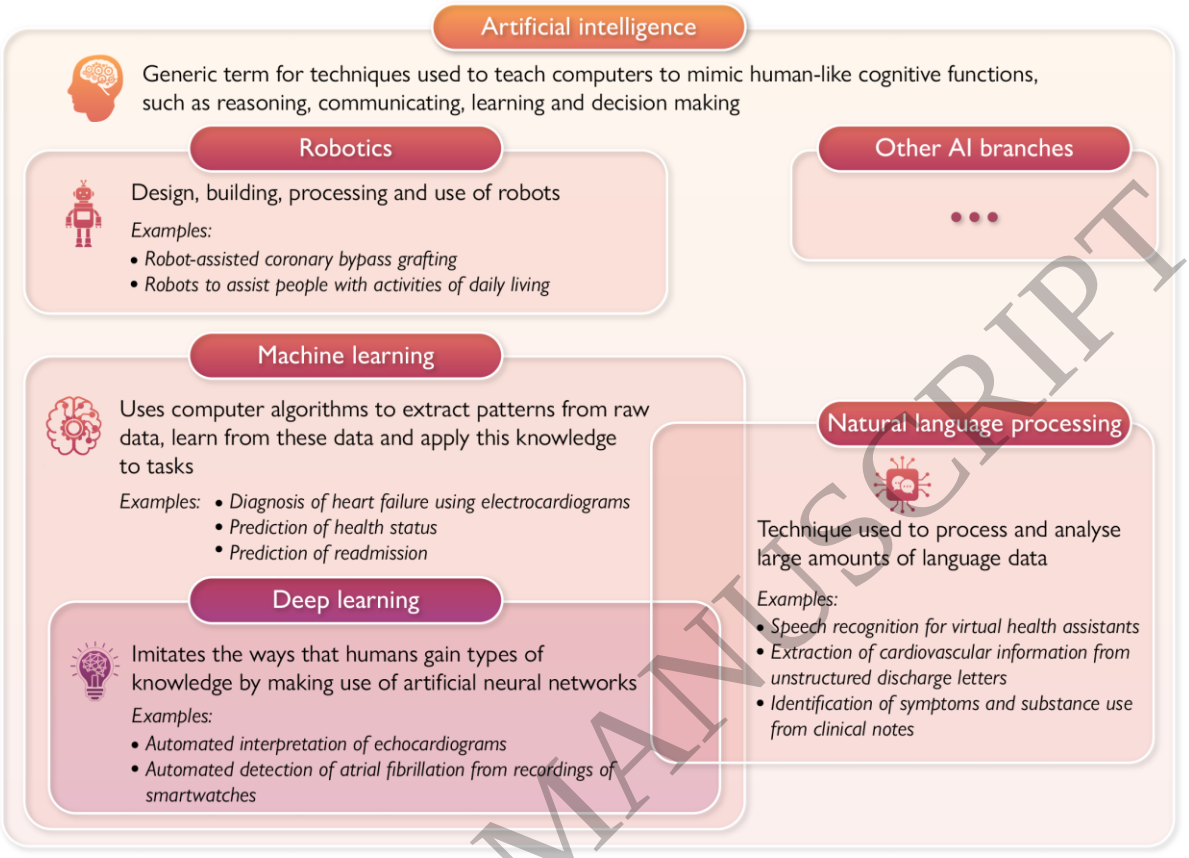

Figure 1
160x114 mm (2.2 x DPI)