# Artificial Intelligence and Nursing: Looking Back at Florence Nightingale

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**Background:** The reaction of nurses to the advent of artificial intelligence (AI) during the fourth industrial revolution era remains questionable. Understanding Florence Nightingale's achievements may provide valuable lessons that will be helpful to contemporary nurses. **Aims:** To understand Nightingale's nursing philosophy and methods and provide suggestions for future nursing practice, education, research, and health policy. **Source of evidence:** Literature. **Discussion/Conclusion:** Just as Nightingale captured the situation of her time and introduced latest scientific methods, modern nurses need to learn from Nightingale's drastic actions to meet social needs. Nursing can regain a solid humanistic foundation by returning to core values of nursing and humanities, while simultaneously adopting state-of-the-art technologies. **Implications for Nursing Policy:** AI-driven technologies will advance nursing services and provide greater human-centered and personalized care by eliminating iterative and labor-intensive tasks. Nursing educational policy should support the advancement of nursing curricula to develop AI competencies and specialists within the nursing field.

**Key Words:** Nightingale; Artificial intelligence; Nursing policy; Fourth industrial revolution

## Advent of AI

The technological advancement of artificial intelligence (AI) is phenomenal. The professional Go players' community recognizes the excellence of αGo that defeated the world's masters, and interestingly, these professional players want to learn from that new champion. Futurologists defined a certain time point as "technological singularity", where technology rapidly advances and thus it transcends humans (Glenn, Gordon, & Florescu, 2014). The United Nations Future Report forecasted this time point will be 2045, and the following phenomena will occur around that time: jobs being replaced by robots, alternative energy overcoming climate change, and human boundaries blurring with the advances in biotechnology and medicine. The world has already entered the era of the fourth industrial revolution, which is in full swing.

## Objectives

Nursing, like any other field, is facing a grave challenge with the advent of AI. Despite of an advantage that repetitive works can be replaced by AI, many nurses fear it rather because they may lose their jobs (Pepito & Locsin, 2019). There is an urgent need to understand the new technology deeply and to adjust to it sagaciously. In this study, we intend to explore the possibility of a paradigm shift in nursing by reinterpreting the life of Florence Nightingale, who was the founder of modern nursing and lived during the era of transition from the second to the third industrial revolution. Using historical analogy, an approach that features fundamentally analogous events in different times or spaces (Temkin, 2020; Axelrod & Forster, 2017), I tried to offer suggestions for future nursing practice, education, research, and health policy that will be useful in this uncertain era, by reviewing relevant literature about her nursing philosophy, major achievements, and historical background.

## Time of Nightingale

Nursing before Nightingale's time was predominantly influenced by religion and theology (Texas Woman's University, 2021; McDonald, 2018). The definition of nursing

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was not clear, but nursing was an important role similar to that of a mother: caring, nurturing, and protecting based on the Christian philanthropic spirit of humanistic values (sacrifice, service, etc.) (Small, 2017). At a time when positivism-based scientific methodologies were mainstream, accumulating scientific knowledge and producing theoretical bases in the field of nursing were required (Bluhm, 2014).

## Nightingale's Contribution to Nursing

Nightingale was able to use scientific methods including those of mathematics (Bradshaw, 2020), management (Rafferty & Wall, 2010), epidemiology and public health policy (Tye, 2020; Small, 2017; Wildman & Hewison, 2009). The latest knowledge and skills were already spread throughout at least Europe at the time, but it was obviously rare for females to be proficient at these (McDonald, 2018; Small, 2017). By utilizing the latest scientific methods, Nightingale visualized the findings of studies about the practical influence of environmental factors on patients (Arnone & Fitzsimons, 2015). Her efforts excited interest in nursing patients in a poor sector of society and significantly contributed to professionalizing the status of nursing and nurses by identifying the social needs of nurses (Stichler, 2014). As a result, in the humanistic aspect, a healing environment was established in which nurses could focus solely on care and could effectively provide holistic and personalized care to patients, in contrast to the pre-Nightingale era. In summary, Nightingale read the trend of the times, introduced empirical knowledge to nursing, and greatly contributed to establishing nursing as a science.

## Challenges in Contemporary Nursing

Nursing after Nightingale was highly characterized by the systematization of knowledge (Hoeck & Delmar, 2018; Bluhm, 2014). The social recognition and authority of nurses improved, and the uniqueness and independence of nursing research and practice were newly recognized (Mishra, 2015). However, contemporary nursing faces a range of challenges. The nursing education system is dominated by biomedical-empirical knowledge related to clinicians, and this pushes the humanity part, the basis of humanism, to the back seat (Mazzotta, 2016). Accordingly, nursing practice may not be sufficiently autonomous and independent in its public perception as a combination of capital-dependent hospital workers (Mishra, 2015), female-dominated organizations (Whittock & Leonard, 2003),

nursing practices derived by physicians' prescriptions (Pijl-Zieber, 2013), instead of as a direct contract relationship between a client and a nurse. The causes of this phenomenon may be the lack of integration between humanity and science in nursing education (Moyle, Barnard, & Turner, 1995), the poor work environments causing difficulties in the provision of holistic and human-centered care in nursing practice (Kieft, de Brouwer, Francke, & Delnoij, 2014), or the issues in measuring nurses' invisible contributions to clients and health in nursing research (Hovenga & Lowe, 2020; Allen, 2015).

## Lessons from Nightingale: 1. Humanity

What, then, is the message that Nightingale delivers to the modern nursing society? First, Nightingale was a humanist. Regarding the background of Nightingale's life, nursing was reborn at a time when the side effects of the Industrial Revolution were at their peak and nurses worked for underprivileged people (the poor, the elderly, and the sick) (McDonald, 2018). During the Crimean War, from October 1853 to February 1856, Nightingale abandoned all her positions and gave devoted nursing care to wounded and marginalized soldiers (Small, 2017). At that time, war symbolized dehumanization, polarization, and irrationality, but nursing symbolized humanity, harmonization, and rationality.

Modern nurses need to capture the essence of nursing in these times by advocating for nursing clients like quasi Nightingales. A great deal of nursing research and practice these days is predominantly focused on scientific knowledge rather than art and humanism (Dellasega, Milone-Nuzzo, Curci, Ballard, & Kirch, 2007), turning a blind eye to the philosophy, ethics, literature, history, religion, law, and art that true nursing should embrace. In other words, nursing practice and education have emphasized humanity less and science and technology more in understanding humans' experiences and suffering (Moyle, Barnard, & Turner, 1995). However, with the advent of the fourth industrial revolution, a regression to areas indigenous to human beings (mind, consciousness, creation, faith, love, imagination, beauty, truth, inspiration, insight, transcendence, happiness, etc.) is becoming inevitable. This humanistic approach is the essence of nursing. Therefore, it is necessary to strengthen the humanities and arts in nursing education and establish a basis for the realization of aesthetic care for the identity and professionalism of nursing practice and research (Herholdt-Lomholdt, 2019). When focusing on humanism, nursing education can maintain its valued status as a discipline that leads the lat-

est trends of the times, and nursing research and practice will develop based on this.

## Lessons from Nightingale: 2. Artificial intelligence (AI)

Second, Nightingale was a statistician and data scientist (Bradshaw, 2020). She achieved much by applying mathematical and statistical knowledge and later in life became the first female member of the Royal Statistical Society in the United Kingdom (Stichler, 2014). Tye (2020) illustrated Nightingale's massive commitment to health care, such as in medical records, infection control, and hospital management and architecture. As Nightingale's Rose Diagram showing the causes of soldiers' mortality was effective for persuading the public, the visualization of big data in the nursing field will be a powerful tool for demonstrating the value of nursing to the public in a visible way.

Just as Nightingale was able to employ her expertise in data collection and analysis to focus on the humanistic elements of nursing, the field of nursing today relies on understanding and applying data science as key elements in its functioning (Zhu et al., 2019; O'Connor, 2018). Specifically, it is believed that nurses in the era of the fourth industrial revolution should apply AI to nursing practice, education, and research so that they can better embody the humanistic aspects of nursing.

Today, AI is simply state of the art. It is defined as "the science and engineering of making intelligent machines" (McCarthy, 2007). Considering AI's potential influences on nursing in future (Sunarti et al., 2021; Nguyen & Li, 2018), it is estimated that nurse-driven technology and interventions will be made in nursing research. The study by Fritz and Dermody (2019) is a good example of what the introduction of AI in nursing will be like, and the researchers suggested that the implementation of AI will provide nurse-led methods for monitoring and detecting chronic conditions at home by integrating the clinician's knowledge and the client's daily movements. In addition, humanistic education and practices will be strengthened in nursing education, and patient safety and quality nursing services will be achieved by reducing shortages in the nursing workforce and easing the excessive workload through automated systems for nursing practice (Kritz, 2019). AI can be explained as a world consisting of mathematical knowledge, logic, probability, and statistics, indicating that such a mathematical and logical world could be replaced by AI. The competencies required for future human resources will be areas that AI cannot dare cover, including creativity, communication, and collaboration; thus, knowledge that interprets humanistic values and meanings, such as philosophy, art, psychology, and communication, is certainly expected to be of greater importance. Figure 1 illustrates automated AI-assistive health monitoring and how nurses can use it to communicate and interact with patients. This is pure nursing that AI cannot do, but nurses can realize advocacy is a therapeutic agent for connecting with their clients in various situations. Susskind and Susskind (2015) predicted that nurses rather than



**Figure 1.** Artificial intelligence in clinical nursing.

physicians may examine patients given the future of AI systems. Given recent technologies, especially AI medical imaging that enables the automatic diagnosis of musculoskeletal diseases that occur in the spine, shoulders, and knees, nurses could provide clients with a planned rehabilitation program and coach them in healthy lifestyles aimed towards more personalized care, freed from the constraints of a doctor's prescription (Robert, 2019).

## Implications for Nursing Education and Policy

To survive the upcoming competition with AI and play a crucial role as an independent professional force in society, nurses must consider multidisciplinary work in the information, computer, cognitive, and life sciences. Then nurses need to apply advanced technologies and skills autonomously and creatively in the development of clinical practices and nursing knowledge to improve patient and client outcomes in various health care settings. If such a movement is successful, fields of start-ups and patents will be activated, which will encourage nurses' research and development and, as a result, secure capital for the solo practice. One representative example is MakerNurse, which is a community for the creation of innovative nurse-led technology solutions to promote patient and client outcomes (MakerNurse, 2019). AI-driven technologies will advance the nursing service to be able to provide greater human-centered and personalized care by eliminating iterative and labor-intensive nursing tasks. Nursing educational policy should support the buildup of nursing curricula to develop AI competencies and foster AI specialists in the nursing field. Long and Magerko (2020) defined AI literacy and suggested a set of AI competencies: "recognizing AI, interdisciplinarity, AI's strength and weakness, data literacy, critically interpreting data, and so on." In a similar vein, Shea et al. (2019) proposed the Data Science Curriculum Organizing Model (DSCOM) as a nursing curriculum for PhD-level students that included the six constructs (domain, ethics, theory, technical, analytics and dissemination) of data science. Moreover, Kim, Jang, Yeon and Park (2018) emphasized "comprehension of technology, caring and human touch, inter-professionalism, leading role of nurses, and resilience competency" for balancing two sides of nursing, human and technology.

The last thing one could possibly consider is the health care systems and policy approach Nightingale also considered. The health care systems and the environment surrounding nursing and AI are changing capriciously, uncertainly, complexly, and ambiguously but are crucially shaping the professional boundaries. No matter how the professional ethics, nursing practice standards, and state-of-the-art technology are implemented, the actual contributions of nursing can be invisible and can be hampered by legal and institutional factors. Furthermore, the use of AI in nursing creates several opportunities, but it also has risks, such as prejudiced data and ethical problems (Sunarti et al., 2021). Therefore, health policy regarding AI is strongly required to influence the social, economic, and legal systems of nursing. The content of health policy, economy, and financing concerning AI needs to be enhanced within nursing curricula.

# CONCLUSION

The rapid development of science and technology accumulated by human rationality has had the advantage of bringing material affluence to mankind, but there have also been side effects of materialism and dehumanization due to technological dominance. Again, we are standing at the time of transition from the third to the fourth industrial revolution. Whether the new era will be the heyday of nursing with humanism or the end of nursing that will be replaced by robots depends on nurses' choice. Just as Nightingale captured the situation of her time and then introduced modern reasons and the latest science, nursing in this AI era will need to be reorganized so that it can regain a solid humanistic foundation in practice, education, research, and policy and strengthen technological and social approaches to achieve a new heyday of nursing. As a result of AI medical imaging that enables the automatic diagnosis of musculoskeletal diseases, nurses will provide clients with a planned rehabilitation program and coach them in healthy lifestyles. Nurses have great potential to contribute to health outcomes of the populations by providing clients with more individualized and personalized care through recent AI-assistive systems.

## CONFLICTS OF INTEREST
The author declared no conflicts of interest.

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