EDITORIAL

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Technologies for nursing care and education: Challenges and opportunities for the future

As tecnologias para o cuidado e a formação em enfermagem: Desafios e oportunidades para o futuro

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As trainers of human resources in nursing, we experienced, even before the COVID-19 pandemic, an almost insurmountable distance between how care is taught – and a lot of it comes from how it is taught – and how students actually learn.

Due to social distancing during the pandemic, technology took center stage, which led to the rapid *literacy* of nursing teachers and caregivers, almost detached from a more in-depth reflection on the use of technologies (Sordi; Fonseca, 2023).

Technologies are tools that may or may not be powerful aids in the teaching-learning process of care and in care itself. In this process, one must consider the *intentionality* of the act of educating and caring in nursing and *how* to achieve what is intended. Technologies must be strategically integrated into learning processes and aligned with the theoretical frameworks of education and care, preventing them from operating in a way that is disconnected from these spaces.

This Editorial highlights the Education-Technology-Care triad, which has undergone major transformations over the years, sometimes in harmony and sometimes in disarray. However, one cannot deny the transformative impact of these elements on each other in the most different historical periods. Nursing care is permeated with history and affected by different factors, from globalization, values, crises, transitions and disruptions, health programs and policies, and rights, to the complexity of today's health systems.

Crises impact care and cover several dimensions: the health crisis reduces the Human Development Index; the economic crisis increases unemployment; the social crisis intensifies inequality; the political crisis exacerbates polarization and spreads disinformation; the environmental crisis amplifies extreme events; and the geopolitical crisis increases unpredictability. Therefore, this panorama of crises results in demographic, socio-economic, geopolitical, ecological, and digital transitions and disruptions (Marcovitch, 2010).

In this scenario, professionals must be proactive and possess critical and reflective skills to face the challenges of this new era, which include promoting environmental sustainability, achieving the Sustainable Development Goals (SDGs), adapting to globalization, technological and digital transition, and promoting cooperation.

Given the complexity of education, technology, and health care, nursing professionals face many challenges in providing broader, more competent, high-quality education and care. In this challenging context of training for care, which is still marked by a predominantly content-based and verticalized approach, vigorous efforts must be made to promote active learning and achieve significant transformations.

An educators' guide focused on achieving the SDGs and the Education 2030 Agenda reflects this vision of education, emphasizing a student-centered, action-oriented, and transformative approach (UNESCO, 2017).

For more than two decades, the World Health Organization (WHO) has stressed the importance of improving health and nursing skills and the need to increase knowledge about the social and emotional aspects of patients and their families (WHO, 2000).

According to the Pan American Health Organization (Organização Pan-Americana da Saúde, 2023), nurses have been recognized as a key element in achieving the

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SDGs. However, paradoxically, there is a shortage of nurses worldwide, as well as an undervaluing of the nursing profession and a pressing need to develop leadership training in this field (WHO, 2020; International Council of Nurses [ICN], 2022). In today's education, the connected and digital world is expressed through flexible and hybrid teaching models, with many possible combinations and active strategies that start from critical reflection and transform reality in a continuous process of learning and transforming oneself and can contribute significantly to the training of professionals capable of finding solutions to current problems in the health system (Moran, 2018). Technology has established itself as an indispensable tool for tackling health challenges and offering innovative solutions. Its importance is recognized in improving the effectiveness, efficiency, and quality of health services (WHO, 2021a).
The WHO expands the concept of health technologies and e-Health to Digital Health, including digital consumers and addressing intelligent and connected digital technologies, such as the Internet of Things, artificial intelligence (AI), big data, and robotics, among others (WHO, 2021b).
Two components cannot currently be left out of discussions and concerns about Digital Health: patient safety and AI. Regarding patient safety, the large-scale production of health apps calls for the implementation of data protection measures to prevent unauthorized access and violation of patient privacy and improve the safety of care in vast digital applications for health education, given that several devices guide patient actions without proper evidence-based practice (WHO, 2021c).
The WHO has been monitoring the development and use of AI in healthcare with concern. This concern has culminated in the creation of a guide on the ethics and governance of AI for health, which addresses fundamental issues such as autonomy, well-being, safety, public interest, inclusion, equity, transparency, and the need for responsive and sustainable AI (WHO 2021d). However, in light of the rapid advancements and trends in AI-assisted software development in this field, the WHO has not only expressed caution regarding the use of AI in 2023 but also reissued the revised guide to address key issues such as generative AI and deep machine learning, a type of machine learning that imitates the functioning of the human brain in processing data and generating patterns for decision-making. Deep learning models use complex architectures known as artificial neural networks. These networks include several interconnected layers that process and transfer information, mimicking the behavior of neurons in the human brain, with so-called Large Multi-modal Models (LMMS). LMMS can perform tasks that are not explicitly programmed, which has led the WHO to publish 40 new recommendations to ensure that the use of these models has ethical and effective benefits for global health. To this end, the WHO has established five areas of application in the health field: (i) diagnosis and clinical care; (ii) patient-guided use, research into symptoms and treatments; (iii) administrative tasks and filling in electronic health records after a patient visit; (iv) medical and nursing education; (v) scientific research and drug development (WHO, 2024).
In nursing, the WHO and the ICN approach technologies in two ways: for education and for care practice. These technologies enhance the workspaces of professionals through the use of other technologies such as telehealth, simulation technologies, the Internet of Things, robotics, digital literacy, virtual reality, lifelong learning, mobile technology, and AI, among others (WHO, 2020; ICN, 2023).
However, to make the education-technology-care triad interact effectively and achieve the expected results, nursing needs to reflect on overcoming challenges and acting accordingly to promote future improvements. These reflections and actions are aimed at the profession's evolution, addressing issues such as the lack of qualified professionals, leadership and protagonism in nursing, career attractiveness, and the need for adequate training in contemporary issues. The development and implementation of health technologies will face various challenges. These include the need to create multidisciplinary teams, the lengthy time required to develop technological products, the high financial costs involved in developing these technologies, and the importance of designing and improving promotion policies. In addition, it is crucial to keep up with the latest advances in innovation, address the lack of AI algorithm development skills, mitigate misinformation in health, especially through digital media, and seek out qualified experts to validate the technologies. Other challenges include the lengthy processes for registrations and patents, the scarcity of technology databases, the access and affordability of technologies, the lack of auditing of productions, and data security. Moreover, technology themes should be selected based on the intentionality of the training and care process, taking into account the complexity of health systems and the need to expand public health research to address cultural issues, health disparities, and vulnerable populations. Other nursing challenges to be overcome in the future include the creation of networks aimed at developing knowledge societies, building centers of excellence, and encouraging internationalization. It is important to establish partnerships and exchanges in different realities, align the curricular guidelines for education and the pedagogical projects of the courses, train teachers and nursing professionals in the use of technologies, conduct randomized trials and multicentre studies, promote collaborative research to strengthen the outcomes of the use of technologies, and improve the dissemination of products and processes. The translation of knowledge and greater visibility of the social impact of the use of technologies are also important.
It should be noted that technologies should complement human care and not substitute it. Empathy and attentive listening are essential in nursing practice, and technologies should be used to enhance these skills, not replace them. In addition, there is a risk of technology being exclusionary, so mitigating the digital divide and improving the quality of nursing care and teaching are essential in contemporary times.

To conclude this editorial, it should be noted that technology plays a fundamental role in nursing education and practice. It is essential to face challenges to meet current global health challenges and the SDGs, which guide global action towards a more sustainable, inclusive, and equitable future. Even if the specific targets of the SDGs are not fully achieved, the framework and principles underlying these goals remain fundamental for future generations, who can harness the potential of technologies to improve the effectiveness and efficiency of health services. Technologies have enabled access to quality educational resources, improving student training and preparing them for professional practice. However, it is crucial to consider the challenges and ensure that technologies are used in a balanced, ethical, safe, and complementary way to human care. In short, the future of nursing is closely linked to technological advances, and it is a responsibility of professionals and educators to fully harness the potential of technologies to promote increasingly safe, efficient, and humanized nursing care.

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