



# The impact of digital technologies in nursing care and their application: A narrative review

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## Abstract

**Background and aims:** Digital technologies promise great opportunities to overcome current challenges in the care sector. Examples include the growing presence of robotic systems and society's reliance on mobile, the internet, and social media. Despite substantial advances, challenges in the nursing use of digital technology persist. A lack of good empirical reviews of current technologies in the literature prompted us to conduct this review.

**Methods:** This study was conducted using a narrative review method. We reviewed studies published from 2010 to 2022. Data were collected by searching different English and Persian databases, namely, Google Scholar, Elsevier, PubMed, ProQuest, and Scientific Information Database (SID). Search terms were "digital technology," "social media," "monitoring technologies," "eHealth services," "nursing care," "digital technology application," and "innovative technology."

**Results:** Evidence shows that digital technology in the field of nursing care is classified into three types (types of digital technology in nursing, advantages and disadvantages of digital technology, and challenges and attitudes of nurses in the use of digital technology in nursing care). Each dimension was examined separately. This study uses digital technology in nursing care: Information and communication technology (ICT), ambient assisted living, assistive devices, monitoring/sensors, robotic technology, and virtual reality.

**Conclusion:** Despite substantial advances, digital technology challenges persist in nursing use. Nurses must catch up with rapid changes in digital technologies and their impact on society, limiting their potential benefits to nursing practice and patient care. To respond to these challenges and prepare for the future, nursing must begin the immediate transformation into a digitally enabled profession that can respond to the complex global challenges facing health systems and society.

**Keywords:** Digital technology, Social media, Nursing care

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## Introduction

Healthcare worldwide is facing significant changes because of dwindling human resources, increasing transfers of health care from hospitals to home after discharge, and increasing an aging population with chronic conditions such as diabetes, heart disease, cancer, stroke, and arthritis. The health workforce is also aging, and replacing them is a challenge. Many countries worldwide are experiencing a growing shortage of physicians and registered nurses, especially in health care (1).

Although the demand for healthcare professionals continues to increase, the demand exceeds the availability of all specialist doctors and specialized and non-specialized nurses. The need for both new graduates and experienced nurses leads to difficulties in recruiting staff with the appropriate skills in healthcare centers (2).

The solution to this problem is more than just graduating more health professionals. What is also needed is more and better use of the Internet and digital technology. The existence, application, and benefits of digital technologies in nursing care are related to the current discussion on technologies as possible solutions to problems such as the shortage of skilled workforce and increasing demand for

long-term care due to demographic changes (3).

Nowadays, society's reliance on mobile phones, the Internet, social media, artificial intelligence, and the increasing dependence on telehealth and other virtual care models are more evident than ever. Therefore digital technologies are rapidly changing health care and are increasingly affecting nursing globally (4).

Digital nursing technology (DNT) has been defined by Krick et al in 2019 (3) and Krick et al in 2020 (5). DNT is referred to technologies that fulfill one or all of the following criteria: i) "support the immediate action of a caregiver"; or ii) "contribute to the self-reliance of the person in need of care in such a way that direct on-site care assistance can be avoided"; or iii) "substitute the nursing support by using technology," or iv) "support the training or education of nurses."

DNTs include information and communication technologies, robotic systems, robots, sensors, monitoring technologies, assistive devices, ambient assisted living technologies, virtual reality, or tracking technologies (5-7).

Various studies have shown that digital technologies can be used in hospitals, nursing homes, care centers, home care, and even inpatient and nursing education. In this

regard, Brown and colleagues' study in 2020 showed that nurses use technology to access data, manage e-records, and provide care via e-medicine and telehealth platforms. This issue will create opportunities for improvement, increase, and positive transformation of clinical care and treatment (8).

The findings of a qualitative study by Curtis and Brooks regarding the factors affecting the implementation of digital technology in the nursing home also show that nurses emphasized implementing programs that can use digital algorithms to identify the risk of falling and timely management of it. They also use these programs to prevent the risk of dementia and Alzheimer's, the risk of skin damage in pressure areas, and prevention of bedsores (9).

Digital drug registration is another hospital technology that prevents drug interactions and reduces the risk of allergic reactions. It can also reduce prescription errors by comparing the doctor's order with the standards, make assessment more accessible and thus increase patient safety (1), and positively affect following health guidelines (10).

Mobile devices, brilliant phones, and health applications enable nurses to provide remote advice for reducing pain in cancer patients by providing innovative educational solutions to transfer information and create educational opportunities to be used remotely (6).

Improving nursing education is one of the benefits of digital technology. Recently, in one of the nursing schools in the USA, knowledge of informatics, social media, emerging technologies, and their impact on decision-making and quality of care have been raised as the main issues regarding the performance of the nursing profession (6).

In various studies, nurses have emphasized that using digital technologies will increase the quality of nursing care, and they will spend more time with patients by spending less time on administrative tasks (9,11).

Regarding the substantial growth in the use of

technology in nursing care, this review article aims to investigate the use of digital technologies in different areas of nursing care and compare their advantages and challenges.

**Materials and Methods**

**Design**

This narrative review was conducted in 2022.

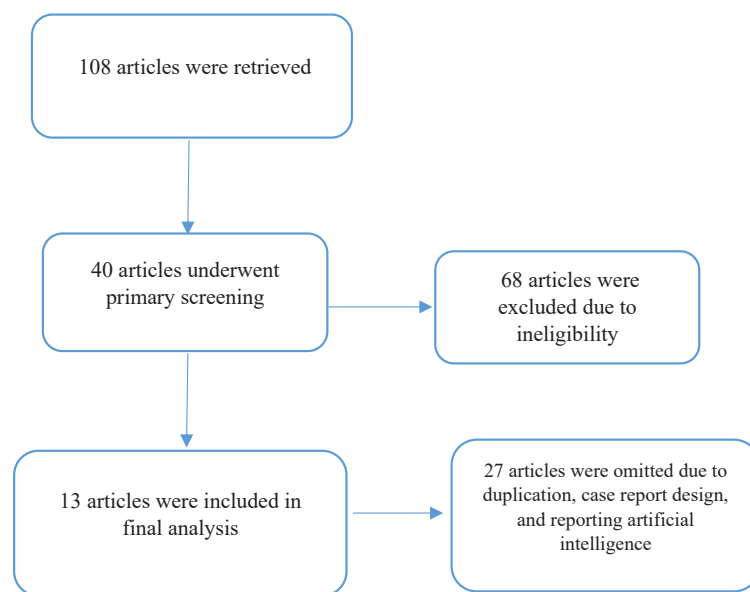
**Data collection**

Data were collected by searching different English and Persian databases: Google Scholar, PubMed, ProQuest, Scientific Information Database (SID), Magiran, IranDoc, IranMedex, and Elsevier. Search terms used were "digital technology," "social media," "monitoring technologies," "eHealth services," "nursing care," "digital technology application," and "innovative technology." The reference lists of the retrieved articles were also hand-searched. Inclusion criteria were published between 2010 and 2022, including the relevance of digital technology in nursing care and access to the full text. Commentaries, theoretical analyses, letters to the editor, conference articles, unrelated studies of digital technology in other medical sciences, and reflections on artificial intelligence (AI) were not included. The bibliographical data and the abstracts of the retrieved studies were assessed for eligibility, duplicated records were deleted, and the two authors manually reviewed the remaining articles.

**Results**

The initial database search yielded 92 articles, and thirteen were finally included in the study (Figure 1). The reviewed studies used various methodologies, including qualitative, quantitative, review, case analysis, and prospective cohort designs.

After reading the full texts of the selected articles, digital technology in the field of nursing care were classified



**Figure 1.** The flow diagram of the study

and analyzed in three dimensions, consisting of types of digital technology in nursing, the advantages of digital technology, and the challenges and attitudes of nurses in the use of digital technology in nursing care.

### *Types of digital technology*

There is no single universal definition in the field of classification of digital technology (3). This technology has been divided into the areas of care and its application in nursing in various studies with few differences (3,6). These technologies are primarily used in hospital care, although some studies also examined their application in-home care (3). The types of digital technology include information and communication technology (ICT), ambient assisted living, assistive devices, monitoring/sensors, robotic technology, and virtual reality.

#### *Information and communication technology*

ICT includes Communication support, computerized decision support system (CDSS), electronic health records (HER), electronic medical records EMR), telecare, hospital care, hospital information system (HIS), and specific software applications/apps. ICT also includes a wide range of technology and can be defined as technology that collects, stores, prepares, and manages interpersonal communications (9). ICT or communication technology provides information that further enhances interpersonal relationships (3). There are different types of information and communication technology, which include:

##### *1. Hospital/care institute information system*

HISs are used to collect, store, manage and transfer data in hospitals or other care institutions (8,12).

EMR and EHR are digital patient health information records (3,11). EMR refers to patient information that is stored and exchanged in the hospital and includes a range of different functions, including patient information management, medicine management, a computerized record of doctor's orders (CPOE), data results management system, care record, and nurse reminder systems (11). However, the purpose of EHR is to transfer information between two systems (11).

##### *2. Computerized decision support system*

The most advanced point-of-care information summary generation systems are CDSSs designed to link patient-specific information in EHRs with evidence-based knowledge to generate case-specific guidance messages. CDSSs have been proposed as a potential remedy for improving health care's overall efficiency and quality. The CDSSs have been reported to encourage better adherence to evidence-based guidelines, improve the use of preventive measures, identify potential risks associated with the prescription of multiple medications, increase the availability of more accurate medical records, and enhance patient-physician communication (11).

This system focuses more on medical decision-making

and primary care and is used by the physician. There are few studies on the positive effects of its application in nursing care (11).

##### *3. Telecare*

Two different definitions have been presented for telecare:

The first definition is "an intervention that involves regular care support from a professional caregiver delivered via digital technology from a distance," and the second: is "any kind of technology that enables a person in need of care to outlive at home or support a caregiving family member" (11). This intervention can be done through phone, video, sending messages, or internet-based software. Studies have shown fewer positive results than other technologies (11), which will be discussed in the section on the benefits of digital technology applications.

##### *4. Communication support*

Communication support is another subgroup of ICT. This technology is suitable for the hospital environment; it increases professional communication and includes various software such as a nurse information system, task management system, hands-free communication system, remote conversation software, and distance health care training (11). Its advantages and disadvantages will be explained in the advantages section.

##### *5. Specific software applications/apps*

This category includes software that supports nurses and people who need care; their main focus is based on something other than communication. They do not have complex information management systems such as HIS and are mainly used for people with dementia or people who need long-term care (11).

#### *Robotic technology*

Robots are machines designed to perform tasks independently, through guidance, or automatically. They can be divided into three types: doctor health care robots, nurse health care robots, and home health care robots (6). Different types of robots facilitate nursing care (11). Robots used in nursing usually work under the guidance of a person (e.g., a nurse) and are used with a degree of independence to provide patient care in the hospital (6).

For example, robots help the patient with feeding and bathing (6), and companion robots provide attention or care, move patients or objects, and teach the patient (6). Robots can give multiple supports at different physical, psychological, social, organizational, security, educational and therapeutic levels (3,6). Social robots, therapy, and robotic underarm systems such as mobility assistant robots are the most frequently used (3).

One of the most critical tasks of robots is physical support, although they can serve different functions in the field of therapy, social and emotional (11). Among the emotional robots, we can mention the PARO robot (10,13). This robot can open and close its eyes and

respond to care and can also be used in nursing homes and for children with autism (10).

#### *Monitoring/sensors*

In recent years, the research area has included technical solutions that use different sensors to monitor patients and support caregiving (11).

Sensors can measure behaviors, movements, and falls and can be used with other devices, such as pumps or alarm systems (3). Along with ICT, sensors and monitors are the most frequently used technologies in care. Analysis of patient behaviors, identification and prevention of unique risks, and analysis of behavioral patterns for nursing decision-making in patient care are some of the applications of sensors reported in studies (11).

#### *Virtual reality*

Virtual reality refers to a non-immersive, fully immersive, 360-degree artificial environment experienced through a head-mounted display (4).

Articles that have worked on using virtual reality in the hospital have been less reviewed, and their most frequent has been related to nursing care education (3). Distraction therapy was an example of the use of virtual technology in the hospital for patients with pain (3). The most attention is paid to reducing the patient's pain during wound care, which nurses have evaluated according to the need for painkillers (11).

#### *Assistive devices*

Assistive devices are physical devices used to support or assist a caregiver or a person in need of care in a particular task that is enhanced with digital technology (9).

These devices are mainly related to network technology and sensors (12). In the hospital, it is usually challenging to distinguish between these devices and medical technology. Still, it can include electronic devices for drug distribution, nurse-coordinated drug self-administration, intelligent pumps, and multi-faceted devices (11).

#### *Ambient assisted living*

AAL systems are integrated multifunctional, often modular systems that support a person in their living environment.

This application generally includes technologies that create security, well-being, and independent living in older adults (11).

#### *Wearable technology*

This technology was not included in the above classifications in the studies. Still, it can be the next step to enter digital technology and become a suitable tool for nursing care (14). These devices can recognize people's vital information such as physical condition, location (via GPS), and specific values such as heart rate and breathing (14). This technology enables nurses to personalize health care based on the patient's current problem and need,

makes them more knowledgeable about respect, and provides information to the nurse less annoyingly and reliably (14).

#### *Advantages and benefits of using digital technology in nursing care*

In recent decades, nurses have encountered a large number of technological advances (14), which are mentioned and explained below.

##### *1. Digital registration of information and increasing client safety*

The use of digital technology can facilitate the registration and evaluation process and improve patient safety (1). A digital drug registration system prevents drug interactions, reduces the risk of allergic reactions, and can reduce errors in drug prescribing by comparing the doctor's order with the standards (1).

Reducing medication errors, facilitating the process of giving medication to the patient, and improving registration are among the benefits of COPE (14).

The basis of this technology is to include the drugs in the database and identify them using an electronic code, which makes it possible for the nurse to check the safety of its administration to the patient, so the nurse can match the proper medication protocol and also will be able to link it to the laboratory results and the patient's pain level and vital signs (13,14).

Studies that examined the benefits of EHR/EMR stated that this technology could improve patient safety and reduce the time of registration and access to patient information (11).

Studies that addressed medication management systems have shown that this technology can reduce medication errors and contribute positively to following health guidelines (11). One of the benefits of EHR is the 24-hour access of nurses to vital patient information for better-coordinated care (10). Reducing the burden and time of drug therapy for caregivers and reducing the number of incomplete registrations and errors are among the positive results of using these technologies (11).

In a study that examined the results related to the patient, it was observed that this technology could reduce the readmission of the patient to the hospital within 30 days after discharge and the number of emergency visits (11). In a study, its positive effect on the quality and safety of care and the promotion of access to information were reported as some of its benefits (12).

In most of the studies, the use of robots showed positive results in different dimensions, such as the positive effect on depression indicators, restlessness of people suffering from dementia, loneliness, and increasing the sense of well-being in people with dementia, accompanying nurses in night rounds in the intensive care unit, and saving the time of drug delivery to the patient and the patient's independent mobility (11).

Sensors are another digital technology that can



effectively prevent falls and pressure sores. Mattresses with pressure sensors, photoelectric sensors, portable skin monitors, and vital signs monitoring are included in this category (11).

## *2. Organizational effectiveness by reducing nurses' workload and increasing care time*

In summary, most studies in the field of digital technology state that it can provide physical, social, and psychological security at organizational levels (7). The studies have also reported that the target groups of this technology can be patients (care recipients), care providers (nurses), and even children with special needs (3). Some studies pointed out its effectiveness from the patient's perspective and mentioned that digital technology could also be effective from an organizational aspect (9).

Digital technology provides opportunities for complete or partial assignment tasks that are comparably less important in patient care and are performed by nurses. These technologies also offer opportunities to use new models of care in nursing activity (6), such as telehealth programs through which nurses can perform daily monitoring, management, and triage of patients with several chronic diseases and reduce the admission of patients to emergency department (6). From the viewpoints of some nurses, DNT can make their work easier and increase efficiency, reduce physical and mental pressure, save time and improve the quality of care (7).

Some also argue that digitization can improve adequate and accessible patient care. This is an opportunity to continuously update the nurse's information because it is easy to use and makes it possible to search for diseases and care quickly. On the other hand, eHealth promotes health care for the nurse and the patient (1).

The advantages of using robots in patient care include feeding, preparing food, being with the patient in emergency conditions, bathing, emotional support, giving medicine, helping the patient walk, and transferring and moving the patient (6). Home care robots also expand to create a sensory and professional relationship with patients (6).

Palliative care for outpatients is another use of telecare reported in the studies. Positive results include cost benefits, quality of care, communication, and documentation effort, but most effects were unrelated to the patient (11). Some studies also mentioned that telecare could increase the safety and security of older adults if it was alien to the personal needs of patients and is supported by the service provider (15).

Regarding the benefits of using communication support, a study that examined "silent special care" and "inter-operative messengers with the patient's companion" showed that it created more effective communication and reduced the response time between the patient and the companion. (11).

A study showed that the use of vital signs sensors would stay in the ICU length of stay (11). The use of

AAL for people with dementia reduces the nurse's worry and anxiety and increases the rehabilitation activities' duration (16).

## *3. Improving nursing education*

One of the benefits of digital technology is the improvement of nursing education (6). Smartphones and health applications enable nurses to advise to reduce the pain of cancer patients. They can be used as a supplement by providing innovative educational solutions to transfer information and create educational opportunities (6).

Lesson plans can be used to increase the use of digital technologies in all practice areas. Recently, in one of the nursing schools in the USA, knowledge of informatics, social media, emerging technologies, and their impact on decision-making and quality have been raised as the main issue regarding the performance of the nursing profession (6).

Robots can improve diagnosis, decrease aggressive mode, and create a more comfortable experience for the patient. Besides this, robotic simulation can complement clinical experiences in nursing education (10).

## *Challenges and attitudes of nurses in the field of using digital technology*

Despite the significant progress made over time and the fact that technology tools and equipment have always been the center of the nurse's work in patient care, the challenges of using digital technology for nurses remain (6,13,16). According to the reviewed studies, some of the difficulties mentioned by the nurses are as follows:

### *1. Non-alignment of support for health organizations with digital technologies*

One of these concerns is that nurses feel uncomfortable with the rapid changes in digital technology and its impact on society, and this issue can limit the potential benefits for patient care and nursing (6). Nurses state that uncoordinated digital systems increase their workload and stress and decrease job satisfaction (1). According to others, digital systems are more useful for administrative reports instead for care recipients' needs (1).

Some nurses report that working with computer systems is time-consuming. If there is a problem, there is a need for support structures to fix the system problem, even on holidays when the person responsible for support may be absent (1).

The nurses believe that eHealth technology has quickly changed their work environment by changing work methods and increasing new work routines and responsibilities, causing a loss of their peace of mind at work (1).

They stated that needing more organizational support to use digital technology and asking questions from the patient using prepared forms were sometimes tricky (1).

### *2. Lack of educational content regarding the use of digital technologies in hospitals in the curriculum of nursing students*

Digital technologies require learning, and nurses need

more skills and time to learn digital care (1). Nurses expressed dissatisfaction with the lack of routine training and nursing training courses. They argued that nurses should be trained in using digital technology in the same way as they learn the skills necessary to take care of patients practically (1).

Nurses argue that a busy work environment, heavy duties, and some organizational obstacles provide them with few opportunities to participate in educational programs about eHealth, and it is, therefore, better to benefit from such training during academic studies (1).

### *3. Reducing interaction and face-to-face communication between nurses and patients and creating machine care*

Some nurses considered digitization a threat to the interaction between nurses and patients and preferred to work face-to-face with patients (1).

They expressed that the digitization of nursing care can prevent safe patient care because they lose personal contact with the patient, and the holistic approach to patient care is lost. The nurse needs to have an identity to feel like an executive rather than a nurse who takes care of the patient (1,10).

In a study, nurses mentioned that the time they talk with the patient is reduced because this time is lost for recording information, which can be one of the disadvantages of this technology (16).

### *4. Inadequacy and gap between designed systems and users*

Nurses believe there is a wide gap between the designated system and the people who use it; in other words, they want the eHealth system to be coordinated with them instead of the nurse coordinating with the system (1,3).

From the viewpoint of nurses, one of the critical issues in this regard is that they are never asked to present their ideas in the decision-making processes and optimization solutions of eHealth and other digital systems, even though these systems are the working tools of nurses (1). The electronic health service system should be upgraded according to the user's conditions so that it is easier to work with it daily (1,6).

### *5. Existence of concern about robots replacing nurses in the future*

Nursing is often rooted in humanism and altruism, and nurses share this feeling when caring for the patient. Therefore the opposition against technology is rooted in this issue (6).

As a disruptive or unpleasant newcomer to the traditional role of nursing care, digital technology conflicts with traditional nursing ideals such as comprehensive patient care, it may make nurses reluctant to adapt to access approaches to digital technology (6).

One of the challenges nurses expressed regarding using robots is the concern about the need for more feeling in them, which can never replace human care (10). The use

of technology can make nurses invisible, and this is the difference between interactive care and machine care.

### *6. Inapplicability of many technologies in clinical care*

This technology is most useful when it is used for an organization's unique needs, is not complex and is easy to use, is presented in supportable packages, and nurses are consulted on the use of a particular device and the time required to learn and work with it.

Some reasons for not accepting digital technology were that it needed to be more user-friendly and its benefits required to be visible in patient care. Among other reasons, we can mention the type of design and usability, the lack of technical competence, and the lack of patient acceptance (13).

### *7. The existence of organizational challenges*

Nurses face organizational challenges in integrating new technology with patient care, including balancing human factors and digital technology, balancing cost and resources, training the nursing workforce in technology, and ensuring its continued competency and ethics in using it (10).

Therefore, in response to these challenges and preparing for the future, nursing must become professional with digital capabilities to respond to these complex global changes in front of the health system (6).

## **Discussion**

Since the areas of digital technology have expanded to support nursing care, this review article was conducted to address digital technology in nursing care. The results showed different technology types and other digital tools experiences. Most nurses acknowledge that digital advances are inevitable. The benefits of using them can be seen alongside the concerns of implementation (1), and improve leadership capabilities in digital technology such as clinical decision support systems, electronic health records, mobile technology, and artificial intelligence and critical leaders who understand the consequences are needed in this field (6).

The use of digital technologies creates new policies and legal, ethical, and regulatory requirements (6). The nurse's interactions and patient care should be reframed (6,17). To increase the effectiveness of patient care, nurses should promote virtual care methods and share their experiences in the field of remote health and care with each other (6,11).

The interpretation of patient privacy in both physical and digital fields and inter-professional functions should also be jointly designed by the health team, patients, and their caregivers in digital technology (6). Acceptance of digital activity in the profession requires cultural changes, and stakeholders and leaders of the nursing profession demand better evolution of digital systems to meet current and emerging needs (6). The recent benefits of

the technology include rationalization and productivity in increasing the boundaries of the realm of care. It is, therefore, necessary to consider technology not as an external pressure that endangers nursing care but as an internal and ongoing process of evolving evolution (6,14).

The digital literacy of nurses to perform primary care is considered one of the vital critical competencies for advancing nurses (6). In a study conducted by McKibbin et al, one of the reasons for the reluctance of healthcare institutions to use innovative technologies at the bedside is the existence of limited evidence for the positive impact of digital technology in the nursing care of patients (18). The results of the systematic review showed that although technology may benefit from the quality of care and improve clinical processes, there needs to be evidence regarding the measurable impact on patient communication, such as cost, mortality, hospital stay length, etc. The conflicting results obtained regarding the use of technology can be due to the type of intervention (11).

Novice nurses who are early adopters of technology may be more receptive to technology than nurses who resisted it or stayed behind because, in any case, the world of healthcare technology is expanding with new tools to help patients (14). Whenever nurses become accustomed to technology and technology improves their satisfaction level increases, requiring time (14). Because, as mentioned earlier, nurses feel worried due to rapid and sudden changes in technology, and time plays an influential role in their satisfaction (14,17), time is a significant factor for any new system to create a positive attitude towards it (14).

Therefore, nurses and the nursing profession need support to use digital technology to obtain more scientific information, analyze data, and provide virtual care models and joint digital solutions with the patient (6).

## Conclusion

The results of this study can be used as a basis for further research in the field of using digital technologies in nursing care. Although using digital technologies can increase the quantity of care by overcoming time and place limitations, it may also lead to specific concerns, including practical learning and adaptation of nurses to digital technologies, maintaining effective communication with patients, and observing ethics while using these technologies.

## Authors' Contribution

**Conceptualization:** Mansoureh Ahmadifaraz.

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**Writing – review & editing:** Mansoureh Ahmadifaraz.

## Competing Interests

None.

## Ethical Approval

Not applicable.

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