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Nurses' Views on the Potential Use of Robots in the Pediatric Unit

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ABSTRACT

Purpose: To describe nurses' views on the potential use of robots in the pediatric unit.
Design and methods: A qualitative descriptive design was employed. Semi-structured interviews were conducted with 23 nursing staff who worked in the pediatric unit. The interviews were audiotaped, transcribed, and analyzed using qualitative content analysis.
Results: Three themes emerged related to the nurses' views on the potential use of robots in the pediatric unit (1) care impact - advantages, which included: (a) reducing healthcare providers' workload and (b) adequately meeting the needs of pediatric patients and their families; (2) care impact - shortcomings, which included: (a) deficiency of individualized care and (b) reduced employment opportunities for skilled nursing staff; and (3) attitude impact, including (a) lifelong learning and (b) integrating culture and technology to meet pediatric care needs.
Conclusions: Robots' application may ameliorate the overall quality of pediatric care, allowing for better apportioning of nurses' time and energies to focus on direct patient care and reducing nurses' workloads. However, some possible disadvantages need attention, including robots' inability to provide genuine human touch, demonstrate human emotions associated with pediatric care, and exhibit cultural sensitivity. It is desirable to embed nursing practice needs in the advanced functions of robots and thereby ensure safe, reliable robotics suitable for pediatric care usage.
Practice implications: The findings can be used as a reference for nurses encountering challenges in working with robots, and for lifelong learning needs for pediatric nurses.

Background

With technology's continued rapid development and widespread implementation, the use of robotics and artificial intelligence (AI) in healthcare has gradually become a global trend. Technological-information literacy and AI informatics skills have become major prerequisites for nurses (Akman, Erdemir, & Tekindal, 2014). Boissy, Corriveau, Michaud, Labonté, and Royer (2007) identified three key applications of robotics in healthcare: (a) rehabilitation therapy assistance via mechatronics, (b) object manipulation assistance via a robotic arm device, and (c) care assistance, including errand performance and spoken reminders via programmed or remotely controlled robots in 2007. In the intervening decade, advances in technology have made possible autonomous robots that can work and accomplish tasks without constant human control (Broadbent, 2017). Experts now predict that by 2025, robotics and artificial intelligence may become part of many human beings' daily lives due to their use in multiple industries, including healthcare (Smith & Anderson, 2014). Are nurses, who represent the largest percentage of care providers in the field, keeping up with the times? As technology continues to advance, it is essential to explore nurses' views and attitudes regarding robots' potential use in the clinical setting.

The use of robots in healthcare has become increasingly common, with applications in a variety of tasks solving diverse problems for patients, hospitals, and the healthcare industry overall (Kujat, 2010). Rapid advancements in AI and robotics technology have led to a proliferation of intelligent devices embedded in our personal and professional environments. However, healthcare has always been, at its foundations, human-centered, and many people in the field may not yet be ready to cooperate with robots (Smith & Anderson, 2014). Since the devices can improve outcomes, however, it is important to consider how healthcare professionals learn about and interact with robots, share the workspace, and achieve healthcare goals together.

In nursing care, the use of elder care robots or robotic care devices has already become common (Homma & Matsumoto, 2017). Incorporating robots in healthcare delivery for elders not only increases patient autonomy but also helps to relieves the growing burdens that elderly

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populations place on healthcare providers. Coco, Kangasniemi, and Rantanen (2018) compared the attitudes of Finnish and Japanese elder care personnel and found that the Japanese workers felt more positively about the usefulness of robots. The study revealed significant differences between the views of two countries' care personnel regarding the importance of potential tasks for robots. It also showed that the elder care personnel, especially the Finnish personnel, experienced fears about the possible introduction robots into the care setting.

In pediatric care, evidence to recommend the use of robotics is limited. However, socially assistive robotics in therapy for children with autism spectrum disorder have been found to increase social engagement (Coeckelbergh et al., 2016). As the use of robotic technology in healthcare grows, moving beyond operating rooms, rehabilitation, and telemedicine (Papadopoulos & Koulouglioti, 2018), understanding pediatric nurses' attitudes toward robots can facilitate integration of robotic technologies into future pediatric patient care. Pediatric healthcare brings special considerations into play. For example, nurses often use direct physical contact to guide patients, such as leading a child to a lab room or touching a child's hand to give comfort, administering medication, and engaging in therapeutic play with children. Furthermore, cultural attitudes toward robots vary and need to be taken into account when robotic products are being considered for different countries and cultures (Papadopoulos & Koulouglioti, 2018), especially with regard to family-centered pediatric care.

Aim

The aim of this study was to explore nurses' views on the potential use of robotics in the pediatric unit. The specific objectives were to ask and analyze the answers to these two questions: How do pediatric nurses describe the roles of robotics in clinical practice? What impacts do they associate with the use of robotic care in the pediatric unit?

Methods

A qualitative descriptive approach was adopted in this study because of the advantages of qualitative research in obtaining a better understanding of the views or meaning of human experience (Polit & Beck, 2008). Furthermore, a descriptive approach was useful when information was limited but the desired outcome was a rich depiction of the perceptions being studied (Sandelowski, 2000). Data were collected through in-depth interviews to obtain a fuller understanding of the participants' views (Legard, Keegan, & Ward, 2003).

Sampling and setting

All participants were registered nurses who were recruited intentionally from five hospitals, including medical centers and regional hospitals, in Taiwan. These hospitals use robot-assisted surgery, such as the da Vinci Surgical System, or tour guide robots, so participants had opportunities to witness and experience the application of robots and to share insightful views on the potential use of robots in the pediatric unit. The study was approved by the Human Research Ethics Committees of the hospital prior to commencement. E-mails were distributed by first author, who had access to the nurse administrators of the hospitals. The nurse administrators assisted by fostering interest in the study but, because they were not in a position to affect a participant's employment status, they did not pressure participation. They also distributed the first author's email requesting to be contacted by the prospective participants. The participants were selected by purposive sampling based on the following criteria until data saturation was achieved: registered clinical pediatric nurse, employed at the hospital for a minimum of one year, and willing to participate voluntarily. The prospective participants were contacted via an e-mail that included a letter of introduction and an information page stating the aims of this study. After receiving the potential participants' approval, the first author contacted each by phone to further explain the purpose and process of the study and to arrange a face-to-face interview. Informed consent was obtained from all participants before the interviews began. All interviews were conducted in private settings of the participant's choice, such as discussion rooms in their hospitals. Each interview was transcribed verbatim within one week.

A total of 23 female nurses with an average age of 30.8 $\pm$ 6.0 years participated in this study (Table 1). With regard to their educational background, five were MSNs (Master of Science in Nursing) and 18 were BSNs (Bachelor of Science in Nursing). With regard to their practice positions, four were head nurses and 19 were staff nurses, including four pediatric nursing practitioners. All participants were RNs and worked in a pediatric unit, eight in medical centers and 15 in regional hospitals that used robot-assisted surgery, such as the da Vinci Surgical System, or tour guide robots so they had opportunities to witness and experience the application of robots and to share insightful views on the potential use of robots in the pediatric unit.

Data collection and analysis

Data were collected by the first author, who conducted and audio-recorded face-to-face individual interviews and wrote field notes. Each interview lasted approximately 45–60 min. The interviews were conducted with a semi-structured interview guide (Table 2) with open-ended questions to give participants guidance while allowing for greater breadth of narratives that focused on the participants' views on the potential use of robots in the pediatric unit. The related literature review (Mackay, Anderson, & Harding, 2017; Mather et al., 2012; Mettler, Sprenger, & Winter, 2017) was critical to ensuring appropriate guiding questions were created. Thereafter, discussion among the researchers (authors) formed and guided participants' interviews to ensure rich data were collected. Data collection continued until data saturation had been achieved at 18 participants; five additional participants who had already been agreed to be recruited were interviewed to ensure data saturation was achieved. No additional themes emerged from the data gained by the additional participants.

The analysis was based on the method of qualitative content analysis according to Elo and Kyngas (Elo & Kyngäs, 2008). Lincoln and Guba (Lincoln & Guba, 1985) pointed out the need for incorporating rigor to enhance the trustworthiness of the findings. Thus, the audiotaping and verbatim transcriptions of all participant interviews aided in preventing bias. The analysis was led by an experienced qualitative researcher (HF), who led a team of three other researchers who participated in data analysis and interpretation. Primarily, the analysis was conducted independently by two experienced reviewers (HF and HW) who first read the verbatim text to note short phrases to serve as the headings with open coding and, second, collected headings onto coding sheets and from them created categories (Burnard, 1996), condensing similar expressions or content-related categories. Third, the reviewers abstracted the data by articulating an overall depiction of the research subject based on the categories generated. Each category was named

Table 1
Demographic data of pediatric nurses (n = 23).

Variables	n (%)	Range	Mean	SD
Pediatric nurses' age		25.4–45.1	30.8	6.0
Hospital level				
Medical center	8 (34.8)			
Regional hospital	15 (65.2)			
Length of employment in pediatric unit (years)		1.3–17	4.9	4.5
≤3	11 (47.8)			
3.1–6	7 (30.4)			
≥6.1	5 (21.7)			

Table 2
Semi-structured interview guide.

1. What is your opinion about the use of robots in the pediatric setting? Can you imagine and describe how your roles could change if robots are implemented in your unit in the near future?
2. Do you feel that there are any impacts of using robotics while providing pediatric care?
3. What changes in care might occur when applying robotics in the pediatric setting?

using content-characteristic words; subcategories with similar events and incidents were grouped together as categories, and categories (or subthemes) were further grouped as central categories (Elo & Kyngäs, 2008), or themes. During this stage, they discussed any disagreements in order to reach consensus.

Results

From the data analysis, three themes related to the potential use of robotics in a pediatric unit emerged, centering around nurses' perceptions of the potential positive and negative impacts of robotics on patient care, and on their own attitudes. The themes were identified as follows: 1) care impact - advantages, 2) care impact - shortcomings, and 3) attitude impact. These revealed the benefits and drawbacks associated with pediatric nursing roles in relation to the potential use of robotics in a pediatric unit. Although each theme is presented separately for ease of understanding, advantages, shortcomings, and nurses' attitudes are inextricably linked. That is, one influences and is in turn influenced by the other. For example, the categories of "reducing healthcare providers' workload" and "adequately meeting the needs of pediatric patients and their families" within the first theme (care impact – advantages) also had an influence on perceiving individualized care deficiency and reduced employment opportunities for skilled nursing staff under the second (care impact – shortcomings) theme, and also impacted nurses' attitudes (Theme 3). Participants' quotes are referred to by their practice position (head nurse, nurse practitioner, or staff nurse), with a number (one for each of the 23 participants), their age, and their hospital type (medical center (M) or regional hospital (R)).

Theme 1: care impact - advantages

Most participants described that robotics could bring many advantages in nursing care for pediatric patients and their families, two subthemes that emerged from this theme are presented, along with their supporting categories, as follows.

Subtheme 1. Reducing healthcare providers' workload

Participants believed robotics could reduce their workloads. An important factor affecting participants' perception of the advantages of robotics was their sense that intelligent devices were ideal for performing repetitive actions and assisting with precision treatment. There are three categories to support this subtheme, as follows.

Assist in routine work

Many respondents believed that the use of robotics could reduce the clerical or administrative portions of certain routine tasks. For example, when nurses receive word of an admission, they could use robots to perform generic setting orientations for patients or family members. Robots could also demonstrate and explain to newer nursing staff unfamiliar environments or equipment used in pediatric care. Most respondents' comments included positive views of these possibilities:

> *Usually while new patients are admitted, we have to do a physical assessment and a family assessment. We also have to do a unit orientation; it usually takes a lot of time…. I think robotics can help us in this area.* (staff nurse 2–26yrs-R)

> *I would like robotics to help me with the strategies of garbage classification, how to weigh the diapers, remind me to collect urine at regular intervals…this kind of routine. Furthermore, patients or families can ask robots to repeat something as many times as…they need.* (nurse practitioner 3–32 yrs-R).

Respondents believed that with robotic help for routine workloads, nurses would have more time and energy to provide skilled nursing care for patients and families, alleviating the pressures of time that are especially tight in emergency situations. Furthermore, participants expected that robots could assist them in collecting and interpreting data.

> *I hope robots can help us track the result of patients' lab data and interpret it, since patients always have multiple tests in the lab and we get the data back at different times. If robots can collect all results and interpret blood tests, genetic tests, and other tests for us, it will help a lot.* (head nurse 5–33 yrs.-M).

Assist in precision treatment

Although medications are prescribed by physicians, they are usually administered by nurses. Nurses are expected to make no errors in medication administration. In pediatric medicine, the dosages are usually very small compared with those for adults, so nurses must be especially careful and precise when it comes to medication administration. Participants also spoke positively when considering the potential for robotic assistance in this area.

> *Robotics can help me to prepare the precise medicine for pediatric patients, including injections and oral administration, even very tiny doses. Pediatric patients are tiny, not like adults. I have to watch out that I am administering the precise dose.* (staff nurse 7–25 yrs-R).

> *Robotics can help me to find the exact blood vessel, because they are hard to find when we administer intravenous injections for little children.* (staff nurse 1–26 yrs-R).

Deliver uniform, comprehensive instructions to clients

When patients or their family caregivers encounter any pediatric care questions, they could contact the nursing staff to arrange for a robotic device that could provide the information they need. This would empower patients or their family caregivers with care knowledge and skills. Furthermore, it would ensure that no important steps or pieces of information are omitted or misstated, reducing the chances of mistakes that could lead to adverse outcomes. Patient issues could be answered promptly, which would help reduce redundant nurse-summoning by patients and family members, as well as reduce anxiety among patients, family members, and nursing staff. Participants' comments related to the role of robots in this regard include the following.

> *Robotics can assist in introducing the setting for children and caregivers consistent. Videotaped instruction presented by robots would allow caregivers to return to material they have questions about and rewatch that specific segment of the video. Robots could save nurses a lot of time.* (staff nurse 6–26 yrs-R).

Subtheme 2. Adequately meeting the needs of pediatric patients and their families

Most participants perceived a benefit of robotics to be a reduction in medical costs and service consumption while helping to meet the needs

of patients and their families. There are two categories to support this subtheme, as follows.

Providing therapeutic play or attendant care for patients

Robotics can alleviate the pressure on nurses' accompanying children at all times, yet still allow them to provide care in situations where they need to communicate with or check on pediatric patients. One participant said,

> *I know therapeutic play with children or accompanying them is essential. However, I did not have enough time to be with them. If we have a cute robot like McDonald's uncle, or cartoon characters —whatever the children like—children will love it, and they will cry less.* (staff nurse 8–30 yrs-R).

Providing immediate companionship for or response to clients

Participants believed that robots could help in responding to and providing a reassuring presence for children when care is needed but nurses are not immediately available:

> *I think robots can help us be there for the children while we are busy, before we arrive at their beds.* (nurse practitioner13–39 yrs.-R).

Participants felt that robotics could also be a useful aid in furthering communication with children by decreasing stranger anxiety. Robots could provide a helpful buffer between healthcare providers and pediatric patients.

> *I think cute robots could make my patients smile or decrease their anxiety instead of seeing me in the nurse uniform with injection equipment most of the time. I believe robotics is a good buffer in the relationship between patients and me. They can comfort the children before I come.* (staff nurse 9–28 yrs-R).

Participants suggested that robotics could also be a useful tool in multi-language communication with children and family caregivers from foreign countries, improving their understanding of the healthcare situation. One participant said,

> *Robotics can allow family members to feel assured by immediate access to care counseling and guidance, and confident about their preparedness for occasional abnormal events. Further, with the robotics, patients and families who are non-native speakers can receive instruction in their own languages.* (head nurse 4–43 yrs-R).

Theme 2: care impact - shortcomings

Participants believed that robots could help with numerous nursing tasks, but recognized the inherent limitations of robots only being able to do what they are programmed to do. Nurses also understood that it would remain their responsibility to make up for any robotics deficiencies. There are two subthemes as follows.

Subtheme 1. Deficiency of individualized care

Although robots can perform many tasks to assist clients and relieve nurses' workloads, they are still machines, incapable of feeling emotions. Thus, they cannot provide true human touch or feel a human connection with their patients. There are two categories to support this subtheme, as follows.

Not actively providing adequate care for children and their families

Participants described that robots are machines that cannot justify and judge children's changing moods and their unique care needs. They cannot discern patients' individual needs, especially with regard to culture, nor provide individualized responses. They lack human senses to judge a patient's progress. One participant said,

> *Robots are passive and cannot perceive children's individual development impacted by their families' culture. Robots aren't even smart enough to tell the next step during CPR.* (staff nurse 15–36 yrs-M).

Another said,

> *Although a robot can collect data and precisely assess data –but only from objective data—there are things like emotions, feeling data, it cannot perceive and assess. It is hard for a robot to assess patients' mood and feelings and respond appropriately.* (head nurse 12–41 yrs-R).

Data handling and privacy concerns

Robots may store patients' personal data from other departments, such as blood tests, x-rays and other examination outcomes. Without protection standards, patient privacy may be jeopardized. Additionally, data from other departments are updated frequently, requiring precise handling to ensure adequate patient outcomes. One participant said,

> *It is convenient for every department to import the patients' data when they get the examination outcomes. If everyone could easily get patients' data, or change data, it would harm patients and their personal privacy. Furthermore, it is hard for robots to maintain privacy in a public area. Everyone there could hear the robots' answers.* (staff nurse 14–32 yrs-R).

Subtheme 2. Reduced employment opportunities for skilled nursing staff

The respondents believed that an increase in the use of robotics could mean that many nursing tasks would be replaced, leading to fewer nursing job opportunities. The participants expressed having very contradictory feelings. They understood that the intention of introducing robotics was to provide help for nursing staff, particularly in the area of precise and repetitive work. However, they worried that more of their work would eventually be performed by robots, and they could lose their jobs. There are two categories to support this subtheme, as follows.

Reduce nurses' clinical skills

Participants agreed that many clinical skills require significant practice to perfect. If robots assume many nursing tasks, nurses will have fewer opportunities to maintain their clinical skills. One participant said,

> *Like the intravenous injection skill—if I haven't done it every day, I may not be able to inject into child's tiny vessels successfully. I believe any skills require daily practice to perfect. If robots help us to do the clinical tasks, we'll reduce nurses' clinical skills and maybe lose our jobs.* (staff nurse 10–32 yrs-M).

Another said,

> *If robots do medication preparation and administration, it means hospitals don't need as many healthcare providers. So many nurses may lose their jobs.* (staff nurse 17–29 yrs-M).

Reduce nurses' interactive communication skills

Participants described that efficient communication with children requires the use of mutually understood signs, symbols, and semiotic rules. Human perception is needed to recognize children's non-verbal communication and the needs that conveys. One participant said,

> *Robots have no sense to feel children's anxiety, fear, happiness, or sadness. How can they offer adequate care for children and their families?* (staff nurse 22–26 yrs-R).

Theme 3: attitude impact

Having witnessed early applications of robotics in the health care setting, all participants believed that robots could positively contribute

to nursing care in the pediatric unit and in other units. Specifically, the implementation of robotics could respond to changes in nursing care delivery. Thus, it is essential to further develop the pediatric nursing role in order to meet and benefit from the advances of technology. The two subthemes, and supporting categories, emerged as follows.

Subtheme 1. Lifelong learning

All participants agreed constant learning and lifelong learning in improvements of technology is essential to respond to the alterations in pediatric nursing practice to stay professional development while working within the pediatric unit. There are two categories to support this subtheme.

Knowledge in technology

Participants recognized that technology changes daily and that learning is a lifelong matter. One participant said,

> *I agree that robots can help with a lot of nursing care. Thus, we have to keep up with the times to learn the technology; otherwise we cannot operate the advanced technology, such as robots.* (staff nurse 18–26 yrs-R).

Another said,

> *Without proper learning, we cannot detect technological errors and the robots could harm our patients.* (staff nurse 23–27 yrs-R).

Knowledge in highly skilled response for complex health problem demands

Most participants indicated that providing good quality care for children and their families is the goal of pediatric nursing. Thus, nurses have to maintain current knowledge of highly skilled responses to meet the demands of complex health problems. One participant said,

> *Continuing education in knowledge and clinical skills, as well as in advanced technology such as the function and usage of robots, is important for nurses to respond to pediatric patients' physical, mental, and social care needs.* (staff nurse 19–26 yrs-R).

Subtheme 2. Integrating culture and technology to meet pediatric care needs

The new technologies including robots have to be assimilated into children and their families' lives. Furthermore, each pediatric child is unique as well as their families that have their unique culture affecting their way of life. Thus, it is essential to integrate culture and technology to meet pediatric care needs. There are two categories, as follows.

Integrating culture care into technology

Participants believed that although robots can be designed and programmed to exhibit approximations of human personalities, they cannot take the place of human care, especially with regard to culture. Thus, integrating culture care into the technology is essential. One participant said,

> *The robots have to speak many languages, for example, Indonesian for an Indonesian mother, Vietnamese for a Vietnamese mother.* (nurse practitioner 13–39 yrs-R).

Another said,

> *The robots have to use our cultural greeting to greet patients or families. For example, they have to greet people with 'How are you?" as well as "Have you had a meal yet?" in order to be welcomed in our setting.* (nurse practitioner16–29 yrs-M).

Using critical thinking in conjunction with robots

Although robots can assist healthcare providers, nurses recognized that they would have to check on the robots' actions regularly. One participant said,

> *Although I think robots could do everything, including checking vital signs, we would still need to think critically to make sure each process is adequate and correct.* (head nurse 11–45 yrs-M).

Another said,

> *Before the robots' administering of medication, we would have to check to see if the robot is functioning normally or not. It may be out of order. If we don't check, it will harm pediatric patients. Furthermore, we have to check in afterwards for the patients' or families' response.* (staff nurse 20–27 yrs-M).

Discussion

Twenty-three pediatric nurse participants were interviewed about their views on the potential use of robots in the pediatric unit in this study. According to the findings, it is apparent that nurses believed the use of robotics has many advantages and also brings disadvantages. Nursing staff can make use of their advantages and while remaining wary of their shortcomings. Therefore, they need to have an attitude of openness toward constantly learning new technologies and integrating appropriate culture into robotics use.

In the theme of "care impact – advantages," participants approved the use of robotics as beneficial to pediatric units. They agreed of the use of robotics for patient escorting, medication administration, medication/procedure counseling for families, the provision of health education resources, and as temporary providers of "company" and reassurance for children and family members. They considered robotics especially useful for therapeutic play with patients and for recorded but interactive teaching, since hospitalized children often require more of these interactions. These findings further support the literature correlating perceptions of helpfulness and precision with favorable views of robot usage (Best et al., 2014; Iavazzo & Gkegkes, 2015; Von Gruenigen, Sawyer, Ponsky, & Hurd, 2009). Studies have shown several uses in pediatric treatment for robots, such as improvements in positive social behaviors in patients with autism. Furthermore, robots have considerable functional, emotional, and social value (Ricks & Colton, 2010).

Robotics has value for the nursing care of pediatric patients, according to this study of pediatric nurses. First, robots may assist in routine work and decrease nurses' overall workload, particularly with respect to repetitive tasks and precision administration of medication. They can help nurses deliver uniform, comprehensive explanations and demonstrations for patients and families, ensuring consistency. Robots programmed for teaching and counseling can provide immediate patient and primary caregiver education when nurses are not available, or as a complement to nurses' responses to strengthen patients' knowledge and self-management skills. Second, participants emphasized that a robot designed specifically for children—a "child-like or cute robot"—could decrease anxiety in pediatric patients by acting as a buffer between nurses and patients. In addition, they thought that robots might be efficient and effective escorts for guiding pediatric patients and their families to and from different areas in the hospital, giving nurses more time to be with patients when face-to-face human interaction is critical. Consequently, robots might not only reduce nurses' workloads and allow for more efficient use of their time, but also reduce nursing service consumption. Participants added that robots could easily undertake therapeutic play with children and help relieve hospitalized children's anxiety.

In the theme of "care impact – shortcomings," participants expressed concern, however, that robots might displace them for certain types of work, which could lead to job loss in the future. These results align with literature predicting that future jobs may be displaced by robotics (Frey & Osborne, 2017; Smith & Anderson, 2014). Nurses may thus feel conflicted about the introduction of robots, recognizing that although they can aid their care practice, they might also reduce

employment opportunities. Therefore, issues deserving of consideration include recognizing duties or responsibilities for which human nurses are irreplaceable as some of the more repetitive or precision tasks are handed off to robots. It will be necessary for administrators to establish standard nursing-staff operating norms with respect to robotic assistance, as well as to clearly define the responsibilities of both nurses and robots in pediatric nursing.

Several ethical issues were pointed out in this study. Robots that help nurses will be overseen and operated by specific nurses but will interact with multiple nurses, patients, families, and other health care providers. Thus, there needs to be sufficient protection of personal data. There are also possible risks to patient privacy and safety and professional standards of conduct that warrant consideration. To reinforce healthcare professionals' awareness and build operating standards, it will be necessary to develop guidelines and protections for all parties involved, and to develop adequate training. Participants' responses also suggest that implementing robotic assistance would necessitate cooperation among the entire healthcare team, including executives and technology support personnel, to ensure safe, appropriate, and correct operations. Perhaps most important in considering the advantages and disadvantages of robotic assistance for pediatric nurses is identifying the boundaries between what could or should be robot-assisted and what should remain the purview of human nurses to ensure adequate care for patients and families. This would likely allow pediatric nursing care to become more efficient and effective.

Finally, nurses expressed that they cannot blindly depend on robots but need to think critically and observe patients' conditions themselves. These results confirm a previous study (Wikström, Cederborg, & Johanson, 2007) that indicated that technology is not completely trustworthy but requires human observation skills to be used in concert with it.

In the theme “attitude impact,” participants believed that ongoing learning and improvement are essential to advancing the quality of patient care. Regular opportunities for professional development are critical to effective practice. Continuing to build upon technological expertise, especially in an ever-changing climate, is necessary for providing the highest quality care possible (Huggins, 2004). Furthermore, technology and nursing have been inextricably linked; the caring values and practice of modern nursing cannot be separated from the technology that supports their delivery (Bagherian, Sabzevari, Mirzaei, & Ravari, 2017; McGrath, 2008). Especially with regard to new technologies, lifelong learning among healthcare providers is critical for patient safety.

Pediatric patients' health needs may be complex, including physical, mental, and developmental care, and families' cultural care. Integrating these factors within technology best meets clients' needs. Adequate care requires human assessment, but robots can assist with precise pediatric treatments and routine care. Pediatric nurses need to use critical thinking skills to manage the increasing acuity of patients' needs and to adjust to the constantly changing nature of the healthcare practice (Raymond & Profetto-McGrath, 2005). If robots are used in the pediatric setting, nurses'critical thinking and relational skills are further required in considering patients' psychosocial and families' cultural needs, and to what extent addressing these needs can be adequately integrated into robots' programming to meet standards of excellence.

Implications for practice

This study found that pediatric nurses perceived both advantages and disadvantages for the potential use of robots in pediatric nursing care. Furthermore, pediatric nurses realize that continuing lifelong learning can keep them up-to-date with new technology. Their continuing education has to integrate technology innovations such as robotics to assist them in developing their knowledge base, critical thinking, and clinical competences to meet the rapid advances and gradually increase their reliance on technology. Moreover, it is critical that nurses understand the influence of culture on pediatric nursing care. While conducting technology-focused continuing education for nurses, nursing administers and educators are encouraged to emphasize the integration of culture with technology in order to meet pediatric culturally competent care needs and safety for pediatric patients and their families. With an intentional approach, making good use of robotics or advanced technology in nursing care can be fostered and nurses can more fully understand the impact of culture on technology, and vice versa, in order to provide culturally competent care.

Limitations

Our study used a qualitative approach; additionally, all of the respondents in the study were pediatric nurses and the majority were female. Thus, the generalizability of the study's results may be limited. Furthermore, although the participants interviewed were employed at medical centers and regional hospitals, the technological environments in their work settings that were reflected in some responses seemed to indicate that their exposure to electronic systems might be limited. It is recommended that future studies could use quantitative methods, and participants could be employed in diverse healthcare services and include healthcare professionals from different cultures and in different professional healthcare roles. Furthermore, we did not recruit families of pediatric patients for this study. Because nurses' perspectives on appropriate applications of robotics in pediatric care may or may not align with what families would find acceptable, further studies to gain a family-centered view are suggested.

Conclusion

This study examined the views of pediatric nurses with respect to the potential use of robotics in pediatric nursing. It suggests that strategic implementation would offer numerous advantages but also the necessity of attending to the inherent weaknesses of the technology, including robots' inability to provide genuine human touch, demonstrate human emotions associated with pediatric care, and exhibit cultural sensitivity.

It seems inevitable that the increased use of robotics and AI will affect job descriptions and employment opportunities in nursing, as some tasks will be replaced or heavily modified; it is also possible that advances in technology will expand opportunities for nurses by augmenting their abilities and roles. In any case, it is essential that the individual care currently provided by nurses, as well as their knowledge and skills, continue to be delivered by some means; the extent to which this is assisted by technology remains unknown. Improving nurses' knowledge and awareness of robotics operations is essential. For future clinical practice, it is desirable to consider the integration of nursing practice and the advanced functions of robots and thereby ensure reliable robotics suitable for safe pediatric nursing care usage. Administrative cultivation of technology-related standards and guidelines, particularly concerning ethics and privacy in data security, will improve the quality of care. Furthermore, some individualized nursing care for pediatric patients and their families is irreplaceable.

Declarations of interest

None.

Conflict of interest

The authors state no conflict of interest regarding the publication of this article.

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