Views of nurses and other health and social care workers on the use of assistive humanoid and animal-like robots in health and social care: a scoping review

Abstract

Background: Robots are introduced and used in many health and social care settings, from the operating room to the care of older adults with dementia.

Objectives: The goal of this scoping review is to provide an overview of the existing evidence related to the views of nursing staff and other health and social care workers about the use of assistive humanoid and animal-like robots in the health and social care sector.

Methods: Using the Joanna Briggs Institute guidelines we searched MEDLINE, PUBMED, CINHAL, EMBASE, PsycInfo, Web of Science, and IEEE Xplore digital library. Nineteen (19) articles met the inclusion and exclusion criteria and were retrieved, reviewed and summarised.

Results: Health and social care workers reported mixed views regarding the use of robots in a healthcare setting. They mainly focused on the impact that robots could have on their patients and not to themselves. They considered an array of tasks that robots could perform; they addressed the issue of patient safety and raised concerns about privacy.

Conclusions: A limited number of studies have explored the views of health and social care workers about the use of robots. Considering the fast pace with which technology is advancing in the care field, and with professionals in health and social care increasingly being asked to use such technologies, it is critical to conduct more research in this area.

Keywords: Nurses, Healthcare Professionals, Social Care workers, Views, Robots, Humanoid robots, animal-like robots

Impact Statement: Robots will increasingly have a role to play in nursing, health and social care. The potential impact will be challenging for the healthcare workforce. It is therefore important for nurses and other health and social care workers to engage in discussion regarding the contribution of robots and their impact not only on nursing care but also on future roles of health and social care workers.

Background

Assistive robots are those that can support and help a human user. Examples include rehabilitation robots, wheelchair robots, robotic walkers or other mobility aids, educational robots and companion robots. These robots can be used in homes, schools and the healthcare sector. An advanced form of robotic technology is the socially assistive robot that provides assistance to humans through social interaction (Feil-Seifer & Matarić, 2005).

An increasingly ageing population worldwide and a shortfall of healthcare professionals has increased the need for assistive technologies and robots to be used in various healthcare settings, such as in the care of older people, in stroke rehabilitation, and in primary care (Vermeersch, Sampsel, & Kleman, 2015). Robots, along with sensors and telemedicine, are technologies that can be used in the prevention of social isolation and depression in older adults and to prolong independent living (Khosravi & Ghapanchi, 2016). A systematic review of the use of socially assistive robots in the care of older adults found positive effects on wellbeing (Kachouie, Sedighadeli, Khosla, & Chu, 2015). For example, the robotic seal Paro has been used in the care of people with dementia and has been shown to reduce stress and increase social interaction (Wada, 2007).

Public attitudes towards the use of robotics in healthcare is mixed. A survey done by the European Commission suggested that most people think that robots should be used for situations that are too dangerous or complex for humans, but that they should not be used in healthcare or care of older people (European Commission, 2012). A snapshot analysis of Eurobarometer data has shown that many people, both young and old, are opposed to the idea of robotics being used in the care of older people. There were a minority of people that were in favour, but this depended on factors such as age, level of education, and country differences (Hudson, Orviska, & Hunady, 2017). In contrast, a UK-based survey by the

British Science Association found that most people prefer that the robots are used in less demanding roles such as looking after older people or people with disabilities (British Science Association, 2016). Pew Research found that the American public's views about robotics is also mixed, with some optimism about the potential positive outcomes, but also concern about the potential negative impact that the use of robot technology may have on society as a whole. Survey respondents displayed slightly more worry (47%) than enthusiasm (44%) about the use of robot caregivers for older adults (Pew Research, 2017). Fifty nine percent (59%) said they would prefer not to have the use of a robot caregiver for themselves. They stated worries about robots not being able to replace the decisions that humans make and the human contact that caregivers provide.

However, the attitudes of the various stakeholders who are directly involved in care of older people (such as older people themselves, health professionals and caregivers, and family caregivers) are not well researched. Recent reviews have addressed the different factors that can influence the acceptability of robots. Many individual factors have been identified such as age, education, gender, experience with technology, culture and perceived need for maintaining independence (Broadbent, Stafford, & MacDonald, 2009). The appearance of the robot, its role, its interaction with the user and ethical issues related to its use were significant issues for older adults when they thought about the use of robots (Vandemeulebroucke, de Casterlé, & Gastmans, 2017). Many previous attempts to use robots in homes have shown that humans prefer to interact with 'socially intelligent' robots, but user acceptance of the robot requires a good fit between the robot's capabilities and the user's needs (Frennert, Eftring, & Ostlund, 2017).

As socially assistive robots continue to be used in healthcare, thereby changing the working landscape, it is interesting to explore the views of health and social care workers regarding these changes. This is because they are key stakeholders in the use of robots in

healthcare, due to having to work with and alongside them. In a study of attitudes towards the use of robotic telepresence for the care of older people, nursing teachers have been found to have more positive attitudes than nursing students (Kristoffersson, Coradeschi, Loutfi, & Severinson-Eklundh, 2011). The use of a robot bathtub in elder care was received with enthusiasm from managers, but not from nursing staff, who just accepted it as a new process (Beedholm, Frederiksen, Skovsgaard Frederiksen, & Lonborg, 2015).

The main purpose of this scoping review was to explore the existing evidence related to the thoughts, views and attitudes of nurses and other health and social care workers regarding the use of socially assistive humanoid and animal-like robots in health and social care. To our knowledge, a scoping review on this topic has not thus far been conducted. We focused on socially assistive humanoid/animal-like robots because they require some degree of interaction with the robot itself rather than being a means of interacting with a human (e.g. robotic telepresence) or merely a non-interactive robot (such as a surgical robot).

Methods

Aim and Design

The study followed the method for carrying out scoping reviews as set out by the Joanna Briggs Institute (The Joanna Briggs Institute, 2015). A scoping review was considered appropriate since evidence on the thoughts/views/attitudes of nurses and other health and social care workers on the use of socially assistive humanoid/animal-like robots is currently emerging. Our goal was to understand the current evidence on this topic which may assist in posing more specific questions in the future. We developed our research question using the PCC mnemonic (P = Population, C = Concept and C = Context). The research question is: ‘What are the views of nurses and other health and social care workers professionals in relation to the use of socially assistive humanoid/animal-like robots in health and social

care?' The population of interest was health and social care workers especially nurses, physicians and allied health professionals. We were particularly interested in the use of socially assistive robots, especially humanoid robots since there appears to be a great interest on the ethical use of robots and potential substitutions of health and social care workers by robots. Therefore, the concept of interest was related to the professionals' views about the use of these robots and the context was any health or social care setting.

Key Search Terms and Search Strategy

Searches were conducted between June 2017 and March 2018. Our search strategy included the following main steps: a) six electronic databases were initially searched: Medline, CINHAL, EMBASE, PubMed, PsycInfo, and Web of Science using the same set of keywords (Table 1). The Boolean operators OR and _* were used for expansion and to ensure that different combinations of the words were included and the operator AND was used for combining the main search terms to identify articles that included data on health and social care workers' views about assistive robots; b) we then searched for specific authors and identified articles through ResearchGate, Google Scholar and by hand ; and c) lastly following the recommendation of experts in the field we refined the search strategy in order to capture more articles and we searched the IEEE Xplore digital library for identifying articles and conference proceedings relevant to the topic that we may have missed. The IEEE Xplore digital library is maintained by the Institute of Electrical and Electronics Engineers (IEEE), a professional association where many of the latest research on robotics are usually published.

Study Selection

The selection of the articles followed a series of steps. Initially, a set of specific inclusion and exclusion criteria was determined. We included studies only written in English language and those focused on describing the use of assistive or social animal-like or

humanoid robots and studies describing the opinions, views or attitudes of health and social care workers towards these types of robots. We excluded any articles reporting the views of service users only, or non-professional caregivers only such as family members. We also excluded any studies describing the use of robots or robotic devices without any social or interactive element, such as robots used in surgery, robotic telepresence devices, or telehealth robots used solely for monitoring vital signs. We did not impose a limit on age groups or a time frame in the search or selection of articles.

Two of the authors independently searched each database. Titles and abstracts were screened for inclusion according to the above criteria. This was followed by an exclusion of duplicates and articles that could not be retrieved. Subsequently, full-texts of the remaining articles were screened by the authors independently. It was an iterative process; any discrepancies were discussed between the authors. Figure 1 describes the selection process. Nineteen articles were included in the final analysis and details can been seen in Table 2.

[Figure 1 near here]

[Table 2 near here]

Extraction of the Results

An excel spreadsheet was initially created to assist with the abstract screening. A table was then created to record the following information of the articles which were included in the review: Authors' names and year of publication, country of origin and setting of the study, aims/goals of the study, type and size of sample, type of robot, methodology/methods and main findings.

Results

A total of 19 research articles were identified. These were published between the years of 1991 and 2017. Of these, four studies were conducted in New Zealand, three in Australia, two in USA, one in Japan and nine in Europe. The articles described a variety of

methodologies: 4 used mixed methodology; 10 used qualitative methodology (semi-structured interviews or focus groups) and 5 used a quantitative methodology (survey or administration of a structured questionnaire).

In 11 of the studies participants interacted with a robot and in 8 studies participants did not have to interact with the robot but were asked to describe and/or report their views on robots via questionnaire response. Three studies used a sample consisting of only health and social care workers. In all other studies, staff members were included in the sample along with patients and family caregivers. In some cases, the actual sample size was not stated (refer for details to Table 2).

With the exemption of two studies, the sample of health and social care workers was very small, and they were working mainly in long-term facilities, caring for older adults and people with dementia. The participants included by the studies were a mixture of qualified nurses, nursing assistants, care workers, clinical care coordinators, recreational therapists and managers working in the health care sector.

Robotic Devices

The following are examples of robots were described in the articles.

- Paro: an animal-like robot which takes the form of a Canadian harp seal. It has white fluffy fur, weighs around 2.7kg and responds to light, touch, movement and sound. This was the most commonly described robot in the articles (Bemelmans, Gelderblom, Jonker, & de Witte, 2016; Birks, Bodak, Barlas, Harwood & Pether, 2016; Moyle, Bramble, Jones, & Murfield, 2016; Robinson, Broadbent, & MacDonald, 2016; Robinson, MacDonald, Kerse, & Broadbent, 2013).
- JustoCat: an interactive robotic cat with washable fur (Gustafsson, Svanberg, & Mullersdorf, 2015).

- Guide: a humanoid robot. It can measure vital signs (e.g. blood pressure, heart rate) and interact through speech and via a large touchscreen. It can be used to make web-based calls and it can also provide information. It stands at 1.6 metres tall (Broadbent et al., 2015; Robinson et al., 2013).
- Cafero**:** a humanoid robot which stands at a similar height as the Guide robot. It has wheeled locomotion, and a touch screen for interaction. It can monitor vital signs, has telecommunication capabilities and can also engage the user in games which provide cognitive stimulation (Broadbent et al., 2015).
- Kompai: a humanoid robot which stands at 1.3 m tall, weighs 45 Kg and has a large touch screen for interaction. It has a head but no arms. It has a handle that can be used for mobility assistance (e.g. standing up). It has telecommunication capabilities and its roles include raising an alarm in an emergency, providing information, and providing cognitive and physical stimulation (Zsiga et al., 2013).
- Care-O Bot 3: a humanoid robotic assistant which is able to fetch, carry and manipulate objects. It also has sensors which can detect objects and can supervise the user's environment (Bedaf, Draper, Gelderblom, Sorell, & de Witte, 2016; Bedaf, Marti, Amirabdollahian, & de Witte, 2017).

Mixed Views and Concerns

A variety of views and attitudes was reported reflecting the differences in exposure to the technology among the participants in the studies. Views were influenced by the robot's observed capabilities but also perceived capabilities, usefulness and potential 'role'. Different views were expressed when health professionals considered the robot as part of the healthcare team as opposed to when they considered it as a companion to the older adult (Jenkins & Draper, 2015).

In some of the studies health professionals and managers had positive views towards the use of robots or for having a robot in their clinical area (Broadbent et al., 2015; Robinson et al., 2016; Zsiga et al., 2013), while interacting with the robot for a period of time positively influenced their attitudes and feelings towards it (Gustafsson et al., 2015; Robinson et al., 2016). However, the surveyed staff who did not interact with a robot and had to imagine the robot's capabilities expressed usually uncertainty over the robot's use in a health care setting and did not think that humanoid robots could perform any clinical tasks (Broadbent et al., 2012; Fuji et al., 2011; Goransson et al., 2008). Bedaf et al., (2017) found that professional caregivers were hesitant about using the robot because they were concerned that the older person should have enough time to get used to the new type of caregiver, and that if the older person has limited experience with technology, they might need help with understanding how to use the robot. They were also concerned about the more socially isolated older people and about the possibility that they would miss out on social connection if the caregiver was a robot rather than a human.

The intention of health and social care professionals to use robots was found to be influenced positively by social networks (the beliefs of those close to the person), trust (the belief that the technology is reliable and trustworthy) and performance expectations (Alaiad & Zhou, 2014). Reliability was especially mentioned as an issue by health and social care workers who interacted with and often experienced problems with the technology (Broadbent et al., 2015). Intention to use robots was influenced also by the manager's perceived opportunity to innovate in the workplace and the need to identify new and cost-effective ways to manage workload (Mendell, Palkon, & Popejoy, 1991). In addition, perceived usefulness of the robot increased home care workers' positive attitudes and influenced their intentions to introduce the technology in their practice (Rantanen, Lehto, Vuorinen, & Coco, 2017).

On the other hand, intentions were negatively influenced by concerns regarding privacy and ethics, for example some participants expressed fears about privacy breaches resulting from disclosure of information about the user (Alaiad & Zhou, 2014). Similar concerns were reported by healthcare professionals who would not like the see the robot being used as a video surveillance system (Broadbent et al., 2012) or as a method of 'policing' the patient and the health and social care providers (Jenkins & Draper, 2015). Protecting the user's autonomy and being in control of any such technology was considered essential (Bedaf et al., 2016). The high cost of robotic technology was another concern, but a few professionals thought that animal-like robots could be a much better alternative to having actual pets in the healthcare setting (Moyle et al., 2016; Robinson et al., 2013). Infection control and safety were identified as major issues and it was regarded imperative for the robot to comply with current health and safety guidelines. In line with this perspective, they expressed a preference for a robot which is easy to clean, be compliant to hygiene rules and not pose any injury risk for patients and staff (Broadbent et al., 2012; Fuji et al., 2011; Gustafsson et al., 2015).

Current Views of Potential Benefits of Robots in Health and Social Care

Health and social care workers identified many practical tasks that robots could help with, such as lifting, helping a user stand up from a sitting position, helping with dressing, picking up things, escorting, and giving directions. Also, they identified that robots could be useful in monitoring vital signs (Broadbent et al., 2015), emotions, and generally by 'keeping an eye' on an individual (Darragh et al., 2017). Robots were also identified as being able to provide practical help, for example by raising the alarm in an emergency, reminding the user to take their medicine, perform other health related activities (e.g. take a walk, use the toilet), assisting them in exercising, and being involved in telemedicine (Bedaf et al., 2016 Broadbent et al., 2015; Jenkins & Draper, 2015; Zsiga et al., 2013). They especially viewed

as major advantage the 24hr availability that a robot could potentially offer to patients and staff (Bedaf et al., 2017).

Health and social care workers highlighted the potential of robots to be useful in helping to fulfil patients' social and emotional needs, for example, by providing reassurance when needed especially by people with dementia and cognitive impairment but also monitor changes in mood, agitation and confusion when occurred (Darragh et al., 2017). Robots were considered to have the potential to encourage social interaction between residents, to facilitate group activities (Broadbent et al., 2012), to be used as therapeutic tools (Birks et al., 2016), and as new avenues for communication among people with dementia (Gustafsson et al., 2015). Health workers appreciated the fact that the robot could potentially help to calm down people with dementia who had become agitated (Moyle et al., 2016, Robinson et al., 2016) and thought that Paro was more suitable for older people with dementia compare to other robots (Robinson et al., 2013). The use of Paro among people with dementia was perceived to be beneficial for additional reasons: for instance, Paro has been found to improve mood, provide stimulation and decrease isolation in people with dementia (Robinson et al., 2016) and successfully enhance existing therapeutic interventions (Bemelmans et al., 2016).

Monitoring vital signs, acting as a communication agent with the family and reminding the patients about their medication were the three most preferable functions of the robot according to patients and professionals (Alaiad & Zhou, 2014), along with raising alarms, and providing social interaction. However, health and social care workers did not view robots as helpful when they were carrying out nursing / caring activities such as general nursing care, feeding, assisting with a patient's personal hygiene, helping with physiotherapy, or assisting patients who had had an amputation (Göransson, Pettersson, Larsson, & Lennernäs, 2008).

Robots in the Health and Social Care Workplace; Views and Attitudes of Care Workers

The topic of how the robot can impact a health/social carer's work did emerge especially among those who were involved in studies where a robot was used. Most staff members who participated in the Robinson et al., (2016) study reported that the robot (Paro) did not affect their job because they did not have time to use it, but a few said that Paro made their job more interesting since it affected their patients in a positive way. Similarly, staff using the JustoCat felt that their everyday job was made more exciting by having the robot assisting in the care of their patients (Gustafsson et al., 2015). Much like Robinson et al.'s (2016) findings, most staff members in the Broadbent et al., (2015) study reported that the robots (Guide and Cafero) did not affect their job, with some mentioning that the robots had a positive effect by keeping patients entertained. However, Hebesberger, Koertner, Gisinger, and Pripfl, (2017) reported that staff expressed mixed feelings about sharing their work space with a robot.

Discussion

Very few existing studies have explored the thoughts, views and attitudes of health and social care workers regarding the use of socially assistive humanoid or animal-like robots in a health or social care setting. Despite the limited available evidence, some key themes emerged. In general, the views and attitudes of health and social care workers were more positive than negative about the use of robots in a clinical setting. They mainly focused on the impact that the robot could have on their patients and not on themselves. They considered the benefits that the robot could have with respect to their patient's physical and psychological health, as well as the patient's safety and how this technology would fit into the healthcare context.

According to a review by Mesquita, Zamarioli, & Campos de Carvalho, (2016) all technological inventions related to robots and older adults are mainly focused on monitoring

activities, aiding with mobility and daily activities and rehabilitation. Consistently, health and social care workers in our scoping review expressed similar thoughts and views regarding the use of humanoid and animal-like robots. It may be reasonable to assume that their focus on practical robotic tasks such as reminders and monitoring, are perceived as helpful and time saving for them.

A concern raised by Saborowski and Kollak, (2015) in their research on assistive, and ICT- based assistive technology is related to the difficulties faced by care workers due to technology malfunctions, the lack of reliable or easy to use technology as well as inability to meet every day needs of the users. This scoping review identified similar concerns such as patient safety, reliability and usefulness of the robotic technology. These findings raise the issue of workforce development and the need for easily accessible technical support.

It is encouraging to read about the positive attitudes towards the use of robots for the care of older people which is consistent with the views of family members and older adults with Alzheimer's disease. Wang, Sudhama, Begum, Huq, and Mihailidis, (2017) found that informal caregivers and older adults themselves had an open mind towards the use of robots and could identify multiple activities that the robots could potentially do for them.

It was surprising to find that despite the discussions in the mass media on the replacement of humans by robots in the public sector (Gayle, 2017), the health and social care workers in this review did not appear to be threatened by the use of robots in their workplace. On the contrary, they reported that their work was not necessarily affected but the use of robots could have positive outcomes. A possible reason for this finding could be that the robotic technology that these workers encountered in these studies was viewed as an adjunct to their role rather than overlapping with it. Another possibility is that the technology was not perceived to be advanced enough to potentially threaten their job role.

Limitations

There are certain limitations to this review which should be considered. First only articles written in English were included. Many of the robots are being produced and used in Japan. This means that relevant articles may not have been included in our review as they did not meet our inclusion criteria.

Another limitation is that the participants in these studies were usually a very small sub-sample of the study samples. In addition, the reviewed studies included a variety of health and social care workers: nurses, nursing assistants, therapists, managers, care workers, administrators, but the differences or similarities among the various groups of health professionals were not assessed. It has been suggested that specific individual socio-demographic characteristics such as age and level of education can have an impact on a person's attitudes and acceptance of technology (Heerink, 2011; Giuliani, Scopelliti, & Fornara, 2005; Sun & Zhang, 2006). However, individual factors such as age and education were not assessed in the studies included in this review. It has also been suggested that familiarity and experience with using technology may positively influence attitudes and facilitate its acceptance (Bedaf et al., 2017; Flandorfer, 2012).

It should be noted that scoping reviews aim to provide a summary on an emerging topic of interest which can and should be used as a stepping stone for generating new research questions. Therefore, the findings of a scoping review should be used as a general guide and should not be used for changing practice or influencing policy. Since scoping reviews do not require the evaluation or quality assessment of the selected articles, they cannot be used to provide specific suggestions for practice.

Implications for Research

As technology progresses it is important to continue to understand the views of all stakeholders and engage in a critical debate about the use of robots, if we want to ensure the provision of dignified and ethical care for older adults (Gallagher, Naden, & Karterud, 2016).

Nursing researchers in Japan are critically debating the future of nursing and the future of caring relationships in an environment where advanced humanoid robots are part of the caring team. They urge us to think of the implications of non-human to human relationships and the essential capabilities that a humanoid robot should have if it is expected to care for patients directly, such as the ability to judge and respond as human nurses do (Tanioka, Osaka, Locsin, Yasuhara, & Ito, 2017). For example, Malle and Thapa Magar, (2017) reported that when participants in their study were asked of the desired mental capabilities of a social robot, they mentioned objective reasoning (e.g. to be able to explain the reasons of its actions) and having social moral skills (e.g. to praise, to have goals, to have emotions) to be important.

Following on from the results of this study, it is important to continue in a comprehensive way to further explore the views of health and social care workers about the use of robots, the implications for practice and relationships. It is also imperative to better understand the views of other stakeholders, such as patients, family, policy makers, and roboticists.

Even though culture was not mentioned in the studies included in this review, it is likely to influence the acceptance of socially assistive humanoid/animal-like robots. The influence of culture has recently been a leading question in the field of robotics as it has been for many years in the field of transcultural nursing. As socially assistive robots continue to be used in healthcare settings, an emerging area of research for nurses is the field of patient-robot interaction. In the authors' research on nursing robotics (Author & Author, In press; Author, Sgorbissa & Author, 2017) the role of culture is being explored through questions such as: How can we develop culturally intelligent robots? How can a robot avoid stereotypes? Can a robot be culturally sensitive?

The type of robot used may also be important. According to Tanoika et al., (2017) socially assistive humanoid robots have the potential to provide elements of individualized care which are normally provided by a human nurse. This type of care cannot occur without a holistic approach towards the user. A critical element of this approach is acknowledging a person's cultural background and recognising the way culture impacts a person's health beliefs, coping mechanisms, preventive practices and ways of restoring his/her health (Author et al., 2017).

Conclusion

Currently, there are limited humanoid and animal-like robot applications in healthcare. Animal-like robots such as Paro (the robotic pet seal) is mainly used with people suffering from cognitive impairment and dementia and health and social care workers have overall positive views for its application. As technology is advancing rapidly, it is imperative for health and social care workers to engage in the changes of their work practices not only as users of the developing technology but as creators of innovative approaches to caring. They should place themselves in the forefront of the debate and innovation and should see themselves as the groups of professionals who best understands the ethical, practice-related and safeguarding challenges, which the arrival of the artificial intelligent robotics era has and will continue to bring, in the near future.

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