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Views about perceived training needs of health care professionals in relation to socially assistive robots: an international online survey

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Background: As Artificial Intelligence and social robots are increasingly used in health and social care, it is imperative to explore the training needs of the workforce, factoring in their cultural background.
Objectives: Explore views on perceived training needs among professionals around the world and how these related to country cultures.
Design: Cross-sectional, descriptive, mixed-methods international online survey.
Methods: Descriptive statistical analysis explored the ranking across countries and relationships with three Hofstede cultural dimensions. Thematic analysis was conducted on the open-ended text responses.
Results: A sample of $N = 1284$ participants from eighteen countries. Knowing the capabilities of the robots was ranked as the top training need across all participating countries and this was also reflected in the thematic analysis. Participants' culture, expressed through three Hofstede's dimensions, revealed statistically significant ranking differences.
Conclusions: Future research should further explore other factors such as the level of digital maturity of the workplace.
Impact Statement: Training needs of health and social care staff to use robotics are fast growing and preparation should factor in patient safety and be based on the principles of person- and culture-centred care.

Keywords: training needs; socially assistive robots; nurses; midwives; social care professionals; country culture; international study

Introduction

Globally, many countries have developed strategies to increase preparedness for the inevitable surge in the use of Artificial Intelligence (AI) and robotics technology (OECD AI Policy Observatory, 2021). A key theme across these strategies is to invest in education and skills training for the future workforce starting from the improvement of their digital literacy more broadly (Royal College of Nursing & NHS Health Education England, 2017). Nurses are calling for the embedding of digital health technology proficiencies into all aspects of nursing education (Beevi, 2022) and the re-imagination of nursing practice as smart technologies and robotics are being integrated in the provision of patient care (McAllister et al., 2021). Even before the pandemic, the need for training to increase digital capabilities among the healthcare workforce was rising. Examples from the UK and Australia include the Topol review (Health Education England, 2019) and Australia's National Nursing and Midwifery Digital Health Capability Framework; both documents recommend the investment in education and training of healthcare professionals so that they have the necessary skills and knowledge to use robotics, AI and digital technologies (Nix et al., 2022).

A recent review of the literature on issues that affect nurses' capabilities to use digital technology in their workplace revealed that continuing education is imperative as new technologies emerge continuously and challenge the provision of patient care (Brown et al., 2020). Digital literacy is an important factor in the use of technology at large, as well as one which has received growing attention within the framework of the development of e-Health strategies in over half of the World Health Organization (WHO) countries (World Health Organization, 2016). However, digital literacy only tangentially captures technologies such as robotic devices, social robots, or AI systems, and is focused on the ability to adequately use information and gained knowledge from electronic sources to solve health related problems (Dunn & Hazzard, 2019). Therefore, in order to develop appropriate training for robotic and AI applications, it is important to explore perceived training needs of healthcare professionals (Van Aerschot & Parviainen, 2020). Such exploration is additionally paramount because it fills a significant training gap which is not covered by the concept of digital literacy.

The COVID-19 pandemic has only incredibly accelerated a previous, irreversible process whereby advanced technologies have become pervasive in health and social care (Loh, 2018), and the digital competence of the workforce, at all levels, is key, both currently and more and more in the future (Foadi & Varghese, 2022). The WHO, together with several national health systems worldwide, have underlined the urgency for the health workforce to be prepared to and know how to work appropriately with AI (World Health Organization, 2021). Notwithstanding this scenario, not many studies have explored what healthcare professionals need to know in order to adapt in such changing landscape, with specific reference to AI and robotics technologies. Corroborating the need for training, a recent systematic review found that the literature is calling for the integration of AI training into medical and health informatics curricula (Sapci & Sapci, 2020). However, there appears to be no study focussing on the health and social care workforce training needs toward the introduction of the specific advanced technology of socially assistive robots (SARs).

In addition, it is well known that a person's cultural background influences their learning style (Oxford & Anderson, 1995; Reid, 1987), as well as their attitudes and views, all of which are of crucial importance when considering attitudes towards AI and advanced technologies (Papadopoulos & Koulouglioti, 2018) and the development of training, in both content and approach. Hofstede's cultural dimensions (Hofstede, 1984) have been previously used as an approach to understanding national cultures and how they influence learning. The Hofstede model of national cultures and their scored set of dimensions (Hofstede et al., 2010) have been utilised to refine models of technology acceptance, use and diffusion, from the Technology Acceptance Model (Cardon & Marshall, 2008) to the more recent Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003). Overall, literature exploring the relationships between Hofstede's cultural dimensions and technology (Nistor et al., 2014; Tabibi et al., 2015) suggests that there cannot be a universal model predicting acceptance and diffusion of a technology that can hold valid across countries. On the contrary, cultural factors 'bend' each model and call for culturally specific understandings and training in relation to views and preparation towards technological innovations (Masimba et al., 2019; Srite, 2006).

Study's aims

This article reports and discusses some of the findings of a cross-sectional, descriptive, exploratory mixed-methods international online survey. The main aim of this article was to explore the perceived training needs of health and social care professionals in different countries around the world in relation to the use of SARs in their work setting. The second aim was to explore how country culture, as expressed by the Hofstede cultural dimensions, related to the training needs.

Methods

Design

This study was a cross-sectional, exploratory, international online survey which collected both quantitative and qualitative data. The survey's items were developed based on previous research conducted by the research team and other scholarship active in this field. The survey was piloted among members of the international team who provided feedback both at a content and technical level which improved the clarity of the questions, the answer options, and the feasibility of translations. The full questionnaire is accessible online at [https://cultureandcompassion.com/victcory/international-on-line-compassion-survey]. Besides questions relating to the demographic and professional characteristics of the respondents, the survey was also exploring their perceptions concerning three distinct areas: the potential benefits of socially assistive robots (SARs) in health and social care settings, the functions that SARs should (and should not perform), and their perceived training needs. However, the sole focus of this paper is upon the section of the survey which related to perceived training needs. Firstly, participants were asked to give rankings of the importance of 14 training needs, from extremely important to not important at all. In order to acquire a richer understanding of the participants' views of the importance of the training needs, a follow-up question called for a free-text response in which participants were asked to provide a rationale for their ranking, and to add any further reflections.

Data collection procedures and sample

The leading research team (based in the UK) recruited volunteer co-researchers from among their international network of colleagues. An invitation letter describing the study, including the questionnaire, and detailing the conditions and tasks of the international co-researchers was circulated to recruit one or two co-researchers from each country. The role of the co-researchers included the translation and back-translation of the survey, where applicable, thus ensuring the quality and accuracy of the questionnaire in their own language. After data collection was complete, co-researchers translated into English of the qualitative data collected in the free-text responses.

Upon receiving the translated questionnaires, the UK research team uploaded them onto the web-based electronic survey software *Qualtrics*, and links to the on-line survey for each country were created which were distributed to the co-researchers of the international team, along with a proposed invitation letter for their country's participants, which was translated if necessary. The co-researchers then disseminated the survey link within their own countries to potential participants who met the following inclusion criteria: (1) having a nursing or midwifery qualification and background; (2) working in health or social care settings as a care worker or nurse/midwifery practitioner or assistant.

Data were collected over a one-year period, from the end of October 2019 to the end of September 2020. The recruiting strategy enlisted an international convenience cohort totalling 1341 participants. A country's dataset was included in the study if a minimum of 40 completed questionnaires were collected from it, and ultimately 18 countries and one entity (Turkish-speaking Cyprus) met this criterion for inclusion in the study. The countries included in the study were: Slovakia ($n = 140$), Poland ($n = 100$), Spain ($n = 102$), Hungary ($n = 96$), Germany ($n = 89$), Czech Republic ($n = 81$), Thailand ($n = 73$), Greece ($n = 63$), Japan ($n = 62$), UK ($n = 60$), Norway ($n = 57$), Philippines ($n = 57$), Israel ($n = 55$), Nepal ($n = 53$), Cyprus (including a Greek speaking group of $n = 52$ and a Turkish speaking group of $n = 57$), Turkey ($n = 52$), Iran ($n = 52$), and Australia ($n = 40$). To establish the participants' level of identification with the culture of the country of residence (national culture), the survey included the question 'Do you identify with the culture of the country you currently live and work in?' to which they could answer 'Yes' or 'No'. Nearly half of the participants who reported not identifying with their country of residence came from the Turkish-speaking part of Cyprus. Due to the extreme differences identified in the data of the Turkish-speaking Cyprus group compared to the rest of the sample, sensitivity analyses were conducted, which revealed that the findings were impacted (data not included in this article). Therefore, this group was excluded from the analysis of both the rankings of the relative importance of the list of training needs and of the free-text responses, which resulted in a total sample of 1284 from the 18 countries included.

Ethics

The study was given ethical approval by [Middlesex University Research Ethics Committee]. Additionally, the researchers from each country followed their institution's ethical approval regulations. Study participants were informed that their participation would be anonymous, confidential and voluntary.

Data analysis

The quantitative analyses were carried out using *SPSS* statistical software (Version 25). Ranking data were converted into mean ranks across the sample for each item. Non-parametric inferential tests (Mann–Whitney U test and Kruskal–Wallis) were used to explore the relationship between demographic and ranking of training needs. These tests were also used to analyse differences in the ranking of the training needs according to country groupings on three Hofstede's cultural dimension. Missing data were excluded from the analysis and a significance level of $p < 0.05$ was used as a threshold for statistical significance in all analyses.

Participating countries were grouped according to their attributed scores on the following three Hofstede cultural dimensions (Hofstede, 1984, 2003). (1) Individualism/Collectivism, (2) Uncertainty Avoidance (UA) and (3) Long-Term Orientation (LTO). Individualism/collectivism is about whether the country culture values the individual's independence and autonomy or places more emphasis on the values and interdependence of the collective; UA refers to how comfortable people feel with the uncertainty of the future; and LTO expresses how people deal with the challenges and changes of the future (Hofstede Insights, 2021). Despite the recognised usefulness of exploring all six Hofstede dimensions (Espig et al., 2021), the research team selected these three dimensions as deemed them particularly significant in relation to the future introduction of this new technology in health and social care settings. Hofstede's Cultural Dimension Theory is based on extensive cultural preferences research. As a result of it, country cultures dimensions have been quantified. An index has been created and each country is attributed a score on a spectrum between 0 (extremely low) and 100 (extremely high) which indicates the level of that country's each culture dimension (Hofstede Insights, 2021). By convention, countries ranked below an index of ≤50 are considered low in that dimension, vice versa high if their index is ≥50. For two of the participating countries, a score was not available for the selected dimensions, and therefore the score of a neighbouring country with a similar culture was used instead: the scores for Greece were used for the Greek-speaking Cyprus group, and the score for India was used in place of the missing long-term orientation score for Nepal (Hofstede Insights, 2021).

The qualitative data were analysed using thematic analysis (Braun & Clarke, 2006), based on a descriptive, inductive approach (Thomas, 2006), to enrich the ranking questions on training needs. *NVivo12* software supported the qualitative analysis. The data were coded line by line into small units of meaning, then into categories, which were consolidated and synthesised into subthemes and themes. Two researchers analysed, coded, and went through three rounds of searching, reviewing, and defining the themes (Braun & Clarke, 2006). At the start of the analytic process, a pilot exercise was conducted with three researchers independently coding some of the qualitative data, and the preliminary analysis was compared across researchers and discussed. Following this, a coding frame was established to ensure similarity of the coding for the remaining data. The researchers had weekly team discussions of the emerging themes and changes to the coding structure.

Results

Demographic and professional characteristics of the sample

The demographic and professional characteristics of the sample are summarised in Table 1. The sample was predominantly female, two-thirds of it was aged 35 years or over, and nearly half of the participants had a higher degree. The professional background of most of the participants was nursing, with over half having 11 years or more of professional experience in their field, and over half worked in hospital settings. Few participants had either had experience of working with SARs or had seen SARs operating in a professional setting.

Perceived training needs across countries

As seen in Table 2, the analysis of the ranking data revealed that 'knowing the capabilities of the robot' was ranked as the most important training need, with 43% ($n = 537$) of the sample selecting

Table 1. Demographic and professional characteristics of the sample

Gender	
Female	1137 (85%)
Male	199 (15%)
Age	
18–34	477 (36%)
35–44	327 (24%)
45–54	350 (26%)
55–64	163 (12%)
≥65	22 (2%)
Professional background	
Nursing	998 (74%)
Midwifery	84 (6%)
Other	259 (19%)
Highest level of qualification	
Vocational	219 (18%)
Bachelor’s degree	520 (42%)
Master’s degree	339 (27%)
PhD	165 (13%)
Work setting	
Hospital	735 (55%)
Nursing/midwifery education	220 (16%)
Community/primary care	142 (11%)
Social care/care homes	93 (7%)
Other	151 (11%)
Length of professional experience	
1–5 years	359 (27%)
6–10 years	188 (14%)
>11 years	792 (59%)
Experience with or seen SARs in work setting?	
No	1206 (90%)
Yes	135 (10%)

The sample was predominantly female, two-thirds of it was aged 35 years or over, and nearly half of the participants had a higher degree. The professional background of most of the participants was nursing, with over half having 11 years or more of professional experience in their field, and over half worked in hospital settings. Few participants had either had experience of working with SARs or had seen SARs operating in a professional setting. The demographic and professional characteristics of the sample are presented in more detail in this table.

this item as their first choice. This was reflected through the qualitative comments encapsulated in Theme 1: *Knowledge about the robot’s functionality, capability and purpose.* Participants wanted to learn what the robot was capable of doing, so that they could know what kind of tasks it could be given, which would help with planning their own work. Accordingly, there was an interest in understanding the purpose of the robot, in terms of its meaningfulness and added positive value. By contrast, the training need ranked as least important was ‘how to deal with the relatives of patients who have a robot involved in their care’, selected by 45% of the sample ($n = 565$). Table 3 summarizes the top three ranked training needs across all countries and the similarities across countries are also echoed by the analysis of the free-text responses to the open-ended question.

The second top ranked training need was ‘knowing the tasks that the robot can undertake’ among all participating countries except Iran, where the participants overall ranked as their second choice the training need of ‘knowing what information the robot is collecting’. This statement of need corresponds to the qualitative theme ‘Legal and ethical issues’ (Theme 3). Beyond the high ranking in the Iranian cohort, many of the participants’ qualitative data emphasised the

Table 2. Ranking of training needs for the whole sample.

Training needs	Mean rank (*SD*)
The capabilities the robots have	2.8 (2.5)
The tasks the robots can undertake	3.5 (2.4)
How to turn the robot on and off	5.3 (3.9)
How to enter and upload specific information about the clinical/caring environment	6.7 (2.7)
What information the robot is collecting	6.8 (2.9)
How to electrically charge the robot	7.2 (3.7)
How to enter and upload specific information about the patient/s	7.4 (3.1)
If I need to obtain the consent of the patient before a robot is assigned to him/her	7.9 (3.5)
What to do if the robot acts in ways which compromise the safety of the patient	8.1 (4.5)
Where is the information collected by the robot stored and who has access to it	8.0 (3.0)
How to clean the robot	8.8 (3.8)
What to do if the robot malfunctions	9.3 (3.3)
Who to contact if the robot malfunctions	10.2 (3.4)
How to deal with the relatives of the patients who have a robot involved in the care of the patients	10.8 (3.9)

Note: SD = Standard deviation.

importance of learning about the ethical and legal implications of using a robot with patients, in relation to the type of data collected, data protection, privacy and consent (see Table 3).

More differences appeared in the ranking of the third top training need, with participants from 11 countries choosing the item 'knowing how to turn the robot on/off'. Responses from the open-ended qualitative data offered additional insights in this respect, with two additional themes. One is 'Learning how to operate the robot' (Theme 2). This was articulated in relation to the provision of quality care, as well as patient safety, by for example preventing malfunctions or other technical issues. A last theme, 'General training requirements' (Theme 4), encapsulates a variety of rankings, indicating that participants wanted the training to be thorough, due to unfamiliarity or lack of experience with robots. Participants reported that they wished that the training would enable them to become confident, thus being able to anticipate and deal with any potential issues or problems. Similarly, participants stated that they wanted training that would allow them to be prepared before the robot was deployed in their workplace, for example, sing a trial, simulation or as part of a team exercise (see Table 4).

Differences in the ranking of the top three training needs in terms of level of education, gender, age, years of working experience, and work setting were also explored, but no significant differences were found.

Perceived training needs in relation to three Hofstede country cultural dimensions

To explore the differences in training needs between collectivist and individualistic countries we divided the countries using their Hofstede indices into two groups:

Group A: Collectivist: Greece, Iran, Japan, Nepal, Philippines, Thailand, Turkey, Cyprus GS (Greek-speaking); and Group B: Individualistic: Australia, Germany, Hungary, Israel, Norway, Poland, Slovakia, Spain, UK, Czech Republic.

Statistically significant differences were found between these two groups. Participants from individualistic countries were found to rank 'how to turn the robot on and off' more highly than participants from collectivistic countries. However, participants from collectivist countries were more likely to rank higher the following statements: 'what to do if the robot malfunctions', 'who to contact', 'what to do if the robot compromises the safety of the patient', 'how to deal with

Table 3. Country comparison of top 3 ranking for each training need.

Country group	First ranked training need Mean (*SD*)	Second ranked training need Mean (*SD*)	Third ranked training need Mean (*SD*)
Poland	Capabilities 3.25 (3.1)	Tasks 3.58 (2.7)	Turn on/off 4.67 (4.1)
Spain	Capabilities 2.75 (2.1)	Tasks 3.55 (2.2)	Consent 6.37 (3.7)
Hungary	Capabilities 3.20 (3.2)	Tasks 3.49 (2.5)	Turn on/off 3.82 (3.2)
Israel	Capabilities 2.83 (2.8)	Tasks 3.88 (2.9)	Turn on/off 5.44 (3.6)
Nepal	Capabilities 3.16 (2.4)	Tasks 3.62 (2.2)	Turn on/off 3.88 (3.8)
Czech Republic	Capabilities 3.16 (2.8)	Tasks 3.75 (2.2)	Turn on/off 5.09 (3.8)
Greece	Capabilities 2.58 (2.0)	Tasks 3.67 (2.3)	Turn on/off 6.25 (4.0)
Germany	Capabilities 2.93 (2.9)	Tasks 3.17 (2.7)	Turn on/off 5.00 (3.7)
Cyprus GR	Capabilities 2.30 (2.2)	Tasks 3.24 (1.7)	Enter/upload info for clinical/caring environment 5.64 (2.5)
Japan	Capabilities 2.86 (2.6)	Tasks 3.74 (2.5)	What to do if robot malfunctions 6.47 (3.9)
Norway	Capabilities 2.49 (2.4)	Tasks 3.82 (2.5)	What information the robot collects 5.25 (2.7)
Philippines	Capabilities 2.16 (1.8)	Tasks 3.51 (2.4)	Enter/upload information for clinical/caring environment 6.18 (2.5)
Slovakia	Capabilities 2.63 (2.1)	Tasks 3.44 (2.4)	Turn on/off 4.45 (3.6)
Thailand	Capabilities 2.15 (1.6)	Tasks 2.73 (1.7)	Turn on/off 6.16 (4.2)
Turkey	Capabilities 2.46 (2.0)	Tasks 2.88 (1.5)	Turn on/off 4.50 (3.1)
UK	Capabilities 3.32 (2.8)	Tasks 4.45 (2.5)	What to do if the robot compromises patient safety 5.94 (4.3)
Australia	Capabilities 3.21 (3.0)	Tasks 3.64 (2.8)	Turn on/off 5.62 (4.1)
Iran	Capabilities 3.10 (2.8)	What information the robot collects 3.77 (3.3)	Tasks 3.91 (3.2)

Note: SD = Standard deviation.

relatives who have a robot involved in their care', 'what are the capabilities of the robots', and 'how to enter information about the clinical environment' (Table 5a).

A similar comparison was carried out between countries classified as low in UA (index ≤50, Philippines, Nepal, UK) and those classified as high (index ≥50, all other participating countries). Participants from countries classified as low in UA ranked 'what to do if the robot malfunctions' and 'where is the information collected by the robot stored and who has access to it' as more important than countries classified as high in UA. Participants from countries classified as high in UA ranked 'what tasks the robot can undertake' and 'if obtaining consent is necessary', more highly than participants from countries classified as low in UA (Table 5b).

Lastly, a comparison was made between countries classified as low in LTO (index ≤50) and those which score high (index ≥50). Participants from countries classified low in LTO (Greece,

Table 4. Summary of results from the thematic analysis of the open-ended text responses.

THEME	Sub-theme with exemplary quote(s)	Sub-theme with exemplary quote(s)	Sub-theme with exemplary quote(s)
Theme 1: Knowledge about the robot's functionality, capability and purpose	*Tasks of the robots* When it comes to delegation of tasks, I need to know what exactly can be delegated. (Germany, participant 12)	*What to expect from the robot* I gave importance to the capabilities of a robot. Because we need to have a baseline of what/ what not to expect from it. (Philippines, participant 16)	*Purpose and motivation for using robots* I want to know why these robots are created and entered into our health care systems. We can do whatever they want to do and then why we should have them? (Australia, participant 35)
Theme 2: Learning how to operate the robot	*Practical training needs* Practical concerns first, need to know how to turn on and off, charging etc. to be able to enter information. (Norway, participant 28)	*Technical competence for care quality* The most important is to know what skills the robot has and how to use it to improve the quality of life for the patient (Cyprus-Greek speaking, participant 10). I am interested in the capabilities, benefits and operation of the robot in order to know how to use it optimally for the patient. Additional training in a simulator to achieve competence in operating the robot and prevent damage to the patient (Israel, participant 25).	*Patient safety and malfunctions* I decided for the ranking because I would really like to know what a robot can do and how to program it so that it does not hurt the patient but performs the activities as safely as possible. (Slovakia, participant 4) I must learn how to use the robot so that I know what to do in case of a malfunction, I can prevent it from damaging it. (Turkey, participant 6)
Theme 3: Legal and ethical issues	*Patient consent* The key to using a helping robot is that the patient accepts it. It may not be used in direct care without the patient's consent. (Hungary, participant 91)	*Patients and relatives' involvement* Patients (users) must be told that robots will be introduced and their interest must be raised. (Japan, participant 26)	
Theme 4: General training requirements	*Thorough training* Robots are new, so you really need training that is holistic. (Poland, participant 65)	*To be confident and in control* Proper training in all eventualities. I would need to be confident that I would be in charge of the robot and not the other way around! (UK, participant 31) It's something we should give priority to prepare for implementation of robots used to reduce [our] anxiety or solve problems if an error occurs. (Thailand, participant 45)	

Table 5a. Association of training needs with cultural dimensions: Mann Whitney test of group comparisons by individualism/collectivism.

Training need	Group	*N*	Mean Rank	Mann–Whitney *U*	Z-value	*P*-value
The capabilities the robots have	Collectivist	442	587.45	161,750	−2.573	0.010
	Individualistic	799	639.56			
	Total	1241				
How to turn the robot on and off	Collectivist	444	656.57	162,030	−2.555	0.011
	Individualistic	799	602.79			
	Total	1243				
How to enter and upload specific information about the clinical/caring environment	Collectivist	444	582.14	159,678	−2.948	0.003
	Individualistic	799	644.15			
	Total	1243				
What to do if the robot malfunctions	Collectivist	443	536.21	139,196	−6.320	0.000
	Individualistic	799	668.79			
	Total	1242				
Who to contact if the robot malfunctions	Collectivist	445	578.35	158,132	−3.289	0.001
	Individualistic	799	647.09			
	Total	1244				
What to do if the robot acts in ways which compromise the safety of the patient	Collectivist	444	594.16	165,019	−2.068	0.039
	Individualistic	799	637.47			
	Total	1243				
How to deal with the relatives of the patients who have a robot involved in the care of the patients	Collectivist	445	585.40	161,267	−2.858	0.004
	Individualistic	799	643.16			
	Total	1244				

Cyprus GS (Greek Speaking), Poland, Spain, Turkey, Israel, Thailand, Iran, Australia, Norway, & Philippines) ranked ‘how to enter and upload specific information about the clinical/caring environment’, ‘how to enter and upload specific information about the patient/s’, ‘what information the robot is collecting’, ‘if I need to obtain the consent of the patient before a robot is assigned to him/her’ and ‘who to contact if the robot malfunctions’ as more important than participants from high LTO countries (Hungary, Japan, Czech Republic, Germany, Slovakia, Nepal,

Table 5b. Mann–Whitney *U* tests showing differences in rankings by uncertainty avoidance grouping (high versus low).

Training need	Group	*N*	Mean Rank	Mann–Whitney *U*	*Z*-value	*P*-value
The tasks the robots can undertake	Low in UA	160	689.8	75,790	−2.639	0.008
	High in UA	1083	611.9			
	Total	1243				
Where is the information collected by the robot stored and who has access to it	Low in UA	160	562.8	77,178	−2.269	0.023
	High in UA	1084	631.3			
	Total	1242				
If I need to obtain the consent of the patient before a robot is assigned to him/her	Low in UA	160	711.6	72,136	−3.436	0.001
	High in UA	1082	608.1			
	Total	1242				
What to do if the robot malfunctions	Low in UA	160	550.7	75,234	−2.709	0.007
	High in UA	1082	631.9			
	Total	1242				

Table 5c. Mann–Whitney *U* tests showing differences in rankings by long-term orientation grouping (high versus low).

Training need	Group	*N*	Mean Rank	Mann–Whitney *U*	Z-value	*P*-value
How to turn the robot on and off	Low in LTO	682	664.9	162,034	−4.692	0.000
	High in LTO	561	569.8			
	Total	1243				
How to electrically charge the robot	Low in LTO	682	649.4	172,588	−2.990	0.003
	High in LTO	561	588.6			
	Total	1243				
How to enter and upload specific information about the clinical/caring environment	Low in LTO	682	584.5	165,761	−4.096	0.000
	High in LTO	561	667.5			
	Total	1243				
How to enter and upload specific information about the patient/s	Low in LTO	682	576.4	160,246	−4.986	0.000
	High in LTO	561	677.3			
	Total	1243				
What information the robot is collecting	Low in LTO	682	594.0	172,219	−3.058	0.002
	High in LTO	561	656.0			
	Total	1243				
If I need to obtain the consent of the patient before a robot is assigned to him/her	Low in LTO	681	588.4	168,501	−3.611	0.000
	High in LTO	561	713.7			
			661.6			
	Total	1242				
Who to contact if the robot malfunctions	Low in LTO	683	597.9	174,802	−2.706	0.007
	High in LTO	561	652.4			
	Total	1244				

& UK) which ranked 'how to turn the robot on and off' and 'how to electrically charge the robot' as more important that participants from low LTO countries (see Table 5c).

Discussion

This study responds to the growing need in preparedness of the healthcare workforce, at all levels (Foadi & Varghese, 2022; Terry et al., 2019), which is urged by the inexorable advancements of digital technologies in health over the last decade (World Health Organization, 2016). This international survey is pioneering the exploration of the training needs perceived by health and social care professionals in relation to the future introduction of SARs in their workplace. Rooted in the growing evidence on the importance of culture in training, but more significantly in attitudes and acceptance towards technologies in health and social care (Korn, 2019; Metallo et al., 2022), as well as other industries (Sunny et al., 2019), this is the first study to explore how perceived training needs toward SARs may vary in relation to certain Hofstede cultural dimensions. The results of this study have implications for the future implementation of SARs in health and social care settings, and for the training that may need to be commissioned in order to prepare professionals to be able to work alongside this advanced technology. A scoping review of the educational frameworks for health workforce concluded that future frameworks and training programmes will have to factor in the fast-changing landscape of digital health so to incorporated AI and robotics (Nazeha et al., 2020).

SARs are being progressively introduced, in particular in elderly care, in countries with higher ageing population, and after the COVID-19 (Kang et al., 2023). However, SARs are not yet widely deployed in the healthcare sector, particularly in lower-resource settings (Wahl et al., 2018) and the workforce has little hands-on experience with them. Our sample reflects this situation, where the majority did not have previous interaction with a robot. It is therefore unsurprising that, first of all, study participants would like training to practically prepare them in relation to what SARs can do, its tasks and how it can be beneficial, supportive and fitting in their work. Even those with previous experience with robots rated highly very rudimentary and practical training needs, such as learning how to electrically charge the robot. This result suggests that there is the need for basic training devoted to bridging the research-practice gap between robotic engineering and the healthcare settings, with no assumptions about prior staff experience, as another recent study with Korean nurses found (Kang et al., 2023). This finding resonates also with literature on digital literacy training; Nazeha and colleagues' scoping review found that existing frameworks concentrate on providing basic IT skills, the ability to manage health-related information and digital communications, and awareness of ethical, legal, privacy, and security implications relating to IT (Nazeha et al., 2020). The training needs that were ranked and commented on by our participants corroborate current recommended preparation found in the literature in relation to training topics (e.g. general introduction to robots; skills training in how to use robots and how to interpret data collected by robots; about benefits and challenges of using robots; health and safety training; guidance about regulation) (Consilium Research & Consultancy, 2018).

AI represents not only the bright new, but also a shadowy unknown, and as such, it can trigger anxieties and technophobias (Martínez-Córcoles et al., 2017). Attitudes of unease can be accompanied by dystopian scenarios of robots breaking and causing life-threatening dangers to humans or becoming completely autonomous as to overpower us (Oh et al., 2017). These views are well established in the literature and captured by concepts such as that of the 'uncanny valley' suggested by Mori et al., (2012), whereby humanlike robots can arouse a sudden revulsion in users. Training should therefore also address fears, in particular that of 'losing control', where the robot can jeopardise the care quality offered or the safety of patients (Hamill, 2017), by substituting human carers, spoiling the human connection in care (Hung et al., 2022), and taking their jobs (Manyika et al., 2017). Furthermore, according to our results, training should aim to place health and social care professionals in a confident position along a spectrum stretching from basic functions (e.g. how to operate the SAR, deal with malfunctions) to more elaborate ones – such as how to provide good patient care, including associated social and communication skills, and ethical and legal issues in relation to data protection, privacy and consent (Konttila et al., 2019). Ethics is of paramount importance in health workforce training in digital health. Ethical, legal and safety competences are a core element of several nursing training curricula, as it was found by the TIGER Initiative, an international survey which included and evaluated technology preparedness as a key nurses' competence (Hübner et al., 2016).

Ethical, legal and regulatory considerations are linked to people culture, while also offering transcultural principles. An example of this link is in the recent, ongoing NHS England AI and Digital Healthcare Technologies Capability Framework, which stemmed from a wide learning needs analysis of the workforce (Health Education England, 2023). This NHS Framework is built on the foundation of digital literacy skills, upon which all the more advanced technologies preparation sits (Health Education England, 2023). All throughout the stages of a progressively more digitally educated organisation, human factors, such as people and their culture, together with ethical and regulatory principles play an important role (Health Education England, 2023). Ethics and culture are associated in a recent qualitative study on the use of robots in long-term care (Hung et al., 2022). This work focussed on the risks and ethical implications of this technology, and authors formulated a list of recommendations among which appears one named 'cultural safety and justice' (Hung et al., 2022). This recommendation refers to the importance that patients' cultural values and believes are respected. The need for cultural adjustment was found as a barrier to AI technologies implementation in the health settings (Gray et al., 2022), corroborating the importance of account for users' cultural background.

In our international survey, reported perceived training needs were found to have relations with cultures sensu Hofstede. In those country cultures where people feel less comfortable with future uncertainty, we have seen a higher preoccupation of losing control and knowing what the robot can do, as well as with the patient's information it collects. This resonates with previous findings that in cultures with higher UA practices technological solutions are more appealing, precisely to reduce unpredictable human errors, but their introduction is well controlled and institutionalised, together with technology education (Cardon & Marshall, 2008). Conversely, where fear of the uncertain is less prominent, an attitude of problem-solving and how to deal with patient's information emerges as more important in our study.

In the short-term oriented countries and collectivist societies, several of the higher-ranked training needs were those relating to the robot's capabilities, data and information used and stored by the robot, safety of the patient, how to deal with the relatives, what to do if the robot malfunctions, who to contact, and whether or not to obtain consent. These are all training needs emphasising a preoccupation for the patient, their relatives and the role of professional carers' towards them both. This result suggests that training content developed for these cultural contexts should consider and factor in the importance of the family and social relations and how robots could fit in and become part of a web of relations and interactions (Korn et al., 2021). In countries where individualism and LTO are higher, participants formulated their training needs around practical user-robot actions, such as how to turn it off and charge the robots, and on the specific operational functions of SARs. This result is consistent with individualistic values, such as autonomy and independence, in as much as it expresses very practical exigency, more limited to one-to-one user-robot interaction. Turning off and charging the robot is also indicative of a frame of mind more prone to planning rather than worrying in relation to the future. This result is echoed by a recent study which compared an individualistic culture (German) with a collectivist one (Arab); survey respondents with the German background tended to view the robots in functional terms and as machines more appropriate for industrial contexts; whereas Arab respondents had a preference for anthropomorphic robots, and were more prone to accept robots within the domestic realm and to conceive them as social actors (Korn et al., 2021). Preparedness should therefore take into account these different predispositions and give more breath to specific training modules accordingly. Even though the statistically significant differences are small, these rankings provide information about the types of topics that may need to be covered in training to cater for particular cultural values.

In a recent, aforementioned study with Korean nurses who used a SARs in elderly care during the pandemic, it was found that nurses needed hands-on training with the robot, but the support and time needed to feel comfortable and competent using them was different between nurses, according to the type of robot and nurses' previous experience experiences with technology and care robots; this implies that both basic and more advanced skills training would be useful (Kang et al., 2023). In another qualitative study, participants from care homes in the UK were invited to reflect on the future introduction of robots in their workplace after having seen a humanoid social robot interacting with the care home residents (Papadopoulos et al., 2021). Staff reported that they would want to know about the robot's functionality, role/purpose, and to develop technical competence in using the robot. This was framed within the context of person-centred care, as well as persons' wellbeing, safety, and care quality (Papadopoulos et al., 2021). As mentioned above, across the data of this study, the priority given to issues such as patient safety, privacy of patient's information, and obtaining consent, reveals underlying cross-cultural values of person-centred, compassionate care. Indeed, virtue ethics are at the heart of nursing ethics (Turja, 2023). Together our results suggest that values of person-centred care (van Wynsberghe, 2013) should be an important part of the implementation of robots into the caring environment of every country.

Strengths and limitations

This study benefited from having an international perspective with a large sample size, including the views of participants from different healthcare settings and contexts. However, there may have been self-selection bias in the sampling of participants, in that people who were more interested in the topic of robotics (or had stronger views about robotics) may have been more likely to participate. Nevertheless, the finding that similar training needs were highlighted across a range of different countries and cultures suggests that the results may have some transferability to groups of health and social care professionals in other countries. While these results are of interest (particularly given the dearth of research on this topic), future research in this area would benefit from more rigorous attempts to ensure that representative samples were recruited from each participating country.

Another limitation is about cultural outliers. The vast majority of our participants reported that they identified with their country culture ($n = 1261$, 98%). This question intended to investigate cultural homogeneity of country cohorts, and also to lead in the choice of an apt theoretical model. Hofstede model was in the end chosen, as it relies on majority county culture models (Hofstede, 2003). The resulting limitation is that our study is lacking insights from minorities as well as from more heterogeneous countries, where immigration and multiculturalism are more recent phenomena. This is the case of the Turkish-speaking part of Cyprus, which was indeed excluded from this work. More research is therefore needed from minority groups. A related limitation of the study is that, while Hofstede's research has indeed been very influential in the study of cross-cultural differences in a wide range of fields, it was conducted in the commercial, industrial, and financial sectors, and different considerations might apply in the health and social care settings of different countries. Hofstede's research was adopted to inform our exploratory study because it has been hugely influential, and in the absence of any specific approach to understanding cultural differences in health and social care settings. It is recognised that the study's findings are unsatisfyingly limited because of this, and it is acknowledged that an approach to understanding cultural differences that is directly derived from and relevant to health and social care is sorely needed. This would make it possible to explore the influence of cultural factors on key factors in technology acceptance such as perceived usefulness and perceived ease of use (Davis, 1989), and social influence processes and cognitive instrumental factors (Venkatesh & Davis, 2000) in a way that is specific to the health and social care field. This is likely to be crucially important in the implementation of technology such as SARs in such a culturally diverse field.

Conclusion

According to the data we have presented in this article, training about socially assistive robots should be basic, thorough, spanning from practical aspects to ethical issues, and catering for the healthcare professionals' cultural values. Furthermore, training should be based on the principles of person-centred care, which has significantly emerged as a cross-cultural training exigency. Investment in research, education and training in this area should be a priority on the agenda of governmental, local and international organisations.

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