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The perspectives of current health professionals regarding their interaction with specific technology

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Abstract

Technological evolution in healthcare has been continuous. To access the advantages and disadvantages of professional-machine interaction from the user's perspective in health professionals we developed an online questionnaire.

A total of 107 responses were obtained from 12 health technologies areas, showing some differences between them. The majority are 5 to 10 years of experience (28.0%). Speed, safety and efficiency stands out as benefits and dehumanization of the care provided and the reduction of jobs as risks. The user's perspective contributes in an elementary way to the current and future industry in the health area, and therefore should not be neglected.

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Keywords: Type your keywords here, separated by semicolons ;

1. Introduction

The world health organization defines health technology as the application of organized knowledge and skills in the form of medicines, medical devices, vaccines, procedures, and systems developed to solve a health problem and

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improve quality of life [1]. These technologies are fundamental in the health care systems improving the quality of healthcare provided [1].

Technological evolution in health areas has been continuous and in a much faster timeframe than when the transition from analogue to digital took place, transforming the healthcare [2]. This transformation has allowed to enhance quality, efficiency and safety of healthcare [3, 4], as well as reduce times, improve resource use, prevent medication errors, increase the use of preventive care and enable greater adherence to clinical guidelines[5–8]. The technology implementation in healthcare systems had to be considered in terms of accessibility and costs. Costs sometimes constrain the upgrading of equipment, and there may be a longer period of time between their invention and their installation and use in healthcare [9].

The technological industry in the health area currently includes professionals with skills more directed to the area in question - bioengineering - as well as new knowledge of artificial intelligence that has imposed new dynamics in the idealization of devices and software, at the level of the applicable legislation or even digital ethics.

Even though technological advances over time have decreased the intervention of human resources, it is observed simultaneously the emergence of new intervention areas that requires new or updated skills from health professionals in order to respond with greater quality to the health services requested. Digitally competent human resources is essential in this new era [7, 10]. This evolutions challenges health professionals in terms of data interpretation and impacts the entire hospital organization and management, especially in the automated diagnostic area [11].

This technological evolution and the facility with which clinical information and users' personal data are exchanged also presents a challenge to institutions in order to guarantee the patient privacy [11].

In the scope of this process, there seems to be a greater concern with the user's perspective, but it seems to us that this is still incomplete and not transversal, because higher education institutions in the health area are often unable to keep up with the technological evolution of the industry, given the financial investment that this would mean for the institution and for the ministry itself. Thus, in a first phase, it is possible to have a graduate who is not adapted to a technical-clinical reality of a specific context and who requires complementary training in this dimension; as well as professionals who throughout their professional career may feel out of place, afraid or with a decrease in productivity at certain moments.

In this way, it is important to understand the real advantages and disadvantages of this professional-machine interaction from the perspective of its major user, given the daily manipulation with equipment and software.

2. Methodology

An observational, cross-sectional descriptive study was conducted. For this purpose, an online questionnaire was designed to assess the opinion of health technology professionals, which was conducted at a single moment in time. After the approval by the Ethics Committee of the School of Health of the Polytechnic of Porto (ESS|P.Porto), the participants were recruited through social networks, through a publication on the study and a request for collaboration; as well as through a request for dissemination of the study to the Course Coordinators and/or Internship Supervisors of the ESS|P.Porto. The inclusion criterion was being over 18 years of age and being a Senior Diagnostic and Therapeutic Technician practicing in Portugal. The questionnaire was developed in Google forms, without identifying data, and is available at the following link <https://forms.gle/HYbdzgwWHJfXEY9>. The information collected and respective procedures comply with Regulation 2016/679 of the European Parliament and of the Council of 27 April 2016. The pseudo-anonymization process is guaranteed by the absence of registration and collection of identifying data of the participants, so that the data collected cannot be attributed to a particular person, thus ensuring their confidentiality. The data obtained were descriptively analysed using the Microsoft Excel software. In order to verify the existence of a relationship between the response to the different items and the independent variables sex, professional area and years of professional activity, a bivariate analysis was performed in SPSS 28 software, using non-parametric statistical tests appropriate to each case. The significance level used was $\alpha=0.05$.

3. Results

Our study had the participation of 107 health technology professionals, keeping the gender distribution in this area already usual, with a majority of the sample being female ($n=87$, 81.3%).

It was not possible to obtain collaboration from all areas of intervention, having participated only professionals from the areas of pharmacy (n=32, 29.9%), clinical analysis and public health (n=24, 22.4%), audiology (n=13, 12.1%), physiotherapy (n=8, 7.5%), radiology (n=7, 6.5%), speech therapy (n=6, 5.6%), cardiopneumology (n=5, 4.7%), neurophysiology (n=5, 4.7%), osteopathy (n=3, 2.8%), anatomical pathology, cytology and thanatology (n=2, 1.9%), radiotherapy (n=1, 0.9%) and nuclear medicine (n=1, 0.9%).

Regarding years of professional experience, our sample is divided as shown in the following circular graph (Fig. 1), with half of the participants having less than 10 years of professional experience, which means that they are professionals working in the digital domain rather than the analogue domain.

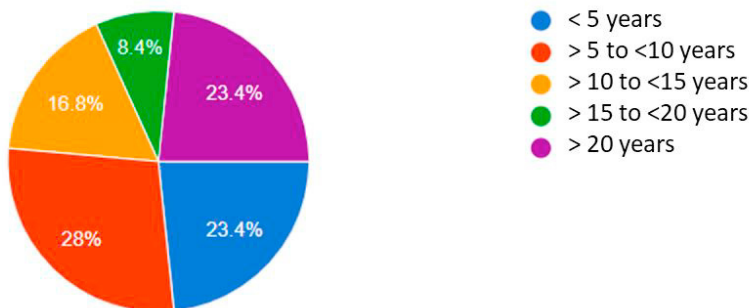


Fig. 1. Distribution of the sample by number of years of professional experience.

The results to be exposed next correspond to questions whose answers were given on a Likert scale ranging between 1 and 5, where 1 represents "totally disagree" and 5 represents "totally agree".

In the item "In recent times I have felt difficulties in keeping up with technological evolution in my professional area" more than 3/4 of the sample disagreed with the statement (score 1 n=56, 52.3%; score 2 n=32, 29.9%). In the item "I often feel that I do not have enough computer knowledge to handle the software in my area" the trend was similar (score 1 n=43, 40.2%; score 2 n=33, 30.8%). On the other hand, in the item "Whenever there is a replacement of equipment, we are provided with on-site equipment training (do not consider months with restrictions due to the pandemic)" a significant fraction of the sample selected agree or totally agree with the statement (score 4 n=31, 29%; score 5 n=27, 25.2%).

Turning now to the item "I consider that this new equipment and software may produce an increased error rate without myself being able to identify" participants disagreed with this statement (score 1 n=29, 27.1%; score 2 n=42, 39.3%). Similarly, the item "I feel that technological developments and artificial intelligence may put my autonomy and skills at risk" did not show much agreement from participants (score 1 n=24, 22.4%; score 2 n=40, 37.4%).

The sample was more dispersed in the item "I believe that in two decades there will be equipment and software capable of performing my functions autonomously", as can be seen in Table 1.

Also, in this line of expressiveness of opinion, in the item "The security of personal data has increased significantly with the new technologies" the sample is mostly in the middle of the scale and therefore in a more neutral position, as can be seen in Table 1.

Participants are also quite divided in two items of the same domain "These advances will allow less skilled individuals to operate the same type of equipment that I handle" (score 1 n=29, 27.1%; score 2 n=25, 23.4%) and in "Software developments decrease my clinical reasoning" (score 1 n=27, 25.2%; score 2 n=29, 27.1%).

Finally, the item "I believe that human error has reduced with new technologies" corroborates the opinion previously expressed in the item "I believe that these new equipment and software may produce an increase in the error rate without myself being able to identify it" (score 4 n=47, 43.9%; score 5 n=20, 18.7%).

The questionnaire also included two open questions which are now systematized.

Regarding the risks associated with these new technologies, the answers included: reduction of human resources and usurpation of functions, need to acquire new skills, security and privacy of sensitive/personal data, dehumanization in the professional-patient dyad, overdependence on technologies, higher volume of work and/or

automation, professional stagnation, overdiagnosis, decreasing in the importance of the scientific/clinical dimension, economic/financial restrictions and devaluation of the professional.

With regard to the benefits associated with the advancement of new technologies, the participants mentioned: increased satisfaction with the service/care provided to both professionals and patients, speed and increased responsiveness, telemedicine, standardization and optimization of procedures, increased productivity, fewer errors and more reliable results/greater diagnostic accuracy, decision-making assistance, safety, easier implementation and less bureaucracy, more resources and greater variety, freedom of the professional to perform other tasks, creation of databases, development of knowledge in new areas and evolution of the area itself.

Table 1 – Results obtained for each question whose answers were given on a Likert scale ranging between 1 and 5, where 1 represents "totally

Items	Totally disagree n (%)	Disagree n (%)	Neither agree nor disagree n (%)	Agree n (%)	Totally agree n (%)
In recent times I have been experiencing difficulties in keeping up with the technological evolution in my professional area.	56 (52.3)	32 (29.9)	11 (10.3)	8 (7.5)	0 (0.0)
Whenever there is a replacement of equipment, we are provided with face-to-face training on it (do not consider months with restrictions due to the pandemic)	11 (10.3)	16 (15.0)	22 (20.6)	31 (29.0)	27 (25.2)
I often feel that I don't have enough computer knowledge to handle software in my area.	43 (40.2)	33 (30.8)	17 (15.9)	13 (12.1)	1 (0.9)
I consider that these new equipment and software can produce an increase in the error rate without myself being able to identify	29 (27.1)	42 (39.3)	17 (15.9)	17 (15.9)	2 (1.9)
I feel that technological and artificial intelligence developments may jeopardize my autonomy and skills	24 (22.4)	40 (37.4)	23 (21.5)	20 (18.7)	0 (0.0)
I believe that in two decades there will be equipment and software capable of autonomously carrying out my functions	27 (25.2)	26 (24.3)	25 (23.4)	17 (15.9)	12 (11.2)
The security of personal data has increased significantly with new technologies	12 (11.2)	19 (17.8)	34 (31.8)	27 (25.2)	15 (14.0)
These advances will allow less educated individuals to operate with the same type of equipment that I handle	29 (27.1)	25 (23.4)	21 (19.6)	22 (20.6)	10 (9.3)
The evolution of software decreases my clinical reasoning	27 (25.2)	29 (27.1)	24 (22.4)	24 (22.4)	3 (2.8)
I believe that human error has reduced with new technologies	29 (27.1)	42 (39.3)	17 (15.9)	17 (15.9)	2 (1.9)

disagree" and 5 represents "totally agree". Results presented in absolute value and percentage.

Using the Mann-Whitney U-Test for independent samples, we found that there is a statistically significant difference between the sexes for the item "I believe that in two decades there will be equipment and software capable of autonomously carrying out my functions", $p=0.044$. Figure 2 shows the responses differences between both sexes.

No statistically significant differences were observed between responses to different items and years of professional experience. Regarding the area of activity, differences were found for the items listed in Table 2. In Table 3 we can observe the mean and standard deviation values for each item regarding the different professional areas.

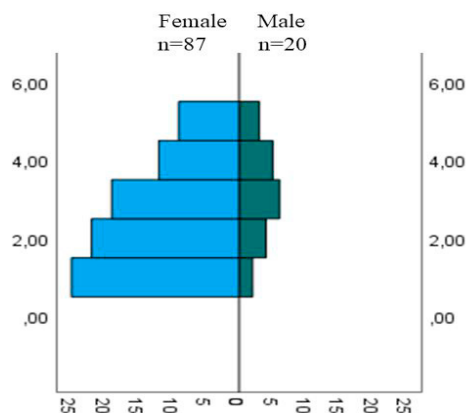


Fig. 2 - Differences observed in the item "I believe that in two decades there will be equipment and software capable of autonomously carrying out my functions", between both sexes.

Table 2 – p values obtained by the Kruskal-Wallis test for a significance level of $\alpha=0.05$, in which statistically significant differences were obtained between different areas of activity.

Items	p value ($\alpha=0.05$)
In recent times I have been experiencing difficulties in keeping up with the technological evolution in my professional area.	0.006
Whenever there is a replacement of equipment, we are provided with face-to-face training on it (do not consider months with restrictions due to the pandemic)	<0,001
I believe that human error has reduced with new technologies	0.007

Table 3 - Mean and standard deviation values per item for each professional area. It is only presented the areas which have more than one participant.

Items/Professional areas	In recent times I have been experiencing difficulties in keeping up with the technological evolution in my professional area	Whenever there is a replacement of equipment, we are provided with face-to-face training on it (do not consider months with restrictions due to the pandemic)	I believe that human error has reduced with new technologies
Pharmacy (n=32)	1.59±0.15	3.47±0.20	4.03±0.12
Clinical Analysis and Public Health (n=24)	1.54±0.12	4.46±0.20	4.04±0.18
Audiology (n=13)	1.46±0.24	3.23±0.34	3.23±0.30
Physiotherapy (n=8)	2.50±0.38	2.75±0.31	3.38±0.38
Radiology (n=7)	1.57±0.43	3.29±0.36	3.43±0.43
Speech Therapy (n=6)	3.50±0.22	1.67±0.21	2.83±0.31
Neurophysiology (n=5)	1.40±0.24	3.60±0.68	3.80±0.37
Cardiopneumology (n=5)	1.60±0.4	2.60±0.81	2.60±0.51
Osteopathy (n=3)	2.00±0.58	2.00±0.58	3.33±0.33
Anatomical Pathology, Cytology and Thanatology (n=2)	1.50±0.50	4.50±0.50	4.50±0.47

4. Discussion/Conclusion

This exploratory study aimed to survey the professionals' perception of health technologies, especially in recent years, in which there has been not only a shift from analogue to digital, but also a systematic and continuous development within the specialty technology itself, in which telemedicine and the applicability of artificial intelligence in these areas of intervention are already a reality and have even been promoted in these months of pandemic context. Obviously, this technological development is felt more in some specialty areas to the detriment of others, see, for example, clinical analysis and public health versus physiotherapy, what can justify the differences between different areas observed to some questions.

Unfortunately, it was not possible to obtain answers from all areas of health technologies in this study, and, in some cases, the number of answers was quite low. However, the sample proved to be consistent and with a Likert scale trend in some of the items assessed, thus allowing us to draw some conclusions for this group in particular. Firstly, it should be noted that the sample, in general, started working in the present century and therefore their technological framework has a strong predominance regarding the digitalisation of complementary means of diagnosis and even the processing and storage of clinical information and other patients' personal data. This seems to us to be an important and justifiable factor for the non-agreement of almost the entire sample in feeling difficulties in keeping up with technological developments. In addition, the possession of minimum knowledge in these areas to perform the assigned tasks was systematically reported, as well as their own training when new equipment is acquired, or a new procedure is implemented. However, we observed differences between the professional areas, for example laboratory areas (such as Clinical Analysis and Public Health) have access to more training when new equipment is acquired than other areas. In this dimension, two factors not explored can be added, but to be considered in the future, which are the multiplicity of training in the same team regarding years of professional activity working as internal self-trainers and the fact that most commercial companies have technicians and engineers capable of providing specific training whenever new equipment/software is acquired.

In terms of training, it should be noted that for this new technological reality, it may not be enough just to have specific training for the implementation of new equipment/software. This new reality requires new competencies and skills from health professionals. However, this does not mean an entire change in health education practices [10]. It is important that health science educators are aware of the need for specific skills to respond in a timely manner to labour market, allowing a successful technological evolution for health technology professions. In this perspective, the internships included in the student's courses in health technology professions, is a key aspect.

Although a high percentage of respondents considered that technological advances could lead to a reduction in jobs, it is important to note that, on the other hand, most professionals cannot imagine being completely replaced by a machine or artificial intelligence. It should be noted that the issue of dehumanisation has been listed several times as a risk associated with these advances. This is a fundamental point in all this problematic because this provision of products and services is at a diametrically opposite pole to the acquisition of food or other basic subsistence. The society of this century, highly digital, has a deep need for human contact and interaction, where the area of health stands out. An example of this is the recent creation of humanisation services, especially in central hospitals, as well as the introduction of this field and other similar ones in the academic training of all professionals in this area.

Another issue identified relates to the security of large databases and the commitment to full compliance with the new General Data Protection Regulation, in force since 2016. Although all computing systems, especially those on a large scale and integrating sensitive data, have highly controlled storage, access and transfer mechanisms, a percentage of the sample considers that there may be leakage or risk of improper access, in practice a violation of the much sought-after privacy. This is just as important, if not more important, when issues associated with insurance or similar arise. In this respect, the large computer systems implemented are central, but the individual training of each professional is also major and should be taken as mandatory, since the protection of personal data is internationally a legal requirement [12].

In a more global way, the balance between the risks and benefits of this new reality and short-medium term future seems to be quite balanced, based on the analysis of the data collected, focusing on the optimisation of procedures, increased productivity and effectiveness, with a consequent increase in patient satisfaction. A curious fact that emerges from this is the focus on the possibility of the health professional focusing on other tasks and activities, which, although no participant specified what those activities would be, it seems natural to us that one of them would undoubtedly be

research, which has been permanently undervalued in the dimension of health technologies, partly due to the lack of time (and resources) of the professionals themselves to dedicate to this dimension, even during their working hours. There is plenty of evidence that research benefits multidisciplinary and collaborative teams, which simply translates into benefits for patients, which is the same as saying for each one of us [13]. Another value-added tasks could be quality assessment, particularly important in laboratory diagnostics, or implementation of new methodologies/tests or developing the so-called personalized medicine. These change in job roles can be intellectually satisfying, thus enhancing the morale and productivity of the staff [8].

In summary, in the coming years the focus of investment should be on digital literacy, healthcare humanisation, data protection regulation, cybersecurity and management of information technology and artificial intelligence.

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