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## ORIGINAL RESEARCH

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## Approach to the use of technologies in health systems: eHealth and mHealth

*Aproximación hacia el uso de las tecnologías en el sistema sanitario: e-salud y m-salud*

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### | Abstract |

**Introduction:** Given the demands of society in the twenty-first century, information and communication technologies should be incorporated into future models of the public health system.

**Objective:** To investigate about the use of eHealth and mHealth through a quantitative study.

**Materials and methods:** A quantitative study was carried out using a 16-item questionnaire that inquires about 9 dimensions: self-diagnostic technologies, complementation genetic test, use of smartphones, data privacy, electronic medical records, costs of medical services, annual physical examinations, concern about radiation exposure, and management of internet and technologies.

**Results:** The exploratory sample (n=250) was made up of health professionals (55 doctors and 77 medical students) and health service users (122 patients) from Spain. One of the similarities was the promotion of the use of smartphones, but there were differences regarding the value given to diagnosis made by using technologies as opposed to that made by professionals.

**Conclusion:** The most relevant difference in terms of expectations among health service users and health care professionals was related to the ownership of the medical history.

**Keywords:** Technology; Quality of Health Care; Health Services Accessibility (MeSH).

### | Resumen |

**Introducción.** Ante los actuales reclamos de la sociedad del siglo XXI, es evidente que las tecnologías de la información y la comunicación deben ser incorporadas en los futuros modelos del sistema sanitario público.

**Objetivo.** Indagar en el uso de e-salud y m-salud a través de un estudio cuantitativo.

**Materiales y métodos.** Se realizó un estudio cuantitativo a través de un cuestionario de 16 ítems orientados hacia 9 dimensiones: tecnologías de autodiagnóstico, pruebas complementarias genéticas, hábito del *smartphone*, privacidad de datos, historias clínicas electrónicas, costes de servicios médicos, exámenes físicos anuales, preocupación sobre la exposición a radiación y manejo de internet y tecnologías.

**Resultados.** La muestra exploratoria (n=250) estuvo conformada por profesionales sanitarios (55 médicos y 77 estudiantes de medicina) y usuarios del servicio sanitario (122 pacientes) de España. Entre las similitudes se detectó el apoyo al uso del *smartphone* y entre las diferencias, el valor otorgado al diagnóstico realizado por las tecnologías frente al formalizado por los profesionales.

**Conclusión.** La diferencia más significativa entre usuarios del sistema sanitario y profesionales sanitarios estuvo relacionada con sus expectativas sobre la propiedad de la historia clínica.

**Palabras clave:** Tecnología; Gestión de la calidad; Accesibilidad a los servicios de salud (DeCS).

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## Introduction

The World Health Organization (WHO) advocates the adoption of measures that help users manage their diseases through the implementation of educational interventions, incentives and tools. (1) This may lead to consider that digital and information technologies could play a key role in the field of health. To this end, the concept of eHealth becomes relevant as defined by the WHO, that is, as the use of information and communication technologies for health (2); it also proposed its incorporation into health systems. (3) Moreover, in 2016, the WHO extended this idea and talked about the use of mobile wireless technologies for public health purposes (mHealth). (4)

Eysenbach (5) proved that patient care improves with the use of eHealth, although there is still a need to educate users who are considered to be in the so-called “digital divide” on access and knowledge of patient information.

Ollero-Baturone & Orozco-Beltrán (6) recognize the need to consider people as the center of the care system, which implies orienting passive patients towards proactivity through empowerment. In this regard, the European Network on Patient Empowerment defines proactive or empowered patients as those who know their health state and its implications, make decisions along with their doctor, and change their lifestyle according to the detected need. (7)

The need for patient empowerment should be stressed, as the traditional approach tends to ignore personal preferences and create dependency. (8) Ruiz-Azarola & Perestelo-Pérez (9), in the SESPA Report, stated that the difficulty of professionals to accept the abandonment of their traditional role and delegate power to the patient is a drawback to achieve healthcare change.

Proactive patients claim the power to participate in decision making, to learn about the pathology they suffer, and to create a plan to address their situation. This need for self-management has led them to create websites and support associations with information on how to become more proactive.

The systematic process of learning and practicing skills that enable people to manage their day-to-day health condition reduces the physical and emotional impact of their illness. (10) Access to computer tools by users is not the most important factor for controlling a pathology, but training on the disease and how to use the applications and interpret their results is the basis for empowerment. Health professionals should be promoters, so that patients feel the need to self-regulate the evolution of their disease. Consequently, patients should be educated to make decisions based on the information provided and accommodate their physician's prescription plans. However, Calvillo *et al.* (11) emphasize on the digital gap among patients, and state that they require prior training in the use of technologies.

The Paciente Experto Anticoagulado (Anticoagulated Expert Patient) program, talks about the figure of expert patients who know their disease and its implications. This leads them to adopt the role of promoters of information in order to transmit it to other patients suffering from the same disease and their families, and also to engage in the process of support, education and commitment to self-care of new patients through talks and workshops during which they share real testimonies. (12)

De la Cámara-Egea (13) acknowledges that the Interterritorial Council of the Spanish National Health System opted for the creation of a permanent commission to protect citizens' rights, based on errors made in previous experiences such as, for example, the VISC+ Project in Catalonia, to which not only public health bodies but also private companies had access.

Accordingly, this work aims to carry out an exploratory study that provides information on the use of eHealth and mHealth in self-care

processes in relation to certain dimensions and taking into account the opinions of different population groups (doctors, patients and students) from Spain (Canary Islands). In addition, this work seeks to contribute to the promotion of the necessary changes for the health/technological advance binomial according to current demands.

## Materials and methods

Quantitative study carried out in Tenerife, Spain, with healthcare professionals (HP) —including doctors and students of medicine/health sciences— and healthcare service users (HSU).

HP participants include the teaching staff from the Faculty of Health Sciences of the Universidad de La Laguna (ULL), and doctors from the Hospital Universitario de Canarias and the Hospital Universitario de Nuestra Señora de Candelaria. The students included in this group are fifth and sixth year medical students of the Faculty of Health Sciences of the ULL. The HSU were invited on site at two health centers and two university hospitals located in the urban area described above.

The entire sample was randomized and participants were informed at the start of the study about the purpose of the research, the confidentiality of the information and the use of the data obtained.

The exploratory sample ( $n=250$ ) consisted of HP [51 physicians (39.8%) and 77 medical students (60.2%)] and HSU (122 patients) from Spain. The participation of women was higher: 55.7% of HSU and 70.3% of HP.

The predominant age segment of the participants was 20-29 years, HP being younger than HSU, with mean ages of 23.8 years and 44.3 years, respectively.

In relation to the educational attainment of the participants, most of them had completed their compulsory studies (33.6%), 31.1% were university graduates, and lower percentages were found for compulsory secondary education (18%) or high school degree (17.2%).

The most common specialties among medical professionals were family and community medicine (27.45%), obstetrics and gynecology (19.61%), and general and digestive system surgery (11.7%).

The questionnaire used for data collection was the How Consumers and Physicians View New Medical Technology: Comparative Survey. (14) Some adjustments were made to adapt it to the care culture of the context of the study, taking into account the relevance of the concepts and the issues raised. These contributions were made by four independent evaluating judges. The changes included modifications to the lexicon and elimination of some items or the response protocol of the instrument, which in some cases were done using the Internet. An online format was created for the physicians' survey.

The final instrument consisted of 16 questions about nine dimensions relating to self-diagnostic technologies, complementary genetic testing, smartphone use, data privacy, electronic medical records, medical service costs, annual physical examinations, concern about radiation exposure, and use of internet and technologies. The survey was anonymous and did not collect personal or clinical data. Researchers adhered to the principles of the Declaration of Helsinki. (15)

Data analysis was done in an Excel database using IBM SPSS Statistics Base v.19.

## Results

The use of technologies for self-diagnosis of non-serious medical conditions have similar percentages among HSU and HP: 52.5% ( $n=64$ ) and 58.6% ( $n=75$ ), respectively, with preference for a diagnosis given by a professional, even if the test is performed by the patients themselves. However, one third of the sample in both groups, 38.5% ( $n=47$ ) and 37.5% ( $n=48$ ), respectively, opted for

both actions to be carried out by qualified staff. Confidence in a diagnosis made by technology is 9% (n=11) among HSU and 3.9% (n=5) among HP ( $p<0.224$ ).

Most participants are in favor of the use of genetic testing in medical situations. Acceptance percentages are more associated with the diagnosis of fetal pathologies (HSU: 97.5% and HP: 98.4%) and with the diagnosis and treatment of diseases (HSU: 97.5% and HP: 98.4%).

Significantly ( $p<0.01$ ), HSU supported more the use of genetic testing to identify and treat infections (91.8%) than HP (74.2%); the former also supported more their use (91.8%) to identify drug side effects in contrast to the latter (64.8%) ( $p<0.01$ ).

Genetic testing to prolong shelf life is significantly more accepted by HSU than by HP (77% vs. 63.3%,  $p=0.18$ ). When it comes to planning a pregnancy, HSU showed more predisposition for planning than HP (84.4% vs. 71.1%,  $p=0.011$ ). Regarding disease prevention and identification of cause of death, HSU continued to reflect a higher percentage of acceptance (Table 1), although there was no significant difference between the two (HSU 92.6% vs. HP 89.8% and HSU 90.2% vs. HP 83.6%, respectively).

**Table 1.** Acceptance of use of genetic testing.

Purpose	Healthcare system users	Healthcare professionals	p
Planning pregnancy	103 (84.4%)	91 (71.8%)	0.011
Diagnosis of fetal problems	119 (97.5%)	126 (98.4%)	0.613
Identifying and treating diseases	119 (97.5%)	126 (98.4%)	0.613
Disease prevention	113 (92.6%)	115 (89.8)	0.438
Identifying and treating infections	112 (91.8%)	95 (74.2%)	<0.001
Identifying drug side effects	112 (91.8%)	83 (64.8%)	<0.001
Extending shelf life	94 (77%)	81 (63.3%)	0.018
Identifying cause of death	110 (90.2%)	107 (83.6%)	0.125

Source: Own elaboration.

Most participants did not stand for the possibility of sending information via smartphone in certain medical situations. The future possibility of performing blood tests with these devices was accepted by 54.7% of the HP, compared to 45.1% of the HSU, without a significant difference between them (Table 2). However, there was a significant disagreement within the HP group: 74.5% of doctors would accept blood tests obtained from patients' smartphones, but only 41.6% of students share the same position.

**Table 2.** Use smartphones for blood tests

Use of smartphones	Healthcare system users	Healthcare professionals
Yes	55 (45.1%)	70 (54.7%)
No	67 (54.9%)	58 (45.3%)
P	0.129	

Source: Own elaboration.

The majority of participants were not in favor of using this type of devices to send information about heart rate/frequency (HSU 41%, HP 46.1%) or eye exams (HSU 29.5%, HP 14.2%) (Table 3). With

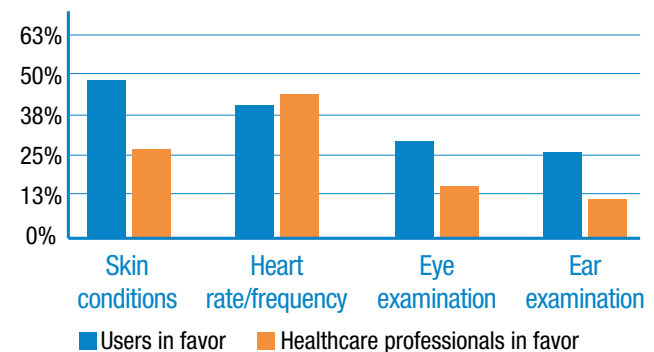
respect to their use in dermatological pathologies, it was significantly ( $p=0.001$ ) less approved by the HP than by the HSU (14.2% vs. 29.5%, respectively).

**Table 3.** Sending and accepting information via smartphone.

Type of information	Healthcare system users	Healthcare professionals	p
Skin conditions	59 (48.4%)	36 (28.1%)	0.001
Heart rate/frequency	50 (41%)	59 (46.1%)	0.415
Eye examination	36 (29.5%)	19 (14.8%)	0.005
Ear examination	32 (26.2%)	15 (11.7%)	0.003

Source: Own elaboration.

There was a significant difference ( $p=0.03$ ) between the positions adopted regarding the possibility of sharing information about eye examinations: 29.5% of the HSU were open to accept it compared to 14.8% of the HP (Figure 1). Similarly, and significantly ( $p=0.003$ ), HP were more reluctant (11.7%) than HSU (26.2%) to consider accepting a mobile hearing test.



**Figure 1.** Sending/accepting information via smartphone.

Source: Own elaboration.

Similar results were observed between HSU and HP in relation to privacy: almost half of the participants were suspicious of the privacy and confidentiality of the data included in electronic medical records and their use (HSU 48.4%, HSU 50.8%) (Table 4).

**Table 4.** Concern for privacy.

Concerned	Healthcare system users	Healthcare professionals
Yes	59 (48.4%)	65 (50.8%)
No	63 (51.6%)	63 (49.2%)
P	0.702	

Source: Own elaboration.

When faced with the question of ownership of medical records (Table 5), the responses of HSU and HP responses were significantly different ( $p<0.001$ ): while only 47.5% of the HSU believed that the patient is the owner of the medical history, the vast majority of professionals (95.3%) felt the same way. No HP believed that they owned the histories, while 15.6% of the HSU did so. The number of HP who did not know to whom the medical history belongs corresponds to 4.7%, while the percentage increases among the HSU to 36.9%.

**Table 5.** Ownership of medical records.

Owner	Healthcare system users	Healthcare professionals
Patient is the owner	58 (47.5%)	122 (95.3%)
Physician is the owner	19 (15.6%)	0
I don't know.	45 (36.9%)	6 (4.7%)
P	<0.001	

Source: Own elaboration.

The HP stated that patients should have access to all the results of the complementary tests, with a significantly higher percentage (94.5%) compared to the HSU (82%). Accepting user access to medical history observations was supported by 59% of HSU and 47.7% of HP (Table 6).

**Table 6.** Access to electronic medical records.

The patient has the right to see:	Healthcare system users	Healthcare professionals	p
Results of complementary tests	100 (82%)	121 (94.5%)	0.002
Medical observations	72 (59%)	61 (47.7%)	0.072

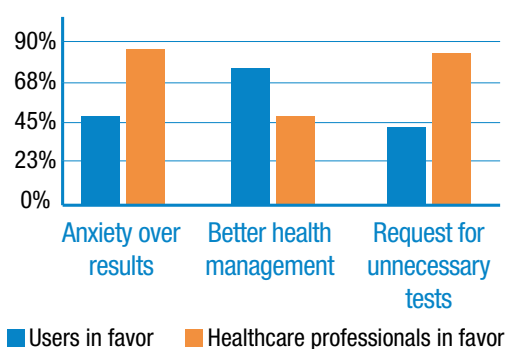
Source: Own elaboration.

Regarding the possible consequences of having access to the patient's medical history (Table 7), the opinions of the HSU and the HP were significantly different ( $p<0.001$ ) in the three aspects evaluated. First, 85.2% of the HP believed that access would generate anxiety in patients over the results, while only 51.6% of HSU had the same opinion. Second, 76.2% of HSU believed that having access to their history would help improve their health, but only 47.7% of HP shared this view. Finally, 83.6% of the HP believed that this would lead patients to request unnecessary diagnostic tests, opinion shared by 40.2% of the HSU (Figure 2).

**Table 7.** Consequences of access to electronic medical records.

Consequence	Healthcare system users	Healthcare professionals	p
Anxiety over results	63 (51.6%)	109 (85.2%)	<0.001
Better health management	93 (76.2%)	61 (47.7%)	<0.001
Request for unnecessary tests	49 (59.8%)	97 (83.6%)	<0.001

Source: Own elaboration.

**Figure 2.** Consequences of access to electronic medical records. Source: Own elaboration.

Both participating groups had similarities regarding patient access to the results: 18.9% of the HSU and 10.2% of the HP believed that it should be immediate. A significant difference can be observed among the group of healthcare professionals ( $p=0.009$ ): 19.6% of the doctors were in favor, while students were overwhelmingly against it, as only 3.9% supported the idea. On the other hand, 22.1% of the HSU and 22.7% of the HP believed that physicians should only review results that might cause concern to patients. Most believed that physicians should review all results before the patient had access to them (HSU 59%, HP 67.2%) (Table 8).

**Table 8.** Results of lab tests.

Opinion	Healthcare system users	Healthcare professionals
Patients should have immediate access to results	32 (18.9%)	13 (10.2%)
Doctors should review all results first	72 (59%)	86 (67.2%)
Doctors should only review results that may cause concern	27 (22.1%)	29 (22.7%)
P	0.139	

Source: Own elaboration.

80.3% of HSU said they worry about the cost of the tests or treatments they are given, whereas HP differed significantly ( $p<0.001$ ), as only 10.9% thought their patients were concerned about it.

With regard to the possibility of a public entity that sends each patient an annual report on the healthcare expenditure incurred during the year, both HP (80.5%) and HSU (77.8%) were in favor ( $p<0.207$ ).

As for the results on whether or not an annual physical examination was necessary, both groups of participants had similar figures, with the majority believing that it is necessary (HSU 77%, HP 67.2%). 18% of the HSU and 21.1% of the HP showed interest in alternatives to this physical exam to monitor health ( $p<0.101$ ).

63.1% of HSU and 72.7% of HP express concern about radiation exposure. No significant differences were found in this aspect ( $p<0.106$ ).

About internet use, 49.2% of HSU had never used it before seeing a doctor to look for their symptoms, 36.9% used it at some point, 8.2% used it quite often, and 5.7% always used it. HP significantly disagreed ( $p<0.001$ ) when affirming that 31.3% of their patients accepted that they consulted their symptoms online; 64.1% of the HP stated that their patients accepted that they did it quite frequently, as opposed to 4.7% of the HSU who said that they always did it ( $p<0.001$ ).

With respect to the search of information on internet about the diagnosis received after a visit to a professional, 49.2% of HSU said that they had never done so, 34.4% had done so before, 9.8% did so frequently and 6.6% always did so. More than half of HP (56.3%) stated that they used the internet frequently when they have doubts about the diagnosis or treatment, 35.9% stated that they sometimes used it, 1.6% never did it and 6.3% always did it ( $p<0.001$ ).

The use of new technologies among participating groups was significantly different. While 73.4% of HP believed they must do so to stay current, only 36.1% of HSU shared that opinion. The percentage of people who believed that new technologies were exciting and used them as much as they could was higher among the HSU (27.9%) than among the HP (21.9%). On the other hand, 29.5% of HSU stated that they were surpassed by new technologies—no HP is included in this group—, while 4.7% of the HP confessed that they felt overwhelmed by them, as was the case with 6.6% of HSU ( $p<0.00$ ).



## Discussion

The National Observatory for Telecommunications and the Information Society carried out a survey on the perception and use of eHealth by the Spanish population. The results are similar to those found in this research, where 60% of respondents said that they used the Internet to search for medical information, 35% searched information before going to the doctor, and 45% did so after the appointment to confirm the diagnoses or treatments prescribed by their doctor. In addition, half of the people surveyed said they looked for medical information on the Internet before and after attending their medical appointments. It should be noted that the study carried out by the Ministry of Industry, Energy and Tourism and the National Observatory for Telecommunications and the Information Society (16) concludes that more than half of the Spanish population use the Internet to search for medical information, as is the case of the European average. (16)

After comparing this research with the study of Boeldt *et al.* (14), it is possible to find similarities and differences in the results. One of the similarities is that patients show greater support for the use of the smartphone as a means of sending information to their doctors, in other words, this device is useful for storing data and performing activities just like any computer.

Regarding access to medical records and the privacy of information, both HP and HSU have the same concern over the privacy of medical data; this was evident in this research and in the study of Boeldt *et al.* (14) The HP, faced with possible patient access to medical records, believe that this would generate anxiety and lead them to request unnecessary diagnostic tests. In contrast, the HSU believe this would contribute to better management of their health.

It is important to highlight the difference in the opinions of HP on the ownership of the medical history. In other contexts, a high number of physicians consider that the medical history belongs to the patient. A possible cause could be related to the difference in perception between professionals when it comes to including the medical comments of each professional in the medical history. (17)

With respect to the differences found, in the study by Boeldt *et al.* (14), technology based inquiries were predominant in HSU, that is, they support diagnoses made by technologies more than those made by a health professional. These authors also reported that, unlike the findings of this study, most of the HSU did not support technologies use by PS in different medical situations.

There are other data that show some concern about the use of health devices or applications (8% of the participants in the study) (16), although more than half of the participants say that they have been helpful to improve their state of health. Half of the people consider the information found on the Internet as reliable, and 40% think that exchanging emails with their doctor could be a key tool. Further studies should also be directed to inquire about which healthcare websites are visited by users, taking into account the variety of accurate or sometimes erroneous information.

In 2016, the most searched chronic pathologies in Spain, according to Google Trends, were cancer (with more than 2 million queries per month), followed by lupus, psoriasis and diabetes; this search was done using keywords. The growing use of the Internet led the Organización Médica Colegial (Medical Colleges Organization) to take measures in May 2017, bringing a hundred sites with pseudoscientific content before the Attorney General's Office because they represented a "danger to public health", referring to them as "Sanitary Sects" (18).

In 2017, the Hospital Álvaro Cunqueiro reported the implementation of mobile applications in the Public Health System to make appointments, access results of complementary tests and electronic prescriptions, and allow relatives to monitor the course of surgeries.

(19) Actually, the private sector, according to data provided by an insurance company (20), foresees the use of wearables for the follow-up of patients. Thus, it is possible to adjust the costs of health insurance to improve the current statistics regarding the use of smart devices.

The complete development and implementation of these applications and Big Data has slowed down due to concerns about the security of patients' personal clinical and administrative information. Concern about the possible exposure of these data has been evident, especially in recent months, due to the various cyber-attacks worldwide that have affected the National Health Service. (21) This has aroused the interest of large multinationals that are currently working on projects related to the extraction and analysis of data from medical records to make them available to professionals and consumers. In Spain, this was evident when the Generalitat de Catalunya decided, in early 2017, to replace the controversial VISC+ program by the PADRIS project (a Big Data system at the level of the Autonomous Community of Catalonia), because the first offers the possibility of commercializing the clinical data of patients. This new program, according to the Agency for Health Quality and Assessment of Catalonia, allows making data anonymous and de-identified, as well as making them available to scientific research bodies, but under the supervision of an ethical committee. (22)

Ultimately, the findings confirm that while most patients and professionals believe that new technologies should be mastered to keep up with them, there is greater controversy among users who consider that they may be exciting or overwhelming. A high percentage of participants from both groups do not agree with entrusting a diagnosis to new technologies instead of a HP—regarding the process of sending and accepting information via smartphone about the results of physical exams—or with the patient performing a blood test with his or her own device. This last aspect has been more widely rejected by the HSU than by the HP and, among them, medical students.

A significant majority of participants are in favor of using genetic testing in different settings, but HP are more reluctant with its use for planning a pregnancy, identifying and treating infections, identifying drug side effects and significantly prolonging shelf life.

There are no marked differences between the two groups regarding data privacy concerns. However, there are significant differences with respect to the opinion of the HSU, since 50% consider that they should be the owners of their own medical records and more than 30% do not know to whom it belongs. Moreover, 5% of the HP do not know who owns the medical record either.

About access to the results of the complementary tests, both groups, although more significantly in the HP group, support the idea of the patient having free access to them. However, the HSU have a slight tendency to wanting access to medical notes, while HP are more conservative and mostly reject the idea. Both groups coincide in the opinion of the doctor being the person who reads the results of the complementary tests before patients can have access to them, with medical students being the ones who most second this proposal in a significant way.

The HP differ significantly from the HSU regarding the support to the possible consequences that they believe having free access to electronic medical records can have on patients; these consequences include anxiety, poor benefits to health and requesting unnecessary tests.

Most participants are in favor of sending an annual report on health expenditure, but both groups differ significantly in their concern. On the one hand, the HSU believe they care about spending, but the HP say they do not care.

Both HP and HSU consider that an annual physical examination is necessary, and share their concern about radiation exposure. Half of the HSU state that they do not make any search on the Internet before

or after seeing their doctor. However, many HP differ significantly by affirming that their patients do it quite frequently. In short, it is necessary to carry out further research aimed at ascertaining the sources of documentation used by the HP to confirm diagnoses via Internet.

## Conclusions

Although this study makes an approximation to the state of the situation regarding the use of eHealth and mHealth, future studies should gather exhaustive descriptive statistics with broader samples in order to better understand the nuanced differences between HSU and HP. Understanding their attitudes can be particularly useful in the process of validating new digital technologies in health systems because, besides having access to faster diagnostic processes, users' participation in their care process would be more active and management would be more efficient.

The results of this research show that both the HSU and the HP generally support the use of technologies in health care contexts, although with considerably greater enthusiasm among the HSU. Access to and ownership of medical records are the aspects with the greatest difference in expectations among HSU and HP, but, in general, findings similar to those reported in different health systems are evident.

## Conflicts of interest

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