Perceptions and needs of health professionals concerning health information systems

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In recent decades, there has been an increasing interest in patients' needs and their satisfaction with health systems. Various studies have presented several benefits of information management application in health care. Health information technology can contribute to improving health care services performance, cost savings, and greater engagement of patients in their own health. Therefore, many health care organizations are planning to increase their overall adoption of information technology in their activities. The aim of our research is to assess health professionals' views on the adoption and value of health information systems and to assess their usage. The research focuses on the use of health information technologies in the National Health System in Greece and was performed using a structured electronic questionnaire answered by 1,216 doctors, nurses, and other health care staff. Among the study sample, 92.11% of the hospitals had installed a Health Information System (HIS). Of the respondents, 86.18% believed that the adoption of HIS was extremely important, and 88.8% reported a high or very high frequency of usage in their workplace. However, in 22.3% of the cases, health professionals highlighted the need for integrated information systems: because there was no connection or information exchange installed within the various (clinical and administrative) information systems, this was considered to be a barrier for the effectiveness and improvement of the health care system. The analysis led to the proposal for an information system based on the needs for information and health professionals' skills in the field of information and communication technologies.

Povzetek: narejena je analiza potreb uporabnikov zdravstvenih informacijskih sistemov.

1 Background and Significance

The development of information and communication technologies (ICTs) and their applications has provoked a technological revolution that has drastically changed the way people live, work, and communicate. The health care sector cannot ignore this evolution, as health care systems face major challenges regarding both patients and health professionals' demands for services and treatments delivery, innovations, and access to more information, financial gain, and patient empowerment [1,2]. Thus, a substantial body of literature focuses on assessments of efficacy and the feasibility of using ICT in the health care sector [3].

As information technology is being widely adopted by health care organizations worldwide, it will soon affect all areas of health care [4]. Because of the use of ICT in the health care sector, we can envision the creation of an anthropocentric health care system [5]. Thus, health care's first and foremost aim is to address the needs of every patient by offering a sustained medical follow-up and supplementary features as well as the ability to schedule same-day appointments and preserve continuity while implementing beneficial developments across the health care landscape [6].

However, as health care organizations are striving to address all their problems and needs, and as they have realized that the technology itself is not the solution, their efforts are orientated toward leveraging the benefits of integration by investing in both technology and their users [7,8].

In Greece, the introduction of medical information networks and applications followed the evolution of information technology. The country's network infrastructure was started only in the early 1990s to become contemporary. Collaboration and coordination of care processes is a major challenge. In addition, security and privacy are great concerns while implementing cloud-based health care services, especially after the enforcement of the EU General Data Protection Regulation (GDPR), which was implemented to enforce a uniform data privacy law throughout Europe as well as to defend and allow all EU citizens safe access to their data and to redesign the way organizations throughout the area handle data privacy [9]. Traditionally, the health care

sector in Greece has been considered as a late adopter of modern technology, such as Health Information System (HIS) implementation with big data. Most health care facilities rely on infrastructure that involves papers and hard copies of medical records, reports, test results, x-ray film imaging, disintegrated IT systems, and incompatible warehouses of information. As a result, information exchange between medical professionals is unproductive, and data efficiency is rare. Most medical staff rely on out-of-date technology for their communication requirements [10].

On the other hand, several studies within European countries revealed that well implemented HIS improved efficiency in management, reduced missed appointments and waiting times. While at the same time offering better communication with patients and medical personnel and allowing the exchange of information in real time providing improved coordination and decision making. [11,12]. Other studies suggested that ICTs in healthcare can significantly improve relationships between patients and nurses, information exchange and empower incentives.

Nonetheless, as some researches in European countries revealed, there are some drawbacks as well, mainly located in the design and development of Health Information Systems. These include incompatible and heterogenous software, outdated hardware, shortage in resources and access to limited funds. Another factor influencing the effectiveness of HIS is computer literacy of medical professionals [12,13]. Although this subject was investigated in depth for other European countries, there is a lack of insights for HIS in Greek national healthcare system. Therefore, this study will try to investigate the conditions that exist in Greek healthcare and the adoption of Health Information Systems.

2 Objectives

The aim of the present research is to assess health professionals' views on the adoption and value of health ICTs in Greece. In addition, we also seek to identify the ability of health professionals to operate HISs as well as to determine the level of acceptance and access needs to information. Furthermore, health professionals' usage of health ICTs will be analysed. The adoption of ICT in the health care sector in Greece has started to increase in recent years, as it previously included only independent and autonomous units with little exchange of data and information between them.

3 Methods

The study used data from 1,216 health professionals employed in the National Health System of Greece. More specifically, the research sample consisted of 192 doctors, 400 nurses, 200 health practitioners, 344 administrative staff, 64 pharmacists, and 16 dentists, all of whom were randomly selected. Data were collected from October 2019 to March 2020 using an online structured questionnaire. The online questionnaire was promoted to the regional health authorities to be sent to hospitals, to the Medical Association of Greece, and to the Nurses Association of Greece. The questionnaire was designed in the frame of the relevant literature [14,15,16] so as to facilitate data collection and analysis. The questions were presented in the form of multiple choices using a 5-point Likert scale.

The questionnaire was designed to shed some light on health professionals' views on the adoption and value of health ICTs in Greece. For this reason, the questionnaire was categorized based on questions concerning the following:

• respondents' ability to use ICTs; respondents were asked to assess their ability to use health information systems and relevant applications

• ICT usage in the National Healthcare System in Greece; respondents were asked about the penetration of ICTs in their departments and organizations

• perceptions on ICTs' in health care pros and cons; respondents were asked to assess the advantages and disadvantages of the application of ICTs in health care

• the need for access to information; respondents answered questions about their current access to patient information, their need for patient information, as well as their perceptions about the need for patients to have access to their own information.

We used descriptive statistics to describe participants' demographic characteristics. Correlation tests were carried out to detect statistically significant relationships between the variables of interest, whereas a factor analysis was used to point out the core constructs of the respondents' ability to use health ICTs. Finally, a generalized linear model was used to analyse health professionals' ability to use health ICTs. All of the above-mentioned statistical tests were selected depending on the proper theoretical conditions; thus, because of the asymmetric distribution of most of the variables, nonparametric tests were carried out using SPSS at a 95% level of confidence.

4 Results

4.1. Sample characteristics

Table 1 briefly presents information about the sample demographics.

Table 1. Sample information.

	Demographics	Frequency	Percent
Gender	Male	352	28.9
	Female	864	71.1
Age	18-35	572	47.0
	35-45	440	36.2
	45-55	160	13.2
	55-65	32	2.6
	Over 65	12	1.0

Education	Secondary education	24	2.0
	Upper secondary education	40	3.3
	Undergraduate studies	312	25.7
	Postgraduate studies	680	55.9
	Ph.D.	160	13.2
Employment	Public hospital	41,2	41.2
	Private hospital	22,7	22.7
	Private clinic	8,2	8.2
	Other	27,9	27.9
Staff category	Doctor	192	15.8
	Nurse	400	32.9
	Health practitioner	200	16.4
	Administrative officer	344	28.3
	Pharmacist	64	5.3
	Dentist	16	1.3

4.2. Familiarity with information systems and degree of use

The questions to be analysed concern the respondents' familiarity with the use of information systems as well as the degree of their usage. The first question is about the familiarity with the use of information systems.

Table 2. Respondents' familiarity with the use of information systems.

	Neutral	**Familiar**	**Very familiar**
Doctor	20	72	100
Nurse	56	132	212
Health practitioner	32	64	104
Administrative officer	24	96	224
Pharmacist	16	20	28
Dentist	4	4	8
Total	152	388	676

As presented in Table 2, a little less than 55.92% (percentage of respondents with a postgraduate degree), i.e., 55.59%, declared that they were very familiar with the use of information systems. This is because of their young age and high level of education. A total of 31.91% were very familiar whereas 12.5% were moderately familiar with information systems use. For the staff category, half of the respondents seemed to have a very good relationship with information systems. It is worth noting that no respondent reported having little or no familiarity with information systems—a fact that highlights the penetration of information systems into the health care field.

An important aspect to be examined is the existence of an integrated information system at the respondents' workplaces. Of the respondents, 92.11% declared that there was an information system at their workplace.

4.3. Access to information

A very important aspect for both health services providers and every person employed in the health sector is the access to their patients' information. Table 3 shows the health staff access to their patients' information. It is notable that nursing staff had access to more information in terms of the patients' diagnosis history, medication history, current medication, medical examination results, and health insurance provider information than the doctors did. Furthermore, dentists seemed to be the less informed about their patients. Finally, very low access to information concerning patients' diagnosis-related groups was recorded, as administrative officers are the most informed ones (19.8%).

Table 3. Access to patients' information by staff category (%).

	Doctor	**Nurse**	**Health practitioner**	**Administrative officer**	**Pharmacist**	**Dentist**
Medical history	56,3	43	50	54,7	31,3	50
Diagnoses history	43,8	47	42	45,3	18,8	0
Medications history	50	55	46	41,9	68,8	25
Hospitalization history	56,3	52	34	48,8	6,3	25
Current medication	62,5	63	44	33,7	81,3	25
Medical examinations results	70,8	73	52	47,7	12,5	0
Insurance provider	47,9	72	46	66,3	62,5	25
Insured services	33,3	20	20	39,5	6,3	25
DRGs	18,8	17	18	19,8	6,3	0
Insured service usage	18,8	16	12	22,1	12,5	0

4.4. Information systems advantages

The adoption of information systems by health organizations can have many positive effects, these results are presented in Table 4. According to most health professionals who participated in the survey, improvement in efficiency is the most important positive effect of information systems (91.1% agree or strongly agree).

The demographic characteristics of the sample appeared to partially affect respondents' views on the advantages of

information systems. For the examination of possible correlations, Spearman's correlation coefficient and Pearson's chi-square have been used.

Table 4. Positive effects of information systems (%).

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Efficiency	0.33	3.29	5.26	25.33	65.79
Common data	0.70	4.30	10.50	31.90	52.60
Ease of access	0.99	4.93	6.25	25.66	62.17
Quality improvement	0.33	3.29	5.59	22.04	68.75
Changes support	0.99	3.62	10.20	29.28	55.91
Cost monitoring	0.66	4.61	7.24	26.64	60.85

From Table 5, we can conclude that the data presented the following table, respondents' views on the advantages of information systems, are affected by the variables concerning health professionals' age, educational level, employment, and staff category. However, employment has no effect on the examined views, which means that the views on the advantages of information systems are the same for all respondents regardless of whether someone is working in a public or private hospital or a private clinic. Finally, staff category is correlated with the advantages of common data usage, quality improvement, and support for organizational changes. By using-cross tabulation analysis, we can conclude that doctors, nurses, health practitioners, and administrative officers are the staff categories for which a higher level of agreement with the aforementioned advantages was recorded.

Table 5. Correlation of respondents' demographics and their perceptions of the advantages of ICTs.

		Sig.	r[a]	Test
Age	Efficiency	0.000*	0.120	ii
	Common data	0.000*	0.152	ii
	Ease of access	0.002*	0.089	ii
	Quality improvement	0.005*	0.081	ii
	Changes support	0.000*	0.160	ii
	Cost monitoring	0.000*	0.106	ii
Education	Efficiency	0.000*	0.195	ii
	Common data	0.000*	0.173	ii
	Ease of access	0.000*	0.114	ii
	Quality improvement	0.000*	0.112	ii
	Changes support	0.000*	0.196	ii
	Cost monitoring	0.000*	0.220	ii
Employment	Efficiency	0.089		i
	Common data	0.057		i
	Ease of access	0.218		i
	Quality improvement	0.412		i
	Changes support	0.058		i
	Cost monitoring	0.034		i
Staff category	Efficiency	0.112		i
	Common data	0.000*		i
	Ease of access	0.098		i
	Quality improvement	0.000*		i
	Changes support	0.000*		i
	Cost monitoring	0.218		i

Tests: (i): Pearson's Chi-Square, (ii) Spearman's correlation coefficient
[a] Denotes Spearman's Rho
* Denotes statistically significant correlation

4.5. Health professionals' ability to use information systems

For a more in-depth analysis of health professionals' ability to use information systems, a general linear model will be constructed. To do so, we conducted a factor analysis.

The factor analysis used the Varimax rotation, which reduces the total sum of variables with increased load and converts them into a more understandable form. The main aim is to obtain important correlations among the variables. Consequently, we calculated correlation coefficients as well as partial correlation coefficients. In addition, the relative magnitude of the correlation coefficients with the partial correlation coefficients should be compared. The measurement that provides the value of this comparison is Kaiser–Meyer–Olkin. Here the Kaiser–Meyer–Olkin value is 0.872, which can be considered satisfactory. The factor analysis exported five factors:

•Information systems advantages
•Information on patients' medication history
•Ability to use information systems
•Patients' access to data
•Information on patients' insurance

According to the above results, health professionals' ability to use information systems is the third factor in the factor analysis we conducted. The variables included in this factor are presented in Table 6.

Table 6. Variables included in the factor.

Variable	Factor loading
Familiarity with PC's usage	0.756
Ability to use health information systems	0.677
Ability to use word processors	0.709
Ability to use spreadsheets	0.823
Ability to use data bases	0.810
Ability to use statistical analysis software	0.738

The next step is to construct the univariate general linear model. The dependent variable was the factor concerning health professionals' ability to use information systems, whereas the independent variables were the demographics.

Table 7. Tests of between-subjects effects.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	1.776	1	1.776	4.307	0.038
Gender	4.346	1	4.346	10.537	0.001
Age	14.315	4	3.579	8.677	0.000
Education	21.455	4	5.364	13.005	0.000
Employment	13.257	3	4.419	10.715	0.000
Staff category	14.803	5	2.961	7.178	0.000

Before constructing the regression model, it is useful to explain the way the categorical variables were taken into consideration. For example, the variable regarding the respondents' gender has two values: male and female. Because this variable is categorical, no mathematical calculations can be made. That is why the so-called dummy variables are created. Because this categorical variable has two values, one dummy variable is created. Now, X1 means that gender is male; otherwise, gender is female.

Table 8. Regression parameter estimates.

Parameter		B	Std. Error	T	Sig.
Intercept		47.853	10.287	4.652	0.000
Gender	Male (X_1)	-33.743	7.501	-4.498	0.000
	Female	0[a]	.	.	.
Age	18-35 (X_2)	15.793	5.513	-2.865	0.004
	35-45 (X_3)	21.128	5.658	-3.734	0.000
	45-55 (X_4)	-17.754	5.126	-3.463	0.001
	55-65 (X_5)	-5.314	5.633	.943	0.346
	Over 65	0[a]	.	.	.
Education	Secondary education (X_6)	-13.865	3.460	-4.008	0.000
	Upper secondary education (X_7)	-67.627	18.306	-3.694	0.000
	Undergraduate studies (X_8)	-48.988	13.180	-3.717	0.000
	Postgraduate studies (X_9)	35.179	13.470	-2.612	0.009
	Ph.D.	0[a]	.	.	.
Employment	Public hospital (X_{10})	-21.066	6.627	-3.179	0.002
	Private hospital (X_{11})	-30.066	6.781	-4.434	0.000
	Private clinic (X_{12})	-3.870	8.802	-.440	0.660
	Other	0[a]	.	.	.
Staff category	Doctor (X_{13})	28.750	6.781	-4.240	0.000
	Nurse (X_{14})	-2.840	.786	-3.613	0.000
	Health practitioner (X_{15})	-18.812	3.870	-4.861	0.000
	Administrative officer (X_{16})	-15.402	3.826	-4.026	0.000
	Pharmacist (X_{17})	3.176	.454	-6.994	0.000
	Dentist	0[a]	.	.	.

[a] This parameter is set to zero because it is redundant.

According to the data presented in Table 8, we can see that all of the demographic variables were correlated at a statistically significant level with health professionals' ability to use information systems. The model's adjusted R2 was 0.740, which means that the demographics can explain 74% of health professionals' ability to use the variability of information systems. The general linear regression model can now be written as follows:

$$Y = 33.74X1 + 15.79X2 - 21.13X3 - 17.75X4 - 13.86X6 - 67.63X7 - 48.99X8 + 35.18X9 - 21.06X10 - 30.06X11 + 28.75X13 - 2.84X14 - 18.81X15 - 15.40X16 + 3.18X17 + 47.85 \quad (1)$$

According to the above equation, both older health professionals and these with a lower level of education seemed to have lower levels of ability to use information systems. Furthermore, nurses, dentists, and health practitioners also had lower levels of ability to use information systems.

5 Discussion

The aim of our research was to assess health professionals' views on the adoption and value of health ICTs and to analyse their usage in Greece.

Our research findings showed that 92.11% of the hospitals in the sample are hosting an HIS. However, only 52.7% of the hospitals and health centres in Greece have a fully developed health care information system, including an electronic health record (EHR), and just 8.1% of them have any type of internet-enabled applications [17]. In addition, the health care organizations have progressed with the deployment of numerous types of information systems available from different vendors, without major concerns regarding information sharing, cross-operability, or integration with the current working systems. The latest reformations in the Greek health care system took place in 2010, although these were mainly focused on financial and organizational aspects. Admittedly, the lack of technical

skills and development of a uniform information system causes problems in information flow [18]. Consequently, the Greek Ministry of Health must move toward the development, implementation, and administration of comprehensive national standards for the design, competence, and use of EHR systems [19,20].

Furthermore, our findings showed that 88% of personnel employed in the health sector declared that they were familiar or very familiar with the use of information systems, whereas 86.18% of the respondents believed that the adoption of HIS is extremely important, and 88.8% of them reported a high or very high frequency of usage in their workplace. In a relative study, researching the end users' (employees' and physicians') attitudes toward the introduction of e-procurement procedures in Greece public hospitals, the vast majority (93.7% of the employees and 89.4% of the physicians) answered that the introduction of e-procurement into public hospitals is indispensable; this finding is also confirmed in the literature [19,21].

The intention to use the EHRs is a function of many variables (i.e., gender, age, and educational level). According to our findings, older health professionals and those with a lower level of education seemed to have lower levels of ability to adapt to information systems. At the same time, nurses, dentists, and health practitioners also have lower levels of ability to use information systems, although there is no correlation with administrative officers.

This phenomenon, was also reported in other studies as well. Low computer literacy of medical professionals is preventing optimal use of HIS [12,13,22,23].

In our factor analysis, the health professionals' ability to use information systems exported five factors: information systems advantages, information on patients' medication history, ability to use information systems, patients' access to data, and information on patients' insurance. In another study, the authors reported that the health care workforce intends to use the EHR once they understand that it is easy to use and how useful it is for their work progress. Finally, knowledge about searching for and locating health information, the ability to show awareness and comprehension of health information, and the capacity to retain, process, and apply information are among the necessary components and properties that the health care workforce identified as critical. Hence, combining these components will assist medical professionals in effectively searching for, comprehending, and using health insights within the health care environment. This observation was also confirmed from previous studies. There multiple benefits derived from HIS implementation for medical personnel, including improved efficiency in management, reduced missed appointments and waiting times, better communication with patients and exchange of information in real time [11,12,24].

The adoption of information systems by health organizations can have many positive effects. According to most of the health professionals who participated in our study, improvement in efficiency is the most important positive effect of information systems (91.1% agree or strongly agree). Other studies have highlighted additional positive effects of HIS, such as the promotion and functional chronic disease administration in medically underprivileged communities; [25] suitability for use of applications for social, language/literateness, and anthropological aspects among one or more weak populations; [26] changes in clinical processes and positive improvement in specific patient outcomes; [27] and potential benefits in facilitating patients' self-management [28]. These advantages support the goal of helping all patients to be informed, active participants and to increase the quality of their own care [1,29]. Innovations in medical care in various health environments imprint the data effectiveness of strategic implementations and feed data back into the loop of innovation [30] as well as improve organizational and performance cost [20,31].

However, as our findings suggest, health professionals highlighted the need for integrated information systems, because there is no connection or information exchange between various (clinical and administrative) information systems installed, a barrier for the effective improvement of the health care system. Same barriers were also presented in various other studies, such as the complex relationship between different technical, social, and organizational dimensions identified in the health care sector [31]. Thus, we conclude that without successful integration of HIS into the clinical workflow, clinicians in today's ambulatory care settings will continue to resist adoption and implementation of EHR technology [30,31]. Other various studies regarding the acceptance of health professionals of HIS unveiled similar adoption factors, such as facilitating conditions, computer usage concern, and self-efficacy. In addition, other important factors are training, service quality, expected risk and information probity, and anticipated risks for professional independence. These characteristics were found to be closely related to impact factors, empowered indirectly with the ability to influence the use of health information systems [35,36,37,38,15].

Health Information Systems will continue to evolve in the future. Cloud-based computing in health care can bring revolutionary transformative change in the health care landscape, facilitating an evolution in the practice of medicine, enabling personalization of treatment, and helping to reduce the cost of health care [39]. Simultaneously, the entry and storage of administrative and clinical big data has the potential to transform medical practice by using information created daily to enhance the quality and competence of medical care [40]. Thus, the development of integrated information systems has the ability to amplify the interaction between public health professionals and patients. Consequently, this can be a crucial factor in the development and modernization of health services.

Continuous developments are prominent for tech and platform companies to enter the healthcare sector and have the ability to improve the quality of life for patients around the world. These developments include smart products and services with the integration of data sourced from sensors, forecasting and analysis models and interconnectivity of multiple devices in a health network able to provide a novel health information service. This kind of health service has already partially implemented from Amazon and Google. Regardless of the future developments, matters such as accuracy of predictions, confidentiality and privacy of health data, are essential. Future HIS research should focus on data sharing and knowledge distribution on the one hand, and the protection of health information on the other [41].

6 Conclusions

The results of our research indicate the need for the familiarization with health ICT usage, because, taking into account current circumstances, there is a high possibility of underutilization of sources. First, because older health professionals have lower levels of familiarization, special training programs should be organized. Such training programs should optimize both the use of the systems and the use of data [42]. The older health professionals' motivation for training will not be particularly difficult, as in the above analysis, we have already seen that as age increases, the benefits of ICT are more understood.

Furthermore, based on the above equation, we see that the ability to use health ICTs is lower for nurses, dentists, and health practitioners. This could have the same negative results as indicated for older health professionals. In this case, special training programs should focus on the specific needs of each category.

The training programs could be of in-service type and should be organized in a way that will provide the above categories of health professionals with expertise in both health information management and the use of ICT applications. In this way, both a higher level of effectiveness will be acquired and the existing knowledge divide will be bridged [42].

Additionally, from the point of view of ethical consequences, security and privacy are some of the major concerns while implementing health care systems. A cloud-based HIS should be built to maintain privacy and security of medical data, [43] in particular, the enforcement by the EU of the GDPR, which was designed to comply with data privacy laws across Europe. Organizations should revise their methods of storing data and maintain data privacy by using encryption in their systems [44,9].

Finally, it is worth mentioning that the frequency of changes implemented in the health system is rather slow because of the insecurity that prevents the creation of a comprehensive policy. However, there is a clear need to introduce ICTs in the health sector, so the first tentative steps are already being taken to provide better health services. Because of the lack of implementation of integrated information systems in the NHS of Greece, the disruption in the provision of health care services resulted in reduced efficiency and the inefficient use of financial resources [18,45, 46].

Managerial Implications

Health professionals highlighted the need for integrated information systems, lack of connection or information exchange between fragmented information systems is a barrier for the effective improvement of the health care system. According the majority (91.1% agree or strongly agree) of health professionals who participated in the survey, improvement in efficiency is the most important aspect of information systems. The development of unified information systems will assist medical professionals in effectively using health insights within the health care environment.

Conflict of Interest

The authors declare that they have no conflicts of interest in the research

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