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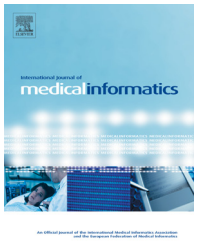

Adoption of health information technologies by physicians for clinical practice: The Andalusian case

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ABSTRACT

Objectives: We investigated the level of adoption of Health Information Technologies (HIT) services, and the factors that influence this, amongst specialised and primary care physicians; in Andalusia, Spain.
Methods: We analysed the physicians' responses to an online survey. First, we performed a statistical descriptive analysis of the data; thereafter, a principal component analysis; and finally an order logit model to explain the effect of the use in the adoption and to analyse which are the existing barriers.
Results: The principal component analysis revealed three main uses of Health Information Technologies: Electronic Health Records (EHR), ePrescription and patient management and telemedicine services. Results from an ordered logit model showed that the frequency of use of HIT is associated with the physicians' perceived usefulness. Lack of financing appeared as a common barrier to the adoption of the three types of services.

For ePrescription and patient management, the physician's lack of skills is still a barrier. In the case of telemedicine services, lack of security and lack of interest amongst professionals are the existing barriers.
Conclusions: EHR functionalities are fully adopted, in terms of perceived usefulness. EPrescription and patient management are almost fully adopted, while telemedicine is in an early stage of adoption.

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1. Introduction

Health Information Technologies (HIT) comprise the application of Information and Communication Technologies (ICT) involving both computer hardware and software that deal with the processing, storage, retrieval, sharing and use of health care information, data, and knowledge for communication and decision making [1]. Several studies state that HIT can alleviate the socioeconomic challenges that healthcare systems in Europe face, like the demographic change and the increasing prevalence of chronic diseases [2,3].

According to Fonkych and Roger [4], the process of diffusion of new technologies starts with their technical development, and it culminates in full adoption when they are integrated and normalised into the health care processes. Other studies [5,6] that analyse the integration of HIT into medical practice states that they need to be embedded in the health care system and that the physicians play a key role in the process through the adoption of the technology. In addition, there is a need to adapt the HIT adoption models specifically to the health care context [7], considering its drivers and barriers. That is, which are the factors that promote or prevent the adoption of HIT for the clinical practice [8–11].

Thus, the aim of this study is to investigate the level of adoption of HIT taking the physicians' perceived usefulness of the technology, as defined in Ref. [7] as culmination of the adoption process described by Rogers [12]. For that, we consider the different technological adoption models reviewed by Holden and Karsh [7]. In addition, we assess which barriers affected this adoption. To do this, we investigate the following two questions: (1) to which extend have the physicians adopted HIT? Does the use affect the perceived usefulness? (2) Which are the remaining adoption barriers in Andalusia?

Factors for adoption of HIT have been one of the critical areas of research of the European Commission during the last decades. Its research centre, the Institute for Prospective Technological Studies (IPTS), in Andalusia has collaborated with the Andalusian Public Health System (SSPA) to analyse the eHealth integration in the area.

The choice of Andalusia as a case study is not trivial. Several studies have highlighted Andalusia as a guiding example of eHealth deployment in Europe [13–15]. Andalusia is a region situated in the south of Spain accounting for 17.8% of the Spanish population (more than 8 million citizens). The Andalusian health system is a public integrated system [16] managed and governed by the SSPA that has made the integration of HIT a top priority of the Andalusian health policy since its foundation in 2000. Concretely, it managed the deployment of Diraya [17] in primary and specialised care whose services portfolio includes both preventive activities and chronic care for the Andalusian population. Some examples of these services are the electronic health record (EHR), electronic prescription (ePrescription) and appointments made via a call centre or through an online service. This deployment started in 2004, and it covered more than 94% of the whole population by January 2010. The political stability of Andalusia, whose parliament has been held by the same political party for the last 30 years, has permitted the presence of the main facilitators to ensure the full integration into the system [18], such as a strong policy commitment, a reorganisation of services and new governance mechanisms to guarantee the care continuum and the provision of funds coming mainly from Europe as structural funds to cover the up-front costs.

The paper is organised as follows. Section 2 describes the survey and its instruments, the data collection process, data analysis methodology and econometric models. Section 3 contains detailed descriptions of the results, which are discussed in Section 4. Finally, Section 5 contains the conclusions of the study.

2. Methods

2.1. Survey design and data collection

The research was conducted by the IPTS with collaboration from the SSPA. Both institutions provided appropriate ethical approval, piloted the survey and approved the final version.

The survey instruments were supported by previous questionnaire [6] and the literature review carried out by Holden and Karsh [7]. In addition, both experts from both institutions discussed the instruments to adapt it to the Andalusian context. The questionnaire is organised into three sections: section (A) population demographics by age and workplace; section (B) use of the Internet in clinical practice; section (C) use of HIT in clinical practice; including remote monitoring and telemedicine.

In section C, the survey contained an instrument querying the availability and frequency of use of 16 HIT functionalities. Another instrument assessed the perception of usefulness of the same HIT services. In addition, physicians assessed the presence of several barriers that may hamper the adoption of such services. A detailed description of the above instruments may be seen in Table 1.

The survey was sent to the whole population of primary and specialised care physicians of the SSPA with institutional e-mail addresses, a total of 12,500, in July 2011. The invitation outlined the objective of the study and contained a link to an online questionnaire. The confidentiality of individual responses and ethical issues were guaranteed, and there was no financial incentive to take part in the survey. Two reminders were sent before October 2011.

2.2. Data analysis

The analysis consisted of two steps. First, a principal component analysis of 16 questions (i.e. items) related to the perceived usefulness of HIT services for clinical practice. This is a multivariate analysis which classifies all items into groups maximising the variance of the answers. We considered an item to be saturated if (1) the size of its loading was over 0.45, as suggested by Comfrey and Lee [19]; (2) its communality was over 0.4; and (3) the difference between the main loading size and the cross-loading sizes was over 0.15. All chosen factors contained at least two saturated items, and the amount of total variance explained by all factors was necessary over 50%.

The second step was to measure the association between the frequency of use and the perceived usefulness within each factor by fitting an ordered logit model to our dataset. This is a

Table 1 – HIT services and possible barriers.

HIT services	Barriers
1. Internal EHR system shared within your centre	1. Technology not adapted to professionals' needs
2. EHR system shared outside your centre	2. Organisational issues
3. Share laboratory system	3. Lack of infrastructure
4. Basic ePrescription system	4. Lack of regulation and standardisation
5. Appointment management system	5. Lack of integration with existing tools
6. Remote monitoring system at your patients' home	6. Lack of security and confidentiality
7. Teleconsultation system	7. Lack of financing
8. Radiology reports access system	8. Lack of incentives
9. Reports management system	9. Lack of skills
10. Handheld devices such as iPad or smartphone	10. Time consumption
11. Telemedicine diagnosis system	11. Lack of knowledge and training amongst professionals
12. Telemedicine treatment prescription system	12. Lack of knowledge and training amongst patients
13. Advance ePrescription system	13. Lack of infrastructure at patients' homes
14. Radiology images access system	14. Lack of interest amongst professionals
15. eReferral system	15. Lack of interest amongst patients
16. Email consultations with your patients	
One instrument asked rate of availability and frequency of use (0: unavailable, 1: never, 2: rarely, 3: often and 4: very often). Another instrument asked the perceived usefulness (1: useless, 2: hardly useful, 3: useful and 4: very useful)	Instrument asked "How do you define the existence and importance of following barriers hampering the use of the technology tools for clinical practice…?" Answers coded as 1: present, 2: often present, 3: sometimes present and 4: not present. Barriers 12–15 are telemedicine specific

nonlinear multivariate analysis for ordered ordinal dependent variables [20]. The dependent variable (*Usefulness*) for each factor and physician was derived as an index containing the information of all respondent's answers to all services in the factor of interest. Possible values of this index are 1 (useless), 2 (hardly useful), 3 (useful), and 4 (very useful). For example, if a physician had graded with 2, 3, 4 and 3 the usefulness of the four e*Prescription and patient management* services (services 4, 5, 13 and 15 in Table 2), then the dependent variable was coded 3 which is the median of the values above. The median was chosen because it is robust against outliers and maintains the ordinal nature of the survey answers as well as the ordering. Similar indices were created for EHR functionalities and telemedicine.

The explanatory variable (*Use*) was frequency of use of each HIT service by a given physician.

The frequency of use of the Internet outside the workplace as a proxy of physicians' digital skills was also included. We controlled for physicians' age, gender and workplace (primary care or specialised care). Ordinal variables accounting for the existence of barriers for adoption (4: not present, 3: sometimes present, 2: often present, 1: present) concluded all the explanatory variables in the model. Interaction variables were also considered when choosing the best model. A variable was defined as having an individual significant associating with usefulness when the p-value of the individual t-test was less or equal than 0.05. Models reported in the results were chosen as the best model fitting the data in the

Table 2 – Descriptive analysis of HIT tools availability, usage and perceived usefulness for clinical practice.

	Availability		Usage		Perceived usefulness	
	SC (%)	PC (%)	Median SC	Median PC	Median SC	Median PC
1. Internal EHR system shared within your centre	88	97	4	4	4	4
2. EHR system shared outside your centre	71	77	2	3	4	3
3. Share laboratory system	94	92	4	4	4	4
4. Basic ePrescription system	61	95	1	4	4	4
5. Appointment management system	80	95	3	4	4	4
6. Remote monitoring system at your patients' home	46	37	0	0	3	0
7. Teleconsultation system	56	38	1	0	3	0
8. Radiology reports access system	88	67	4	2	4	2
9. Reports management system	92	95	4	4	4	4
10. Handheld devices such as iPad or Smartphone	55	45	1	0	3	0
11. Telemedicine diagnosis system	55	50	1	1	3	1
12. Telemedicine treatment prescription system	52	47	1	0	3	0
13. Advance ePrescription system	52	99	1	4	4	4
14. Radiology images access system	87	57	4	1	4	1
15. eReferral system	73	94	1	4	4	4
16. Emails consultation with your patients	68	57	1	1	3	1

The first column shows the rate of availability (0: not available and 1: available) of these 16 HIT tools. The second column shows the median of the frequency of use (0: unavailable, 1: never, 2: rarely, 3: often and 4: very often). The third column shows the median of responses of perceived usefulness (1: useless, 2: hardly useful, 3: useful and 4: very useful), both for specialised care (SC) and primary care level (PC).

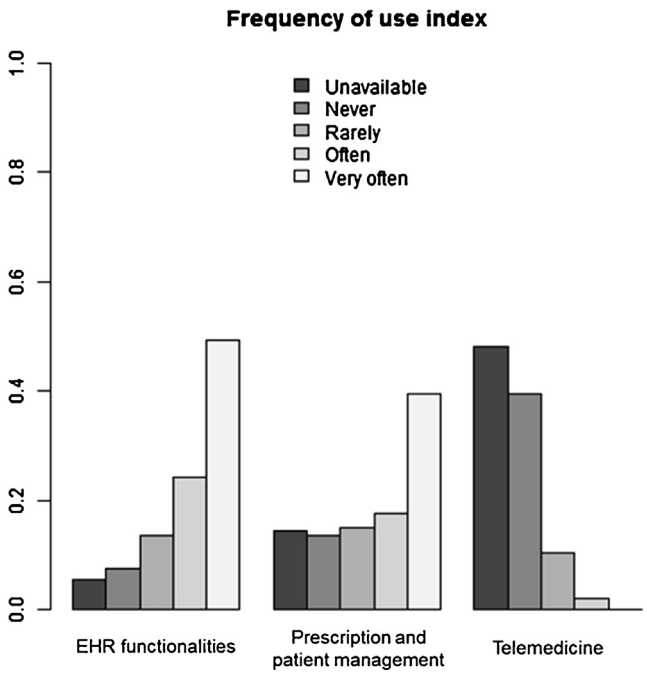

Fig. 1 – Distribution of frequency of use index of the three different types of HIT services.

sense that it had the smaller Akaike Information Criteria (AIC) value.

3. Results

A total of 876 physicians answered the questionnaire (response rate of 7%), of which we focused on 705 practitioners who worked in clinical practice both in primary care and specialised care. The discarded answers were from physicians working in management and research. The strata between services are 58% worked in primary care and 42% in specialised care. Regarding the gender, 60% were males and 40% females. The age range is between 29 and 65 years old (18% were 40 or younger, 32% were between 41 and 50 and 50% were over 50 at the time of the survey). Thus, half of the answers come from professionals over 50 years old, who have worked in both environments, i.e. with HIT and without.

We created an index of frequency of use with the values: 0 (unavailable), 1 (never), 2 (rarely), 3 (often), and 4 (very often). The distribution of this index is shown in Fig. 1. As we can see, EHR functionalities were available for most centres, and they are very often used. The availability of ePrescription and patient management was lower. This is the case of radiology images which are available for specialised care but not for primary care professionals. Telemedicine was hardly available, and it was used often only by a few. Therefore, the index of use of telemedicine was finally coded 0 or 1 depending on whether the physician had used telemedicine before. If the median of frequency of use of telemedicine services was 2, 3 or 4, then the index of use of telemedicine for that professional was coded 1. Otherwise, it was coded 0.

Table 2 contains the descriptive analysis of the availability, frequency of use and perceived usefulness of the 16 studied functionalities. The availability of the Electronic Health Record (EHR) is high, over 80%, within the same centre and over 70% shared outside their centre. However, physicians report that they do not use the EHR between centres very frequently, especially at hospital level. Laboratories, appointments and reports management systems are highly deployed and used, both in primary care and specialised care. However, teleservices, such as teleconsultation, remote monitoring and telemedicine are only available to less than half of the respondents and hardly used by them although they perceive them as very useful. The perceived usefulness of these services is higher amongst specialised physicians.

EPrescription, both a basic system or first generation and the advance one, is available in all primary care centres but is only available in half of the hospitals. Even so, all physicians agree on the high level of usefulness of this application. On the other hand, the tools related to radiology are available to most specialised physicians and only half of the primary care physicians. The former find this application very useful while the latter find it hardly useful.

The principal component analysis with varimax rotation on the perceived usefulness of HIT services resulted in three factors that describe the main uses of HIT in the clinical practice. Table 3 shows the correlation matrix and loadings of each factor in the analysis.

The first factor refers to *telemedicine services*, including teleconsultation, remote monitoring, handheld devices, telemedicine systems and contact with patients through Unfortunately, most professionals at the time of the survey had not had experience with such services, and their answers have to be handled with care.

The second factor refers to *EHR functionalities* which relates to digitalised access, management and exchange of patients' information amongst tiers of care. This comprises the EHR, shared laboratory system, shared radiology system and reports management system. Most physicians in the survey were familiar with this technology.

The third factor refers to *ePrescription and patient management*, comprising ePrescription, appointment system and eReferral, which permit patients' flows within the health system and between the health system and the pharmacies.

In a further analysis, the authors measured the association between the frequency of use of services and the perceived usefulness which acts as a proxy of eHealth adoption. The hypothesis was that the initial resistance to new technologies fades away with the use. The authors also explored the existing barriers according to the physicians 'opinion. The following subsections report results for each HIT service.

3.1. *Adoption of EHR functionalities*

We first evaluated the estimated probabilities of perceived usefulness, which are shown in Table 4. The frequency of use was significant as well as the frequency of use of the Internet outside the workplace. According to the physicians' responses, the barriers still present in the adoption of EHR functionalities were organisational issues, lack of integration with existing tools, lack of security and confidentiality, and lack of financing. The gender is significant showing that in average females value the EHR usefulness more positively than males.

Table 3 – Loadings and communalities of the principal components analysis.

	Factor 1 Telemedicine	Factor 2 EHR functionalities	Factor 3 ePrescription and patient management	Communalitites
Remote monitoring system at your patients' home?	**0.81**	0.09	0.25	0.72
Teleconsultation system?	**0.79**	0.12	0.17	0.66
Telemedicine diagnosis system?	**0.78**	0.20	0.19	0.69
Telemedicine treatment prescription system?	**0.71**	0.18	0.38	0.69
Emails consultation with your patients?	**0.70**	0.05	0.26	0.56
Handheld devices such as iPad or Smartphone?	**0.66**	0.29	−0.04	0.52
Radiology reports access system?	0.25	**0.77**	0.06	0.66
Radiology images access system?	0.33	**0.75**	0.02	0.67
Share laboratory system?	0.05	**0.72**	0.24	0.57
Internal EHR system shared within your centre?	0.05	**0.71**	0.26	0.58
Reports management system?	0.12	**0.66**	0.20	0.49
EHR system shared outside your centre?	0.10	**0.64**	0.27	0.49
Advance ePrescription system?	0.20	0.16	**0.81**	0.72
Basic ePrescription system?	0.27	0.16	**0.77**	0.69
eReferral system?	0.22	0.33	**0.74**	0.71
Appointment management system?	0.24	0.34	**0.63**	0.57
SS loadings	3.73	3.48	2.78	
Proportion variance	0.23	0.22	0.17	
Cumulative variance	0.23	0.45	0.62	
Proportion explained	0.37	0.35	0.28	

Furthermore, their perception of EHR usefulness appeared less affected than the perception of their male colleagues when EHR functionalities were not integrated with existing tools.

There was a very clear positive correlation between the frequency of use and the perceived usefulness of the EHR functionalities. Indeed, the probability of answering *very useful* increased with the frequency of use reaching 92% for those who used EHR *very often* and even a 69% for those who have never used them. In general, physicians' perceived usefulness of EHR was very positive.

The positive perception of usefulness of EHR functionalities increased with the level of digital skills of physicians.

Table 4 – Estimated average probability of perceived usefulness of EHR functionalities. Levels of significance: *** p-value <0.001, ** p-value <0.01, * p-value <0.05 and p-value >0.1.

		Useless	Hardly useful	Useful	Very useful
Use***	Unavailable (0)	0.012	0.053	0.378	0.557
	Never (1)	0.007	0.032	0.279	0.683
	Rarely (2)	0.004	0.018	0.191	0.787
	Often (3)	0.002	0.01	0.123	0.865
	Very often (4)	0.001	0.006	0.076	0.917
Internet use**	Rarely/never (0)	0.022	0.084	0.424	0.47
	Often (1)	0.002	0.012	0.128	0.858
Gender*	Female (0)	0.001	0.005	0.056	0.938
	Male (1)	0.017	0.061	0.282	0.64
Organisational issues*	Present (1)	0.001	0.006	0.068	0.925
Lack of integration with existing tools*	Present (1)	0.011	0.044	0.274	0.671
Lack of security and confidentiality*	Present (1)	0.001	0.007	0.087	0.904
Lack of financing*	Present (1)	0.007	0.031	0.249	0.713
Gender: Lack of integration with existing tools*	Female: Barrier present (0:1)	0.002	0.01	0.113	0.875
	Male: Barrier present (1:1)	0.017	0.069	0.385	0.529

Table 5 – Estimated average probability of perceived usefulness of ePrescription and patient management. Levels of significance: *** p-value <0.001, ** p-value <0.01, * p-value <0.05 and p-value >0.1.

		Useless	Hardly useful	Useful	Very useful
Use***	Unavailable (0)	0.062	0.083	0.466	0.39
	Never (1)	0.039	0.056	0.401	0.504
	Rarely (2)	0.024	0.037	0.321	0.618
	Often (3)	0.015	0.023	0.241	0.721
	Very often (4)	0.009	0.015	0.171	0.805
Gender**	Female (0)	0.016	0.025	0.23	0.729
	Male (1)	0.029	0.042	0.315	0.613
Lack of financing**	Present (1)	0.152	0.133	0.426	0.29
Lack of skills·	Present (1)	0.027	0.038	0.262	0.673
Lack of financing: Lack of skills*	Both present (1:1)	0.02	0.03	0.264	0.685
	Lack financing present + lack skills overcome (1:4)	0.17	0.156	0.464	0.211
AIC	585.679				

3.2. *Adoption of ePrescription and patient management services*

The perceived usefulness of ePrescription and patient management (appointments and referrals services) was positively associated with the frequency of use, similarly than for EHR functionalities. In average, the probability of a positive perception of these services usefulness was greater for physicians who used them more frequently. As shown in Table 5, gender was significant at a 1% level, showing that male physicians were less likely to answer *very useful* and more likely to answer *useless* than their female colleagues. Lack of financing appeared as the main barrier, those for who the barrier is present have a lower probability of responding *very useful* then *useful*. Lack of skills is not significantly correlated with the perceived usefulness but its interaction with lack of financing it is.

3.3. *Adoption of telemedicine services*

Due to the small number of physicians who had been exposed to telemedicine and remote monitoring services in Andalusia, the index of frequency of use was defined with only two levels. Physicians who had a median of use less or equal to 1 (technology unavailable or never used) were coded by 0, and physicians who had used it at least rarely in their clinical practice were coded by 1. Marginal effects in Table 6 show that the frequency of use is not individually significant, meaning that the perceived usefulness of telemedicine was not different between users and non-users. However, the frequency of use together with the lack of financing was significant. When there are financing constraints, those who had not used telemedicine before are more likely to consider it *useless* or *hardly useful* than physicians who had previously used it, meaning that those who have used telemedicine consider financing as an important barrier to overcome. Workplace appeared as a significant variable, showing that although most respondents find the technology useful or very useful, more primary care than specialised care physicians found telemedicine very useful and similarly less of them found it useless. The significant barriers were lack of security and confidentiality, lack of financing and lack of interest amongst professionals.

4. Discussion

The perception of usefulness of EHR and ePrescription and patient management services were clearly positively associated with the usage, which demonstrates that both use and perceived usefulness (as dimension of adoption) have increased in later years. In particular, the average probability of considering EHR functionalities as very useful, for physicians who use them very often, was 92%. In comparison, this average probability for ePrescription and patient management was 80%, and for telemedicine it was 57%.

Table 6 – Estimated average probability of perceived usefulness of telemedicine services. Levels of significance: *** p-value <0.001, ** p-value <0.01, * p-value <0.05 and p-value >0.1.

		Useless	Hardly useful	Useful	Very useful
Use	Never used (0)	0.067	0.162	0.486	0.284
	Used (1)	0.025	0.068	0.34	0.567
Workplace**	Primary care (0)	0.046	0.121	0.456	0.377
	Specialised care (1)	0.076	0.175	0.477	0.271
Lack of security and confidentiality**	Present (1)	0.032	0.089	0.414	0.466
Lack of financing**	Present (1)	0.179	0.284	0.418	0.12
Lack of interest amongst professionals**	Present (1)	0.033	0.093	0.426	0.447
Use: lack of financing*	Never used + lack of financing	0.278	0.429	0.126	0.278
	Used + lack of financing	0.058	0.14	0.467	0.335
AIC	746.544				

The adoption was correlated with the digital skills of physicians (i.e. the frequency of use of the Internet outside work was the proxy used). This is very intuitive because we would expect to find more resistance to new technologies from people who are not comfortable using similar tools outside work.

Age was not significant in any of the models. This is a positive result which shows that the generational gap does not exist. Female physicians had a higher opinion of the usefulness of EHR and ePrescription and patient management than their male colleagues, while no significant differences were found in telemedicine.

In EHR and ePrescription and patient management the workplace, primary care or specialised care, did not influence the adoption. Regarding telemedicine, primary care physicians perceived telemedicine to be more useful than their colleagues in secondary care. This is interesting because telemedicine is mainly available to specialised care physicians in Andalusia at the moment in relation to research funds. However, solutions offered by telemedicine would have a huge impact on the assessment of chronic conditions which are managed by primary care. This may be the reason why primary care physicians have a significantly better perception of its usefulness.

Out of the 15 barriers assessed, only six were present in our results. Lack of financing, basically to cover up-front costs arising from HIT implementation, was present in the three types of HIT with a very negative correlation with the perception of telemedicine usefulness. This result was especially noticeable in physicians who had never used telemedicine before. The lack of integration with existing tools and organisational issues were reported by the physicians as barriers for EHR adoption. Physicians had used for years their particular tools adapted to their organisation; and they may have been reluctant to adapt to a new integrated EHR. Nonetheless, the perceived usefulness is very high as explained at the beginning of this section. The lack of security and confidentiality, and the lack of interest amongst professionals were present in telemedicine, but their effect on the expected usefulness was not dramatic. The interaction of lack of skills with lack of financing was reported by physicians in relation to ePrescription and patient management. This result may indicate that the lack of skills is related to the lack of financing specific programs to train the physicians or invest in more easy to use systems.

Our results are in line with previous studies [21,22], which identified financing issues as one of the major barriers due to the implementation costs of these services. In contrast, May [23] stated that the major barrier in the United Kingdom was the absence of policy commitment, mainly shielded behind the lack of empirical evidence of a positive impact of HIT. However, it is not possible to measure the impact of these services properly until they have not been fully adopted. The SSPA has had a strong commitment with the integration of eHealth in Andalusia for decades and that is why we chose it to analyse the normalisation of HIT into the clinical practice. In a scenario where the introduction of this technology was a political decision made by the regional health authority, our results show that physicians adopted EHR and ePrescription and patient management (in a lower degree) without major problems. This result differs with previous theories concluding that professionals have been reluctant to the integration of HIT [24,25].

The response rate of this survey was 7%, which does not ensure the randomness of the sample. This rate is customary for online surveys of health professionals compared to Ref. [26] and stated in Ref. [27]. Besides, it is shown in Ref. [28] that the response bias of health professional's surveys is lower than those of other respondents. Unfortunately, it is not possible to analysis the source of self-selection bias from the collected answers.

As with any Internet based survey there may be an under representation of those who make little or no use of ICT. This underrepresentation may manifest in a higher number of positive opinions about the usefulness of telemedicine.

Even though the deployment of Diraya was a health policy implemented and managed by the SSPA independently of physicians' preferences, it was not possible to account for unobserved physician's heterogeneity with cross-sectional data: those who are more open minded to HIT, use them more often and may have a better opinion of their impact. Thus, this study does not claim a causal relationship but it reports the existence of associations between the frequency of use of HIT and its perceived usefulness.

5. Conclusion

According to our empirical study, physicians who have used the technology in their clinical practice, have a positive opinion of its usefulness: they have adopted the technology. The political decision to implement and integrate Diraya, with a top-down approach, has contributed to the adoption of the technology amongst the physicians.

Age was not related to the adoption of the technology, while female respondents are more likely to adopt EHR and ePrescription and patient management. In addition, there are not significant differences between primary care and specialised care physicians, with the exception of telemedicine.

Regarding the barriers, we demonstrated that several barriers that been overcome in Andalusia according to the physicians' responses: lack of infrastructure, lack of regulation and standardisation, lack of incentives, lack of knowledge and training amongst professionals and the idea that using technology is time consuming. Still, there are others that need attention: lack of financing for the three groups of functionalities; lack of integration with existing tools for EHR, and lack of security and confidentiality for EHR and telemedicine.

We conclude that EHR functionalities are fully adopted in terms of expected usefulness. EPrescription and patient management are almost fully adopted, while more effort is necessary to pave the way for the adoption of telemedicine. The diffusion of the latter is still in an early stage, and the deployment at the moment is limited.

Disclaimer

The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

Summary points

What was already known about the topic?

- Health Information Technologies integration culminates with the full adoption of services.
- There were barriers related to technology, governance mechanisms, personal issues and financial aspects, hampering the adoption.

What does this study add to our knowledge?

- The use of HIT by physicians has a positive effect on their perceived usefulness, contributing to the adoption and overcoming the barriers.
- Financing issues remain as a major barrier even with a strong policy commitment, while technological issues seem to be no longer hindering the adoption.
- EHR functionalities, ePrescription and patient management are widely adopted, whereas telemedicine services are still in an early stage of integration.

Author contributions

Elena Villalba and Isabel Casas have designed the research questions and performed the statistical analysis. Furthermore, they have elaborated the results and discussion. Francisco Lupiañez-Villanueva has designed the survey and collected the data. They all have contributed to the final editing of the paper. Ioannis Maghiros was the research coordinator of the project and contributed to the final editing of the paper.

Conflict of interest

The authors declare they have no conflict of interests.

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