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Title: The integration of Information and Communication Technology into medical practice

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Corresponding Author: Dr. Francisco Lupiáñez-Villanueva, Ph.D

Corresponding Author's Institution: Open University of Catalonia

First Author: Francisco Lupiáñez-Villanueva, PhD

Order of Authors: Francisco Lupiáñez-Villanueva, PhD; Michael Hardey, PhD; Joan Torrent, PhD; Pilar Ficapal, PhD

Abstract: Objectives. To identify doctors' utilization of ICT; to develop and characterise a typology of doctors' utilization of ICT and to identify factors that can enhance or inhibit the use of these technologies within medical practice.

Methods. An online survey of the 16,531 members of the Physicians Association of Barcelona who had a registered email account in 2006 was carried out. Factor analysis, cluster analysis and binomial logit model were undertaken.

Results. Multivariate statistics analysis of the 2,199 responses obtained revealed two profiles of adoption of ICT. The first profile (38.61% of respondents) represents those doctors who place high emphasis on ICT within their practice. This group is thus referred to as 'integrated doctors'. The second profile (61.39% of respondents) represents those doctors who make less use of ICT so are consequently labelled 'non-integrated doctors'. From the statistical modelling, it was observed that an emphasis on international information; emphasis on ICT for research and medical practice; emphasis on information systems to consult and prescribe; undertaking teaching/research activities; a belief that the use of the Internet improved communication with patients and practice in both public and private health organizations play a positive and significant role in the probability of being an 'integrated doctor'.

Conclusions

The integration of ICT within medical practice cannot be adequately understood and appreciated without examining how doctors are making use of ICT within their own practice, organisational contexts and the opportunities and constraints afforded by institutional, professional and patient expectations and demands.

Dear Editor,

On behalf of my co-authors, Michael Hardey, Joan Torrent and Pilar Ficapal, I'm submitting a list of changes related to each point raised in your recent email. We would like to thank again you and the reviewers for your comments.

Point 1. The reference has been deleted and we have included Appendix A with all the items used in the factor analysis.

Point 2. Following your recommendation the percentages have been taken out of the manuscript.

Point 3. One of the sentences has been deleted

Point 4. The first sentence is related to information source utilization while the second one is related to the Internet use, so we have clarified the meaning of the first sentence.

Point 5. As we have noted in Point 1, we have included Appendix A with Table A1. Questionnaire items.

Point 6. Taking into account that section 3.1 belongs to the Results we have deleted the sentence.

Point 7. We have added at the end of the factor analysis the following sentence: Details on these factor analyses can be found in the supplementary material at Appendix B. Furthermore, the presentation of the tables has been improved and grouped.

Point 8. The following sentence has been added before Table 3: These factors were selected due to their significance ($p < .001$) within the cluster analysis.

Point 9. On one hand, we have labelled Tables 4 and 5 with both 'Integrated doctor' and 'Non integrated doctor'. On the other hand, we have labelled Table 6 as Determinants of the 'Integrated doctor' as this explains the variables that played a role in the probability of being an 'Integrated doctor'

Point 10. We have re-written the first sentence at page of table 4.

Point 11. Following your advice: "the" has been added.

Point 12. Authors' contributions, Acknowledgements, Statement on conflicts of interest and Summary points have been included in the manuscript.

Point 13. Following your suggestion we have added supplementary data on Appendix A about Questionnaire items and on Appendix B about Factor analysis

We hope that these changes address all your comments and improve the manuscript. Do not hesitate to contact me for any further information.

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Title: The integration of Information and Communication Technology into
medical practice

Authors:

Francisco Lupiáñez-Villanueva^a

Michael Hardey^b

Joan Torrent^c

Pilar Ficapal^c

Affiliations:

^a Information and Communication Department. Open University of Catalonia.
Internet Interdisciplinary Institute, Spain.

^b Hull/York Medical School. Universities of Hull and York, UK

^c Economic Department. Open University of Catalonia. Internet Interdisciplinary
Institute, Spain.

Corresponding author:

Francisco Lupiáñez-Villanueva

flupianez@uoc.edu

Open University of Catalonia

Rambla de Poble Nou, 156

08018 Barcelona (Spain)

Phone (+34) 93 326 35 10

Fax (+34) 93 356 88 22

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The integration of ICT within medical practice cannot be adequately understood and appreciated without examining how doctors are making use of ICT within their own practice, organisational contexts and the opportunities and constraints afforded by institutional, professional and patient expectations and demands.

1. Introduction

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2 It has been argued that 'healthcare is undergoing a paradigm shift, from
3
4 'Industrial Age Medicine to Information Age Healthcare' [1] and that 'the health
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6 system cannot remain oblivious to our rapidly changing technological landscape
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8 and mindset' [2]. This 'paradigm shift' is shaping health systems [3, 4],
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10 transforming the doctor/patient relationship [5-7] and having an impact on the
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12 quality and efficiency of health care [8]. More broadly the World Wide Web has
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14 changed how the public engage with health information [9], shaped the
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16 evolution of health information systems [10] and health service organizations
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18 [11]. In order to map and understand the role and impact of Information and
19
20 Communications Technologies (ICT) on health care a range of methodological
21
22 and disciplinary approaches have been employed. For example, a systematic
23
24 review about doctors' use of the Internet undertaken by Masters [12] noted that
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26 Rogers' Diffusion of Innovations theory [13] and Davis's Technology Adoption
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28 Model (TAM) [14, 15] has been successfully utilised to foster an understanding
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30 of factors 'that impact upon the adoption of new technologies'. Other
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32 sociologically informed research has drawn on the Science and Technology
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34 Studies (STS) paradigm, which has highlighted how work practices may be
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36 intimately interconnected to a range of digital devices and forms of information
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38 [16-18]. However, rather than adopting a specific theoretical stance this paper
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40 seeks to reveal how ICT are utilised in medical work by analysing empirical data
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42 derived from a survey of doctors.
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53 The purposes of this paper are to identify doctors' utilization of ICT; to develop
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55 and characterise a typology of doctors' utilization of ICT and to identify factors
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1 that can enhance or inhibit the role and use of technologies such as the Internet
2 and organizational information systems within health care.
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4 **2. Methods**

5 **2.1. Survey instrument and ethics**

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7 The research reported here is the result of a collaboration between the Internet
8 Interdisciplinary Institute at Open University of Catalonia and the Physicians
9 Association of Barcelona (Col·legi Oficial de Metges de Barcelona). Appropriate
10 ethical approval was provided by both institutions, which were also involved in
11 the design and distribution of the survey instrument. Procedures were put in
12 place to ensure that all responses were rendered anonymous to both the
13 researchers and the Association. The survey instrument was piloted and
14 following consultation with the Association a final version was developed. The
15 consequent survey instrument was organised into five segments: (a) socio
16 demographic and practice details; (b) access and use of ICT; (c) ICT and the
17 doctor/patient relationship; (d) institutional health information systems and (e)
18 perceptions of ICT.
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41 **2.2. Data collection**

42 The Association sent an email invitation to participate in the survey to all 16,531
43 members on 6th July 2006. A second invitation was emailed to the members 15
44 days after the first email. The invitation outlined the nature of the study, the
45 confidentiality of individual responses and ethical safeguards. There was no
46 financial inducement to take part in the survey.
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2.3. Data analysis

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2 Statistical analyses were performed using SPSS version 16.0. In order to
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4 identify doctors' utilization of ICT, an analysis of frequencies of items related to
5 frequently used information sources, Internet utilization, commonly performed
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7 ICT led tasks and information systems utilization was undertaken.
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12 Questionnaire items are listed in the supplementary materials at Appendix A.
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17 To confirm the several internal complementarities of these grouped items, the
18 means and their significant correlation were checked. Factor analysis was used
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20 to assess item correlations and identify common relationships between similar
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22 items, allowing the items to be categorized into various themes or factors. An
23
24 analysis of the correlation matrix (KMO and Bartlett's test of sphericity) was
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26 carried out to check that the correlation matrixes were factorable. Data
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28 reductions were undertaken by principal components analysis using the
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30 Varimax option to identify possible underlying dimensions.
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37 To develop a typology of doctors' utilization of ICT, identifying distinct, yet
38 homogeneous, groups of doctors on the level of ICT utilization a Non
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40 Hierarchical Cluster Analysis of K-means was applied. ANOVA test results
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42 showed that the means of contextual variables differs significantly across
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44 clusters. To attribute statistical significance to the differences obtained an
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46 associated Chi-square test was carried out.
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51 Finally, to estimate the overall effect of individual variables and factors on the
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53 group of doctors with higher level of utilization of ICT (dependent variable), a
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55 binomial logit model was applied. The interpretation of standardized regression
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57 coefficients determines the probability that the independent variables explain
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the higher utilization of ICT within medical practice.

2.4. Population

The Spanish National Health Service (SNHS) provides almost universal health care coverage, through a wide variety of services and a network of hospitals and primary care centers [19]. Members of the Physicians Association of Barcelona are practicing clinicians who work in the Barcelona region (5.416.447 inhabitants) within Catalonia (7 million inhabitants), one of the seventeen Autonomous Communities within Spain. The research reported here is based on the final total of 2,199 responses (13.3%). The first email invitation gathered 1,226 responses (55.75%) and the second produced an additional 973 responses (44.25%). A comparison between the Association's population in 2006 and responses to the survey (Table 1) revealed a difference of 1.9% in gender and less than 5.0% in age (except for men between 51 to 65 years).

Table 1. Comparison between Physicians Association of Barcelona population and survey responses by Gender and Age (percentages)

	Population		Responses	
	Female	Male	Female	Male
30 years or less	9.1	4.3	6.8	2.9
36 to 40 years	13.3	9.1	11.3	7.5
41 to 50 years	14.5	17.3	15.0	20.5
51 to 65 years	7.5	16.7	9.9	22.4
66 years or more	0.6	7.6	0.2	3.5
Total	45.0	55.0	43.1	56.9

Public health care organizations were the sole employer of 50.7% of the respondents. Private health care organizations employed 25.8% of the doctors and 23.5% worked in both the private and public organizations. The majority (66%) of doctors practiced within one organisation; 28.6% worked across two locations and 5.4% more than two. Clinical practice was the main activity of the

1 majority of doctors (53.6%) and 40.5% combined clinical work with activities
2 such as research and management. Only 4.9% worked exclusively in
3 management and 1% were employed primarily in research work.
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9 **3. Results**

10 **3.1. Internet, Information sources and Information and Communication**

11 **Technology utilization**

12 More than a half of participants (55%) reported that they used the Internet
13 everyday as part of their clinical practice. Less than 10% used the Internet only
14 one day per month or less while 19.1% used it three or four times per week and
15 16.7% made use of it two times a week. As might be anticipated the use of the
16 Internet outside work was common and nearly half of the doctors (46.5%) noted
17 that they used it everyday. Indeed, 61.2% had begun using the Internet
18 between 1995 and 2000 although about a third had become users since 2001..
19 For most doctors (73.3%) the Internet was a valued resource that they used to
20 support their medical practice and only 3% stated that it had no utility.
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34 In order to gain an indication of the information practices, doctors were asked to
35 identify what were their most frequently visited information sources (Table 2).
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39 This revealed that international and national medical news updates,
40 international academic journals and workplace information were the most used
41 information sources. Less than 10% of the doctors included in the 'most
42 frequently visited category' Web based information provided by national or
43 international public institutions (for example, Departament de Salut de la
44 Generalitat de Catalunya or the World Health Organization Health).
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1 Reflecting the established place of email within professional work, the use of the
2 email to exchange information between professionals was a common activity.
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4 Significantly, 23% of the participants engaged in email exchanges with their
5 patients. Some doctors also published a personal Website and while just over
6
7 20% provided advice to patients through virtual support groups (Table 2). The
8
9 most used Internet resources are related to the search for information in
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11 academic journals, clinical practice databases and web pages. As the
12
13 implementation of electronic patient records in some institutions are mediated
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15 through a Web browser this is also a significant activity. Almost half of the
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17 doctors used electronic patient records that were available within their
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19 institutions. However, less than 5% made use of ICT to facilitate medical
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21 prescriptions.
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29 The second most frequently reported activities are related to interaction with
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31 health care professionals and patients through applications other than email.
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33 Less than 5% of the doctors used the Internet most frequently to publish
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35 information.
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Table 2. Information sources, ICT and Internet utilization

Most frequently information sources	% (V)
International medical news updates	27.3 (600)
National medical news updates	18.9 (415)
International academic journals	18.0 (395)
Workplace information	17.4 (383)
National academic journals	13.9 (306)
Professional education	13.4 (294)
National public institutions	8.3 (183)
International public institutions	7.1 (157)
Internet utilization	
Email with other health care professionals	89.9 (1925)
Clarify questions about diagnosis, treatment or other medical issues	74.7 (1571)
Participate in professional forums	46.8 (960)
Presence on institutional website	44.7 (1088)
Email with individual patients	22.5 (473)
Presence on own personal website	22.2 (421)
Provide advise on patient support groups websites	20.7 (425)
Most frequently ICT and Internet activities	
Searching for international academic journals	37.2 (817)
Searching for clinical practice data bases and web pages	34.3 (754)
Searching for national academic journals	24.0 (527)
Utilization of electronic patient records	23.0 (506)
Interaction with national health care professionals	15.9 (350)
Interaction with patient	15.2 (334)
Searching for international public institutions	12.1 (267)
Searching for national public institutions	10.5 (230)
Interaction with international health care professionals	8.5 (187)
Publishing information	4.4 (97)
Information systems utilization	
Access from any computer within your institution to electronic patient records	46.0 (1011)
Searching for public information systems and public data bases	31.4 (691)
Sending health records through traditional postal address	16.7 (360)
Access from any computer connected to the Internet to health care records	13.6 (300)
Sending health records digitally	13.2 (290)
Post consultant digital interaction (Internet, webcam...)	11.8 (260)
Sending drugs prescription through postal address	4.5 (98)
Sending drugs prescription digitally	4.0 (87)
Sending SMS to remind drugs to your patients	1.6 (26)

For a large proportion of doctors (75%) information from the Internet was very relevant (10.1%) or relevant (65.1%). In contrast, only 20.4% stated that such information was of little or no relevance. Despite the positive perception of Internet based health information, almost half of the doctors reported that they did not recommend such material to their patients. Only 1.9% stated that they usually recommend health information to patients, although 5.8% noted they often encouraged patients to make use of it.

1 Doctors were asked whether patients discuss health information that they have
2 read on the Internet during a consultation. Over half had experienced patients
3 talking about information they had found on the Internet (10.7% reported that
4 most of their patients had done this and 56.8% reported some had). Only 8.3%
5 of doctors had not engaged in such discussions with patients. Indeed, 35.2% of
6 the participants considered that patients going online for health information
7 could potentially improved their quality of life and their autonomy (7.1%
8 considered that it improved quality of life and autonomy a lot; 30.9% a little;
9 9.6% that do not improve quality of life and autonomy and 6.9% considered that
10 it made their autonomy and quality of life worse). The majority of doctors viewed
11 online health information positively in terms of patient wellbeing (56.9% felt that
12 online health information could improve patients' knowledge and facilitate their
13 treatment a lot or quite a lot). Only 10.1% perceived such information as adding
14 nothing to patients' knowledge.
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17 Nearly all doctors (80.5%) believed that the use of the Internet in their daily
18 practice improved communication with other health care professionals and
19 80.3% stated that it improved the efficiency and productivity of their work. Half
20 of the doctors (50.1%) believed that access to the Internet improved patients'
21 quality of care and 26.4% believed that it improved communication with
22 patients. In addition, doctors were asked about the main barriers to the use of
23 the Internet within their workplace: 54.2% cited lack of time; 35.7% reported
24 concerns about security and confidentiality; 29.9% stated that they lacked
25 training; 25.7% were inhibited by the slow of speed of access and 24.5% noted
26 a lack of access in their workplace. Nevertheless, 23.1% of the participants did
27 not experience any difficulties in terms of access.
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3.2. Factors, typology and the characteristics of Information and Communication Technology and the Internet utilization

A factor analysis was undertaken to identify common relationships between the most frequently used information sources. From the analysis three factors emerged: (1) Emphasis on international information sources (33.79% variance explained); (2) Emphasis on national information sources (14.24% variance explained) and (3) Emphasis on institutional information sources (12.38% variance explained).

A second factor analysis was undertaken in order to examine the pattern of engagement with commonly used Internet resources. From the analysis three factors emerged: (1) Emphasis on the Internet for participation (28.37% variance explained); (2) Emphasis on presence on the Internet (15.77% variance explained), and (3) Emphasis on the Internet for email (13.89% variance explained).

A third factor analysis was undertaken in order to identify common relationships between the most frequently used ICT within daily practice. From this analysis, three factors emerged: (1) Emphasis on ICT for research and medical practice (36.20% variance explained); (2) Emphasis on ICT for interaction and dissemination (11.89% variance explained) and (3) Emphasis on ICT for institutional information (9.54% variance explained).

Finally, a fourth factor analysis was carried out related to information systems use. This analysis revealed three factors that have been labelled as (1) Emphasis on health record information systems (29.61% variance explained); (2) Emphasis on information systems for consultation and prescription purposes

(15.73% variance explained) and (3) Emphasis on postal information systems (11.57% variance explained).

Details on these factor analyses can be found in the supplementary material at Appendix B.

In order to develop a typology of doctors' utilization of ICT, a Non Hierarchical Cluster Analysis of K-means was undertaken, to seven factors of the factor analysis identified above (Table 3). These factors were selected due to their significance ($p < .001$) within the cluster analysis.

Table 3. Profiles of ICT utilization

	Cluster		ANOVA
	1. Integrated doctor 38.61% n=597	2. Non-integrated doctor 61.39% n=949	
Emphasis on international information	.538	-.399	447.790*
Emphasis on national information	.265	-.197	87.390*
Emphasis on ICT for research and medical practice	.383	-.265	171.911*
Emphasis on ICT for institutional information	-.103	.055	9.693*
Emphasis on the Internet for participation	.408	-.257	181.693*
Emphasis on the Internet for produce information	.599	-.377	452.151*
Emphasis on the Internet for communication	.293	-.184	88.603*

* $p < .001$

Notes: Results of K-means - quick cluster analysis. Method of analysis: non-hierarchical cluster, final cluster centroids

Cluster one consists of doctors that place a greater emphasis on international and national information; on ICT for research and medical practice and on the Internet for collaboration and the dissemination of information. These doctors also place less emphasis on ICT for institutional information. This group is thus referred to as representing 'integrated doctors'. The label is used descriptively in order to capture the sense that for these clinicians ICT are a mundane and valued resource. Cluster two is characterised by notably different features to the

1 previous one. The second profile represents those doctors who place less
 2 emphasis on ICT so are consequently labelled 'non-integrated doctors'.
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5 Statistical analysis of the relationship between these profiles (Table 4) revealed
 6 that integrated doctors are more likely than non-integrated doctors to be male
 7 than female; to work in more than one location; to be based in a hospital; to
 8 work in both public and private organizations or only within the private sector
 9 and to combined medical practice with research and teaching activities.
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18 Table 4. Characteristics of 'Integrated doctor' and 'Non integrated doctor': Socio demographic
 19 and clinical role (contingency analysis, significance)
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	1. Integrated doctor n=597 (38.6%)	2. Non-integrated doctor n=949 (61.4%)	Significance
Gender			.000
- Male	66.5 (397)	54.5 (517)	
- Female	33.5 (200)	45.5 (432)	
Do you work at more than one place?			.003
- No	59.3 (354)	66.4 (630)	
- Yes	40.7 (243)	33.6 (319)	
Those who work just in one place...			.000
- Primary care	21.0 (51)	37.4 (119)	
- Hospital	68.7 (167)	53.7 (171)	
- Clinic	10.3 (25)	8.9 (28)	
Ownership of the organization do you work for?			.001
- Totally public	49.4 (295)	59.0 (560)	
- Public – Private	26.8 (160)	20.2 (192)	
- Totally private	23.8 (142)	20.8 (197)	
Activities			.000
- Medical practice	42.7 (255)	64.9 (616)	
- Medical practice, Teaching and Research	32.6 (195)	17.3 (164)	
- Medical practice and Management	7.7 (46)	9.7 (92)	
- Medical practice, Teaching, Research and Management	11.3 (67)	3.6 (34)	
- Other combinations	5.7 (34)	4.5 (43)	

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 47 Further analysis of the relationship between the two profiles (Table 5) revealed
 48 that integrated doctors are more likely than non-integrated to access the
 49 Internet everyday in their workplace; to have used it since 2000 and to consider
 50 that the Internet is central to their medical practice.
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Statistical analysis of the relationship between the two profiles and the doctor-patient relationship revealed that integrated doctors are more likely than non-integrated doctors to consider that health information available on the Internet is very relevant and to believe that patients who go online for health information improve their autonomy and their quality of life. Integrated doctors also are likely to recommend that patients go online to find health information; to have more patients that discuss such information during a consultation and to believe that patients' use of the Internet health information will improve their knowledge about health and facilitate treatment.

Finally, integrated doctors are more likely than non-integrated doctors to believe that the use of the Internet facilitates communication with other health care professionals; improves communication with patients; improves the delivery of patient care and improves efficiency and productivity of clinical practice.

Table 5. Characteristics of the 'Integrated doctor' and 'Non integrated doctor': Internet, patient/doctor relationship and ICT perception (contingency analysis, significance)

	1. Integrated doctor n=597 (38.6%)	2. Non- integrated doctor n=949 (61.4%)	Significance
Internet frequency, experience and utility			
Frequency of the Internet use in workplace			.000
- Everyday	65.7	44.3	
- Three or four times per week	19.2	22.0	
- One or two times per week	11.4	21.0	
- Less than one or two times per week	3.7	12.7	
Begin to use the Internet since...(experience)			.000
- Before 1994	11.0 (66)	6.6 (63)	
- From 1995 to 2000	67.7 (404)	55.6 (528)	
- From 2001 to 2006	21.3 (127)	37.8 (359)	
How do you consider the Internet in your work...			.000
- Very useful	85.3 (509)	67.6 (642)	
- Useful	14.2 (85)	29.4 (279)	
- Little useful	.5 (3)	3.0 (28)	
Patient/Doctor relationship			
How do you consider health information available on the Internet?			.008
- Very relevant	12.3 (73)	7.8 (74)	
- Relevant	69.1 (413)	69.9 (663)	
- Little relevant	18.6 (11)	22.3 (212)	
Do you think that patients go online for health information			.000
- Improve a lot their autonomy and quality of life	11.0 (66)	3.9 (37)	
- Improve their autonomy and quality of life	42.8 (256)	36.1 (343)	
- Improve a little their autonomy and quality of life	32.4 (193)	39.4 (374)	
- Do not improve their autonomy and quality of life	7.9 (47)	12.0 (114)	
- Make their autonomy and quality of life worse	6.0 (35)	8.6 (82)	
Do you recommend your patients to go online for health information?			.000
- Yes, I usually do it	2.6 (16)	.5 (5)	
- Yes, I often do it	9.5 (57)	4.0 (38)	
- Yes, I sometimes do it	44.9 (268)	36.0 (342)	
- No, I never do it	43.0 (257)	59.5 (565)	
Do your patients discuss or share with you their Internet health information findings?			.000
- All of the patients do it	1.4 (8)	.6 (6)	
- Most of the patients do it	14.4 (85)	7.5 (71)	
- Some of the patients do it	53.2 (318)	54.6 (518)	
- A few of the patients do it	25.6 (153)	27.6 (262)	
- Patients don't do it	5.5 (33)	9.7 (92)	
Do you think patients seeking for Internet health information improve their knowledge and facilitate their treatment			.000
- A lot	13.6 (81)	8.8 (84)	
- Quite	47.4 (283)	43.0 (409)	
- A little	28.9 (173)	38.3 (363)	
- Nothing	10.1 (60)	9.8 (93)	
Perception of ICT			
The use of the ICT in you daily work...			.000
- Improve communication with other health care professionals	87.5 (552)	76.7 (728)	
- Improve efficiency and productivity of your work	83.6 (499)	78.2 (742)	
- Improve patients attention	55.8 (333)	48.9 (464)	
- Improve communication with patients	35.9 (214)	20.3 (193)	

3.3. Determinants of the integrated doctor

With the aim of estimating the overall effect of individual variables and factors on the integration of ICT within medical practice a binomial logit model was developed, considering cluster 1 integrated doctor as a dichotomous dependent variable (Table 6)

Table 6. **Determinants of the 'Integrated doctor'**

Variables	Estimated coefficient	Standard Error	Wald	Sig.	Exp (B)
Emphasis on international information	1.511	.122	154.148	.000	4.532
Emphasis on ICT for research and medical practice	.953	.086	122.001	.000	2.595
Emphasis on national information	-.296	.087	11.545	.001	.744
Emphasis in information systems to consult and prescribe	.267	.085	9.806	.002	1.306
Teaching/Research activities	.655	.203	10.418	.001	1.925
The use of the Internet in you daily work improve communication with patients	1.095	.179	37.242	.000	2.990
Work on public and private organizations	.411	.185	4.934	.026	1.509
-2 Log-likelihood	951.749				
R2 Cox-Snell	.363				
R2 Nagelkerke	.490				
Hosmer-Lemeshow	.035				

Notes: Method of regression: binomial login analysis; depend variable: Integrated doctor (value 1, YES; value 0, NO); standardised coefficients; n=1.056; % predicted observed 79.2

From the estimation of the model, it was found that all the variables included have a very significant explanatory power regarding the integration of ICT within medical practice. The relationships of influence found it have a plus sign, apart from the emphasis on national information. It was observed that factors related with an emphasis on international information, emphasis on ICT for research and medical practice, and an emphasis in information systems for consultation and drug prescription play a positive and significant role in the probability of being an integrated doctor. Variables related with performance teaching/research activities, the use of the Internet improve communication with patients, and practice in both the public and the private sector also have a positive and significant role.

3.9. Limitations of the study

As argued elsewhere the email survey offers a valid alternative to the postal, telephone or face-to-face surveys, as long as technical, methodological, ethical and legal considerations are taken into account [21-23]. As noted earlier (see table 1), when compared to the total membership of the Physicians Association of Barcelona, the sample while not representative is not untypical. As with any Internet based survey there may be an under representation of those who make little or no use of ICT. However, all the Association's members are registered by email and use the Association's Web page to maintain contact. The data reported here is a snapshot and so we are not able to trace any changes to ICT use over time. Further research is also needed to better understand the interaction between factors that play a significant role in the probability of being an integrated doctor. A second survey and further analysis are planned to identify changes in doctors' work over time and provide more information on ICT use.

4. Discussion

That most doctors use ICT is not news or surprising [12] given that modern health care is increasingly built around information technology so that the computer has an established place in the consulting room if not the bedside [24]. Indeed, some have argued that within health care such resources are ubiquitous and represent a paradigm shift in health care [1,10]. The pattern of ICT implementation in the Catalan health sector is, as in other places, diverse. For example, some hospitals have implemented electronic patient records and other ICT dependent systems while others have yet to do so. Thus,

1 doctors are clearly presented with new demands to make use of ICT, which
2 includes electronic patient records and electronic prescriptions [20].
3

4 The analysis reported here indicates that there are two significant forms of ICT
5 adoption amongst doctors. For about a third of doctors ICT are integral to their
6 medical practice due to place the ICT resources have within several dimensions
7 of their work. These integrated doctors are in a sense at the forefront of the
8 paradigm shift, which is reflected across their clinical work. For these doctors
9 ICT have a central role in medical practice and research. Such technology also
10 influences their relationship with patients and other health care professionals.
11 Indeed, for the integrated doctor ICT make an important contribution to clinical
12 effectiveness. Given that doctors play an important role in the informal as well
13 as the formal organisation of medical work, the integrated doctor may help to
14 encourage the use of ICT by nurses and others within their organisation [25].
15 The relative autonomy enjoyed by doctors, compared to other medical
16 professionals, provides them with a greater degree of influence over their work
17 but like other professionals they may have constrained choices as new
18 technologies including computerised patient records are introduced.
19

20 The second profile that emerged from our data analysis represents those
21 doctors for whom ICT based resources are less important and are not
22 integrated to the same degree within their routine work. The variables and
23 factors identified previously, that play a positive and significant role in the
24 probability of being an integrated doctor, are shaped by the relationship
25 between technological and non-technological dimensions. For example, it was
26 noted that a positive perception of ICT use in relation to patients, colleagues,
27 organizational structure and access to ICT resources played a positive and
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1 significant role in the probability of acting as an integrated doctor. This suggests
2 taking the role of a non-integrated doctor does not necessarily imply that these
3 doctors failing to take advantage of ICT resources or rejecting their use but
4 rather that their position within the health care structure and past experiences
5 mitigates against their integration into practice.
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11 Our analysis suggests the more doctors come to see the Internet and
12 associated technologies as a useful part of their everyday work the more likely
13 they take advantage of the opportunities ICT offer. These points to a cumulative
14 effect of changing access and use of resources that help conspire to create a
15 positive orientation to ICT resources. The use of ICT by doctors therefore
16 emanates through an ongoing process of negotiation between changing work
17 and professional contexts that include engagement with both patients and
18 colleagues as well as diverse information sources and resources.
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31 **4. Conclusion**

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34 It is likely that all doctors are subject to 'pull' from those of their colleague and
35 patients who are keen to grasp the possibilities afforded by the Internet and
36 'push' by the institutions within (for example by the implementation of electronic
37 patient records or other clinical resources). This highlights a complex interaction
38 between the technical organisational, professional and social aspects of ICT
39 use. There is no one clear factor that encourages or discourages the use of
40 technology resources but rather a set of practices, experiences and
41 opportunities that conspire to encourage their integration into medical work.
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References

- [1] Smith R. The future of healthcare systems. *BMJ*, 1997; 314: 1495-1496.
- [2] Jadad AR, Delamothe T. What next for electronic communication and health care?. *BMJ*. 2004; 328: 1143–1144.
- [3] Haux R, Ammenwerth E, Herzog W, Knaup, P. Health care in the information society. A prognosis for the year 2013. *Int J Med Inform*. 2002; 66(1-3), 3–21.
- [4] Fieschi M. Information technology is changing the way society sees health care delivery. *Int J Med Inform*. 2002; 66(1-3), 85–93.
- [5] Hardey M. Doctor in the house: the Internet as a source of lay health knowledge and the challenge to expertise. *Sociol Health Illn*. 1999; 21(6), 820–835.
- [6] Hardey M. “E-Health”: the Internet and the transformation of patients into consumers and producers of health knowledge. *Information, Communication & Society* 2001; 4(3), 388–405.
- [7] Ball MJ, Lillis J. E-health: transforming the physician/patient relationship. *Int J Med Inform*. 2001; 61(1), 1–10.
- [8] Chaudhry B, Wang J, Wu S, Maglione M, Mojica W, Roth E, Morton SC, Shekelle PG. Systematic Review: Impact of Health Information Technology on Quality, Efficiency, and Costs of Medical Care. *An Intern Med*. 2006; 144(2): 742–752.
- [9] Powell JA, Darvell M, Gray JA. The doctor, the patient and the world-wide web: how the internet is changing health care. *J R Soc Med*. 2003; 96(2): 74-76.
- [10] Haux R. Health information systems – past, present, future. *Int J Med Inform*. 2006; 75(3-4), 268–281.

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- [11] Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: systematic review and recommendations. *Milbank Q.* 2004; 82(4), 581–629.
- [12] Masters K. For what purpose and reasons do doctors use the Internet: A systematic review. *Int J Med Inform.* 2008; 77(1), 4–16.
- [13] E. Rogers, *Diffusion of Innovations*, 5th ed., Free Press, New York, 2003.
- [14] F.D. Davis, Perceived usefulness, perceived ease of use, and user acceptance of information technology, *MIS Quarter.* 1989; 319–340.
- [15] F.D. Davis, R.P. Bagozzi, P.R. Warshaw, User acceptance of computer technology: a comparison of two theoretical models. *Manage. Sci.* 1989; 35, 982–1003.
- [16] Berg M, Toussaint P. The mantra of modeling and the forgotten powers of paper: a sociotechnical view on the development of process-oriented ICT in health care. *Int J Med Inform.* 2003; 69(2-3), 223–234.
- [17] Woolgar S. The turn to technology in social studies of science. *Sci Technol Human Values.* 1991; 16(1), 20–50.
- [18] Latour B.. Technology is society made durable. In Law J, editor. *A sociology of monsters: Essays on power, technology & domination.* London: Routledge Press; 1991. p. 103–131.
- [19] Martin-Moreno JM, Alonso P, Claveria A, Gorgojo L, Peiro S. Spain: a decentralised health system in constant flux. *BMJ.* 2009; 338:b1170.
- [20] Cornet J. What do we need to do to accelerate e-Health in Europe? *Learning from experience: What is working?.* Brussels: Seminar on e-Health: What do we need to do to accelerate e-Health in Europe?; 2009 [cited 2009 Jul

20]. Available from:

http://www.amchameu.be/IssuesPriorities/eHealth/TicSalut_Joan%20Cornet.pdf

[21] Dillman DA. Mail and Internet Surveys. The Tailored Design Method. 2nd.

New Jersey; John Wiley & Sons; 2006. 523 p.

[22] Eysenbach G, Wyatt J. Using the Internet for Surveys and Health

Research, J Med Internet Res 2002; 4(2):e13. Available from:

<http://www.jmir.org/2002/2/e13/>.

[23] Braithwaite D, Emery J, de Lusignan S, Sutton S. Using the Internet to

conduct surveys of health professionals: a valid alternative? Fam Pract. 2003;

20: 545–551.

[24] Lorenzi NM. Beyond the gadgets. BMJ. 2004; 328: 1146–1147.

[25] Strauss A, Fagerhaugh S, Suczek B & Wiener, C. Social Organization of

Medical Work. Chicago: University of Chicago: 1997. 310p.

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Authors' contributions

The survey was principally undertaken by Francisco Lupiáñez-Villanueva together with Michael Hardey supported by the statistical modelling contributed by Joan Torrent and Pilar Ficapal. Francisco Lupiáñez-Villanueva is the guarantor of the article.

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Statement on conflicts of interest

Non-competing interests.

Summary points

What was known before this study?

- Doctors are well connected to the Internet and their professional usage is increasing.
- Information and Communication Technologies have an increasing role within medical practice.
- Patients are making greater use of Internet based information.

What has this study added to the body of knowledge?

- Multivariate statistics analysis revealed two profiles of the adoption of ICT within the medical practice: 'integrated doctors' and 'non-integrated doctors'.
- Factors that can enhance the integration of ICT within the medical practice are related with informational practices; intensive use of ICT; the nature of activities carried out; doctors' perception of ICT and the organizational structure of health care institutions.

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- Factors that can enhance the integration of ICT within the medical practice are related with informational practices; intensive use of ICT; the nature of activities carried out; doctors' perception of ICT and the organizational structure of health care institutions.

Table 1. Comparison between Physicians Association of Barcelona population and survey responses by Gender and Age (percentages)

	Population		Responses	
	Female	Male	Female	Male
30 years or less	9.1	4.3	6.8	2.9
36 to 40 years	13.3	9.1	11.3	7.5
41 to 50 years	14.5	17.3	15.0	20.5
51 to 65 years	7.5	16.7	9.9	22.4
66 years or more	0.6	7.6	0.2	3.5
Total	45.0	55.0	43.1	56.9

Table 2. Information sources, ICT and Internet utilization

Most frequently information sources	% (V)
International medical news updates	27.3 (600)
National medical news updates	18.9 (415)
International academic journals	18.0 (395)
Workplace information	17.4 (383)
National academic journals	13.9 (306)
Professional education	13.4 (294)
National public institutions	8.3 (183)
International public institutions	7.1 (157)
Internet utilization	
Email with other health care professionals	89.9 (1925)
Clarify questions about diagnosis, treatment or other medical issues	74.7 (1571)
Participate in professional forums	46.8 (960)
Presence on institutional website	44.7 (1088)
Email with individual patients	22.5 (473)
Presence on own personal website	22.2 (421)
Provide advise on patient support groups websites	20.7 (425)
Most frequently ICT and Internet activities	
Searching for international academic journals	37.2 (817)
Searching for clinical practice data bases and web pages	34.3 (754)
Searching for national academic journals	24.0 (527)
Utilization of electronic patient records	23.0 (506)
Interaction with national health care professionals	15.9 (350)
Interaction with patient	15.2 (334)
Searching for international public institutions	12.1 (267)
Searching for national public institutions	10.5 (230)
Interaction with international health care professionals	8.5 (187)
Publishing information	4.4 (97)
Information systems utilization	
Access from any computer within your institution to electronic patient records	46.0 (1011)
Searching for public information systems and public data bases	31.4 (691)
Sending health records through traditional postal address	16.7 (360)
Access from any computer connected to the Internet to health care records	13.6 (300)
Sending health records digitally	13.2 (290)
Post consultant digital interaction (Internet, webcam...)	11.8 (260)
Sending drugs prescription through postal address	4.5 (98)
Sending drugs prescription digitally	4.0 (87)
Sending SMS to remind drugs to your patients	1.6 (26)

Table 3. Profiles of ICT utilization

	Cluster		ANOVA
	1. Integrated doctor 38.61% n=597	2. Non-integrated doctor 61.39% n=949	
Emphasis on international information	.538	-.399	447.790*
Emphasis on national information	.265	-.197	87.390*
Emphasis on ICT for research and medical practice	.383	-.265	171.911*
Emphasis on ICT for institutional information	-.103	.055	9.693*
Emphasis on the Internet for participation	.408	-.257	181.693*
Emphasis on the Internet for produce information	.599	-.377	452.151*
Emphasis on the Internet for communication	.293	-.184	88.603*

* p<.001

Notes: Results of K-means - quick cluster analysis. Method of analysis: non-hierarchical cluster, final cluster centroids

Table 4. Characteristics of 'Integrated doctor' and 'Non integrated doctor': Socio demographic and clinical role (contingency analysis, significance)

	1. Integrated doctor n=597 (38.6%)	2. Non-integrated doctor n=949 (61.4%)	Significance
Gender			.000
- Male	66.5 (397)	54.5 (517)	
- Female	33.5 (200)	45.5 (432)	
Do you work at more than one place?			.003
- No	59.3 (354)	66.4 (630)	
- Yes	40.7 (243)	33.6 (319)	
Those who work just in one place...			.000
- Primary care	21.0 (51)	37.4 (119)	
- Hospital	68.7 (167)	53.7 (171)	
- Clinic	10.3 (25)	8.9 (28)	
Ownership of the organization do you work for?			.001
- Totally public	49.4 (295)	59.0 (560)	
- Public – Private	26.8 (160)	20.2 (192)	
- Totally private	23.8 (142)	20.8 (197)	
Activities			.000
- Medical practice	42.7 (255)	64.9 (616)	
- Medical practice, Teaching and Research	32.6 (195)	17.3 (164)	
- Medical practice and Management	7.7 (46)	9.7 (92)	
- Medical practice, Teaching, Research and Management	11.3 (67)	3.6 (34)	
- Other combinations	5.7 (34)	4.5 (43)	

Table 5. Characteristics of the 'Integrated doctor' and 'Non integrated doctor': Internet, patient/doctor relationship and ICT perception (contingency analysis, significance)

	1. Integrated doctor n=597 (38.6%)	2. Non- integrated doctor n=949 (61.4%)	Significance
Internet frequency, experience and utility			
Frequency of the Internet use in workplace			.000
- Everyday	65.7	44.3	
- Three or four times per week	19.2	22.0	
- One or two times per week	11.4	21.0	
- Less than one or two times per week	3.7	12.7	
Begin to use the Internet since...(experience)			.000
- Before 1994	11.0 (66)	6.6 (63)	
- From 1995 to 2000	67.7 (404)	55.6 (528)	
- From 2001 to 2006	21.3 (127)	37.8 (359)	
How do you consider the Internet in your work...			.000
- Very useful	85.3 (509)	67.6 (642)	
- Useful	14.2 (85)	29.4 (279)	
- Little useful	.5 (3)	3.0 (28)	
Patient/Doctor relationship			
How do you consider health information available on the Internet?			.008
- Very relevant	12.3 (73)	7.8 (74)	
- Relevant	69.1 (413)	69.9 (663)	
- Little relevant	18.6 (11)	22.3 (212)	
Do you think that patients go online for health information			.000
- Improve a lot their autonomy and quality of life	11.0 (66)	3.9 (37)	
- Improve their autonomy and quality of life	42.8 (256)	36.1 (343)	
- Improve a little their autonomy and quality of life	32.4 (193)	39.4 (374)	
- Do not improve their autonomy and quality of life	7.9 (47)	12.0 (114)	
- Make their autonomy and quality of life worse	6.0 (35)	8.6 (82)	
Do you recommend your patients to go online for health information?			.000
- Yes, I usually do it	2.6 (16)	.5 (5)	
- Yes, I often do it	9.5 (57)	4.0 (38)	
- Yes, I sometimes do it	44.9 (268)	36.0 (342)	
- No, I never do it	43.0 (257)	59.5 (565)	
Do your patients discuss or share with you their Internet health information findings?			.000
- All of the patients do it	1.4 (8)	.6 (6)	
- Most of the patients do it	14.4 (85)	7.5 (71)	
- Some of the patients do it	53.2 (318)	54.6 (518)	
- A few of the patients do it	25.6 (153)	27.6 (262)	
- Patients don't do it	5.5 (33)	9.7 (92)	
Do you think patients seeking for Internet health information improve their knowledge and facilitate their treatment			.000
- A lot	13.6 (81)	8.8 (84)	
- Quite	47.4 (283)	43.0 (409)	
- A little	28.9 (173)	38.3 (363)	
- Nothing	10.1 (60)	9.8 (93)	
Perception of ICT			
The use of the ICT in you daily work...			.000
- Improve communication with other health care professionals	87.5 (552)	76.7 (728)	
- Improve efficiency and productivity of your work	83.6 (499)	78.2 (742)	
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Emphasis in information systems to consult and prescribe	.267	.085	9.806	.002	1.306
Teaching/Research activities	.655	.203	10.418	.001	1.925
The use of the Internet in you daily work improve communication with patients	1.095	.179	37.242	.000	2.990
Work on public and private organizations	.411	.185	4.934	.026	1.509
-2 Log-likelihood	951.749				
R2 Cox-Snell	.363				
R2 Nagelkerke	.490				
Hosmer-Lemeshow	.035				

Notes: Method of regression: binomial login analysis; depend variable: Integrated doctor (value 1, YES; value 0, NO); standardised coefficients; n=1.056; % predicted observed 79.2

APPENDIX A

Table A1. Factor Analysis questionnaire items

Item name	Scales			
Utilization of information sources	Most frequently	Frequently	Rarely	Never
International medical news updates				
National medical news updates				
International academic journals				
Workplace information				
National academic journals				
Professional education				
National public institutions				
International public institutions				
Internet utilization	Yes		No	
Email with other health care professionals				
Clarify questions about diagnosis, treatment or other medical issues				
Participate in professional forums				
Presence on institutional website				
Email with individual patients				
Presence on own personal website				
Provide advise on patient support groups websites				
Utilization of ICT and Internet activities	Most frequently	Frequently	Rarely	Never
Searching for international academic journals				
Searching for clinical practice data bases and web pages				
Searching for national academic journals				
Utilization of electronic patient records				
Interaction with national health care professionals				
Interaction with patient				
Searching for international public institutions				
Searching for national public institutions				
Interaction with international health care professionals				
Publishing information				
Utilization of Information systems	Yes, I use it	No, but I would like it	No, I do not use it	
Access from any computer within your institution to electronic patient records				
Searching for public information systems and public data bases				
Sending health records through traditional postal address				
Access from any computer connected to the Internet to health care records				
Sending health records digitally				
Post consultant digital interaction (Internet, webcam...)				
Sending drugs prescription through postal address				
Sending drugs prescription digitally				
Sending SMS to remind drugs to your patients				

APPENDIX B

Table B1. Most frequently used information sources Factor Analysis

Variable	Correlation and Means							
	Mean	1	2	3	4	5	6	7
International public institutions	.07							
National public institutions	.08	.377*						
International medical news updates	.27	.306*	.148*					
National medical news updates	.19	.178*	.263*	.318*				
International academic journals	.18	.344*	.164*	.498*	.210*			
National academic journals	.14	.210*	.302*	.208*	.484*	.322*		
Workplace information	.17	.147*	.239*	.079*	.149*	.076*	.214*	
Professional education	.13	.176*	.153*	.224*	.251*	.216*	.240*	.133*

*p<0.001

Variable	Varimax Rotated Factor Matrix			Commonalities
	Factor 1 Emphasis on international information sources	Factor 2 Emphasis on national information sources	Factor 3 Emphasis on institutional information sources	
International public institutions	.615	-.075	.566	.704
National public institutions	.162	.149	.772	.645
International medical news updates	.766	.278	-.039	.666
National medical news updates	.122	.796	.127	.665
International academic journals	.789	.229	.030	.676
National academic journals	.117	.740	.268	.633
Workplace information	-.144	.223	.658	.504
Professional education	.214	.543	.038	.342
Auto values	2.704	1.140	.990	
% Variance explained	33.799	14.245	12.380	

Notes: Rotated components matrix; Sampling method: factor analysis by main components; Rotation method: Varimax with Kaiser-Meyer-Olkin 0.723; Bartlett's test of sphericity p=0.000; Convergence in 5 iterations; Minimum eigenvalue 0.9. Means and Correlation Matrix see Appendix 1

Table B2. Internet utilization Factor Analysis

Variables	Correlation and Means						
	Mean	1	2	3	4	5	6
Participate in professional forums	.47						
Clarify questions about diagnosis, treatment or other medical issues	.74	.344*					
Provide advise on patient support groups websites	.20	.412*	.215*				
Email with individual patients	.21	.132*	.042*	.179*			
Email with other health care professionals	.11	-.156**	-.085*	-.086*	-.130*		
Presence on own personal website	.17	.136*	.095*	.152*	.141*	-.049**	
Presence on institutional website	.50	.157*	.102*	.151*	.133*	.125*	.240*

*p<0.001 **p<0.05

Variables	Varimax Rotated Factor Matrix			Commonalities
	Factor 1 Emphasis on the Internet for participation	Factor 2 Emphasis on presence on the Internet	Factor 3 Emphasis on the Internet for email	
Participate in professional forums	.791	.086	.150	.657
Clarify questions about diagnosis, treatment or other medical issues	.732	-.021	-.061	.541
Provide advise on patient support groups websites	.669	.206	.113	.503
Email with individual patients	.039	.343	.570	.445
Email with other health care professionals	.101	-.096	.857	.754
Presence on own personal website	.093	.803	-.060	.657
Presence on institutional website	.099	.683	.178	.507
Auto values	1.986	1.104	0.972	
% Variance explained	28.375	15.771	13.890	

Notes: Rotated components matrix; Sampling method: factor analysis by main components; Rotation method: Varimax with Kaiser-Meyer-Olkin 0.676; Bartlett's test of sphericity p=0.000; Convergence in 6 iterations; Minimum eigenvalue 0.9. Means and Correlation Matrix see Appendix 1

Table B3. Most frequent ICT and Internet tasks Factor Analysis

Variable	Mean	Correlation and Means								
		1	2	3	4	5	6	7	8	9
Searching for clinical practice data bases and web pages	.34									
Searching for national academic journals	.24	.436*								
Searching for international academic journals	.37	.497*	.508*							
Interaction with national health care professionals	.16	.275*	.239*	.231*						
Interaction with international health care professionals	.09	.264*	.203*	.282*	.442*					
Publishing information	.04	.199*	.227*	.197*	.276*	.316*				
Interaction with patient	.15	.223*	.199*	.162*	.373*	.257*	.236*			
Utilisation of electronic patient records	.23	.354*	.290*	.248*	.229*	.186*	.167*	.265*		
Searching for national public institutions	.10	.332*	.379*	.272*	.257*	.263*	.274*	.253*	.269*	
Searching for international public institutions	.12	.309*	.316*	.377*	.249*	.321*	.273*	.246*	.214*	.564*

*p<0.001

	Varimax Rotated Factor Matrix			Commonalities
	Factor 1 Emphasis on ICT for research and medical practice	Factor 2 Emphasis on ICT for interaction and dissemination	Factor 3 Emphasis on ICT for institutional information	
Searching for clinical practice data bases and web pages	.756	.181	.151	.627
Searching for national academic journals	.710	.057	.302	.599
Searching for international academic journals	.727	.053	.284	.612
Interaction with national health care professionals	.174	.764	.103	.624
Interaction with international health care professionals	.102	.633	.315	.510
Publishing information	.009	.468	.450	.422
Interaction with patient	.172	.692	.042	.510
Utilization of electronic patient records	.592	.346	-.088	.478
Searching for information hosted by national public institutions	.262	.153	.755	.662
Searching for information hosted by international public institutions	.229	.148	.804	.720
Auto values	3.620	1.190	.955	
% Variance explained	36.200	11.897	9.545	

Notes: Rotated components matrix; Sampling method: factor analysis by main components; Rotation method: Varimax with Kaiser-Meyer-Olkin 0.825; Bartlett's test of sphericity p=0.000; Convergence in 4 iterations; Minimum eigenvalue 0.9. Means and Correlation Matrix see Appendix 1

Table B4. Information systems utilization Factor Analysis

Variables	Correlation and Means								
	Mean	1	2	3	4	5	6	7	8
Post consultant digital interaction (Internet, webcam...)	.70								
Sending drugs prescription digitally	.64	.376*							
Sending drugs prescription through postal address	.30	.196*	.276*						
Sending health records digitally	.77	.276*	.263*	.210*					
Sending health records through traditional postal address	.50	.147*	.111*	.302*	.389*				
Sending SMS to remind drugs to your patients	.41	.279*	.189*	.227*	.269*	.182*			
Access from any computer within your institution to electronic patient records	.94	.201*	.091*	.073*	.200*	.170*	.087*		
Access from any computer connected to the Internet to electronic patient records	.88	.215*	.145*	.061*	.198*	.058*	.165*	.373*	
Searching for public information systems and public data bases	.95	.203*	.084*	.090**	.220	.166**	.095*	.441*	.388*

*p<.001 **p<.005

Varimax Rotated Factor Matrix				
	Factor 1 Emphasis in health record information systems	Factor 2 Emphasis in information systems to consult and prescribe	Factor 3 Emphasis in postal information systems	Commonalities
Post consultant digital interaction (Internet, webcam...)	.233	.732	.072	.595
Sending drugs prescription digitally	.012	.780	.084	.616
Sending drugs prescription through postal address	-.082	.353	.570	.456
Sending health records digitally	.241	.279	.612	.510
Sending health records through traditional postal address	.109	-.053	.865	.763
Sending SMS to remind drugs to your patients	.053	.507	.305	.353
Access from any computer within your institution to electronic patient records	.774	.017	.134	.617
Access from any computer connected to the Internet to electronic patient records	.721	.242	-.066	.583
Searching for public information systems and public data bases	.779	.022	.148	.629
Auto values	2.665	1.416	1.042	
% Variance explained	29.611	15.730	11.574	

Notes: Rotated components matrix; Sampling method: factor analysis by main components; Rotation method: Varimax with Kaiser-Meyer-Olkin 0.740; Bartlett's test of sphericity p=0.000; Convergence in 5 iterations; Minimum eigenvalue 0.9. Means and Correlation Matrix see Appendix 1

Dear Editor,

On behalf of my co-authors, Michael Hardey, Joan Torrent and Pilar Ficapal, I'm submitting a list of changes related to each point raised in your recent email. We would like to thank again you and the reviewers for your comments.

Point 1. The reference has been deleted and we have included Appendix A with all the items used in the factor analysis.

Point 2. Following your recommendation the percentages have been taken out of the manuscript.

Point 3. One of the sentences has been deleted

Point 4. The first sentence is related to information source utilization while the second one is related to the Internet use, so we have clarified the meaning of the first sentence.

Point 5. As we have noted in Point 1, we have included Appendix A with Table A1. Questionnaire items.

Point 6. Taking into account that section 3.1 belongs to the Results we have deleted the sentence.

Point 7. We have added at the end of the factor analysis the following sentence: Details on these factor analyses can be found in the supplementary material at Appendix B. Furthermore, the presentation of the tables has been improved and grouped.

Point 8. The following sentence has been added before Table 3: These factors were selected due to their significance ($p < .001$) within the cluster analysis.

Point 9. On one hand, we have labelled Tables 4 and 5 with both 'Integrated doctor' and 'Non integrated doctor'. On the other hand, we have labelled Table 6 as Determinants of the 'Integrated doctor' as this explains the variables that played a role in the probability of being an 'Integrated doctor'

Point 10. We have re-written the first sentence at page of table 4.

Point 11. Following your advice: "the" has been added.

Point 12. Authors' contributions, Acknowledgements, Statement on conflicts of interest and Summary points have been included in the manuscript.

Point 13. Following your suggestion we have added supplementary data on Appendix A about Questionnaire items and on Appendix B about Factor analysis

We hope that these changes address all your comments and improve the manuscript. Do not hesitate to contact me for any further information.