

# IMPACTS OF INFORMATION AND COMMUNICATION TECHNOLOGIES ON MEDICAL CARE - AN OVERVIEW OF ICT ASSOCIATION WITH MEDICAL DOCTORS

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## Abstract

*This study aims to investigate the association of ICT tools with medical doctors for their professionals. A total of 427 respondents from Tamil Nadu state were surveyed using questionnaire method. The aim of this research is to examine the adoption of ICT by medical doctors in the field of medicine to enhance their profession. Since, India is one of the fastest developing nations in the world; India has understood the potential of diffusion of ICTs in the e-health for its rapid growth. This study also found that age, gender, education and occupation has statistically significant association among the adoption of Information and Communication Technology.*

## Keywords:

*ICT, E-health, Medical Doctors, ICT Diffusion and Diffusion of Innovation Theory*

## 1. INTRODUCTION

Information and Communication Technology is denoted as a 'key instrument' in healthcare delivery and public health internationally [2] and the health sector has always depended on technologies. According to the WHO, technologies are the vertebrae of the medical sector in treating illnesses. Innovations in the use of information technology have hastily amplified in all development contexts in healthcare. It is believed that the use of appropriate technologies can increase the quality of treatment. Sanderson [4] stated that 'healthcare ICT innovation can only be more effective if design is deeply adopted and taken into regular practice'.

Information and communication technology literacy depends on the experience and ability to operate internet, mobile, computers, including knowing the structures of computer software and hardware, having the skills to operate computer software and applying computer usage to social developments [1].

Constant improvement in information and communication technologies (ICT) - including the Internet, technical devices and powerful computer systems - have made a greater impact in increasing the use of these technologies in the practice of medicine and in the provision of medical care. This has led to new dimension towards technological implementation towards the field of medicine and has a great impact in society.

According to Lee and Rho [5] medical doctors play important roles in development of nation's socioeconomic and political growth and ICT is the major tool that helps them to access and use relevant information that are needed to enhance their professional knowledge. ICT usages will be more helpful if health physicians adopt it to meet their needs.

Further he observed that the information and communication technology has become a noteworthy component in medicine and has pervaded in many aspects and making it easier to access

information and communication technology worldwide. The Internet is predominantly an imperative and precious resource for information relating to health care.

Farnan [6] endorsed that the field of medicine is one among the leading information accessing divisions. As a result, access to up-to-date and timely information by health professionals remains an important factor for proper diagnosis, prevention and treatment of diseases. Readily available information that affects the well-being of patients is always critical and over the last decade, the advent of Information and Communication Technologies (ICTs) has given more impetus towards the continuous learning, sharing and dissemination of health information amongst medical doctors [3].

Over a decade, information and communication technology as a Knowledge Management (KM), has penetrated increasingly into the healthcare sector and has made many improvements and changes. This major development has made the health care sector as an important economic zone and a main source of employment, generating on an average 9% of the Gross Domestic Product in the EU zone and Canada and a staggering 15% in the US [14].

Each and every action in health care (i.e., patient registration, medical consultations, medical diagnosis, therapy, drug prescriptions, etc.) is being mostly operated by ICT in gathering, storing, processing and sharing information electronically. Examples of ICTs are patients' medical database, online medical referral and cloud computing, medical websites for doctor appointments, or systems on the internet to give feedback to doctors, so they can improve the care they provide. ICTs have the potential to improve health care and the health of patients, remarks [8].

## 2. NEED FOR THE STUDY

Information and communication technologies (ICTs), a byproduct of convergence of information technologies (ITs) and new communication technologies are a topic for critical and intense discussion in both developed and developing nations. The whole world witnessed and is witnessing the revolution brought out by ICTs in various fields, including education, health, agriculture and entertainment. Hence, the contribution of ICTs in health cannot be neglected and a need is felt to study its various aspects.

The adoption of ICT by medical doctors enhances their efficiency and effectiveness in their profession. The adoption includes maintaining the patients' history with the help of computer database management system, updating and gaining knowledge with the help of internet, sharing information, having communication with others through telephone, mobile phone, e-mail, mobile applications and so on. The potential applications of ICTs are extensive and are becoming familiar features in the field

of medicine to enhance the performances in most developed countries [7].

As one of the fastest developing nations in the world, India has understood the potential of diffusion of ICTs in the e-health for its rapid growth. The adoption of e-health can be seen both at national and state levels in government and private hospitals. Some of them failed to succeed while many others are functioning extremely well. At this juncture, it is very important to examine the adoption of ICT by medical doctors in the field of medicine to enhance their profession.

### 3. STATEMENT OF THE PROBLEM

According to the World Health Organization [9], it is an established fact that information and communication technologies are the backbone of the current information system. Their scope is also extremely vast. Health care facilities have been largely benefited by the evolution of ICT. Owing to information and communication technologies, the entire world has become a single window with regard to health informatics. Further, even within a particular state or country, data can easily be transmitted from one place to another within no time at all. This technology helps doctors, hospitals, the general public and all other medical care providers.

Information and communication technology has brought a major paradigm shift in the health care scenario of the entire world and the developing countries are not an exception. Researcher Thanuskodi [10] explored that information and communication technologies are evolving at a tremendous rate in India. It is very difficult to determine the size and distribution of medical professionals who have access to ICT.

This paradigmatic shift focuses on the adoption of information and communication technologies by medical doctors in the field of medicine to enhance their profession. This shift in the approach to the study of the adoption of information and communication technology in the field of medicine by medical doctors is considered a meaningful approach and such a study on an empirical ground becomes a much needed one in a country like India.

In this task, the present investigation explores the adoption of information and communication technology by medical doctors in their profession. It is precisely on this premise that the present study assumes importance and is being set to arrive at meaningful inferences and a conclusion.

#### 3.1 OBJECTIVE OF THE STUDY

The objective of the present investigation, as stated earlier, necessitates certain directions in terms of theoretical and methodological perspectives. The adoption of Information and Communication Technology by medical doctors in their profession has been extensively explored as a research problem in the past. This will enable the researcher to understand not only the problem under investigation, but also certain theoretical formulations needed for the study. Research in new media technologies in the field of medicine is so dynamic and demands a meaningful review of the research in the past, the present and emerging theoretical, methodological and policy initiatives. Since India is emerging as a technological and economic superpower in

the world, instead of intuitive and impressionistic assertions, the need of the hour is a systematic, scientific and empirical analysis of the problem under investigation.

### 3.2 THEORETICAL FRAME WORK

According to Diffusion of Innovation theory profounded by Everett M. Rogers [11] seeks to explain how, why, and at what rate new ideas and technology spread. Rogers argues that diffusion is the process by which an innovation is communicated over time among the participants in a social system.

### 3.3 SCOPE AND APPLICATION

Diffusion research has focused on five areas:

- The characteristics of an innovation which may influence its adoption;
- The decision-making process that occurs when individuals consider adopting a new idea, product or practice;
- The characteristics of individuals that make them likely to adopt an innovation;
- The consequences for individuals and society of adopting an innovation and
- Communication channels used in the adoption process.

Rogers also states the perceived characteristics of an innovation such as relative advantage, compatibility, complexity, trialability and observability persuade an individual to adopt an innovation. 'Is there any association between the dependent variable the adoption of information and communication technology (software, E-mail account, social network, weblogs, website, mobile SMS, online database system, mobile application, teleconferencing, E-health records) in terms of demographics of the Respondents?'

## 4. METHODOLOGY

The present investigation attempts to unearth the usage and acceptance of electronic health management system among medical doctors in the field of medicine to enhance their profession in Tamil Nadu, India. The study is restricted only with the doctors who are working in the major three districts of Tamil Nadu. A multistage stratified random sampling method was adopted by the researchers to identify the eligible respondents, who are included as the sample for the present investigation. At this stage, the questionnaire was distributed in all the chosen districts having around 590 sample respondents from the chosen sectors in which 427 samples, which were complete in all respects, alone were included for the study.

## 5. RESEARCH QUESTIONS

- *RQ 1:* Is there any association between the gender of the respondents and the adoption of information and communication technologies?
- *RQ 2:* Is there any association between the age of the respondents and the adoption of information and communication technologies?

- *RQ 3:* Is there any association between the education of the respondents and the adoption of information and communication technologies?
- *RQ 4:* Is there any association between the occupation of the respondents and the adoption of information and communication technologies?

**5.1 GENDER AND ADOPTION OF INFORMATION AND COMMUNICATION TECHNOLOGIES**

A chi-square test was used to determine whether gender of the respondents is associated with adoption of information and communication technology by medical doctors.

In Table.1, the results of Chi- square shows the association between gender and the adoption of information and communication technologies by medical doctors.

Table.1. Gender vs. adoption of ICT

Gender vs. Adoption of ICT	N	Chi-square value	Asymp. sig. (2-sided)
Software	427	28.161	.000
E-mail Account	427	15.721	.008
Online Database System	427	10.024	.075
Social Network	427	18.501	.002
Weblogs	427	36.014	.000
Website	427	28.033	.000
Mobile Application	427	8.414	.135
Teleconferencing	427	10.305	.067
Mobile SMS	427	12.941	.024
E-Health Records	427	9.475	.092

Table.2. Cross tabulation in terms of Gender

Statements		Male	Female	Total
Software	Yes	163	127	290
	No	61	76	137
	Total	224	203	427
E-mail Account	Yes	213	184	397
	No	11	19	30
	Total	224	203	427
Online Database System	Yes	109	98	207
	No	115	105	220
	Total	224	203	427
Social Network	Yes	197	159	356
	No	27	44	71
	Total	224	203	427
Weblogs	Yes	153	97	250
	No	71	106	177
	Total	224	203	427
Website	Yes	206	169	375
	No	18	34	52

	Total	224	203	427
Mobile Application	Yes	191	157	348
	No	33	46	79
	Total	224	203	427
Teleconferencing	Yes	109	83	192
	No	115	120	235
	Total	224	203	427
Mobile SMS	Yes	125	98	223
	No	99	105	204
	Total	224	203	427
E Health Records	Yes	193	172	365
	No	31	31	62
	Total	224	203	427

The Table.1 reveals that there is a significant relationship at 5% significance level between gender and software ( $\chi^2 = 28.16, p <.05$ ), e-mail account ( $\chi^2 = 15.72, p <.05$ ), social network ( $\chi^2 = 18.50, p <.05$ ), weblogs ( $\chi^2 = 36.01, p <.05$ ), website ( $\chi^2 = 28.03, p <.05$ ), mobile SMS ( $\chi^2 = 12.94, p <.05$ ). The result also shows that there is no significant relationship between gender and online database system ( $\chi^2 = 10.02, p >.05$ ), mobile application ( $\chi^2 = 8.41, p >.05$ ), teleconferencing ( $\chi^2 = 10.30, p >.05$ ), E-health records ( $\chi^2 = 9.47, p >.05$ ).

Hence, it is concluded that there is significant association between the variables such as software, E-mail account, social network, weblogs, website, mobile SMS except online database system, mobile application, teleconferencing, E-health records in respect of gender.

**5.2 AGE AND ADOPTION OF INFORMATION AND COMMUNICATION TECHNOLOGIES**

A chi-square test was performed to determine whether age of the respondents is associated with adoption of Information and Communication Technologies by medical doctors.

The Table.3 showing the results of Chi- square showing the association between age and the adoption of Information and Communication Technologies by medical doctors.

Table.3. Age vs. Adoption of ICT

Age vs. Adoption of ICT	N	Chi-square value	Asymp. sig. (2-sided)
Software	427	64.226	.000
E-mail Account	427	21.869	.016
Online Database System	427	33.544	.000
Social Network	427	55.200	.000
Weblogs	427	44.923	.000
Website	427	38.061	.000
Mobile Application	427	26.509	.000
Teleconferencing	427	41.869	.000
Mobile SMS	427	47.569	.000
E-Health Records	427	21.491	.018

Table.4. Cross tabulation in terms of Age

Statements		25 to 35 years	36 to 45 years	46 years and Above	Total
Software	Yes	121	137	32	290
	No	75	33	29	137
	Total	196	170	61	427
E-mail Account	Yes	179	166	52	397
	No	17	4	9	30
	Total	196	170	61	427
Online Database System	Yes	94	83	30	207
	No	102	87	31	220
	Total	196	170	61	427
Social Network	Yes	160	157	39	356
	No	36	13	22	71
	Total	196	170	61	427
Weblogs	Yes	116	111	23	250
	No	80	59	38	177
	Total	196	170	61	427
Website	Yes	175	156	44	375
	No	21	14	17	52
	Total	196	170	61	427
Mobile Application	Yes	165	139	44	348
	No	31	31	17	79
	Total	196	170	61	427
Teleconferencing	Yes	69	96	27	192
	No	127	74	34	235
	Total	196	170	61	427
Mobile SMS	Yes	114	93	16	223
	No	82	77	45	204
	Total	196	170	61	427
E Health Records	Yes	174	143	48	365
	No	22	27	13	62
	Total	196	170	61	427

The Table.4 reveals that there is a significant relationship at 5% significance level between age and software ( $\chi^2 = 64.22, p < .05$ ), E-mail account ( $\chi^2 = 21.86, p < .05$ ), online database system ( $\chi^2 = 33.54, p > .05$ ), social network ( $\chi^2 = 55.20, p < .05$ ), weblogs ( $\chi^2 = 44.92, p < .05$ ), website ( $\chi^2 = 38.06, p < .05$ ), mobile application ( $\chi^2 = 26.50, p > .05$ ), teleconferencing ( $\chi^2 = 41.86, p > .05$ ), mobile SMS ( $\chi^2 = 47.56, p < .05$ ), E-health records ( $\chi^2 = 21.49, p < .05$ ).

Hence, it is concluded that there is significant association between the variables such as software, E-mail account, social network, weblogs, website, mobile SMS, online database system, mobile application, teleconferencing, E-health records in respect of age.

### 5.3 EDUCATION AND ADOPTION OF INFORMATION AND COMMUNICATION TECHNOLOGIES

A chi-square test was performed to determine whether education of the respondents is associated with adoption of information and communication technologies by medical doctors.

The Table.5 showing the results of Chi-square showing the association between education and the adoption of information and Communication technologies by medical doctors.

Table.5. Education Vs Adoption of ICT

Education vs. Adoption of ICT	N	Chi-square value	Asymp. sig. (2-sided)
Software	427	58.256	.000
E-mail Account	427	33.140	.000
Online Database System	427	60.379	.000
Social Network	427	37.722	.000
Weblogs	427	72.615	.000
Website	427	31.487	.000
Mobile Application	427	42.798	.000
Teleconferencing	427	46.063	.000
Mobile SMS	427	66.426	.000
E Health Records	427	25.938	.004

Table.6. Cross tabulation in terms of Education

Statements		UG	PG	Other	Total
Software	Yes	73	131	86	290
	No	50	45	42	137
	Total	123	176	128	427
E-mail Account	Yes	107	170	120	397
	No	16	6	8	30
	Total	123	176	128	427
Online Database System	Yes	56	96	55	207
	No	67	80	73	220
	Total	123	176	128	427
Social Network	Yes	111	151	94	356
	No	12	25	34	71
	Total	123	176	128	427
Weblogs	Yes	81	115	54	250
	No	42	61	74	177
	Total	123	176	128	427
Website	Yes	103	160	112	375
	No	20	16	16	52
	Total	123	176	128	427
Mobile Application	Yes	100	148	100	348
	No	23	28	28	79
	Total	123	176	128	427
Teleconferencing	Yes	45	95	52	192
	No	78	81	76	235
	Total	123	176	128	427
Mobile SMS	Yes	77	100	46	223
	No	46	76	82	204

	Total	123	176	128	427
E Health Records	Yes	109	152	104	365
	No	14	24	24	62
	Total	123	176	128	427

The Table.5 reveals that there is a significant relationship at 5% significance level between education and software ( $\chi^2 = 58.25, p <.05$ ), E-mail account ( $\chi^2 = 33.14, p <.05$ ), online database system ( $\chi^2 = 60.37, p >.05$ ), social network ( $\chi^2 = 37.72, p <.05$ ), weblogs ( $\chi^2 = 72.61, p <.05$ ), website ( $\chi^2 = 31.48, p <.05$ ), mobile application ( $\chi^2 = 42.79, p >.05$ ), teleconferencing ( $\chi^2 = 46.06, p >.05$ ), mobile SMS ( $\chi^2 = 66.42, p <.05$ ), E-health records ( $\chi^2 = 25.93, p <.05$ ).

Hence, it is concluded that there is significant association between the variables such as software, E-mail account, social network, weblogs, website, mobile SMS, online database system, mobile application, teleconferencing, E-health records in respect of education.

### 5.4 OCCUPATION AND ADOPTION OF INFORMATION AND COMMUNICATION TECHNOLOGIES

A chi-square test was performed to determine whether occupation of the respondents is associated with adoption of information and communication technologies by medical doctors.

The Table.7 showing the results of Chi- square showing the association between occupation and the adoption of information and Communication technologies by medical doctors.

Table.7. Occupation vs. Adoption of ICT

Occupation vs. Adoption of ICT	N	Chi-square value	Asymp. sig. (2-sided)
Software	427	95.510	.000
E-mail Account	427	27.628	.002
Online Database System	427	31.217	.000
Social Network	427	57.246	.000
Weblogs	427	33.886	.000
Website	427	44.074	.000
Mobile Application	427	37.717	.000
Teleconferencing	427	42.630	.000
Mobile SMS	427	17.944	.056
E Health Records	427	29.821	.001

Table.8. Cross tabulation in terms of Occupation

Statements		Government	Private	Own Clinic	Total
Software	Yes	104	144	42	290
	No	62	31	44	137
	Total	166	175	86	427
E-mail Account	Yes	150	163	84	397
	No	16	12	2	30

	Total	166	175	86	427
Online Database System	Yes	85	83	39	207
	No	81	92	47	220
	Total	166	175	86	427
Social Network	Yes	133	147	76	356
	No	33	28	10	71
	Total	166	175	86	427
Weblogs	Yes	99	95	56	250
	No	67	80	30	177
	Total	166	175	86	427
Website	Yes	142	155	78	375
	No	24	20	8	52
	Total	166	175	86	427
Mobile App	Yes	147	136	65	348
	No	19	39	21	79
	Total	166	175	86	427
Teleconferencing	Yes	72	88	32	192
	No	94	87	54	235
	Total	166	175	86	427
Mobile SMS	Yes	102	84	37	223
	No	64	91	49	204
	Total	166	175	86	427
E-Health Records	Yes	151	142	72	365
	No	15	33	14	62
	Total	166	175	86	427

The Table.7 reveals that there is a significant relationship at 5% significance level between occupation and software ( $\chi^2 = 95.51, p <.05$ ), E-mail account ( $\chi^2 = 27.62, p <.05$ ), online database system ( $\chi^2 = 31.21, p >.05$ ), social network ( $\chi^2 = 57.24, p <.05$ ), weblogs ( $\chi^2 = 33.88, p <.05$ ), website ( $\chi^2 = 44.07, p <.05$ ), mobile application ( $\chi^2 = 37.71, p >.05$ ), teleconferencing ( $\chi^2 = 42.63, p >.05$ ), mobile SMS ( $\chi^2 = 17.94, p <.05$ ), E-health records ( $\chi^2 = 29.82, p <.05$ ).

Hence, it is concluded that there is significant association between the variables such as software, E-mail account, social network, weblogs, website, online database system, mobile application, teleconferencing, E-health records except mobile SMS in respect of occupation.

Table.9. Test results

Research questions	Test	Results
<b>RQ 1</b> Is there any association between the gender of the respondents and the adoption of information and communication technologies?	Chi-Square	There is significant association between the variables such as Software, E-mail Account, Social Network, Weblogs, Website, Mobile SMS except Online Database System, Mobile Application, Teleconferencing, E-health Records in respect of gender.

<b>RQ 2</b> Is there any association between the age of the respondents and the adoption of information and communication technologies?	Chi-Square	There is significant association between the variables such as Software, E-mail Account, Social Network, Weblogs, Website, Mobile SMS, Online Database System, Mobile Application, Teleconferencing, E-Health Records in respect of age.
<b>RQ 3</b> Is there any association between the education of the respondents and the adoption of information and communication technologies?	Chi-Square	There is significant association between the variables such as Software, E-mail Account, Social Network, Weblogs, Website, Mobile SMS, Online Database System, Mobile Application, Teleconferencing, E-Health Records in respect of education.
<b>RQ 4</b> Is there any association between the occupation of the respondents and the adoption of information and communication technologies?	Chi-Square	There is significant association between the variables such as Software, E-mail Account, Social Network, Weblogs, Website, Online Database System, Mobile Application, Teleconferencing, E-Health Records except Mobile SMS in respect of occupation

## 6. DISCUSSIONS

The results of the chi-square test show that there is a statistically significant association between gender and adoption of information and communication technology (software, E-mail account, social network, weblogs, website, mobile SMS, online database system, mobile application, teleconferencing, and e health records). Likewise, age has a statistically significant association among the adoption of information and communication technology (software, e-mail account, social network, weblogs, website, mobile SMS, online database system, mobile application, teleconferencing, e health records). Similarly, there is significant association between the variables such as software, E-mail account, social network, weblogs, website, mobile SMS, online database system, mobile application, teleconferencing, E-health records in respect of education and in the study it is found that there is significant association between the variables such as software, E-mail account, social network, weblogs, website, online database system, mobile application, teleconferencing, E-health records except mobile SMS in respect of occupation.

According to the research finding the Rogers diffusion of innovation theory is applicable. The innovation of Information and communication technology is diffused to the doctors in the field of medicine. The doctors adopt the information and communication technology (software, E-mail account, social network, weblogs, website, online database system, mobile application, teleconferencing, E-health records).

## 7. CONCLUSIONS

The aim of this research is to examine the adoption of ICT by medical doctors in the field of medicine to enhance their

profession. Since, India is one of the fastest developing nations in the world; India has understood the potential of diffusion of ICTs in the e-health for its rapid growth. The adoption of e-health can be seen both at national and state levels in government and private hospitals. Some of them failed to succeed while many others are functioning extremely well. According to Drury [15] Information and Communication Technology is designated as a ‘key instrument’ in healthcare delivery and public health internationally. According Eysenbach [12] stated the 10 E’s in “e-health” they are efficiency, enhancing quality, evidence based, empowerment of consumers and patients, encouragement, education, enabling, extending, ethics and equity. He also added that in addition to this 10 essential E’s, E-health also be ease to use, entertaining (no-one will use something this is boring!) and exciting. According to Berg [13] medical doctors play important roles in development of nation’s socioeconomic and political growth and ICT is the major tool that helps them to access and use relevant information that are needed to enhance their professional knowledge. ICT usages will be more helpful if health physicians adopt it to meet their needs. This study also found that age, gender, education and occupation has statistically significant association among the adoption of Information and Communication Technology. The momentum of e-health is accelerating towards the establishment of a complete, viable and fully functioning of adoption of technology.

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