



Use of Internet of Things (IoT) in Indian Healthcare from Doctor's point of view

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ABSTRACT

An improvement in the lifestyle is achieved by different new technologies. In today's world of connectivity, with the advancement of Internet of Things (IoT) all entities are connected to each other by some communication means. IoT enabled sensors for measuring vital parameters can be used by doctors for real-time monitoring of patient. Whereas actual technology used by majority of hospitals is a multimodal monitors which measures and displays the relevant vital parameters. It is commonly integrated into the bedside monitors in critical care units. These devices neither have storage capacity nor connected to internet and they are costly as well. Real time patient monitoring is the main objective of IoT based healthcare systems for improving quality of everyone's life. The purpose of this exploratory research is to provide first insights into the way doctor perceive use of IoT enabled devices in healthcare. A questionnaire was developed. Data was collected from 26 physicians from 26 different hospitals where surgical units are available. Result of survey and interviews of four physicians' shows that there is still not enough awareness and readiness for the use of IoT enabled medical devices, but all are willing to make use of this new technology.

KEYWORDS : Internet of Things, Healthcare, Survey**1.INTRODUCTION**

In recent years, Internet of Things (IoT) has become increasingly ubiquitous. IoT enables a detailed characterization of the physical environment, as well as a rich set of interactions with the physical world. Therefore, IoT has the potential to revolutionize pervasive computing and its applications. The Internet of Things could be a game changer for the healthcare services. It is transforming healthcare industry by increasing efficiency, lowering costs and put the focus back on better patient care [1, 2, 3]. Data is captured via sensors, get transferred to doctors who are far away from patients, complex algorithms analyze the data, and medical professionals can remotely access the information for diagnosis and treatment recommendations [4]. Whereas existing devices i.e. multimode monitor can only read data continuously. It doesn't have capability to process data or to transfer data [5]. Patients can also be monitored around the clock so that subtle changes are detected and drug intoxication is avoided. IoT is a technological improvement, using this new technology in healthcare should be permitted by doctors, hence we decided to take doctors opinion about it.

In our previous paper [6] we have listed some IoT enable devices those are in used by healthcare sector Mimo, Milk Nanny, TempTraq, Smart Diapers, iSwimband, Sleep monitoring, Implantable medical devices (AXL) Pacemakers, defibrillators and neuro-stimulators, Insulin Pump, Temperature Measure, Blood Pressure Measurement Instrument guidance in Surgery (AXL,GYRO),Medicine dispenser. By explaining this all devices listed in this paper we carried out survey with handful of doctors from Chembur, one of the suburbs in Mumbai. In this paper we want to converse findings from the survey.

2.Research Methodology

Data collection tools used in this study: a questionnaire, and personal, semi structured interviews.

Authors could not find any existing questionnaire which could address all the issues of adopting IoT enabled devices in hospitals. Therefore new questionnaire was constructed independently with focus was on Technology Acceptance Model [9, 10]. The questionnaire contained two types of questions: structured questions intended to provide measurable data for quantitative analysis, and open-ended questions intended to provide more information, which was desirable due to the research project. Interviews were conducted face to face. Goal of this study was to throw light on following questions which majorly focuses on attitude, readiness and concerns for using IoT in healthcare.

1. What do you think use of all these devices will increase patient care?
2. Is everybody ready to adopt this new technology?
3. Are these devices safe for use for all kinds of patients?

4. Will it be possible for all hospitals to convert traditional devices into IoT enable devices?
5. Will hospitals be able to provide internet connectivity for 24*7?
6. What do you think on an average for how many years you need data related to one patient?
7. Will this technology save your time?
8. Will it improve decision making process which will indirectly improve patient's health?
9. Will it be helpful to reduce your stress (work pressure)?
10. Is it good to go with new technology?
11. Do you find any loophole in to it?
12. Please write your suggestions?

Sampling

Doctors were contacted directly, though this resulted in non probability sampling, which avoids generalization of results. The sampling of the doctors' population took into consideration the need to include a wide variety of parameters that could potentially impact decision making by doctors and their attitudes toward technology and patient care. We targeted 26 different doctors from 26 different hospitals with different specialties.

Data collection

Questionnaire data was collected through Google Forms. This research did not involve patients nor was any personal health information collected. Participating doctors were assured response anonymity and no personal identification data was collected. There were no ethical constraints on this research; no approval was needed from ethics regulatory committees.

Analysis

Data collection in survey and interviews are analyzed with mix methods. Open-ended questions, both from the interviews and from the questionnaire were subjected to content analysis, while structured questions were analyzed using quantitative methods. Statistical analysis is done using Microsoft excel and Minitab to the structured questions.

3. Results

This research has adopted Technology Acceptance Model [TAM] for construction of questionnaire[9,10].Questions in the questionnaire are divided in three main groups for better understanding of various aspects for using IoT in healthcare 1. Intention to use IoT in hospitals, 2. Readiness for using IoT in hospitals and 3. Usefulness of IoT in hospitals.

Upon being asked whether the use of IoT in hospitals will increase patient care, 81% of doctors said yes, 4% said no and 15% said it couldn't be predicted. The Doctors seemed quite confident about this

technology and its use for increasing patient care.

Also, 96% doctors agreed that it is good to go with new technology, whereas 4% doctors disagreed. Almost everyone is eager and ready to accept this new technology.

On studying about readiness for using IoT in hospitals, it was found out that, only 38% doctors felt positive about it. Out of the 62% doctors who denied it, 75% weren't ready because of tedious job of training staff members for handling the devices and, low availability of digital device facilities and no internet connectivity in rural areas.

Next, the study on, the possibility of all hospitals converting traditional devices into IoT enabled devices, was carried out. Here, 38% doctors found it possible whereas 62% doctors didn't. Presently, hospitals are having big and costly machinery which are difficult to replace. The optimal solution to this problem is converting existing machines into IoT enabled ones.

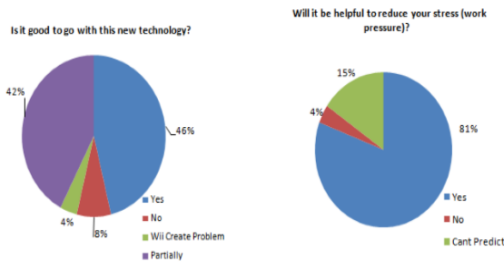


Figure Graph for doctors' responses

Upon being asked whether the hospitals will be able to provide Internet Connectivity 24*7, 65% doctors agreed while 35% disagreed because of non availability of internet connectivity in rural and remote areas. However, IoT enabled devices require Internet Connectivity for data transfer.

Regarding the safety of patients, 54% doctors felt that use of IoT enabled devices is unsafe, while, 46 doctors found it safe. Main concerns of the doctors were radiations coming from the devices which may be harmful in some cases, and also whether these devices can be used on the body of a patient suffering from skin diseases.

92% doctors agreed that this technology will save time, whereas 8% doctors disagreed. In the era of IoT, patients' related data that is past records and present readings will be readily available on mobile devices. This will be of great help for doctors in the decision-making process.

Also, 92% doctors agreed that use of IoT enabled devices will improve decision-making process, thereby improving patient's health. Majority of doctors agreed that timely data transfer to their mobile will make decision process faster and will, in turn, improve patient's health.

Upon being asked whether this technology will be helpful to reduce their stress and work pressure, 46% doctors said yes, 11% doctors said no and 43% doctors said that it would be partially helpful.

q. no	Sr no	Q1	Q2	Q3	Q4	Q5	Q6	Q8	Q9	Q7
1		2	2	2	2	4	4	4	4	1
2		4	4	4	4	4	4	4	4	4
3		2	2	2	2	2	4	4	4	1
4		2	2	2	4	4	4	4	4	1
5		4	4	4	4	4	4	4	4	4
6		2	2	2	4	4	4	4	4	1
7		2	4	2	2	4	2	4	0	1
8		2	2	4	4	4	4	4	4	1
9		2	4	2	2	4	4	4	4	1
10		4	4	4	4	4	4	4	4	4
11		4	4	4	4	4	4	4	4	4
12		4	4	2	4	4	4	4	4	4
13		2	2	2	4	4	4	4	4	4
14		2	4	2	4	4	4	4	4	2

15	4	4	4	4	4	4	4	4	4
16	4	2	4	4	4	4	4	0	1
17	2	2	2	2	4	4	4	4	3
18	2	2	2	2	4	4	4	4	4
19	2	2	2	2	4	4	4	4	4
20	4	4	4	4	4	4	4	4	4
21	4	4	4	4	4	4	4	0	1
22	2	2	2	4	4	4	4	4	1
23	2	2	2	2	4	4	4	0	4
24	2	2	2	4	4	4	4	4	1
25	2	2	2	2	2	2	2	2	2
26	4	4	4	4	4	2	4	4	4

can't predict=0 partially=1 No=2 will create new problems=3 Yes=4

Table 1 questionnaire responses

Doctors' opinion about loopholes of this technology included, increased cost of health care, acceptance of this technology at all levels, internet connectivity in all areas, accuracy and sustainability of IoT devices, training the whole staff for using it properly.

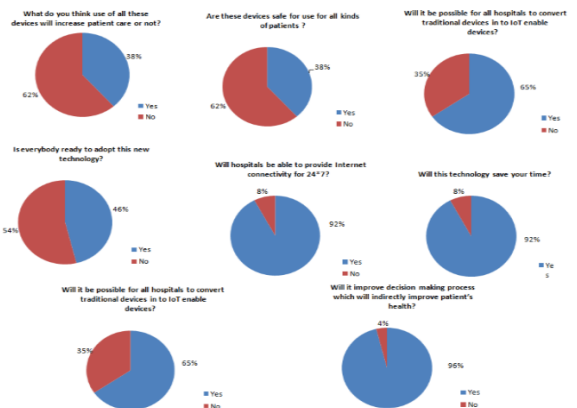


Figure Graph for doctor's response

Few doctors are concern about security and privacy of the patient as data will be shared via internet. Also, most of the doctors felt that physical examination of the patient is very important in order to diagnose the problem and also to understand the mental condition of the patient.

Overall suggestions of doctors' regarding this technology include this technology should be development as per the needs of the hospital and while designing cost factor has to be considered. Second important point mention by them is response from suppliers of these devices to the technical queries of hospital staff should be quick. Somebody has mentioned a point about accuracy, in healthcare accuracy is very important that has to be satisfied. AS these are battery operated devices few are worried about lifespan of IoT. Last but not the least training programs for new users must be conducted regularly. Mostly all the doctors found the technology to be excellent from the innovation point of view.

5. ANALYSIS

Data analysis has been carried out using the statistical package Minitab for Windows [11] by applying Chi square test [12] and Descriptive analysis.

The statistical mean has been calculated for three main groups as the mean is used to derive the central tendency of the data in question. Figure 2 clearly gives idea mean value for all questions in readiness for using IoT in hospitals is 47% doctors participated in this research are saying we are ready for IoT. This values is quite low, we need to improve our readiness for using IoT in healthcare. Whereas questions in category of usefulness of IoT in healthcare gives mean value 69% are positive towards its usefulness and in third group where we ask about patient care and over all technology is good or bad gives 88% are agreed it will improve patient care and its good technology.

Overall acceptance level is 68% again mean of all three groups, this value gives us insight that even though we are not ready for this new technology in terms of infrastructure. Still our doctors are willing to adopt this technology as it will improve patient care, will improve decision making process, will save time for both patients' and doctors.

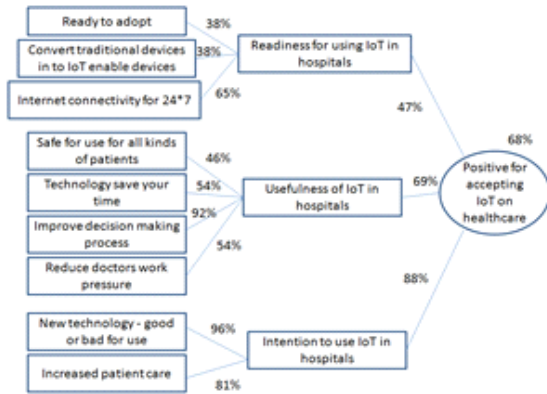


Figure 3 Mean calculations for all three groups

Considering discrete data we decided to use chi square. The data table can be considered as follows all Yes & partial as 1 i.e Y, and all no, can't say as 2 i.e. N so table one rewritten as. Table 2 gives count for the same.

Y	N	
Q1	10	16
Q2	12	14
Q3	10	16
Q4	17	9
Q5	24	2
Q6	23	3
Q8	25	1
Q9	21	5
Q7	23	3

Table 2. Input table for chi square

Author has considered following Hypothesis:

Null hypothesis H01: Doctor's are not positive towards use of IoT in Indian Healthcare

Alternate hypothesis H11: Doctor's are positive towards use of IoT in Indian Healthcare

After applying chi square test we get a result as shown in table 3. Expected counts are printed below observed counts. Chi-Square contributions are printed below expected counts

	Y	N	Total
1	10	16	26
	18.33	7.67	
	3.788	9.058	
2	12	14	26
	18.33	7.67	
	2.188	5.232	
3	10	16	26
	18.33	7.67	
	3.788	9.058	
4	17	9	26
	18.33	7.67	
	0.097	0.232	
5	24	2	26
	18.33	7.67	
	1.752	4.188	
6	23	3	26
	18.33	7.67	
	1.188	2.841	
7	25	1	26
	18.33	7.67	
	2.424	5.797	

8	21	5	26
	18.33	7.67	
	0.388	0.928	
9	23	3	26
	18.33	7.67	
	1.188	2.841	

Total 165 69 234

Chi-Sq= 56.974, DF = 8, P-Value = 0.000

Table 3 chi square test result

P value is significant with Positive response to IOT is more than expected for most of the questions asked in the survey, hence alternate hypothesis is accepted. We can conclude that the value proposition is highly impactful for IoT in hospitals.

5. CONCLUSION

Technology is going ahead at its speed Internet of Things (IoT) is best proof for the same. Doctors are progressing in their domain for betterment of patients. From above survey it is clear that doctors are looking forward for IoT in healthcare for more connect with their patients. Only need of an hour is to provide good infrastructure for the same and to create awareness about this technology in healthcare sector.

Internet of Things (IoT) is set to play a transformational role in hospital's work culture. However, winners will be hospitals that are better prepared to manage digital disruption caused by IoT and are successful in integrating it with their overall care environment to build integrated healthcare ecosystems for betterment of society. Physicians, surgeons and engineers in research should join hand together for better results.

Acknowledgments

The authors would like to thank all the doctors who took part in this research, filled in the questionnaires, were interviewed and allowed us to gain insights into this field.

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