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**Evaluation of Smart Technologies Applications to Improve Service Quality and Customer Satisfaction: An Investigation of Smart Hospitals in Kerala state, India**

**BY**

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**Abstract**

*The healthcare industry is rapidly changing with the advent of technology. The traditional medical practice has lost its productivity with the ever-increasing population. The IoT revolution is fast-paced and has provided a wide variety of smart health applications in the global market. A smart hospital uses data and AI to enhance the work of the healthcare providers and administrators. They can also provide services that are consistent and high-quality to the welfare of the patients. In order to gain a competitive advantage in the market, healthcare institutes must improve their service quality and customer satisfaction. Kerala state is reported to have one of the best health systems in India. This study compare the various factors that influence the service quality and customer satisfaction in relation to Smart Healthcare in Kerala. A survey analysis was done to study the customer satisfaction to various smart health provisions in the hospitals across the state. The findings from the study states that service quality and patient satisfaction are correlated. The study also confirms that the patients are aware of the various smart health provisions in the market and are willing to adapt them. Furthermore, directions for future research in this aspect are suggested.*

**INTRODUCTION**

**Background of Research**

Technology is rapidly transforming every industry including the healthcare industry. Traditional medicine has advanced technologically and began to digitalize and informationalize, incorporating these changes at different levels of healthcare management.

The implementation of technology has enhanced exponential changes in the healthcare industry namely in categories like patient engagements, data and analytics, and new care models. A new generation of information technologies such as Internet of Things (IoT), big data, cloud computing, and artificial intelligence have been used to transform traditional medical system to a more efficient, personalized, and convenient healthcare system. Smart healthcare is born from the concept of ‘Smart Planet’ which was proposed in 2009 by IBM. (Shou Tian et al 2019). There became a need for digital transformation in hospitals due to an increased demand for quality services and patient care. Under the umbrella of smart cities, there is a rapid progress in digital technologies,

especially artificial intelligence, and this has greatly enhanced the development of smart healthcare.

Digital technology has a huge impact on operational efficiency in healthcare industry.

A host of new technologies like artificial intelligence, robotics, precision medicine, etc can be integrated into the care delivery system. These technologies can ensure cost control and efficiency optimization with greater precision and result in better outcomes. The consumer expectations have also increased. As a result, hospitals need to integrate these developments in a phased manner and redesign themselves to improve customer experiences, outcomes, and costs to stay agile in the coming years.

Bo Chen et al (2019) says there are five features that are causing transition into Smart Hospitals and reshaping global healthcare systems.

- Smart hospitals are digitally connected with the rest of the ecosystem: in order to ensure that the patient gets a high-quality healthcare, permissible data sharing is essential between government platforms, health agencies, insurance providers, etc.



- Smart hospitals have a high degree of automation: for increased productivity, upgradation of operations, and smooth workflows it is necessary to rely on automation.
- Smart hospitals are patient-centric and render better patient experiences
- They are driven by analytics and Big Data
- They are holistic interdisciplinary innovators.

In 2015 Indian Government launched the Digital India campaign and by 2017 proposed the Digital health IDs to connect citizens and stakeholders across private and public hospitals. This was more effective in 2020 with the advent of the pandemic when there was seen a huge rise in virtual consultations. The booking for the COVID-19 vaccine also required digitalization. In August 2020 the pilot version of digital health ID began in six territories as a part of India's National Digital Health Mission. It was officially launched in September 2021. The IDs are generated using patient's mobile number and address. In 2022 the Indian Government announced the launch of an open platform connecting universal access to digital health facilities under National Digital Health Ecosystem (NDHE). A part of this mission is the **Ayushman Bharat Digital Mission**. There will be digital registries of the service providers and facilities, consent framework, and a unique health identity. The Government also proposed DISHA (Digital Information Security in Healthcare Act) to protect the patient data. Health innovators including the stakeholders are embracing this rapid development to bring about the new age technology.

India's nationwide **Telemedicine service eSanjeevani** has been highly successful and showed a rapid rise in use during the pandemic, especially in urban areas. In the rural region, there is a rather higher need as the people have limited facilities to travel in hospitals and health centers. Many startups and healthcare institutions are trying to fill this gap between the urban and rural regions and promote better healthcare among villages via telemedicine, telepathology, and e-pharmacy.

All these initiatives have started to make the healthcare system strong and link it to the increasing rate of better services ultimately leading to customer satisfaction.

Healthcare is a very crucial part of any economy and a digital adaptation in this industry highly links to the perception of the patients and their acceptance of the new systems. It not only saves their time but also helps in providing efficient and effective services.

## Problem Statement

Smart technology application in healthcare has evolved a lot over the years and have better reach to the customers after the COVID-19 pandemic. Most of the customers are aware of various healthcare apps and their acceptance of various technology have increased rapidly. As healthcare is a consumer-oriented industry, a higher patient satisfaction is relevant for a competitive marketplace. It is up to the organization to meet the demand of a industry that have

embraced technology and have modernized, in order to improve their customer satisfaction. At the same time, there is a challenge for the employees to pace up with the growing technology and adapt it to their practice. The topic of digital innovation and smart application have been in studied by multiple people, however, the impact of same on service quality and customer satisfaction in one region, especially in private sector hospitals is not focused so far. The core of service industry is service quality and hence there should be enough studies to ensure that technological advancement has made a difference in the sector leading to customer satisfaction.

## Research Aim:

Technological advancement has made everything smart. Smart shopping, smart food ordering, and now the healthcare services also. This research seeks to explore the various factors of smart technology related to customer satisfaction. A core focus of The research is on how digitalization has improved the workflow of healthcare institutions. It shows how organizations can create a more effective and efficient clinical and administrative process to render better patient care in midst of unprecedented medical times. Lastly, there is an evaluation of the impact this innovation has made on the service quality of the hospitals leading to satisfaction of the customers.

## Research Objectives:

1. To examine the specific factors of Smart Technology that influence the service quality leading to customer satisfaction in healthcare institutes.
2. To recommend strategies that can help in promoting the use of Smart Technology in Healthcare Industry to further contribute to the growth of hospitals and customer satisfaction.

## Research Questions:

1. What are the factors that lead to quality service and customer satisfaction with regard to Smart Technology?
2. What are some specific factors that influence service quality leading to customer satisfaction in healthcare industry in Kerala, India?

## Literature Review

This section is a detailed description of views of various authors that have an inclination towards Technological advancement, digitalization, and its use in various industries. A breakdown is provided for smart inventions in healthcare sector and its implications on customer satisfaction. A gap is lastly portrayed to justify the research work.

## Smart Technology

The 21<sup>st</sup> Century has brought a technological revolution that has been rapidly developing and expanding with each passing year. The fast pace of innovation has been changing the way we live, communicate, and work with the help for artificial intelligence and smart technology. SMART refers to self-

monitoring, analyzing, and reporting technology. The Internet of Things helps us to connect our environment with our body, home and city and adapt us to better engage and live with it. An app installed in a smartphone can help an individual to keep track of their experiences throughout the day and record their activities, health, and emotions. Once technology covers the important roles of their life, a customer can learn quickly and appreciate the accessibility and convenience the smart devices offer.

## Smart Technology and Service Quality

In the views of Chao Li et al (2022) servitization is the moderator to examine the interaction between digital transformation and the quality of service. There is a positive influence of digital adaptive governance on the infrastructure transformation digitally and along with servitization they improve the quality of service.

In an article written by Vatolkina et al (2020), it was stated that customer experience has a significant influence on customer satisfaction. It is strongly influenced by the technical quality of the e-services, as well as the quality of the service process and the customer support.

## Smart Technology and Service Quality Leading to Customer Satisfaction

According to a study done by Maddern et al (2007) customer satisfaction is keenly dependent on technical service quality and there is a complex set of relationship between staff satisfaction, service quality, and customer satisfaction.

The smart technology and service quality is highly evident in various industries. As per the article written by Ekaabi et al (2020) smart policing service quality is defined by a group of constitutive elements that vary in their service quality. Smart devices with their expanding role can lead to improved service quality. An evaluation was done for smart policing of service quality at multidimensional hierarchical level. They learned that smart policing of service quality contributes to user satisfaction, enhances their quality of life, and gives them an intention to continue using the services.

## Smart Healthcare

Traditional medicine has gradually begun to digitalize with the advancement of technology. Technology has enabled the creation of hospitals 'without walls'. Harbeck (2019) says that digitalization holds a great promise in the future of education, diagnosis, treatment planning, and patient management for healthcare givers.

Wearable biosensors are devices that are small and lightweight, worn on the body, and monitor vital signs like temperature, heart rate, breathing, etc. While it is not originally designed as a health tool, smartwatches are also becoming an increasingly used app for tracking the heart rate, physical activities and, they can be connected to the mobile phone to connect to a wide range of health applications and features.

Some of the IoT are devices for heart rate monitoring, glucose monitoring, oximeter, Parkinson's disease monitors etc. An

example of this is the Automated Insulin Delivery system, which have proved to be a revolutionary for diabetic patients. It delivers a continuous flow of insulin to the body via a pump and can be automatically adjusted based on the body glucose level.

Connected inhalers can help asthma patients and others with respiratory diseases to track their medication use and they also have audio and visual alerts to remind them to take their medications. Similarly, apps are developed to track an irregular heart rhythm throughout the day can send real-time alerts. It can also inform patients of any nutritional irregularities. Physicians can also track their patient's adherence to treatment plan and connect with the patients to guide them. The response time in diagnosis and treatment can be greatly reduced through wearable body sensors and data collected from lifestyle that can be shared with the doctors and caretakers.

## Smart Healthcare and Service Quality

The smart healthcare is slowly gaining a lot of interest. Especially after the pandemic, healthcare worldwide is forced to move to the smart healthcare options to enhance the service quality. As per the article written by Park et al (2018) technical feasibility, economical feasibility, organizational commitment, and support are required for a sustainable smart connected hospital.

There can be two ways in which the smart healthcare can contribute to service quality. These are:

## IoT and Service Quality in Healthcare

IoT has brought revolutionary changes in healthcare industry by closing the gap between healthcare providers and consumers. (Biswas et al). IoT can collect healthcare data from individuals via mobile phones, computing devices, wearable devices, implanted devices and measure them with the aid of internet and help in early detection of abnormalities, faster tracking of symptoms, and improve diagnosis and management. These improvements have majorly contributed to the service quality in the industry. IoT-based services and products provide functions like monitoring, remote control, optimization, and autonomy. High-risk patients and ones with chronic illness can be monitored.

Sethi and Sarangi (2017) classified the architecture of IoT in healthcare delivery into three phases: (1) the perception layer, (2) the network layer, and (3) the application layer. Perception layer has sensing systems that collect the data. Sensor technology allows monitoring the patient via various sensor devices, cameras, etc., and facilitate the acquisition of a multitude of psychological parameters to fast-track diagnosis and treatment. The network layer includes wired and wireless network such as Bluetooth, Wi-Fi network, RFID, etc. that communicate and store the processed information. These data are either stored locally or send to a centralized cloud server. Application layer interprets and apply the data. This layer is responsible for delivering application-specific services to the users through artificial intelligence. AI has the capability to

read the medical data and contextualize them to generate diagnostic decisions or treatments.

Recent developments in the field of fog and cloud computing offer several benefits to the IoT-based healthcare domain. (Divya Gupta et al 2022). Edge cloud is a newer cloud computing concept that allow the IoT-based sensors to process and analyze data themselves and thus reduce the amount of data to be communicated and saved in a centralized location. (Pan J et al 2018). Blockchain storage also uses a decentralized storage approach. More research is needed on the efficiency of blockchain storage over centralized cloud-based storage solutions in IoT-supported healthcare delivery. (Kelly JT et al 2020).

### AI and Service Quality in Healthcare

Artificial intelligence supports the healthcare industry by a variety of tasks from administrative workflow to clinical documentation and patient outreach as well as specialized support such as in image analysis, medical device automation, and patient monitoring. (Bohr 2020). Precision medicine is the process of collecting genetic and physiological data from and individual and tailoring the treatment according to these variations. Kulski (2020) believe that in the coming decades the global population will be offered full genome sequencing, and this would require a redesigning of the current clinical system. They can also help in identification of genetic mutations and inherited diseases.

Meskò et al. claims that Artificial Intelligence can help in reducing the care costs and prevent repetitive operations. They can encourage the medical profession on critical thinking and clinical creativity. AI requires skills and quality for data-intensive analysis and knowledge-based management and several options in health services have not been researched. (Secinaro et al 2021)

The AI has contributed to the healthcare service quality in several ways. **Electronic Medical Records** are digital patient records that help the medical team to record the diagnosis and treatment process. They help the practitioner to analyze the patient chart easily before, during, and after the treatment. They help to arrange all data chronologically, and easy referral of patients to the specialists. An electronic health record (EHR) is a subset of each care delivery organization's Electronic Medical Record that is owned by the patient or the stakeholder and has patient input and access.

Electronic Health Records have been of great advantage over the years in sharing the medical records among the stakeholders and allows easy access and updating as the patient undergoes treatment. Presently different regulations and standardizations are used for privacy checks but an efficient encryption scheme can be introduced to harmonize these systems to resolve possible conflicts and inconsistencies in the future. (Keshta and Odeh 2021). Medical facilities are working on both structured and unstructured data, which comes from databases, transactions, unstructured content of emails and documents, devices, and sensors so much that both in administrative and clinical areas decision made are

becoming data-driven. (Batko and Slezak 2022). Healthcare delivery system in India is at three levels. The primary healthcare system is via the Public Health Centers, secondary via the District Hospitals and then there are the national level Tertiary Hospitals. Apart from these, there are numerous Private Healthcare Institutions. One of the main challenges Healthcare facilities faces are in collecting, storing, processing, and managing the patient data without compromising the privacy and security.

With the emergence of COVID-19, there is a sudden upsurge in demand for smart healthcare products. The American Telemedicine Association calls telemedicine as a natural evolution of healthcare in the digital world. Telemedicine is the use of information and technology to deliver medical services from a distance. In India with the low doctor-to-patient ratio, online healthcare consultations can reduce the gigantic burden of healthcare. It can also reduce to cost of nations healthcare burden. Sageena et al classified telemedicine based on the timings of the information transmitted as:

- Synchronous telemedicine where both the sender and the recipient are online and live information is transmitted
- Asynchronous telemedicine where sender stores and send the information at the convenience of the recipient.
- Remote monitoring where gadgets are used to screen the patient clinically.

In 2001 the ISRO (Indian Space Research Organization) introduced the Telemedicine Pilot Project in India linking Apollo Hospital Chennai with the Apollo Rural Hospital Chittoor. (Mishra et al 2009). In the recent past the telemedicine in India has come a long way and was exceptionally beneficial during the pandemic in 2020-2021. Agarwal et al (2020) quotes some of the advantages as

- They are a safe and effective alternative to inpatient care in case of ongoing management of chronic diseases like bronchial asthma, hypertension, diabetes, etc during the pandemic when social distancing was relevant.
- They provide psychological support to the patient and their families.
- They reduce the burden in tertiary hospitals
- They provide training to caregivers of the sick, disabled, and elderly.

Mode of communication such as audio, video, and texts are used. Telemedicine has been given legal status in India. The medico-legal aspect states that the identification details of the patient and the Registered Medical Practitioner (RMP) must be established and verified before initiating the treatment. The RMPs can practice teleconsultations all over India.

## Smart Healthcare and Service Quality Leading to Customer Satisfaction

A healthcare organization should satisfy the customers in terms of convenience as well as assessing information. This can have a direct influence on the quality of the healthcare delivered. As the patient becomes the consumer in healthcare, it becomes increasingly essential for the organization to focus on giving the best experience for the patient. Digital technologies can help the organizations to design services and solutions around the core need of the patient and this way create an impact on the patient satisfaction.

Patient satisfaction highly depends on the interaction and trust developed by the patient to their caregiver. Digital health solutions should enable better interaction for the patients in terms of being conversational and easy to comprehend. An omnichannel experience can be achieved in telehealth by meeting the patients where they are.

Westbrook and Reilly (1983) proposed the Value-Percept theory. It describes customer satisfaction as the pleasurable emotional state that occurs as a result of the evolution of services that satisfies a customer's value. This emotional state is triggered by a cognitive evaluative process, the perception of which are compared to one's values, needs, and desires. A faster appointment, shorter waiting time, EMR to guide the doctors all can indirectly relax the patients and make them appreciate the service and the quality.

## Service Quality and Customer Satisfaction

Healthcare organizations are facing a major consumer behaviour problem where quality is the major criteria, irrespective of the services offered. Quality is the disparity between consumer's preferences and their views on the service offered. "Service Quality perception is defined by what will and what should happen and what delivery should actually take place." (Parasuraman, Zeithaml, & Berry, 1994). The opinion of healthcare clients can be based on the influence of word-of-mouth, personal variables, and past experiences. 'Trust elements' play a great role as well as 'experience factors'. Owad et al (2022) stated that the relationship between patient flow and patient satisfaction is positively mediated through healthcare service quality.

SERVQUAL Scale can be used to evaluate the quality of service, according to which a service provider should provide five critical elements of service namely, reliability, responsiveness, tangibility, assurance, and empathy. It was developed in the 1980s by academic researchers Parasuraman, Berry, and Zeithaml and was a breakthrough in the measurement of service quality research. Customer's expectations and perceptions are used by SERVQUAL to identify the strategies in which to improve the business.

## Research Methodology

Research Methodology gives an insight into the method used to collect the data for the analysis. Here the study population, the sampling procedures, the data collection techniques and

procedures, and the administration and analysis of the data are focused. The Saunder's Research Onion method is used here.

This study uses a quantitative method of research approach and hence the methodological choice in the study is mono-method quantitative study. A single data collection technique i.e a questionnaire is used. the questions are expressed clearly so that they are understood in the same way by each participant. Hence the data are collected in a standard manner.

A survey design was opted for this study. A survey is a quantitative method of collecting information via asking survey questions from a pool of respondents. It is a primary step in obtaining quick information about a mainstream topic. The data collected from the survey is statistically analyzed and the research conclusions are drawn from it. Various means can be used for conducting survey research such as emails, online social medias, in-person etc. Some of the benefits of survey are:

- Minimum investment
- Versatile source for response collection
- Reliable for respondents

The survey questionnaire was prepared and given to the respondents using the Microsoft form survey tool. This online survey tool is available to Microsoft product users requiring a sign-in through any of their global e-mail addresses, work or school mail exchange accounts.

Since the survey was about health and hospital visits, for privacy as well as for ethical reasons, Microsoft form was a good choice as it did not require to submit the name and other personal information of the respondents. The participants could sign in and easily input the questionnaire. The survey questionnaire was user-friendly and simplistic to the point of completion. The data could be exported in Microsoft Excel and was available to the researcher for analysis.

The population of the survey represents the general population of Kerala from 15 years and above who have visited the private hospitals in Kerala. A simple random sample is used to ensure that the representatives of the population of the sample reflects the significant characteristics of a wider population, reflecting the demographic characteristics like age, gender, etc. (Newman 1998). This sampling technique is used as it reflects the population being studied and is cost-effective considering the medium used for the study. The decision to apply this sample also serves the research well considering that the study is based on the satisfaction of the customers at health centres applying smart healthcare mode.

The primary data collection of the study was done via survey method getting inputs ethically requested from the respondents for the successful completion of the research.

Microsoft form survey tools and social media platform for escalation and a network of friends residing within different parts of Kerala helped to collect the data.

## Network of Respondents

Professional social media platform was used to share the online survey link with the participants. They were appealed

to follow the link to completion and in some cases were asked to forward the link to known persons. There were personal, periodic gentle reminders to identified resource personnel who assisted to propagate the survey links.

The personal network of the acquaintances of the researcher residing in various parts of Kerala were tapped into to aid in the growth in data sample size. They were reached through personal messages with gentle reminder over time to ensure a good response rate.

### Analysis and Interpretation

The analysis of the responses from the respondents from the quantitative research and the survey done were presented to help understand the view of the customers of healthcare in respect to the adaptation of Smart technologies. Following this, the general description and summary of the analysis was done. The reliability and the validity of the research data analysis were done. A discussion of the analysis was presented followed by the conclusion and recommendation.

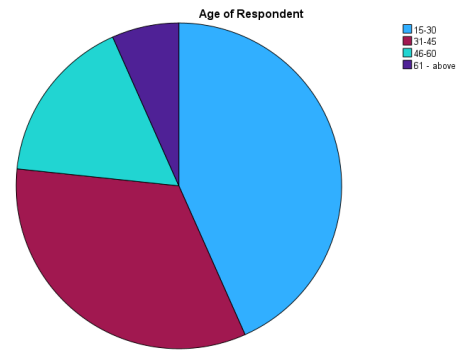
The general descriptive statistics of the questionnaire items were coded and statistically presented below. A total of 30 respondents participated in the survey from various parts of Kerala state, India. The participants included people from the cities, towns, and villages and no one of them were related to each other. The descriptive statistics for the responses obtained are mean, variation, and standard deviation.

### Demographic Data Analysis

Demographic information allows the researchers to understand the background of the participants. In this study, all the participants are residents of Kerala and have similar culture and ethnicity. The factors like age, education, occupation, experience of using smart apps, and the number of hospital visit in the past 3 months are analyzed.

#### Age

Age of Respondent					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15-30	13	43.3	43.3	43.3
	31-45	10	33.3	33.3	76.7
	46-60	5	16.7	16.7	93.3
	61 - above	2	6.7	6.7	100.0
	Total	30	100.0	100.0	

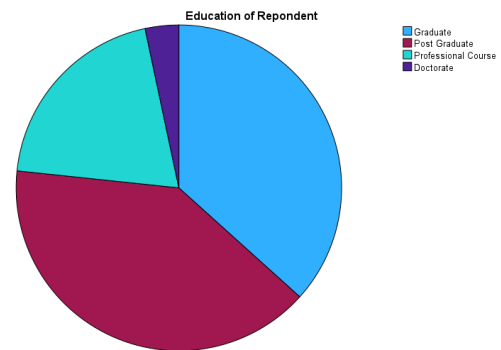


The above graph shows the age of the participants. 43.3% of those who participated in the survey were between 15-30 years. Only 6.7% of people above 61 years preferred to contribute to a study on smart technologies.

### Education

Education of Repondent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Graduate	11	36.7	36.7	36.7
	Post Graduate	12	40.0	40.0	76.7
	Professional Course	6	20.0	20.0	96.7
	Doctorate	1	3.3	3.3	100.0
	Total	30	100.0	100.0	



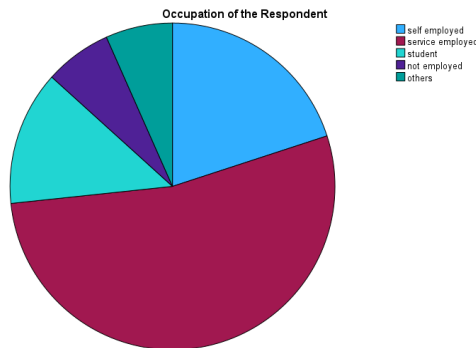
All the participants were educated with most of them holding either graduate or postgraduate degree.

### Occupation

Occupation of the Respondent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	self-employed	6	20.0	20.0	20.0
	service employed	16	53.3	53.3	73.3
	student	4	13.3	13.3	86.7

not employed	2	6.7	6.7	93.3
others	2	6.7	6.7	100.0
Total	30	100.0	100.0	

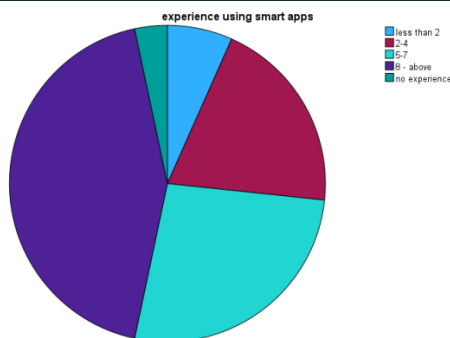


53.3 percent of the participants in this study were service-employed. Around 6.7 percent did not want to reveal their occupation.

### Experience of Using Mobile Phone and Smart Applications

#### Experience Using Smart Apps

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid less than 2	2	6.7	6.7	6.7
2-4	6	20.0	20.0	26.7
5-7	8	26.7	26.7	53.3
8 - above	13	43.3	43.3	96.7
no experience	1	3.3	3.3	100.0
Total	30	100.0	100.0	

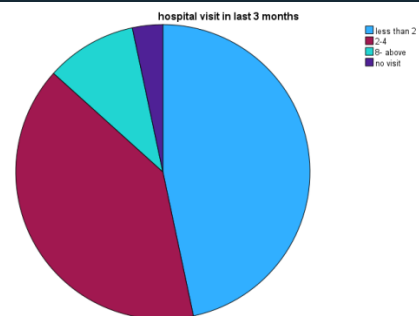


43.3 percent of the participants have 8 years or more of experience using smart applications in mobile, followed by 26.7 percent having 5-7 years. Only one participant has claimed to have no experience using smart applications in their mobile phone.

### Average number of Hospital visits for yourself or family members taken in last 3 months

#### hospital visit in last 3 months

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid less than 2	14	46.7	46.7	46.7
2-4	12	40.0	40.0	86.7
8- above	3	10.0	10.0	96.7
no visit	1	3.3	3.3	100.0
Total	30	100.0	100.0	



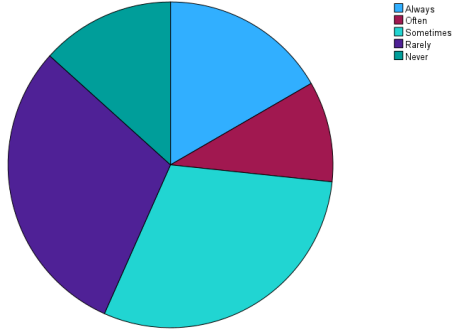
In comparing the hospital visit in past 3 months, all expect one have claimed to visit the hospital atleast once. 10 percent of the participants have visited the hospital for 8 or more times eith for themselves or as accompanied.

### Smart Healthcare Services

**The hospital I visit to has an app and also a 24\*7 call center to make the bookings**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Always	5	16.7	16.7	16.7
Often	3	10.0	10.0	26.7
Sometimes	9	30.0	30.0	56.7
Rarely	9	30.0	30.0	86.7
Never	4	13.3	13.3	100.0
Total	30	100.0	100.0	

The hospital I visit to has an app and also a 24\*7 call center to make the bookings



The participants had different opinion regarding the convenience of booking appointments via call center being active for 24 hours. 30 percent claimed they could sometimes do so while another 30 percent rarely could make appointment conveniently. 13.3 percent didn't find their hospital reliable for reaching out via phone.

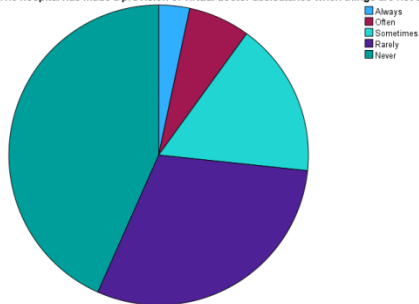
*The hospital has made a provision of virtual doctor assistance when things are not serious.*

**Statistics**

**The hospital has made a provision of virtual doctor assistance when things are not serious**

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Always	1	3.3	3.3	3.3
Often	2	6.7	6.7	10.0
Sometimes	5	16.7	16.7	26.7
Rarely	9	30.0	30.0	56.7
Never	13	43.3	43.3	100.0
Total	30	100.0	100.0	

The hospital has made a provision of virtual doctor assistance when things are not serious



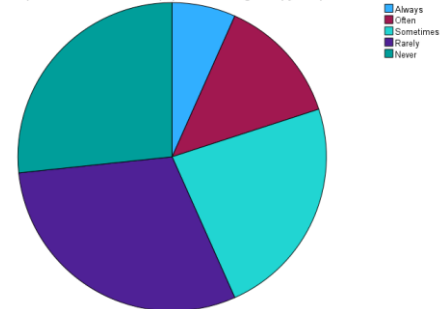
The facility for virtual doctor assistance was never available for 43.3 percent where as only 3.3 percent of the participants could benefit from such facilities in their hospital visit.

*The hospital is making the reports and documents paperless and sends a digital copy of reports to me and the doctor.*

**Reports and Documents are paperless and digital copy of report is send to me and doctor**

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Always	2	6.7	6.7	6.7
Often	4	13.3	13.3	20.0
Sometimes	7	23.3	23.3	43.3
Rarely	9	30.0	30.0	73.3
Never	8	26.7	26.7	100.0
Total	30	100.0	100.0	

Reports and Documents are paperless and digital copy of report is send to me and doctor



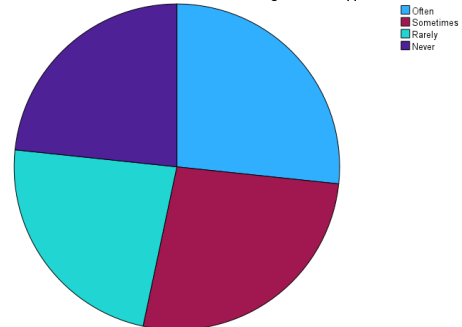
The participants didn't all agree on the reports and documents being digital. There was varying opinion mainly due to the part of the question that asks if the digital copy was sent to the patient and the doctor.

*The details of the doctor (experience, working hours, location, etc). are given on the app.*

**Details of the Doctor are given on the app**

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Often	8	26.7	26.7	26.7
Sometimes	8	26.7	26.7	53.3
Rarely	7	23.3	23.3	76.7
Never	7	23.3	23.3	100.0
Total	30	100.0	100.0	

Details of the Doctor are given on the app



All the participants had different opinions regarding the details of the doctor given in the app. It could be either if the



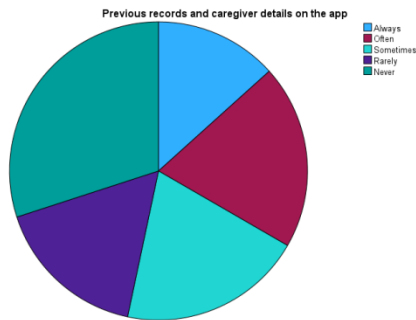
factor vary among hospitals or the general public awareness vary.

**Smart Healthcare Services and Service Quality**

**The quality of services is enhanced as the previous records and caregiver details are there on the app**

**Previous records and caregiver details on the app**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Always	4	13.3	13.3	13.3
Often	6	20.0	20.0	33.3
Sometimes	6	20.0	20.0	53.3
Rarely	5	16.7	16.7	70.0
Never	9	30.0	30.0	100.0
Total	30	100.0	100.0	

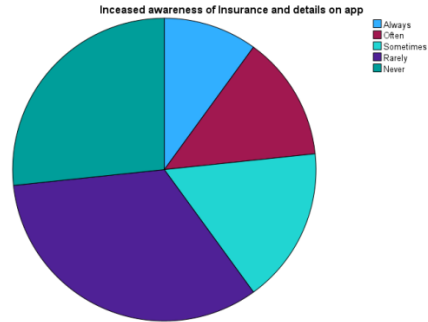


The highest response for this is never and is from about 30 percent of the participants

**The smart healthcare also increased my awareness of insurance, as I don't have to recheck for insurance packages. The details are in the app**

**Inceased awareness of Insurance and details on app**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Always	3	10.0	10.0	10.0
Often	4	13.3	13.3	23.3
Sometimes	5	16.7	16.7	40.0
Rarely	10	33.3	33.3	73.3
Never	8	26.7	26.7	100.0
Total	30	100.0	100.0	

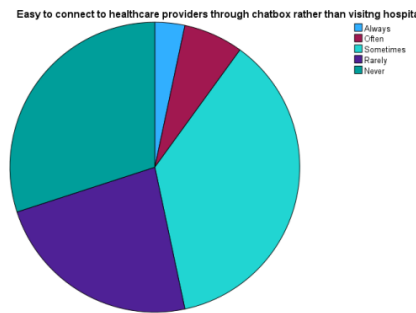


60 percent of the participants claim that they have either rarely or never got any awareness or details regarding insurance packages available from the smart healthcare.

**It is now easy to connect with the healthcare providers through chatbox rather than visiting hospital every now and then.**

**Easy to connect to healthcare providers through chatbox rather than visiting hospital**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Always	1	3.3	3.3	3.3
Often	2	6.7	6.7	10.0
Sometimes	11	36.7	36.7	46.7
Rarely	7	23.3	23.3	70.0
Never	9	30.0	30.0	100.0
Total	30	100.0	100.0	



Only 3.3 percent claims that they can easily connect to their health provider through chatbox rather than visiting the hospital. but 36.7 percent agree that they can as well connect to their doctors via chatbox sometimes if not often.

**The smart healthcare has also got in the advanced products like oximeters, wearable blood sugar measuring machines, etc. This has improved an overall vigilance on health.**

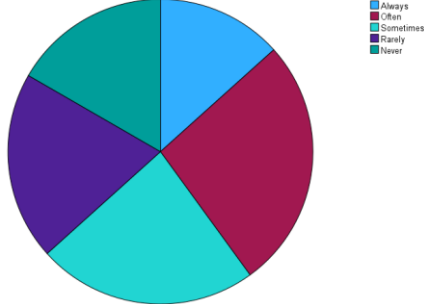
**Statistics**

**Advanced products like oximeter etc present to improve overall vigilance on health**

	Frequency	Percent	Valid Percent	Cumulative Percent
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Valid	Always	4	13.3	13.3	13.3
	Often	8	26.7	26.7	40.0
	Sometimes	7	23.3	23.3	63.3
	Rarely	6	20.0	20.0	83.3
	Never	5	16.7	16.7	100.0
	Total	30	100.0	100.0	

Advanced products like oximeter etc present to improve overall vigilance on health



13.3 percent of the respondents agree that advanced smart healthcare products like oximeter can improve the overall vigilance of health, 16.7percent do not believe they will.

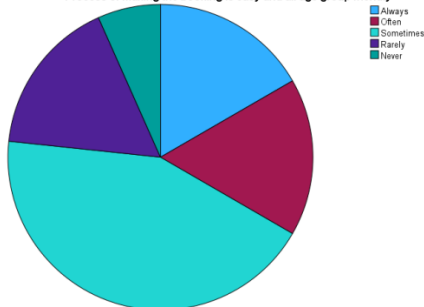
**Smart Healthcare Services and Customer Satisfaction**

**The process of making the bookings via app or call center is easy and all age group friendly**

**Process of making the booking is easy and all age group friendly**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Always	5	16.7	16.7	16.7
Often	5	16.7	16.7	33.3
Sometimes	13	43.3	43.3	76.7
Rarely	5	16.7	16.7	93.3
Never	2	6.7	6.7	100.0
Total	30	100.0	100.0	

Process of making the booking is easy and all age group friendly



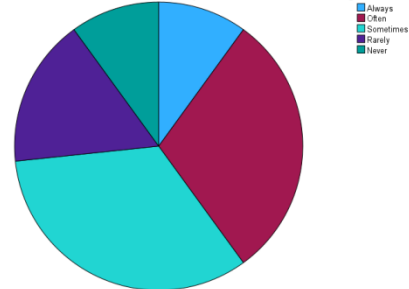
43.3 percent agree that sometimes the booking of appointments with healthcare via apps or the call centers have been friendly for all age group. 6.7 percent do not agree.

**In case of telemedicine or virtual assistance, the person is calm and listens to details before transferring the calls to other departments**

**In case of telemedicine/virtual assistance, the person is calm before transferring the calls to departments**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Always	3	10.0	10.0	10.0
Often	9	30.0	30.0	40.0
Sometimes	10	33.3	33.3	73.3
Rarely	5	16.7	16.7	90.0
Never	3	10.0	10.0	100.0
Total	30	100.0	100.0	

In case of telemedicine/virtual assistance, the person is calm before transferring the calls to departments

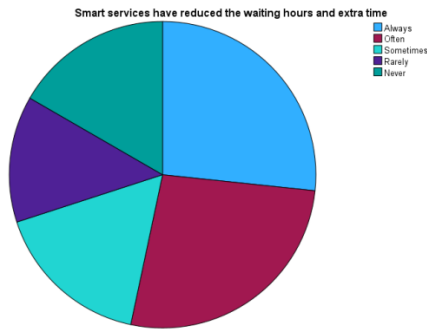


Most of the participants says that often and sometimes the telemedicine assistance is calm before transferring calls to the concerned department

**Smart services have reduced the waiting hours and the extra time (apart from treatments) spent in the hospitals.**

**Smart services have reduced the waiting hours and extra time**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Always	8	26.7	26.7	26.7
Often	8	26.7	26.7	53.3
Sometimes	5	16.7	16.7	70.0
Rarely	4	13.3	13.3	83.3
Never	5	16.7	16.7	100.0
Total	30	100.0	100.0	

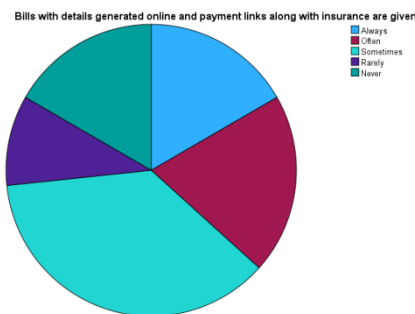


More than 50 percent of the reponents agree that smart services have reduced their waiting time and the extra hours spend is the hospital during the visit. 16.7 percent have not yet found it beneficial at all.

**The payment is also easy as the bill with the details can be generated online and the payment link along with insurance details are given already.**

**Bills with details generated online and payment links along with insurance are given**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Always	5	16.7	16.7	16.7
Often	6	20.0	20.0	36.7
Sometim es	11	36.7	36.7	73.3
Rarely	3	10.0	10.0	83.3
Never	5	16.7	16.7	100.0
Total	30	100.0	100.0	



There is a disparity in opinion on whether the bills are generated online and if it is convenient for them the payment links via insurance are given. When 16.7 percent found it always useful, another 16.7 have never benefitted.

**Discussion of Findings**

The study examined and investigated the opinion of the customers of Smart Healthcare in Kerala, selected on random basis. The findings determine that the customers lack awareness of the various options they have in healthcare that has been implemented digitally. It has been noted that in all the variables studied, the standard deviation has been lower than the mean deviation. There was a disparity in age among

the subjects studied as mostly the younger generation were familiar with smart technology and preferred to take up the survey.

The participants lived in different parts of the state and has different experiences regarding the provision of facilities provided in the smart hospitals. In order to understand the customer’s attitude towards the variables of the study and their distribution, the relevant indicators of variables were summarized as always, often, sometimes, rarely, and never. All the 30 participants have indicated their opinion.

In Smart Health Services, four variables were studied. While more than 50 percent could either always or sometimes could make appointments online, they didn’t get the benefit of a virtual doctor. What was noteworthy was that more than half the people survey did not receive a digital report of their health check up. This points to the fact that the services rendered by the healthcare institutes lack digitalization in many areas. There is vivid disproportionality in healthcare institutes across Kerala. A large geographical ares in the northern parts of the state is still dependent on few tertiary care public medical centers.( Muraleedaran 2021)

In the variables comparing the service quality of the smart hospitals, there was mixed opinion on the availability of the previous records and details of caregiver on the app. It could be refined with a further study based on the time phrase of the visits.

While majority of them find it difficult to connect to their health providers., more than half of the participants disagree on receiving adequate awareness from the hospital and healthcare apps. They are yet vigilant on their health and familiar to products like oximeter etc. with only 16.7 percent stating that they have not been. Mosadeghrad (2014) stated that quality in healthcare is a corporation between patient and the healthcare provider. Supportive visionary leadership, proper planning, education and training, availability of resources, effective management of resources all play a key role in the same. One should understand that it is impossible for the patient to understand the knowledge and professional level of the medical staff and it is only through the hospital’s relevant publicity.

On the variables focusing on customer satisfaction, 43.3 percent agreed that they have found the booking easier and friendly for all age groups. There was positive response to reduced waiting time and overall time spend in the hospital as well as majority felt the payment mode was easier with the bills generated online. One should observe that this is mostly about the convenience of telecommunication, electronic medical records, and online banking methods adapted by the hospitals. Most of the participants are happy with the telemedicine and virtual assistance provided with 26 percent each claiming it often or sometimes. The telemedicine practice has been widely improved during the COVID-19 pandemic period and has allowed many patients online consultations without having to physically come to the hospital. the study found a strong correlation between service

quality and patient satisfaction. The patient's perception of service quality can directly effect the patient satisfaction.

A similar pattern of result was obtained in the study of Jin Chenhui (2019) which described the importance of mobile health technology adoption on service quality and patient satisfaction in China's medical service market. They concluded that the use of mobile apps has, directly and indirectly, affected the patient satisfaction but has no direct impact on the hospital service quality. They suggested that the hospital management should pay close attention to organizational factors that affect the results of the system usage and also enhance the initiative of physician-patient interaction.

## Conclusion

### Review of study aims and objectives

This research paper aims to study the role of smart healthcare technology and its impact of the service, quality, and customer satisfaction among the population of Kerala state, India. Survey and analysis was done to understand the use of smart technology and how it relates to factors of customer satisfaction in the current market. Factors that influence the service quality was also analysed. The various smart health provisions available and their influence on the customers were studied. The aim of the study is to identify the factors relating role of Smart technologies in the hospitals and their influence on the customers. It is from this a strategy can be formed to promote the further development of technology in healthcare.

The study found out that most of the people are aware of the smart health provisions available in the healthcare system. The respondents have positive perception about the role of artificial intelligence in health care. Some of the people surveyed have already been familiar with smart health apps like oximeter etc.

It was established in the study that majority of the participants have noted the convenience in booking appointments, telemedicine, and reduced waiting times. This has helped them to reduce their overall time spend in the hospital. moreover, it was identified that online-generated bills and payments have been a convenience to many.

Most of the participants have not experience virtual doctor assistance.

### Limitations of the Study

Although this research has offered some valuable insight into the opinion of the customers in smart health services, it is necessary to acknowledge several of the limitations. The data was collected using a single method -survey questionnaire and it is not free from the subjectivity of the respondents. The survey was done among random participants in Kerala. Most of the participants were of younger age group. all the participants were graduate and most of them were service-employed. The survey was done among 30 individuals. The objectivity and conclusion of the survey could have been more enhanced if a larger sample size was considered.

The social, cultural, personal, and technical factors that influence the customer behaviour was not noted. Future research is needed to understand the influence of smart healthcare and it needs to involve a larger population to a wider picture.

The survey was done at one point of time but it is important to understand that customer expectations and perceptions keep changing over time. One of the question with a high perception rate was regarding the digital copy of the reports being send to the patients and the doctors. While all hospitals do make digital copy of the reports seldom are they send to the patient. The participants support the idea of receiving a digital copy of their health report.

### Learnings from the Research

All the participants in the survey were educated. It was important to understand that the general public awareness of the facilities in the smart hospitals were very low and this has a great impact on their responses. It is also noteworthy that though the participants were not much experienced in telehealth services, they seem skeptical to the role of digitalization in healthcare. The study of role of the service and quality of the smart healthcare and its influence on customers have enabled the researcher to understand the following factors.

- The quality of service had a direct influence on the customer satisfaction. The five dimensions of service quality namely reliability, responsiveness, assurance, empathy, and tangibility play key role in customer satisfaction and loyalty.
- People, system, and the process are often not connected. People are technically updated but are not generally aware of the smart provisions in healthcare.
- Telemedicine have come up a long way and are better adapted by the customers.

### Scope of Future Research

In course of this study, some areas require further studies and these include:

- Area-specific region and their influence on smart healthcare. The development of hospitals and healthcare institutions vary among urban and rural regions. In India, health centers are in primary, secondary, and tertiary levels and the facilities vary among them.
- A study can also be included to compare the influence of smart healthcare among the health workers.
- Further research can be done about the role of telemedicine and the adaptation of the same by the customers.
- A study into the development of Artificial Intelligence and the changes it has brought into the healthcare industry.
- The benefits of Indian Government's new AYUSHMAN BHARAT digital mission and how it

will change the current system of healthcare throughout the country.

## Recommendations

This paper explores the various smart health applications available in the market, how they improve the service and quality of the healthcare industry, and their impact on customer satisfaction. It was established that the customer satisfaction was directly related to the service quality of the hospital. The next-generation hospitals that uses technology to improve the quality of care, patient safety, experiences, and productivity has a higher chance of acceptance in the market. Healthcare institutes should adapt ICTs such as 5G and IoT to improve their medical services.

From the above study, it was suggested that the healthcare management adopt certain strategies to improve their customer satisfaction while adopting smart technologies

- Communication with patients encourages better feedback. Through interpersonal communication, the management can reveal the customer expectations. Also, it is noted in the study that patients are generally unaware of the updates in technology adapted by the hospitals. Hence it is evident that customer care needs to adopt methods to reach out to general public. Safe communication between all stakeholders, including patients, caregivers, and medical staff should be possible. Patients prefer to get a copy of their health report digitally.
- The hospital environment has a major role in customer service. The physical environment of the hospital, company culture all have a challenging role in their productivity.
- The information generated in the hospital should be paperless, autoformatted and saved in a structured format, and to retrieve for analysis whenever possible
- The management should train their workforce to introduce policies and processes that embrace the use to AI in their service.
- The market size of the smart hospitals should be increased through various policies and revitalize the healthcare ecosystem.

The Indian Government has recently introduced the **AYUSHMAN BHARAT DIGITAL HEALTH MISSION**, which is an open network designed to bring about a healthcare revolution in India. Some of the key points of this mission are:

- All healthcare centers in the country will register under the Unified Health Interface (UHI). All existing medical history is entered into the UHI application.
- All citizens will be given a health card which will be used to register.

- All reports and data of the patients will be available and updates in one platform which can be retrieved from any health center across the country.
- The UHI app will give the customer information regarding the treatment facilities available in each health centers, ambulance facilities, teleconsultation, and home visits available, as well as the availability of drugs in each pharmacy.
- UHI helps the patient to choose the right insurance scheme using the health score of the health card. This eases the insurance policy for patients as well as the insurance providers.
- The UHI database can help the government rule out effective public welfare scheme. In case of epidemic it is convenient for the government to address the affected region and execute the medical management.

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