

iOT an Emerging Technology in Healthcare

By

Manjurika Das

*Dissertation submitted in partial fulfillment of the requirements of the degree
MBA Hospital and Health Management*

Academic year, 2018-2020



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TO WHOMSOEVER MAY CONCERN

This is to certify that Manjurika Das student of MBA Hospital & Health Management from The IIHMR University, Jaipur has undergone internship training at DayToDay Health India. Pvt. Ltd. from 10/02/20 to 15/05/20

The Candidate has successfully carried out the study assigned to her during internship training and her approach to the study has been sincere, scientific, and analytical.

The Internship is in fulfillment of the course requirements.

I wish her all success in all her future endeavors.

Dean, Academics and Student Affairs

The IIHMR University, Jaipur

Professor

The IIHMR University, Jaipur

THE IIHMR UNIVERSITY, JAIPUR**CERTIFICATE BY SCHOLAR**

This is to certify that the dissertation titled ***iOT an Emerging Technology in Healthcare*** and submitted by **Manjurika Das**, Enrollment No. **0770** under the supervision of Dr. S.D. Gupta for award of MBA in Hospital & Health Management at University carried out during the period from 10th February, 2020 to 15th May, 2020 embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other institute or other similar institution of higher learning.

Manjurika Das**Signature**

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DTDHI Health India Private Limited



The certificate is awarded to
Manjurika Das

In recognition of having successfully completed her Internship and her project on "IOT an
emerging technology in healthcare"

She comes across as a committed, sincere & diligent person who has a strong drive and
zeal for learning

We wish her all the best for her future endeavors

Authorized Signatory

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I would like to extend our sincere and heartfelt thanks to **Mr. Prem Sharma, CEO, Dr. Vishnu Vardhan, COO** of DayToDay Health for providing me an opportunity to learn and develop professionally.

I extend my regards to **Ms. Ragini Rana, Director of Product Department** for being constant support and guidance and sharing her expertise and knowledge.

I am grateful to the entire employee of Product Department and the entire stuff of DayToDay Health, who helped us to complete this project directly or indirectly.

I also express my special thanks to **Dr. S.D Gupta and Dr. Nutan.P.Jain** for their guidance throughout the training period.

Lastly, I would like to thank my family for their constant support and for keeping me motivated throughout the journey.

BACKGROUND

Dissertation Period

Every day, life presents me with another test and new chances. Every day encourages me to learn and prepare more. Preparing is a learning procedure of creating aptitudes, information, improving one's capacities, efficiency and execution.

I got this great chance to do thesis preparing (February 10th to May 17st, 2020) in **DayToDay Health, Bengaluru**. This preparation gave me an introduction of getting the hang of, observing and supervision. I was relegated various errands every day for these overviews. It helped me to comprehend the subtleties of preparing the field examiners. I am certain this learning at dissertation preparing will help me in future.

Date	Task assigned	Objective
10th to 28th February	Orientation of all the departments	To know about the work done by all the departments of the company.
2nd March	Assigned with the mentor and understanding the overview of Product Department.	To know about the Product Management team.
3rd to 6th March	Market Research and Competitive Analysis	To learn the market scenario of IoT devices
7th to 11th March	Interview Plans (Approval of Questionnaire)	For Data Collection
12th to 19th March	Data Collection from the patient	For Research
19th to 21th March	Interview Plan for Doctors	For Research
23rd to 25th March	Data Collection from the doctor	For Research
26th to 10th April	Data Analysis using User Bit	Analysis
13th to 24th April	Recommendation	Proposed Solution for problems identified
27th April to 7th May	→ Escalation & Habit Building Process → Vital Assessment Tool	Implementation
8th to 13th May	→ Prototyping → Competitive analysis on the existing condition	User testing
14th to 20th May	Report Drafting	

ABSTRACT

iOT an Emerging Technology in Healthcare

This report is based on the Dissertation 2020 at DayToDay Health India Pvt. Ltd. includes all the tasks and activities which were covered from 10th February 2020 to 30th May 2020. **IoT** can automate patient care workflow with the help healthcare mobility solution and other new technologies, and next-gen healthcare facilities. **IoT in healthcare** enables interoperability, machine-to-machine communication, information exchange, and data movement that makes healthcare service delivery effective.

The study is being conducted in Bangalore city for my dissertation project. As it will be a qualitative study, the focus will be on the patients of Tier 1 and Tier 2 cities suffering from any pre-existing conditions (diabetic, hypertension/hypotension) and patients of DTDHI and record their perception of adopting IOT devices for their vital tracking. General patients having Diabetes /Hyper/Hypotension along with some of the patients of DTDHI will be the focus of the study.

The important two parameters which will be used for selection of the respondent will be based on-

1. Those respondents who are general patients suffering from diabetes and blood pressure.
2. Those respondents who are critical patients, example gone under any surgical procedure (CABH/TKR)



END TO END PATIENT ENGAGEMENT SOLUTIONS

DayToDay Health provide step-by-step, tailored care journeys for hospitals to guide patients throughout the preparation and recovery process.

MISSION

To become the gold standard in patient-centered care



Because most care journeys reach beyond hospital walls, patients are often inadequately supported in the preparation and recovery phases that will determine the quality of their treatment outcomes. DayToDay Health™ equips hospitals to unleash the full potential of their caregiving teams to transform patients' lives.

Benefits

- ✓ Scale guidance
- ✓ Treat Holistically
- ✓ Reduce avoidable readmissions
- ✓ Detect Problems early

What do DayToDay Health Do?



Pre-procedure care

Patients are guided through all the tests, tasks, information and mental preparation they need to be fully ready for their procedure.



Remote Care

Treatment-specific assessments and symptom monitoring equip caregiving teams to manage patients who have returned to their lives beyond hospital walls.



Post- procedure care

After patients are discharged, guiding them on a daily, step by step basis, with nurses checking in to answer questions and look out for any concerning symptoms.



Psychological Support

Guiding patients through condition specific support modules such as mindfulness and breathing exercises and provide compassionate and open support through our nurse care coaches.



Seamless Registration

Onboarding patients with minimal disruption to hospital workflow and manage care journeys in step with provider- side updates.



Rehabilitation

When patients need to follow a rehabilitative protocol such as physiotherapy or cardiac rehab, we continue to support them with tools tailored to their care journey needs.

Features:

- ✓ Holistic Care plans and communications
- ✓ Expert Care coaches
- ✓ Dynamic Patient Journeys
- ✓ Critical Metrics Tracking

PROJECT DETAILS

IOT An Emerging Technology in Healthcare

INTRODUCTION

The Internet of Things (IoT) has become industry-skeptic language to depict how innovation is right now being implanted in different markets, including medicinal services, and developing how business is directed. The IoT has advanced the way partners right now communicate with and will keep on smoothing out the procedures engaged with cutting edge medicinal services work. IoT in medicinal services encourages ordinary yet significant undertakings to improve quiet results and takes a portion of the weight off wellbeing specialists. Undertakings, for example, remote patient checking, treatment progress perception, and the lodging of immunizations are altogether abilities of clinical gadgets with coordinated IoT.

The IoT is depicted as a system of physical gadgets that utilizes network to empower the trading of information. Organizations that spend significant time in social insurance or innovation will in general intensely put resources into IoT. At present, most tech gadgets accompany some type of availability, from wearables, for example, biosensors to X-beam machines with Wi-Fi or Bluetooth. IoT-empowered clinical gadgets give basic information that help wellbeing specialists play out their employments.

All inclusive, wellbeing and clinical consideration administrations are confronting enormous difficulties, for instance, taking off costs, a maturing populace, an expansion in the pervasiveness of ceaseless or potentially different conditions, and a deficiency of talented medicinal services experts. Likewise, customary consideration administrations depending by and large, and additionally subjective information and a one-size-fits-all endorsing approach don't function admirably.

In this specific circumstance, the utilization of IoT in social insurance administrations tends to a significant number of these difficulties by offering the highlights, for example, Seamless combination with different existing advances, Support of large information preparing and examination, Personalized administrations, Remote and continuous checking based associated medicinal services administrations, Quantitative information, which offer more powerful administrations than subjective information, Interactive and ongoing cooperation between human services experts and patients, Ubiquitous access to administrations, Efficient administration of social insurance assets. Every one of these highlights of the IoT-based arrangements will disturb the human services industry by offering different administrations. These administrations can be seen and served in two unique conditions. One is Hospital and facilities and the other one is Non-clinical patient conditions

- **Smart hospitals:** Globally, in both created and creating nations, medical clinics are stuffed with patients. Likewise, they have a lack of assets—including talented experts—and hardware. Remote checking of old patients and those with incessant infections can incredibly diminish social insurance related expenses and improve personal satisfaction for the two patients and

medicinal services experts. Shrewd and associated ambulances can offer on-armada brief and crisis benefits and decrease crisis administrations related episodes. In a working room, associated specialists, staff, and clinical gadgets can offer a superior and smoother working condition.

- **Clinics:** Numerous individuals go to a general professional (GP) practice or facility for essential consideration administrations. These specialist organizations can likewise profit by utilizing IoT applications. For instance, a GP can see and examine for all intents and purposes the patient's pathology report, which spares time for the two gatherings. Significantly, patients will get more opportunity for care-related conversations than data gathering. Facilities can confirm protection inclusion for patients continuously. Arrangement the board in facilities and GP rehearses is a worldwide test. This circumstance can be improved by IoT-based applications.
- **Non-clinical patient environments:** Two potential application zones of IoT could be associated—the patient and the shrewd home. Offering checking and medicinal services administrations to old individuals is an incredible test around the world. Brilliant home arrangements can improve existing administrations and offer new administrations for these profoundly helpless individuals through fall discovery, medicine updates, telemedicine, and general helped living.

Web has changed the way we live. Even though the web seems, by all accounts, to be all over the place, the quantity of associated gadgets/objects is similarly lesser than those that are not associated. The coming upset will result from the need of supplanting detached articles with associated ones, and making these items perpetually wise, and mindful of their environmental factors (utilizing sensors). Utilizing the advancements that let individuals overall offer inviting updates and chitchat, the specialists, paramedics and diagnosticians are meeting up to bring 'distributed computing', the matter of utilizing Internet-based applications to store, recover and insightfully use information to the universe of medication.

IMPORTANCE OF IOT

The web of things assists individuals with living and work more astute, just as deal with their lives. Notwithstanding offering brilliant gadgets to mechanize homes, IoT is basic to business. IoT furnishes organizations with a continuous investigate how their frameworks truly work, conveying bits of knowledge into everything from the presentation of machines to flexibly chain and coordination's activities.

IoT empowers organizations to mechanize forms and lessen work costs. It additionally eliminates squander and improves administration conveyance, making it more affordable to make and convey merchandise, just as offering straightforwardness into client exchanges. In that capacity, IoT is one of the most significant advances of regular daily existence, and it will keep on getting steam as more organizations understand the capability of associated gadgets to keep them serious.

APPLICATIONS OF IOT IN HEALTHCARE

IoT has also introduced several wearables & devices which has made lives of patients comfortable. IoT changes the way the facilities are delivered to the healthcare industry. These technologies improve the product, causing a larger effect by bringing together minor changes.

Medical Devices	Systems and Software	Services
Wearable External Medical Devices Implanted Medical Devices Stationary Medical Devices	Remote Device Management Network Bandwidth Management Data Analytics Application Security Network Security	Deployment and Integration Consulting Support and Maintenance Connectivity Technology

Transforming Indian Healthcare – IoT a game changer, a recent report by PwC forecasts the Mobile Health (mHealth) market in India to be worth \$0.6 billion by the end of 2017. Germany based Beurer GmbH has launched new tech-friendly health and well-being products like Bluetooth-enabled sleep sensor, digital blood pressure monitors, digital BMI weighing scales and mobile ECG device.

Companies Manufacturing Medical Devices For Vital Monitoring

COMPANY	CUSTOMERS	PRODUCT LINE ⁱ	FEATURES ⁱⁱ	PRICE ⁱⁱⁱ	CHALLENGES
Azoi (B to C)	iPhone users	Wello simple Iphone case Kito + for Iphone available in US	<u>iPhone</u> cover with built-in <u>circuitry</u> and <u>sensors</u> that is able to track a variety of <u>vital signs</u> such as <u>blood pressure</u> , <u>heart rate</u> , <u>blood oxygen level</u> , <u>body temperature</u> and <u>ECG</u> (with in 1 min)	12000 Around 10000	Designed to suit iPhone users Switching to android is difficult. Price is an issue

Cooley (B to B to C)	Diabetes Management Company Cardiac Care Company Rehabilitation & Therapy Company and Home Health Agency	Application Smart Devices	App with smart voice assistant 'Maya, Alexa skills incorporated for bed-side assistance, Clinicians dashboard, patient and kin dashboard, smart Bluetooth enabled devices like BP monitor and Weighing Scale for care coordination & remote health monitoring	App free installation Body analyser 3699/- Bp monitor 3950/-	Adoptability Awareness Acceptability Cost factor Brand image
Arcatron Mobility (B to C and B to B to C)	Diabetic patients	i-SENS Cool Blood Glucose Monitor	COOL Glucometer is the most reliable and affordable glucometer by I-SENS Korea. Has long battery life.	1200/-	Multiple pricking required to get accurate result time consuming

COMPETITIVE ANALYSIS: IOT PLAYERS IN INDIAN MARKET

Glucose monitors in the market

Indicate most dangerous scenario, patient could become unconscious. Blood-glucose readings taken are classified into seven:- Low 3- Less than 20 mg/dl; Low 2- Between 20 and 69 mg/dl; Low 1- Between 70 and 99 mg/dl; Normal- Between 100 and 162 mg/dl; High 1- Between 163 and 299 mg/dl; High 2- Between 300 and 600 mg/dl; High 3- More than 600 mg/dl. ^{iv}

	Company	Price
1	One touch	730 – 1450/-
2	Accu check	1336 – 1395/-
3	Allevia	600/-
4	On call plus	699 – 4400/-
5	Apollo sugar glucome	2859/-
6	Cool	1200 – 3000/-
7	Dr. Morepens	904 – 574/-
8	Contour plus one	980 – 1423/-
9	Dr. trust	1199 – 1800/-
10	Dario Blood Glucose Monitoring System	2217/-
11	<u>Contour Next One Smart Meter</u>	499/-

Glucose monitoring devices	Challenges
Accu check ^v	Display E-9 Errors (indicating batteries need to be replaced), Show unexpected low battery icons, Have short battery life Not power on
One touch ^{vi}	Inaccuracy in measuring levels, Insulin management, Lack of awareness among patient about inference.

BP monitors in the market

Pulse is estimated in units of millimeters of mercury (mmHg). The readings are constantly given two by two, with the upper (systolic) esteem first, trailed by the lower (diastolic) esteem. In this way, somebody who has a perusing of 132/88 mmHg (frequently spoken "132 more than 88") has a

- systolic blood pressure of 132 mmHg, and a
- diastolic blood pressure of 88 mmHg.^{vii}

	Product ^{viii}	Price
1	Omron HEM 7120 Blood Pressure Monitor	1545 – 4005/-
2	Health Sense Blood Pressure Monitor	1299 – 9410/-
3	Dr Trust Automatic Talking Digital Blood Pressure Monitor	1599 – 3995/-
4	Dr. Morepen Extra-large Blood Pressure Monitor	899 – 3299/-
5	Citizen CH432 Digital Blood Pressure Monitor	1350 – 2450/-
6	Omron 10 Series	7000 – 8000/-
7	1byone Bluetooth Digital Blood Pressure Monitor	2510/-
9	iHealth Feel Wireless Blood Pressure Monitor	5535/-
11	Welch Allyn Home Series	13002/-
12	Rossmax AU941f 7/14 Blood Pressure Monitor	1499 – 3200/-

BP monitoring devices	Challenges
Omron ^{ix}	Issues with app installation, lack of data synchronization
Dr. Morepen ^x	store only last measured data and the cuff is not placing perfectly on arm

Wearable Devices in the market

1	Wearable Fitness Trackers ^{xi} • Fitbit • Samsung • Garmin • Xiaomi Mi bands • Huawei • Honor band	Price 5697/- 2490/- 7990/- 1200/- 1699/- 1899/-
2	Smart Health Watches ^{xii} • TagoBee Fitness Tracker • Apple watch • AQFit M2 • Fastrack Reflex 2.0 • Noise Color fit • Samsung Gear Fit 2 Pro • Fitbit Charge 3	Price 2662 20900 2499 1695 1699 8999 11999

Trackers	Price	Challenges
• Xiaomi Mi bands ^{xiii}	1200/-	Low global market share Data privacy issue Dependency on sales
• Samsung ^{xiv}	2490/-	Low quality Does not has own OS Huge competition
Watches ^{xv}		Challenges
• Apple watch ^{xvi}	20900/-	Cost is high Replaced by the substitutes at cheap rates
• Fitbit Charge 3 ^{xvii}	11999/-	Inaccuracy steps are measured not by a physical step, but by wrist movement. Smaller competitors and apple treat

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IOT BENEFITS TO ORGANIZATIONS

The internet of things offers several benefits to organizations. Some benefits are industry-specific, and some are applicable across multiple industries. Some of the common benefits of IoT enable businesses to:

- monitor their overall business processes;
- improve the customer experience (CX);
- save time and money;
- enhance employee productivity;
- integrate and adapt business models;
- make better business decisions; and
- generate more revenue.

IoT encourages companies to rethink the ways they approach their businesses and gives them the tools to improve their business strategies.

Generally, IoT is most abundant in manufacturing, transportation and utility organizations, making use of sensors and other IoT devices; however, it has also found use cases for organizations within the agriculture, infrastructure and home automation industries, leading some organizations toward digital transformation.

IoT can profit ranchers in horticulture by making their activity simpler. Sensors can gather information on precipitation, stickiness, temperature and soil content, just as different variables, that would help robotize cultivating procedures.

A home mechanization business can use IoT to screen and control mechanical and electrical frameworks in a structure. On a more extensive scale, brilliant urban communities can assist residents with lessening waste and vitality utilization.

IoT touches every industry, including businesses within healthcare, finance, retail and manufacturing.

1. Simultaneous reporting and monitoring

Constant checking by means of associated gadgets can spare lives in occasion of a health-related crisis like cardiovascular breakdown, diabetes, asthma assaults, and so forth. The IoT gadget gathers and moves wellbeing information: pulse, oxygen and glucose levels, weight, and ECGs. These information are put away in the cloud and can be imparted to an approved individual, who could be a doctor, your insurance agency, a taking an interest wellbeing firm or an outside specialist, to permit them to take a gander at the gathered information paying little heed to their place, time, or gadget.

2. End-to-end connectivity and affordability

IoT can mechanize tolerant consideration work process with the assistance medicinal services versatility arrangement and other new advances and cutting edge human services offices. IoT in social insurance empowers interoperability, machine-to-machine correspondence, data trade, and information development that makes human services administration conveyance powerful. Network conventions: Bluetooth LE, Wi-Fi, Z-wave, ZigBee, and other current conventions, human services faculty can change the way they spot sickness and afflictions in patients and can likewise enhance progressive methods of treatment. Thusly, innovation driven arrangement cuts down the expense, by chopping down superfluous visits, using better quality assets, and improving the designation and arranging.

3. Data assortment and analysis

IoT devices can assemble, report and assessments the data ceaselessly and cut the need to store the unrefined data. This all can happen overcloud with the providers simply picking up permission to convincing reports with outlines. Additionally, social protection undertakings license relationship to get basic therapeutic administrations examination and data driven encounters which quicken dynamic and is less disposed to botches.

4. Tracking and alerts

On-time alert is fundamental in event of hazardous conditions. Clinical IoT contraptions amass significant data and move that data to pros for progressing following, while simultaneously dropping notification to people about fundamental parts by methods for adaptable applications and other associated devices. Reports and alerts offer a firm contribution about a patient's condition, paying little heed to spot and time. It in like manner empowers choose to proficient decisions and give on-time treatment. In like manner, IoT enables progressing disturbing, after, and watching, which awards hands-on drugs, better accuracy, capable intervention by authorities and improve all out patient thought transport results.

5. Remote medical assistance

In occasion of a crisis, patients can contact a specialist who is numerous kilometers away with a shrewd versatile application. With versatility arrangements in human services, the doctors can in a flash check the patients and distinguish the infirmities in a hurry. Likewise, various social insurance conveyance binds that are determining to manufacture machines that can appropriate medications dependent on patient's remedy and illness related information accessible by means of connected gadgets. IoT will Improve the patient's consideration in medical clinic. This thusly, will cut on individuals' breadth on medicinal services.

REVIEW OF LITERATURE

1. Evaluating the different technologies and components of the Internet of Things for better health. By Saraju P. Mohanty, and Madhavi K. Ganapathiraju, January 2018

The article is provided with an intensive survey on the current research trends reflecting the challenges and opportunities available in smart health care. Needleless and cost-effective health-care solutions have always been in great demand. The transition toward smart health-care services may be a slow and steady process. But, this is often mainly because, the health-care professionals have to be constantly educated and convinced to adapt to the digital era. By bridging the gap between researchers and health-care professionals, more research problems and diseases could be addressed, and smarter lifestyles could be adapted.

2. A Review on IoT based m-Health Systems for Diabetes. By Sankalp Deshkar, Thanseeh R. A. and Varun G. Menon, January 2017.

It is fact now days that diabetes is a major chronic disease problem worldwide with major economic and social impact. Undertaking the technology advancements and value reduction in wireless networks and web technologies, numerous electronic/mobile health (e/mHealth) applications is being proposed over these years. In recent years, more

sophisticated eHealth applications are being suggested and successfully implemented, Undertaking the technology advancements and value reduction in wireless networks and web technologies. After reviewing the gaps and challenges faced by the modern applications. Finally, it was suggested possible solutions and future research directions in Internet of Things.

3. IoT Driven Healthcare System for Remote Monitoring of Patients. By Prashant Salunke and Rasika Nerkar, June 2017

Use of Intel Edison provides multi-tasking capability and reduce the power consumption. The proposed method is useful for doctors who are overwhelmed with patient load and beneficial for rural patients who have less access to health care facilities. This IoT based system not only provides an accurate diagnosis of the user's condition, but somewhat an answer, that detects and prevents any adverse health event by carefully following, capturing, and describing the health trends recorded from physiological and contextual sensors.

4. Glucose Meters: A Review of Technical Challenges to Obtaining Accurate Results by Ksenia Tonyushkina, M.D.1 and James H. Nichols, July 2009

Establishing glucose meter accuracy is challenging. Technical accuracy for glucose meters is defined by comparing meter results against clinical laboratory methods that use plasma/serumbased samples. There is no consensus among standards organizations and professional societies, however, for acceptable performance criteria. While technical accuracy defines meter performance, clinical accuracy establishes how treatment decisions agree between meter results and laboratory glucose results. Several factors can affect the accuracy of glucose meter results, including operator technique, environmental exposure, and patient physiologic and medication effects.

5. IoT-Cloud based framework for patient's data collection in smart healthcare system using Raspberry-pi by Kavita Jaiswal, Srichandan Sobhanayak and Bhabendu Kumar Mohanta, 2017

The rise of internet of things has lifesaving application within the healthcare industry by collecting data from bedside devices, viewing patient information and diagnosing in real time. The proposed solution is grounded on how data is integrated with IoT based healthcare system utilizing the raspberry pi and docker container. Raspberry Pi capture and Record the medical data through the sensors attached. The data provided through apps improves the health of the patients. Potential future work may include Location Aware Applications for mobile devices which exploit location information for patients, to come up with a personalized information or alerts regarding the patient.

6. Wearable Technology: If the Tech Fits, Wear It by Robin Wright & Latrina Keith, December 2014

“Wearable technology” and “wearable devices” are phrases that describe electronics and computers that are integrated into clothing and other accessories that can be worn comfortably on the body. While these technologies show great influence in fashion and entertainment, they have the largest impact in the areas of health, medicine, and fitness. Although hand-held devices such as mobile phones are very much engrained in our culture and society today, wearable technology is gaining a place in our society and reshaping our technological scene. Health care workers, educators, and librarians have just begun to scratch the surface of the potential uses of this emerging technology.

7. Wearable Health Devices—Vital Sign Monitoring, Systems and Technologies by Duarte Dias, ID and João Paulo Silva Cunha, July 2018

Wearable health devices are a recent reality in healthcare and still under development with the aim to be integrate in medical health systems. There are some personal monitoring devices on the market capable to provide instantaneous single-parameter assessment and transmission. With new advances in new materials, electronics and telecommunication information technology, together with the entry of big multinational companies, such as Google, but also of small startups, WHDs are expected to overcome their challenges and enter in the consumer market with a higher impact in the following years

RATIONALE:

The aim of the study is to analyze IOT in healthcare from the viewpoint of the product planning, implementation and evaluation in the project. DayToDay patients are expected to track their vitals daily for effective outcome. Having said so, some patients do not record their vitals daily, hence vital inform is not always shared. DayToDay Patients are added to a monitoring care plan who have been assigned to the DayToDay Nurses (Certified and experienced). These nurses track patients’ vitals by manually capturing them under progress note or by calls.

This leads to:

- A. Manual Capturing of such information’s for every patient, hence not scalable.
- B. Incorrect Transfer of patient data that can potentially hamper overall patient outcome if not addressed in time.

RESEARCH QUESTION:

How do DayToDay Patient track and manage their vitals along with the challenges faced by the Patient & Nurses in recording them - Can these issues be addressed adopting IOT devices as a product?

OBJECTIVES:

Broad Objective

- To understand the perspective of Doctors, Patient and Care Givers on Vital Monitoring

Specific Objective

- To identify the need for IOT as a product for vitals tracking.
- To study the existing market scenario of IOT devices.

METHODOLOGY:

Study Design: Non- experimental study

Study Location: DayToDay Health Bangalore

Sampling Method: Non-Probability sampling

Study Period: 3 months

Sample Size: the sample size for conducting survey is different for the different segment group for Patients: DTD (15) Non-DTD (11), Doctors (11), Care Giver (59), Care coaches (10).

Study Tool: The study will be conducted using a set of questionnaires for survey project.

The questionnaire included background information as well as open-ended questions enquiring about the participants' views on the development of project related activities. As it will be a quantitative study, the focus will be on understanding the perception that made them more adherent to use IOT devices for vital monitoring and what are the ideas coming through their mind while vital monitoring using IOT devices.

METHOD OF DATA COLLECTION

Data is collected using various methods In-Person interviews, Telephonic interviews, online interviews. For online interview, data is collected with a set of questions framed in Google form and the responses. Questionnaire – **Appendix-1 and Appendix-2**

Each respondent is selected based on the above criteria. The questions will be open ended questionnaire focusing on the use of IOT in healthcare. All the interview is conducted after taking proper informed consent from the respondent.

DATA ANALYSIS PLAN

Quantitative data would be analysed using data analysing software or MS excel. Qualitative data is analysed using a software called UserBit

Qualitative: Interviews and Userbit Tools

Quantitative: Percentage of existing DTD Patients tracked their vitals daily (source: product data amplitude)

USERBIT

UserBit is a real-time collaborative platform of tools that helps User Experience and product teams better understand business and customer needs. It lets you: Organize - interviews, feedback, audio, video, and notes. Synthesize - powerful qualitative analysis features like tagging, affinity diagrams, word clouds, and more. Leverage UX tools - easily create and share personas, journey maps, visual sitemaps and even case-study reports.

USERBIT FEATURES

KNOWLEDGE MANAGEMENT

- ✓ Cataloging/Categorizing
- ✓ Collaboration
- ✓ Content Management
- ✓ Full Text Search
- ✓ Knowledge Base Management
- ✓ Self Service Portal

QUALITATIVE MANAGEMENT

- ✓ Annotations
- ✓ Collaboration
- ✓ Data Visualization
- ✓ Mixed Methods Research
- ✓ Qualitative Content Analysis
- ✓ Text Analytics

USER EXPERIENCE

- ✓ Usability Testing
- ✓ User Journeys
- ✓ User Research

ETHICAL CONSIDERATION

All the interview will be recorded after taking proper informed consent from the respondent and thematic debriefing will be carried out simultaneously by the note taker.

FINDINGS

The data was analysed by using various survey questionnaire. Whereas the findings are based on the analysed data from each segment are as follows:

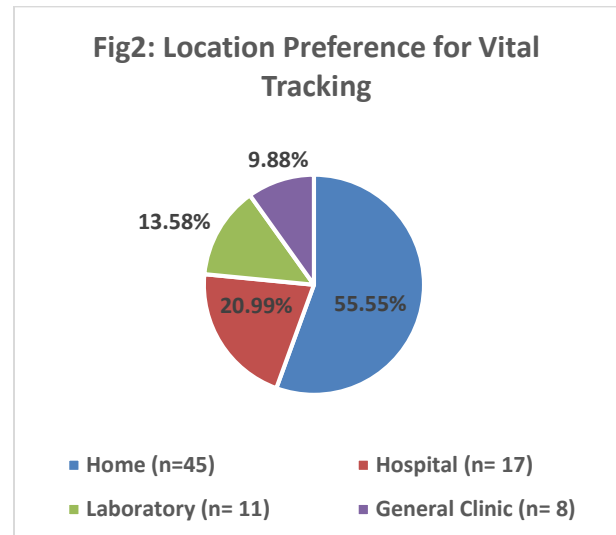
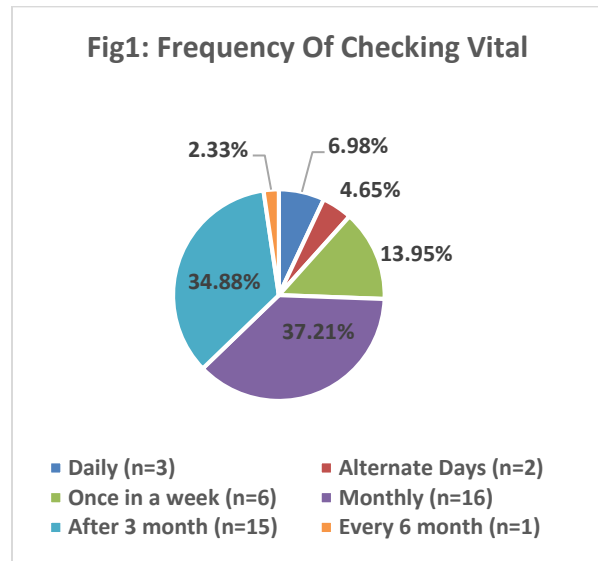
● Patient's Findings

After analysing the survey data broadly, we have come up with certain key findings which had been defined by the patient's perspectives. These defined areas also include certain parameters. First is Patients preference on VITAL TRACKING comparison between Non-DTD & DTD Patients, which is analysed based on following parameters such as frequency of checking vitals, Location preference of vital tracking

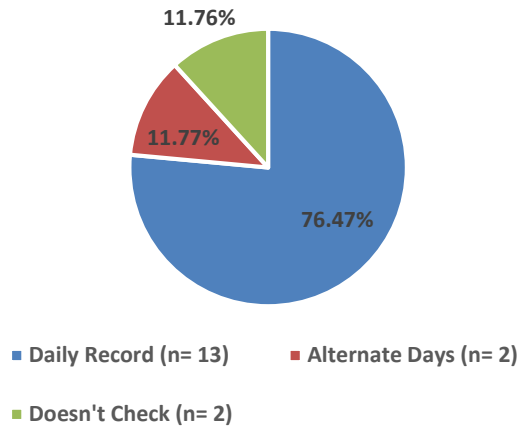
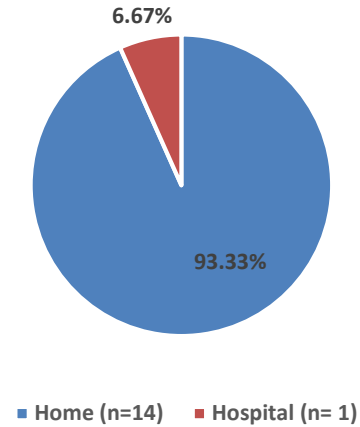
The seconds perspectives were to get VITAL REPORTING by the patients which includes following parameters such as Frequency of Vital reporting and preferred methods to report vitals. The insights as per the patient's perspectives are as follows:

A. VITAL TRACKING

Non-DTD Patients



- In reference to Fig.1, out of 43 patients only 3 patients prefer to check their vitals Daily and 2 patients check every alternate day. Rest 39 patients don't prefer to check their vitals daily.
- In reference to Fig.2, 45 patients prefer to monitor their vitals from home using monitoring devices like BP apparatus, CGM, etc. Rest 36 patient prefer to check their vitals visiting Hospital, Laboratory or General Clinic.

DTD Patients**Fig3: Frequency of Checking Vitals****Fig4: Preference of Vital Tracking**

- In reference to Fig.3, on comparison with the Non-DTD Patients, DTD patients are much more conscious on monitoring their vitals regularly, i.e. 13 patients out of 15 patients prefer to check their vitals daily. And Only 2 patients check every alternate day.
- In reference to Fig.4, 14 out of 15 patients monitor their vitals from home using required monitoring devices only 1 patient check vital visiting hospital.

B. VITAL REPORTING

Fig.5 Frequency of Reporting Vitals

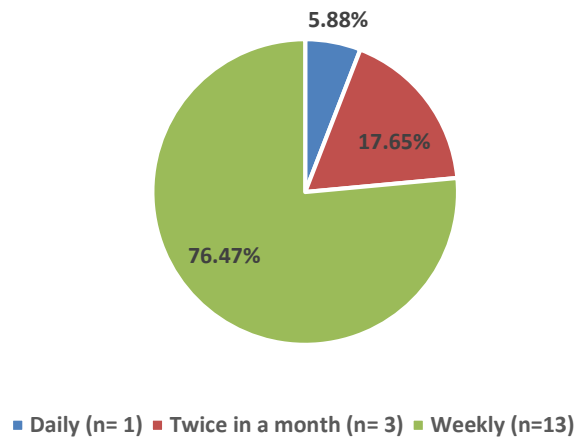
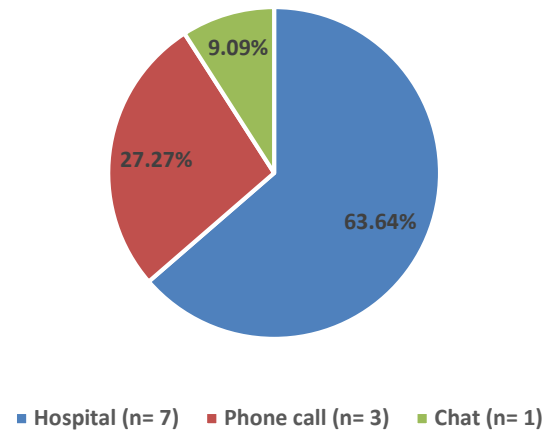


Fig.6 Preferred Method To Report Vitals



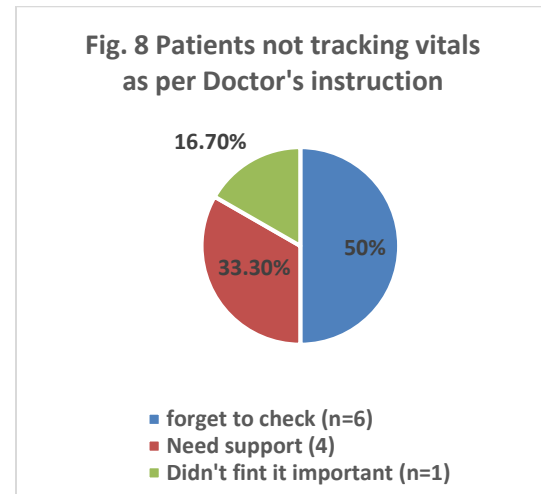
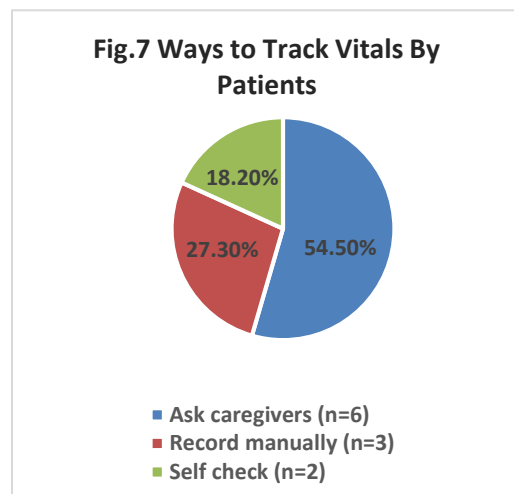
- In reference to Fig.5, 1 patient report his vital recording daily and rest 17 patients prefer to report their vitals either twice in a month or weekly.
- In reference to Fig.6, 3 patients prefer to report vitals through phone calls and 1 person through chat. Rest 7 patient report their vital reports by visiting hospital.

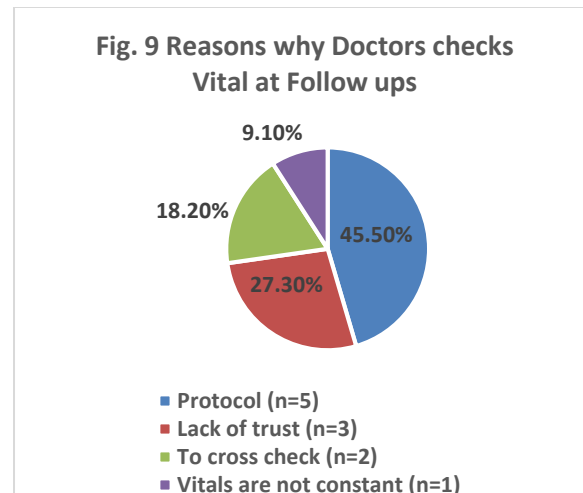
● Doctors finding

After analysing the survey data broadly, we have come up with certain key findings which had been defined by the doctor perspectives. These defined areas also include certain parameters. First is Doctors preference on vital tracking which is analysed based on following parameters such as ways to track vitals by the patients, reasons why doctors check vitals at follow up and patients not tracking vitals as per doctor instruction.

The seconds perspectives were to get the additional details for tracking vitals by the patients which includes following parameters such as pre-symptoms for BP patients and Pre-symptoms for the Diabetic patients. The insights as per the doctor perspectives are as follows:

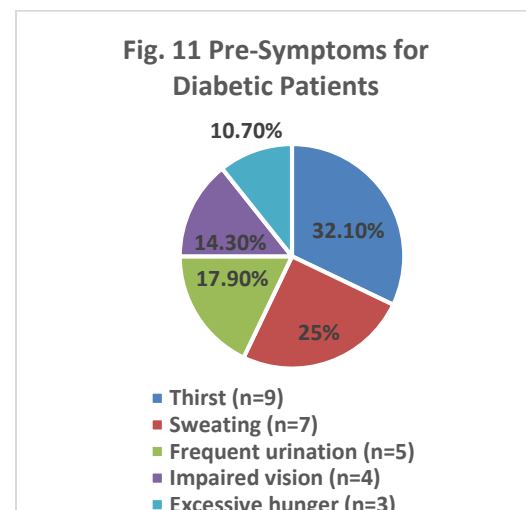
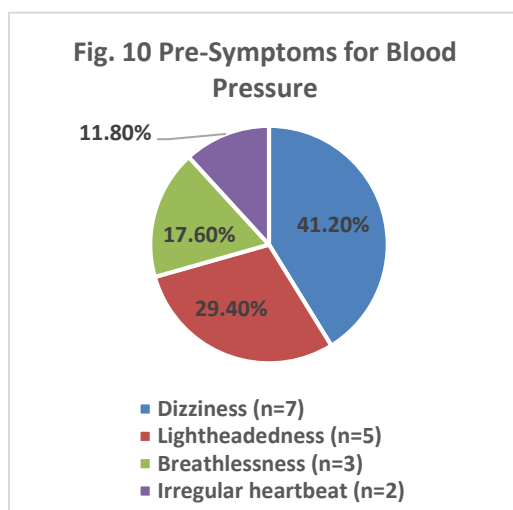
A. Vitals tracking: Doctor's preference





- In reference to Fig.7, 6 out of 11 Doctors ask caregivers to monitor and document patient's vitals as patients themselves are not able to track vitals
- In reference to Fig. 8, 6 out of 11 Doctors says, patient forget to check vitals as per the instructions and, they are dependent on caregiver's support.
- In reference to Fig.9, 5 out of 11 Doctors says, they check vitals at the time of follow up because of the protocol to ensure vitals are correct.

B. Vitals tracking: Additional details



- In reference to Fig.10, for additional details, 7 out of 11 Doctors has voted dizziness as the common pre- symptom to be observed among BP patients

- In reference to Fig. 11, for additional details, 9 out of 11 Doctors has voted thirst as the common pre- symptom to be observed among BP patients

A. Doctor's suggestion on tracking vitals

- 50% of the patients forget to check vitals themselves
- 33% of the patients need support with vitals tracking
- Doctor's ask **caregivers to record patients vital** at home.

B. Doctor recommendation tracking vitals at home: Use of IOT for vital tracking vs.. manual vital tracking (case)

7 out of 11, Doctors agree, use of IOT devices have challenges, such as lack of accuracy in results thus lacking trust.

But, 7 out of 11, Doctors also agree that, using IOT devices at home, reduces unnecessary visits to the hospitals and clinics. Thus, IOT devices helps in keeping eye on patients' daily vitals individually and helps in reducing the risk of adverse event in future.

Doctors also have patients who don't own, any monitoring devices and record vitals manually. They directly visit to the nearby general clinics or hospitals. Also, most of the patients are not aware of using IOT devices and are dependent on caregivers.

Overall preference is, only vital tracking is not enough, additional details are required such as diet intake, lifestyle activities of the patients

RESULTS

Patient Insights on IoT Devices:

Non- DayToDay Patient	DayToDay Patient
X Elders are asked to use the devices, they don't have any say → Because elderly group patients are not aware about the technology.	X Lack of time to track → Because patient need to travel a lot and don't get time for vital monitoring regularly.
X Low Adoption Rate → Because patients don't want to relay on the devices, as they think devices don't give accurate range.	X Don't have necessary devices to track vitals → Because patient never thought to get an IoT device for vital monitoring.
X Feels that it is not important to track → Because until and unless patients don't suffer from serious problem, they don't find it important enough to track vitals daily.	X Lack of Knowledge/Information → Because patients are not aware about the health monitoring IoT devices.

REASONS FOR NOT BUYING IoT DEVICES:

- X** Lack of Information/ education
- X** Lack of trust on the devices, hence, prefer to visit nearby clinics
- X** Lack of accuracy

Patient Insights on Monitoring Devices:

Non- DayToDay Patient	DayToDay Patient
✓ 59% of the diabetic patient use CGM digital monitoring device	✓ 65% of the diabetic patient use CGM digital monitoring devices
✓ 39% of the hypertensive patient use digital BP Apparatus	✓ 36% of the hypertensive patient use digital BP Apparatus
X 4 out of 11 patients do not use any digital monitoring devices	X 1 out of 15 patients do not use any digital monitoring devices

Note: % value of patients using monitoring devices is overall patients of the Non-DTD and DTD patients

Reasons for Buying Digital Monitoring Devices:

- ✓** Doctors Recommendation
- ✓** Purchased by Caregiver

RECOMMENDATION

The research survey was conducted to analyse the process of vital tracking as it was a matter of concern for DayToDay Care coaches. The patient vitals are documented manually under progress notes. After analyzing data, I came up with various parameters that are to be considered. The results showed that most of the patients do not use medical devices for vital tracking because they do not own any medical devices. Also, some of the patients who are owning medical devices are not using them to capture their vitals. Hence, we divided two categories for our recommendation, which are as follows:

For patients who have devices:

1. Increase Patient Engagement around tracking their health vitals on daily basis through our DayToday App.
2. Implement a Smart tracker and monitoring tool that uses vital trends and asks specific questions for determining faster and effective patient outcomes.
 - Building notifications around reminders for caregivers to track and share reports.
 - Add specific assessments around current state of patient vitals

For patient who don't have devices:

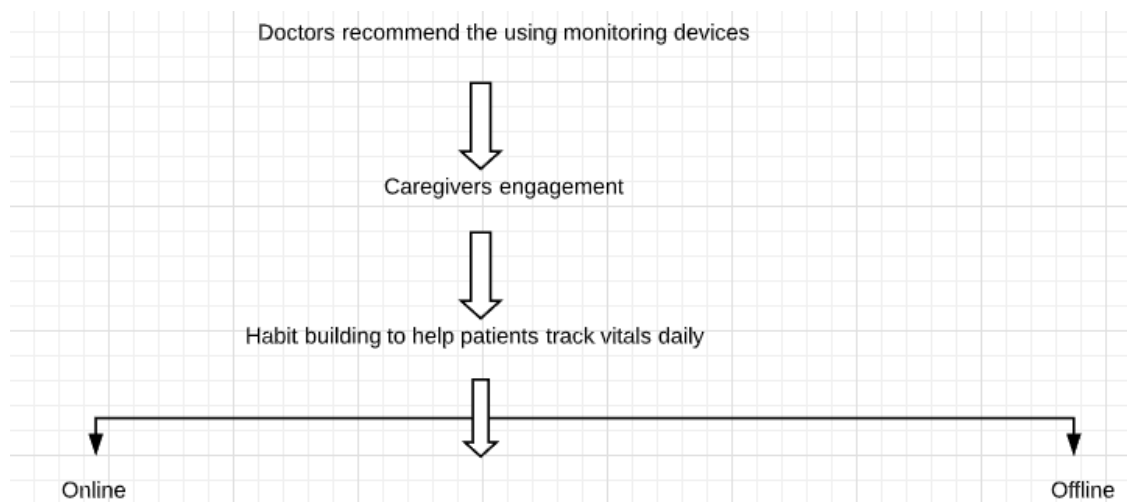
1. Build Caregiver's involvement around tracking patient vitals
 - Caregiver education
 - Access to vital information and reports
 - Reminders to keep a track on vital performance
2. Build awareness among patients around tracking vitals regularly –
 - Get patients invested & trained before they leave hospital by providing counselling to the family member for better health outcomes.
 - Help patients with the following during the different care plan stages to create a habit on -
 - What to buy
 - When to use
 - How to use

IMPLEMENTATION

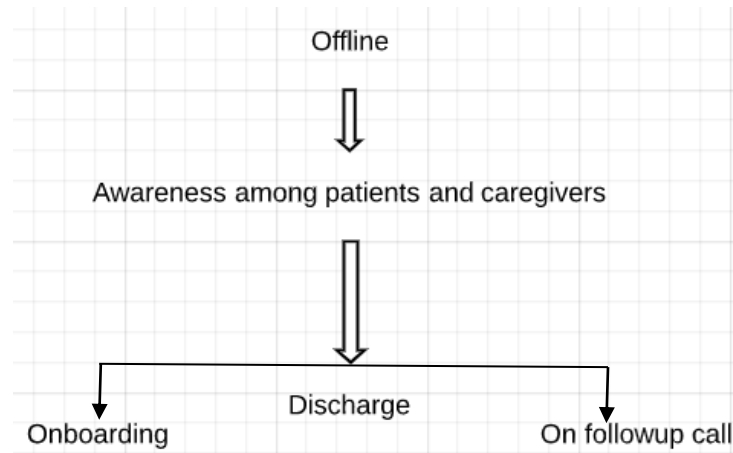
The implementation plan is based on the whole research that is, conducted to help care coaches improving DayToDay product services for better patient outcome. After the study, considering on the recommended points, we have come up with the following steps for the implementation workflow:

I. Habit Building Process

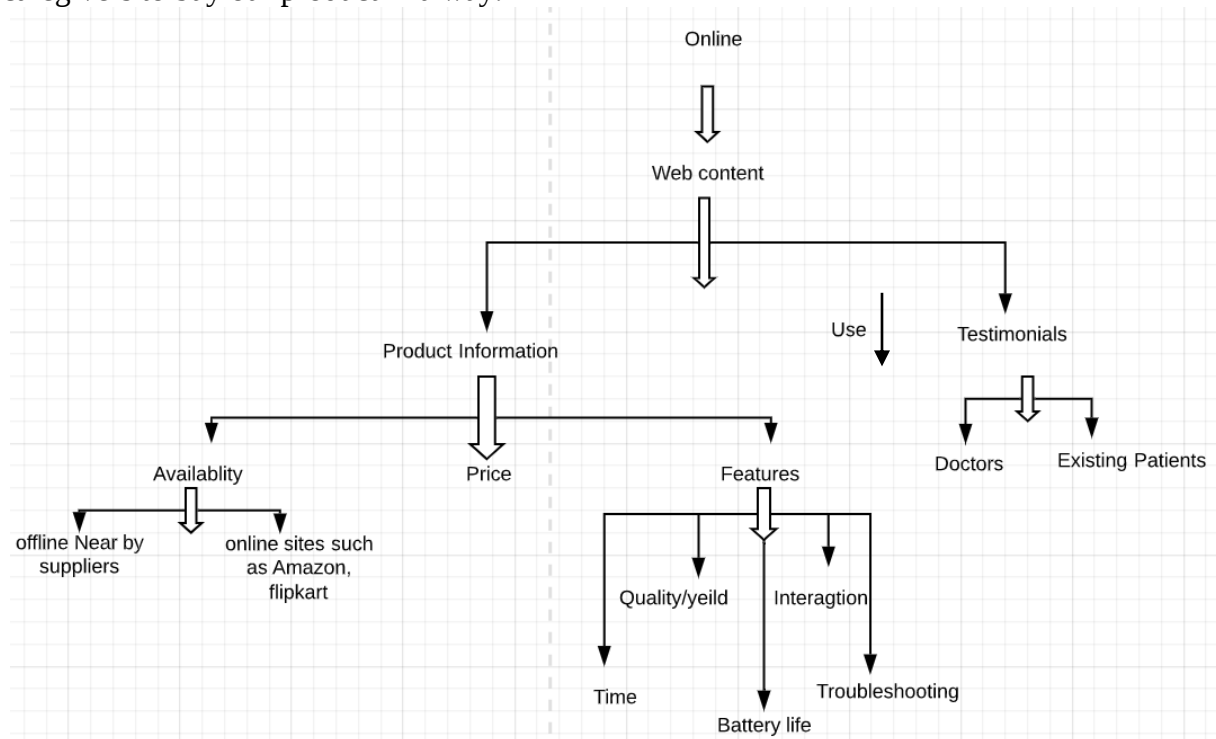
The workflow is designed for integrating existing application, which would in turn helps in creating habits of the patients to track their vitals on regular basis. This workflow is built based on Doctor survey data analysis and research recommendation.



The plan is to engage caregivers as suggested by the doctors for using vital monitoring devices for the patients. There are two ways of Caregivers engagement which can be seen in the flow chart given below:

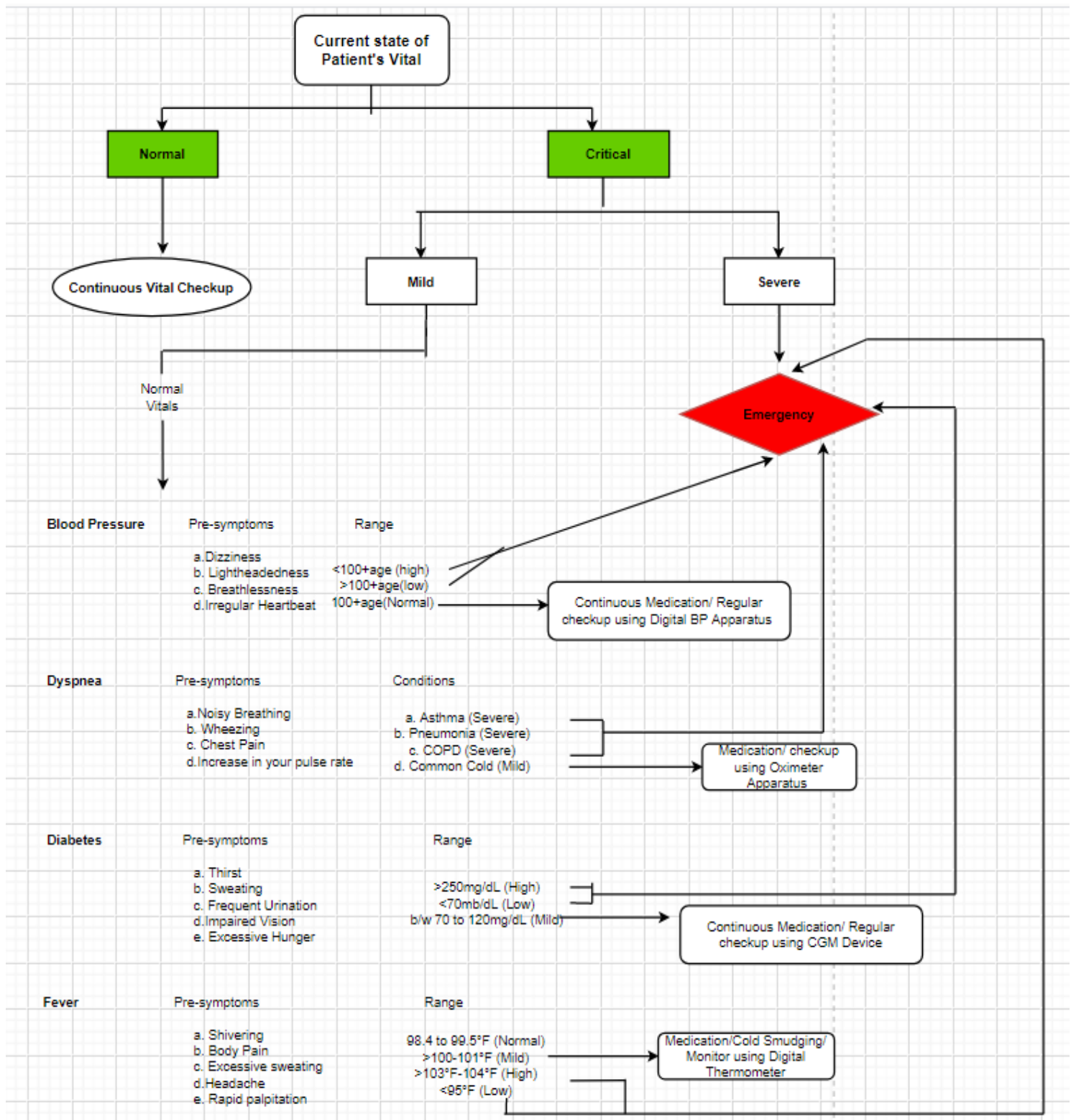


This flow chart shows the Offline way of educating caregivers and the patients. The patient's or caregivers can be approached at the time of pitching for the product. The education provided for improving health outcome can help the care managers to engage the patients. The awareness provided on why they need to track vital would encourage and increase the interest of patients or caregivers to buy our product in a way.



The other way of creating awareness is online, where the user will be provided with the required/customized information on vital tracking. The web content including the product information of various companies will help the user to purchase the vital tracking devices as per their willingness and requirement. The content will also include the testimonials based on the user experience on various devices in the market, existing patient's outcomes after using the devices and doctors' suggestions on the importance of vital tracking. Thus, in turn will help in building habit of user by throwing useful content.

II. Escalation Workflow



The escalation plan is to help care coaches better understand the patient's condition. This would help patients to reach out the facility or the doctors to avoid any adverse event post-surgical procedure. The patient would know when to approach for help directly to Doctors by regular monitoring their vitals. This escalation plan would help them to analyse the severity and emergency sign to reach for hospitals. Also, this escalation plan helps patients of unnecessary visits to the Doctors or Hospitals

III. Vital Assessment Tool

VITAL TRACKING

Q1. Have you been having fever or chills?

- ☐ 1 – not likely
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10 – extreme likely

Q2. Have you been having racing heart beats?

- ☐ 1 – not likely
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10 – extreme likely

Q3. Have you had any trouble breathing today?

- ☐ 1 – not likely
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10 – extreme likely

Q4. How often are you doing your breathing exercises and spirometry?

- ☐ 1 – not likely
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10 – extreme likely



ASSESSMENT TOOL

Based on Co-Morbidity

Q1. Did you check your temperature?

- ☐ Yes
- ☐ No

Q2. Are you following your diet s per instructions?

- ☐ Yes
- ☐ No

Q3. Are you checking your BP as per doctors' instructions?

- ☐ Yes
- ☐ No

Q4. Are you feeling Dizziness/Lightheadedness?

- ☐ Yes
- ☐ No

Q5. Are you feeling any anxiety?

- ☐ Yes
- ☐ No

Q6. Is your insulin level in normal state?

- ☐ Yes
- ☐ No

Q7. Is there any change in your urine frequency?

- ☐ Yes
- ☐ No

Q8. Are you feeling any increase in our appetite?

- ☐ Yes
- ☐ No

The vital assessment tool will help in daily monitoring of the patient's conditions post-discharge. As care coaches are manually recording the daily vitals of the patients. This tool will help in documenting the patient's daily condition. The assessment tool includes some basic question of the patient's daily recovery routine. The tool is designed using such question that would help the care coaches to provide better advice on any issues faced by the patients. And in case of any emergency what can be done. Thus, will reduce the duplication or error in data collection and guiding patient's

CONCLUSION

I observed that, IoT, for patient use at home, is not the preferred choice by patients or their families. Due to very low adoption rate of almost 10-15%, IoT as an integration in DayToDay is not a MUST-HAVE. Having said so, digital medical devices such as BP Apparatus, Continuous Glucose Monitoring Devices, Pulse Oximeter, ECG, etc, are being used by most of the target population. With respect to patient adherence for vitals, our findings suggested that Doctors play in adoption and acceptance of digital medical devices is very high. Despite this, the discoverability of how to track vitals remain an issue. Patient's family members play an important role when it comes to decision making. Talking about how family members get devices, data says 24% of the patient take decision by themselves i.e., Self-Discovery and 50% dependents on Word of mouth by their Friends, Family and Other Sources.

Education and awareness around vitals tracking for patients at home are key to capturing reliable health data and in decreasing the possibilities of red alerts in time. Since the audience at home are patients themselves along with their families, they must be educated first with little support from Doctors. This way we ensure that everyone -is involved in patient care by helping patients and their families become active contributors in the patient's care.

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APPENDIX I

Questionnaire for Patient's and Caregivers:

Consent for using this survey information for studies it will take only 5 mins to fill the questionnaire.

1. Agree

2. Disagree

Caregiver Name _____

Patient Name _____

Patient relation with caregiver

1. father

2. mother

3. grandmother

4. grandfather

5. Uncle

6. Aunty

Patients Education

1. SLS

2. SSLs

3. Graduate

4. Masters

5. Illiterate

6. Other

Patients Profession

1. govt. employee

2. semi govt employee

3. Private. Employee

4. Self-employed

5. home maker

Patient Age (in years) _____

Patient Sex

1. Male

2. Female

Patients Language (preferred)

1. English

2. Hindi

3. Kannada

4. Other

Patient City

1. Tire 1

2. Tire 2

3. Other

Any preexisting condition?

1. Diabetic

2. Blood pressure

3. both 1 & 2

4. High temperature

5. Low temperature

6. Breathing difficulty

Are you on any medication?

1. Yes

2. No

Do you check your vitals?

- 1. Yes** **2. No**

How frequently you go for general health vitas checkup?

1. Daily 2. Weekly 3. Monthly
4. After 3 months 5. Every 6 months 6. Yearly

Have you done your health checkup recently?

- 1. Yes** **2. No**

If no, why don't you check your vitals?

1. Are you not aware of checking vitals
2. You didn't find it important
3. Do you forget it
4. Other

From where do you get your general health (vitals) checkup?

1. Home 2. Laboratory 3. Hospital
4. General clinic 5. other, specify

If at home, which method you prefer to check (vitals)?

1. Digital monitoring Devices (BP, Sugar, respiration rate, pulse, weight, temperature)
2. Smart devices or Application (fit bits, smartwatch, sensor bands, google glasses)

Which digital monitoring device are you using?

1. Continuous Glucose Monitor (CGM)
2. Connected inhalers (spirometer)
3. Bluetooth-enabled coagulation system (detecting blood clot)
4. Digital bp apparatus
5. Digital thermometer
6. both 1 & 4

What is the frequency of using diabetes monitoring device in a day?

1. thrice a day 2. twice a day 3. once a day
4. alternate days 5. once in a week 6. once in a month
7. once in 3 months 8. once in 6 months 9. once in a year

What is the frequency of using BP monitoring device in a day?

1. thrice a day 2. twice a day 3. once a day
4. alternate days 5. once in a week 6. once in a month
7. once in 3 months 8. once in 6 months 9. once in a year

Do you know anything about smart (IOT) health monitoring devices? (applications, wearables or injectables)

- 1. Yes** **2. No**

If yes, how did you get to know about it?

- | | | |
|------------|-------------------|------------|
| 1. Friends | 2. Family | 3. Doctors |
| 4. Self | 5. Other, specify | |

Which (IOT) device are you using?

- | | | |
|----------------------|----------|------------|
| 1. Watches | 2. Bands | 3. Glasses |
| 4. Smart application | | |

How long do you use the (IOT) devices in a day?

- | | | |
|---------------------|---------------|---------------|
| 1. 0 to 2 hrs | 2. 3 to 5 hrs | 3. 6 to 8 hrs |
| 4. more than 10 hrs | | |

How far do you find it useful?

- | | | |
|---------------------|-----------------------|------------|
| 1. Highly satisfied | 2. Satisfied | 3. Neutral |
| 4. Unsatisfied | 5. Highly unsatisfied | |

which brand device are you using? (Open-ended)

Remarks/Observations_____

APPENDIX 2

Questionnaire for Doctors:

Do you recommend your patients to track vitals at home?

1. Yes 2. No

If yes, how do you prefer patients track their vitals at home?

1. Ask caregiver to record and share 2. Ask patients to record manually,
3. Ask them to use a monitoring device

If no, why?

1. it doesn't seem to be important 2. lack of patient's data recording accuracy

"Why do you think it's important to track vitals by themselves?"

1. Self-care (lifestyle awareness) 2. precautionary
3. Drug administering 4. Early warning of health status
5. Helps in recovery process

How does it help them?

1. Track & control their vitals 2. Maintaining diet, lifestyle and medicines
3. Improve health status 4. Mental peace
5. Independency

Do you think patient track vitals as per your instructions?

1. Yes 2. No

If no, why?

1. They need support 2. Do they forget to check
3. they don't find it important

Do you tell patients about pre-symptoms for monitoring BP and blood sugar level?

1. Yes 2. No

If yes, what are the pre-symptoms to be noted by patients to check Blood pressure?

1. Breathlessness 2. Fatigue 3. Anxiety
4. Light-headedness 5. Dizziness 6. All the above

If yes, what are the pre-symptoms to be noted by patients to check diabetes?

1. Sweating 2. Thirst 3. Fatigue
4. Impaired vision 5. All the above

Please specify is there are other Pre-symptoms for BP and Diabetes (Open Ended)

How frequently do the patients update you on their vitals?

- | | | |
|---------------------|-------------------|---------------------|
| 1. Daily | 2. Alternate days | 3. Weekly |
| 4. Twice in a month | 5. Monthly | 6. Once in 3 months |
| 7. Once in 6 months | | |

How they approach you?

- | | | |
|-------------------------------|---------------|-----------------------------|
| 1. Call | 2. Chat/Email | 3. Directly visit to clinic |
| 4. Directly visit to hospital | | |

Do you consider the vital recorded by the patients at home during follow up?

- | | |
|--------|-------|
| 1. Yes | 2. No |
|--------|-------|

Do you need any other information with the vital values recorded?

- | | |
|--------|-------|
| 1. Yes | 2. No |
|--------|-------|

Do you check vitals at the time of patient follow up?

- | | |
|--------|-------|
| 1. Yes | 2. No |
|--------|-------|

If yes, why?

- | | |
|------------------------------|--|
| 1. Is it a hospital protocol | 2. Don't you trust the IOT monitoring records by the patient |
| 3. Other | |

If other, please specify?

- | | |
|--|--|
| 1. Vitals are not constant | 2. For better patient's condition and recovery |
| 3. To ensure that vitals recorded by patients are true | |

Do you have patients who do not own any device?

- | | |
|--------|-------|
| 1. Yes | 2. No |
|--------|-------|

If yes, how do they track their vitals?

- | | |
|-------------------------------------|------------------------|
| 1. using monitoring devices at home | 2. Visit nearby Clinic |
| 3. Visit nearby hospital | |

Do you prefer any (IOT) monitoring device to your patients?

- | | |
|--------|-------|
| 1. Yes | 2. No |
|--------|-------|

If yes, do you find (IOT)smart monitoring device reliable?

1. Yes

2. No

To what extend do you find (IOT)smart monitoring device reliable?

1. Highly satisfied

2. Satisfied

3. Neutral

4. Unsatisfied

5. Highly unsatisfied

Which brand do you recommend for blood sugar monitoring?

1. Accu check

2. Dr. Morepens

3. One touch

4. Dr. trust

Which brand do you recommend for blood pressure monitoring?

1. Omron

2. Health sense

3. Dr. trust

4. Dr. Morepens

What are the challenges you feel using smart monitoring devices?

1. Don't trust

2. Lack of accuracy

How much do you find IOT devices useful to monitor patients vital, and thus reducing the unnecessary visits?

1. Strongly agree

2. Disagree

3. Neutral

4. Agree

5. Strongly Agree

-
- ⁱ <https://mycooey.com/#kinProduct>
- ⁱⁱ <https://arcatron.in/health-care-devices/medical-equipment/bp-monitor.html>
- ⁱⁱⁱ <https://gadgets.ndtv.com/wearables/news/cooey-iot-enabled-healthcare-devices-now-available-on-flipkart-767059>
- ^{iv} <https://www.healthline.com/health/type-1-diabetes-causes-symptoms-treatments#vs.-type-2>
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THANK YOU

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