

Knowledge and Acceptance of Medical Devices Used at Home During Covid-19 Pandemic in Tier 1 Cities of India

Dissertation submitted to



The IIHMR University, Jaipur

for the partial fulfilment for the award of the degree of

Master of Business Administration (MBA)

in

Hospital and Health Management

by

Dr. Shweta Shastri

Under the Supervision and Guidance of

Prof. Veena Nair

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled **Knowledge and acceptance of medical devices used at home during covid-19 pandemic in tier 1 cities of India** is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

Name of Student: Dr. Shweta Shastri

Date: 02/07/2021

CERTIFICATE

This is to certify that Dr. Shweta Shastri in partial fulfilment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur has successfully completed her/his internship at MarketsandMarkets Research Ltd. during March 22, 2021 to June 19, 2021.

Place: Pune

Date: 02/07/2021

Preceptor/Head of the Organization: Mr. Aashish Mehra

Name of the organization: MarketsandMarkets Research Ltd.

CERTIFICATE FROM FACULTY GUIDE

This is to certify that Dr. Shweta Shastri, student of MBA Hospital and Health Management from The IIHMR University, Jaipur has undergone internship training at MarketsandMarkets from 22/03/2021 to 19/06/2021.

The candidate has successfully carried out the study designated 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.

Prof. Veena Nair

Faculty Guide
IIHMR University, Jaipur
Date: 02/07/2021

Dr. Dhirendra Kumar

School Dean
IIHMR University, Jaipur
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Sincerely,

Dr. Shweta Shastri

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ABBREVIATIONS:

AED: Automatic External Defibrillator

COPD: Chronic Obstructive Pulmonary Disease

DHT: Digital Health Technology

ECG: Electrocardiography

HBPM: Home Blood Pressure Monitoring

HIV: Human Immunodeficiency Virus

LMIC: Low and Middle Income Countries

NCD: Non-Communicable Diseases

OSA: Obstructive Sleep Apnea

POC: Point of Care

STDs: Sexually Transmitted Diseases

WHO: World Health Organization

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1. INTRODUCTION

According to the World health Organization (WHO), medical device is defined as “any instrument, apparatus, implement, machine, appliance, implant, reagent for in vitro use, software, material or other similar or related article that is intended for use in the diagnosis of disease or other conditions, or in the cure, mitigation, treatment or prevention of disease”. [1]

Medical devices have made tremendous headway in the past two decades with the progress of technology. As part of the fourth industrial revolution, evidence-based healthcare has recently been transformed into precision medicine employing artificial intelligence. As a result of the advent of telemedicine based health monitoring devices, the medical device sector has advanced significantly, and governments are supporting it to expand health coverage in the nation [2]. Patients are increasingly able to receive care at home because of the advances in digital health technology (DHT) [3].

The Home Health Care Committee of the Food and Drug Administration centre has defined a home medical device as “a device intended for use in a nonclinical or transitory environment, [that] is managed partly or wholly by the user, requires adequate labelling for the user, and may require training for the user by a health care professional in order to be used safely and effectively”. [4] Although the medical devices are transforming each year, in developing countries, the awareness and acceptance of such devices is still sub-optimal.

HISTORICAL USE OF MEDICAL DEVICES

Diagnostic devices were developed much later in the nineteenth century, after diagnostic methods improved with age and medical progress [5]. Diagnoses in the medieval period were limited to clinical symptoms and, in rare situations, auscultation and palpation. This was followed by an examination of bodily fluids for anomalies, which included a thorough examination of the patient's urine before 400 BC and the trend continued well into the eighteenth century [6]. Through the 18th Century, noteworthy attempts to use precision tools in diagnosis were made. Stephen Hale was the first to develop a method for monitoring blood pressure by inserting a lengthy glass tube into a horse's artery [7]. The first manometer / tonometer, invented by Hales was used to calculate blood pressure, heart capacity, and blood current velocity

quantitatively. The sphygmomanometer, which is still used to monitor arterial blood pressure today, was developed as an antecedent to it. The seventeenth century also witnessed the invention of what is now known as the modern day thermometer by Daniel Gabriel Fahrenheit.

The most popular medical gadgets, which may be found in almost every home, are those that deliver medicine or provide first assistance, including first-aid kits and medicine-dispensing tools. Assistive technology and durable medical equipment are two more categories of medical devices that are often utilized in the home. Mobility aids like wheelchairs, walkers, canes, crutches etc and sensory aids are the most common assistive technology. Other than that, prosthetic devices like artificial limbs, orthotic devices like braces for limbs are also in use. [4]

NON-COMMUNICABLE DISEASES:

In the twenty first century, one of the most pressing health and development issue across the globe is the rise of Non-Communicable Diseases (NCDs) across the globe. Earlier, the NCDs were prevalent mostly in the developed countries of the world. However, in recent years, the incidence and mortality of NCDs has increased in LMICs [8] [9]. As of April 2021, the data factsheet published by WHO reported that non-communicable diseases accounted for 71% of the global deaths. Low- and middle-income nations accounted for 77% of the total NCD mortality. The most prevalent lifestyle-modifiable disease is cardiovascular disease, which is responsible for 17.9 million deaths annually, trailed by cancer, pulmonary disorders, and diabetes [10]. Chronic Renal Insufficiency, the sixth leading cause of death across the world, causes an estimated 1.7 million deaths annually [11]. Given the scarcity of epidemiological data, increased ignorance, and limited access to laboratory facilities, such figures are likely to underestimate the true prevalence of renal disease. As a result, it is probable that kidney diseases kill at least as many people each year as cancer, diabetes, or respiratory disorders [12]. Obstructive sleep apnea (OSA) and chronic obstructive pulmonary disease (COPD) are two chronic diseases that are both influenced by and impacted by sleep. These two noncommunicable diseases (NCDs) each affect about 10% of the general population and are steadily increasing in prevalence around the world [13]. According to recent research, China has the highest prevalence of OSA, followed by the United States, India, and Brazil in that order. OSA diagnosis and treatment are critical in Asia because to the high prevalence of OSA and the correlation

between OSA and CV risk [14]. NCD detection, screening, and therapy, as well as palliative care, are all important parts of the NCD response. [8]

THE SHIFT FROM HOSPITAL TO HOME:

Despite the current crisis, this brings up new opportunities for research. Prior to the development and innovation of medical devices and procedures, their use was limited to hospitals that served a large number of patients at the same time. These devices have become prevalent in small medical facilities after the COVID-19 protocols were implemented. As more people opt for at-home care, the need for medical devices that can be utilized at home is increasing [15]. Medical devices are used by a variety of individuals, including professionals, carers, and patients. These users have a wide range of physical, sensory, cognitive, and emotional traits as a group. As a result, home health care gadgets must be simple to use and maintain. [4] Several medical technologies have lately been launched as retail goods, allowing people to more conveniently, autonomously, and economically control their personal health care. To detect various chemicals and disorders, for example, a variety of blood and urine testing kits are available. A number of monitors and meters are available to check health status indicators such as blood pressure and blood glucose levels. Devices used at home for continuous monitoring of chronic diseases have a unique value proposition, as the sensors can monitor multiple biomarkers, including those associated with diabetes hypertension, lung diseases, and many non-communicable diseases. [16]

Newer consumer devices measure blood coagulation, blood oxygen levels, and sleep apnoea for those on blood thinning drugs. Home healthcare is more comfortable and convenient for patients than hospital-based care. Patients receiving care can now remain mobile and self-sufficient thanks to technological advancements [17]. Another significant contributor to this transition is rising health-care expenses and hospital stays, as well as shortages of health-care facilities, nurses, and other competent professionals, which have pushed the medical system to deliver more outpatient care. [18]. As a result, the variety and complexity of medical devices utilized by varied user populations outside of established health care organizations is rising. Even complex technologies like ventilators, infusion pumps, and dialysis machines are being utilized outside of the hospital or clinic, often by laypeople, despite the fact that many of these devices were not designed or labelled for this type of use. There are few restrictions on how these devices can be used in the house. [18]

CHALLENGES:

Depending on the severity of the patient's diseases, clinical treatment and diagnostic processes can be quite complicated. The medical devices used in the hospitals have been replaced by newer versions which have migrated into homes. But this does not necessarily mean that the end user can operate the device efficiently. There is a higher prevalence of NCDs in older individuals. The medical devices are not always necessarily easy to use or operate, which pose a potential problem especially for the older individuals. The same reasoning can also be applied for patients with dexterity or mobility issues.

Complexity of medical terms or instructions of use provided with the device can also pose a challenge if the user is a lay person.

Another challenge in using medical devices at home is accessibility of all devices across the nation. The Indian government regulates the pricing of some medical devices by either fixing a price at which they can be sold according to a formula or limiting the capacity of the medical device's marketer to raise the price by more than a specified percentage at any given time. Another issue is the presence of many regulators, which can make simple operations like correcting an incorrect label declaration a chaotic experience. The presence of outmoded rules that prohibit manufacturers and importers of medical devices from directly marketing their products to customers as treatments for certain prescribed ailments and illnesses is the third issue [19].

COVID-19 AND MEDICAL DEVICES:

In 2020, the Covid-19 pandemic took the whole world by surprise in the month of March, when the cases started accelerating. The population in resource-limited countries face constraints in availing and accessing healthcare services even normally, the pandemic made the situation worse [20]. Many countries including India imposed strict nationwide lockdown intermittently throughout the year. This affected the healthcare services drastically. Both private and government hospitals were overburdened with patients suffering from Covid-19. All non-emergency surgeries and treatments were put on hold to accommodate the increasing cases of Covid positive patients. The Indian healthcare system is a hybrid model – including public and private healthcare service

providers. A majority of private healthcare facilities occupy the urban areas offering secondary and tertiary care [21].

At this point, the government is utilizing all possible ways to mitigate the effect of this crisis. Use of technology like medical devices, digital healthcare solutions, IT linked solutions is suggested [22]. The use of health monitoring systems and devices can reduce physical contact, hospitalization, consultation time, queueing time, and general health expense for a patient. This can also help in mitigating the effort, burden, and stress on medical staff. [23]

2. REVIEW OF LITERATURE

Authors (year)	Study location	Sample size	Sampling techniques	Salient features
Kario, K, Hoshide, S, Chia, Y- C, et al 2021	Multi country	NA	NA	The Hypertension Cardiovascular Outcome Prevention and Evidence (HOPE) Asia Network expert panel identified home monitoring of blood pressure using ambulatory blood pressure monitoring (ABPM) devices as the gold standard for the evaluation of patients with suspected hypertension. This modality helps obtain crucial information that could otherwise not be recorded in a traditional clinic setting such as diurnal variations in blood pressure. Another benefit would be the definitive evaluation of potential white-coat or masked hypertension. Adopting the use of ABPM could provide information for stratification of cardiovascular and cerebrovascular risk better than what would be obtained through office BP measurements.
Chaudhary K, Khadloya T, Dey T, Gill H et al	India	NA	NA	Health technology assessment (HTA) is one of the strategies used globally to determine the value of health technologies such as medications, medical equipment, vaccines, procedures, and healthcare

2021				systems, as well as to facilitate their incorporation into UHC when necessary. Increased capacity and capability, evaluating the applicability of cost-effective assessments, bringing holistic value, harnessing comprehensive data, greater transparency, and stakeholder involvement, and finally acknowledging methodological ambiguity are all critical areas to pay more attention to in order to standardize and streamline procedures and increase transparency in decision-making.
Mondal, H., & Mondal, S. 2021	Japan	NA	NA	This review article identified six commonly used home health monitoring devices viz. automatic blood pressure monitors, blood glucose monitors, body fat monitors, pulse oximeters, electrocardiographs, digital thermometers and infrared thermometers. The authors provided an elementary explanation of the fundamental principles of operating these devices, as well as the correct techniques for their use. The information listed herein is stated in a manner that could directly serve as a source of instruction and information for patients.

Chemweno , P., Pintelon, L. 2020	NA	NA	NA	The study enlisted eight steps essential to carry out home dialysis treatment, namely, (1) dialysis training, (2) selection of dialysis equipment, (3) delivery of the hemodialysis equipment, (4) modifying the home setting to suite installation of the dialysis equipment, (5) installation of the equipment, (6) management of the dialysis process, (7) maintenance of the equipment and its hygiene, and (8) waste handling process. The study further stated that dialysis at home can be challenging due to multiple factors like installation of dialysis machinery and handling of meds, assessing and controlling clinical and technical risks, including device related failure.
Rose E, Kolko B 2019	Chennai	15	Snowball and convenience sampling	Medical devices are an important part of the health-care industry since they help with disease management. Medical devices make complex healthcare treatments simple and effective. The material compliances utilized in the development of medical devices have an impact on their quality. When the quality of biomedical devices is compromised, it can lead to serious side effects or even death in patients. Under the supervision of biomedical

				professionals, quality assurance must be undertaken on a regular basis. Effective medical devices for underprivileged places and populations can improve access to healthcare and improve health outcomes, but when not done with contexts and restrictions in mind, it can also lead to complications.
Bansal, A., & Joshi, R. 2018	NA	NA	NA	The availability of portable and home-based electrocardiography (ECG) is a significant medical advancement that has the potential to revolutionize medical care. The study objective was to gauge the current level of out-of-hospital portable ECG technology in terms of scope, convenience of use, data transfer capabilities, and diagnostic accuracy. Despite the rise in the number of such devices, there is a scarcity of published biomedical literature on their diagnostic accuracy, repeatability, or value.
Kario, K., Tomitani, N., Buranakitja roen, P et al 2018	11 Asian countrie s	1443		The authors described the status of blood pressure monitoring at home use in countries in Asia. Their findings described wide excursions in home blood pressure. They reported that home blood pressure control was inadequate in nearly 50% in accordance with current

				guidelines. The statistics reported for India suggested that white coat hypertension is a significant problem, seen in approximately 25% of the study participants. Uncontrolled hypertension was noted in just over 10% and masked morning hypertension was seen in under 10% of participants.
Keller, S. C., Gurses, A. P., Werner et al 2017	NA	NA	24	This study identified Skilled Home Health Care (SHHC) as a key requirement, particularly in the care of geriatric patients. The 5 cornerstone pre-requisites for the successful implementation of the use of medical devices for SHHC identified by the study were: the older adult must receive the right device at the right time; both the elderly patient and the caregiver should not only receive training regarding the operation of devices, but ongoing support as well; the device must be appropriate to the elderly patient's size and physical capabilities; the device must function effectively; the device must physically fit in patient's house.

3. RESEARCH METHODOLOGY

RESEARCH QUESTION

What is the level of knowledge and acceptance of medical devices used at home among people in the age group of 18 years and above, during pandemic in tier 1 cities of India?

OBJECTIVES

1.a To gauge the knowledge of the existence of medical devices for use at home in tier 1 cities of India.

1.b To gauge the acceptance of medical devices for use at home in tier 1 cities of India.

Sub-objectives:

2.a To gauge the awareness of the names of specific medical devices used at home during the pandemic in tier 1 cities of India.

2.b To gauge the awareness of the use of medical devices used at home during the pandemic in tier 1 cities of India.

2.c To ascertain the willingness to adopt the use of medical devices at home during the pandemic in tier 1 cities of India.

2.d To ascertain the reasons for unwillingness to use the devices at home if any at home during the pandemic in tier 1 cities of India.

2.e To compare the willingness to buy medical devices for home use, pre-covid and currently during the pandemic in tier 1 cities of India.

Study design: A cross-sectional study

Sample size: 179

Study Population:

Inclusion criteria:

- Adults aged 18 years and above.
- Residents of tier 1 cities: Delhi, Mumbai, Pune, Bengaluru, Ahmedabad, Hyderabad, and Chennai

Exclusion criteria:

- Individuals aged below 18 years.

- Individuals residing in non-tier 1 cities.
- Individuals with intellectual or neurocognitive impairment

Research approach: Quantitative and qualitative assessment

Sampling method: Convenience sampling

Statistical methods:

The data obtained was analyzed using Microsoft Excel 2016. Categorical data was represented as mean $\pm$ standard deviation, or as median (quartile 1 – quartile 3) after assessing normality of distribution using the Shapiro Wilk test. Categorical data was represented graphically using software-generated graphs. Wilcoxon signed-rank test was used to compare the scored willingness to utilize medical devices now versus the status in 2019, due to non-parametric distribution of the collected data.

STUDY FRAMEWORK:

Objectives	Indicators	Tools
To gauge the awareness of the existence of use of medical devices at home.	Awareness of existence Sources of information	Structured online questionnaire
To ascertain the willingness to use medical devices at home (collective)	Current use of medical devices	
To ascertain the reasons for unwillingness to use the devices at home, if any.	Reasons cited by survey respondents	
To compare the willingness to buy medical devices for home use, pre-covid and currently.	Self-declared score on visual analogue scale	

Operational definitions:

Generation Z: People born between 1997-2015

Generation Y/ Millennials: People born between 1981-2014

Generation X: People born between 1965-1980

Baby boomers: People born between 1946-1964

Silent Generation: People born before 1946

Willingness score: The tool used was a visual analogue scale ranging from 1-10, 1 representing being extremely unwilling, and 10 representing being extremely willing.

Tier 1 cities: Tier 1 cities of India mentioned in ease of living index published by Ministry of Housing & Urban Affairs in 2021.

Ethical considerations:

De-identified anonymous information was recorded from willing participants. Participation was entirely voluntary. Confidentiality was maintained.

Limitations:

The study was conducted over a period of 3 months. Due to the limited time and resources involved the study was restricted to a small sample size selected by convenience sampling. The conclusions drawn from this study may thus have limited generalizability. The conclusions may be subject to confounding secondary to the selected regions (inclusion of tier-1 cities only without rural representation), but insights about broader healthcare trends can be observed from this study.

4. RESULTS

Demographics

a. Age

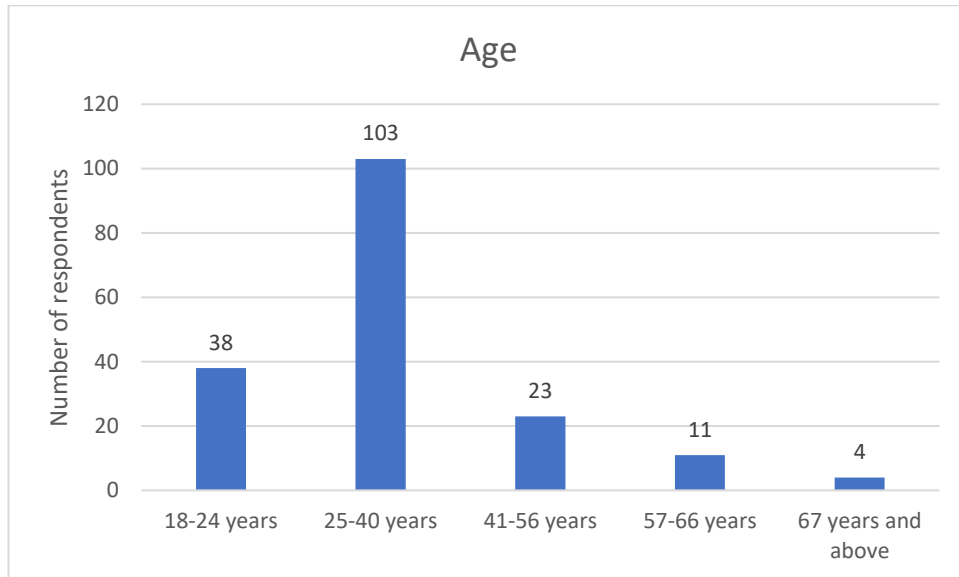


Figure 1: Age of the respondents

Interpretation: The highest represented demographic in this survey was that of individuals between the ages of 25 and 40 years (57.5% of respondents). The other groups had proportionally lower representation as follows: ages 18-24 years (21.2%), ages 41-56 years (12.8%), ages 57-66 years (6.1%) and those aged 67 years and above (2.2%).

b. Gender:

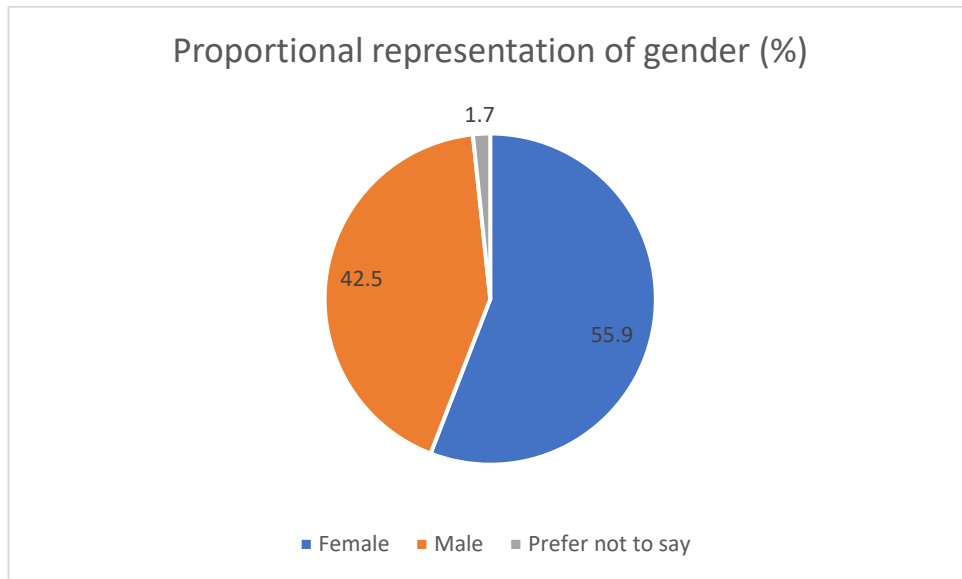


Figure 2: Gender of the respondents

Interpretation: The survey received 100 responses from individuals who identified as female (55.9%) and 76 responses from males (42.5%). 3 respondents preferred not to specify their gender (1.7%)

c. Education

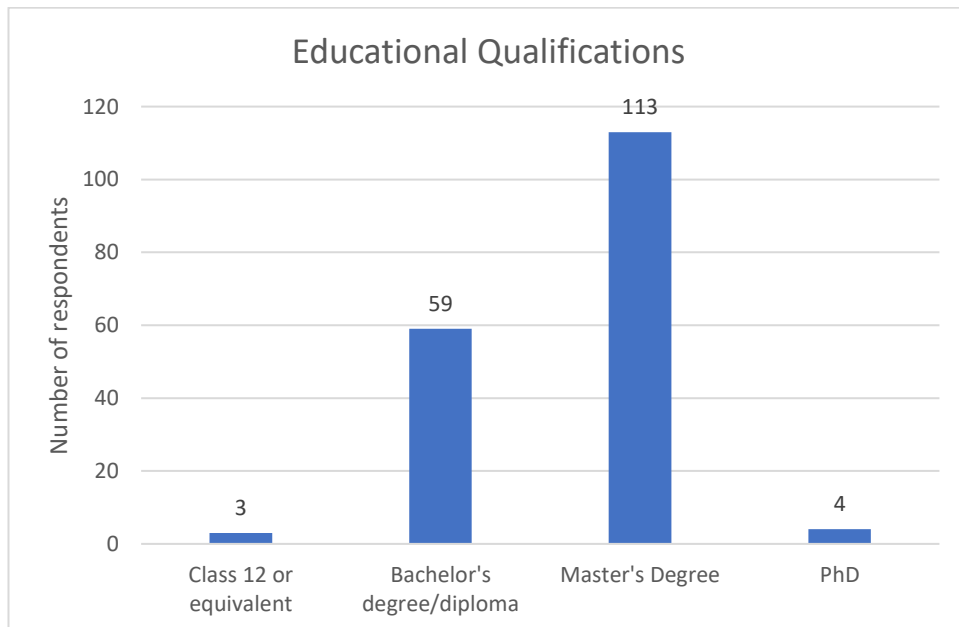


Figure 3.: Educational qualification of the respondents

Interpretation: A majority of the respondents possessed a master's degree (63.1%), followed by individuals with a bachelor's degree (33%), a PhD (2.2%) and a class 12 education or its equivalent (1.7%).

d. Occupation/profession

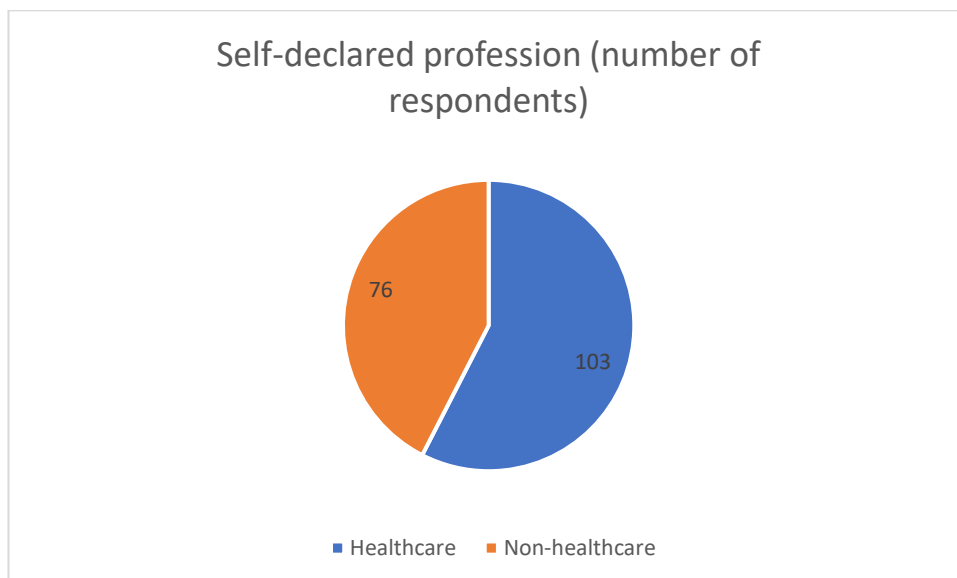


Figure 4: Occupation of the respondents

Interpretation: Most of the respondents worked in the healthcare sector 57.5% versus 42.5% from non-healthcare backgrounds.

Outcomes:

e. Awareness of the existence of home healthcare devices:

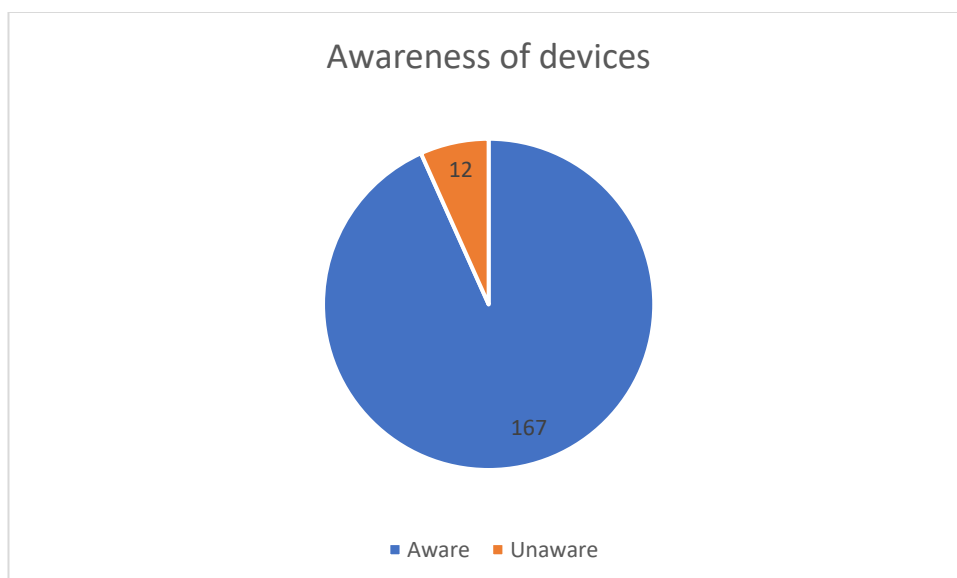


Figure 5: Awareness about medical devices for home use

Interpretation: An overwhelming majority of the respondents were aware that healthcare devices were available for home use (93.3% vs 6.7%).

Awareness was influenced by demographic factors:

I. Age:

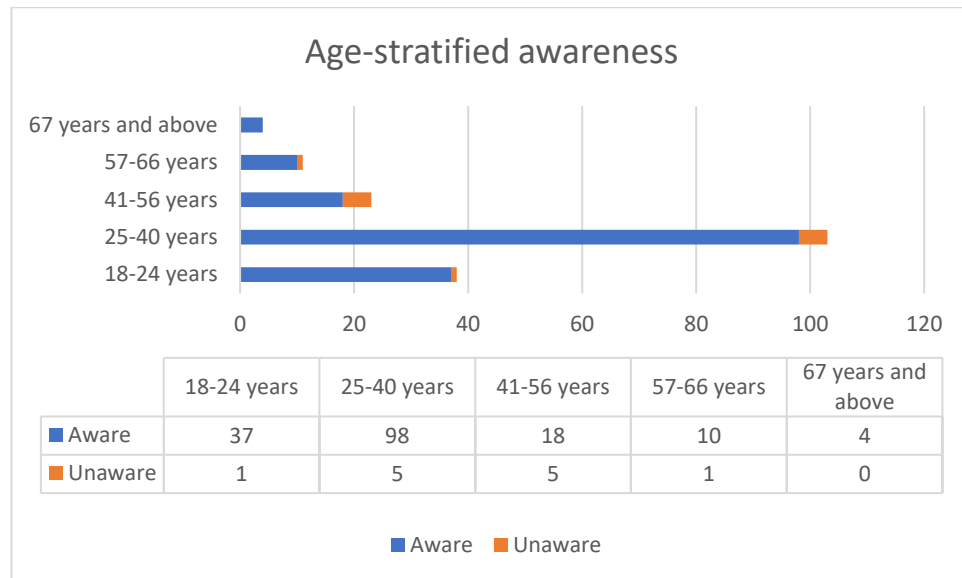


Figure 6: Age stratified awareness of the respondents

Interpretation: Age distribution influenced the proportional awareness, with a drop noted in individuals between the ages of 41-56 years. To assess the differences for this categorical data Chi-square test was used. This difference in proportions, assessed by Chi-square, was statistically significant: $X^2(4, N=179) = 11.176, p = 0.02$

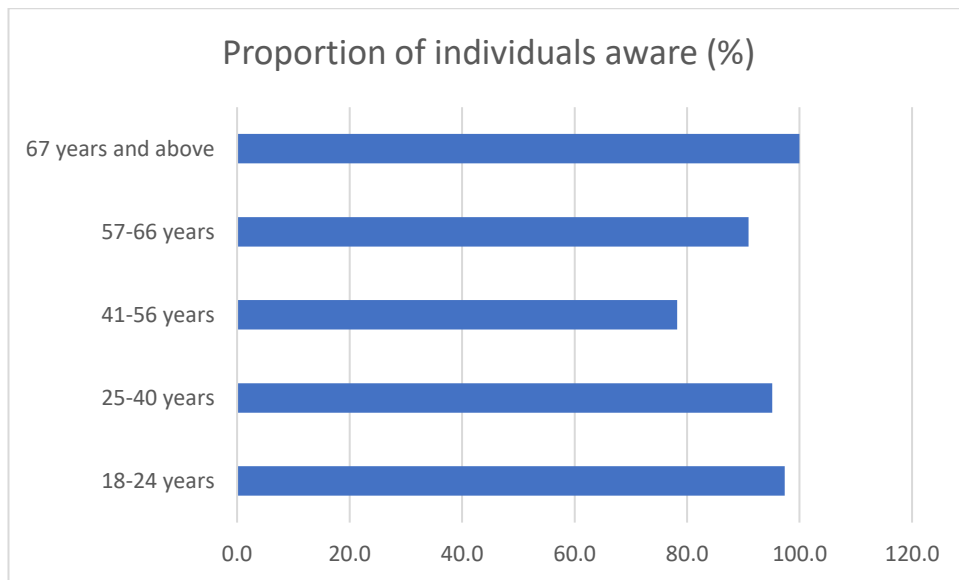


Figure 7: Awareness of the proportion of individuals

II. Gender:

Gender did not have a significant influence on levels of awareness: $X^2(2, N=179) = 3.482, p = 0.175$

III. Education:

The level of education significantly influenced the proportional level of awareness (94.3% with a bachelor's degree or higher vs 33.3% with upto 12 standard education). Having a bachelor's degree/diploma or higher was associated with 33-fold increased odds of being aware of these devices (Odd's ratio: 33.2, 95% confidence intervals: 2.7-397.9)

IV. Occupation/profession:

Individuals working in the healthcare industry were more likely (97.1%) to be aware of these devices than individuals not from healthcare backgrounds (88.2%); Odd's ratio: 4.47, 95% confidence intervals: 1.16-17.14, $p = 0.028$)

f. Differential awareness of various medical devices

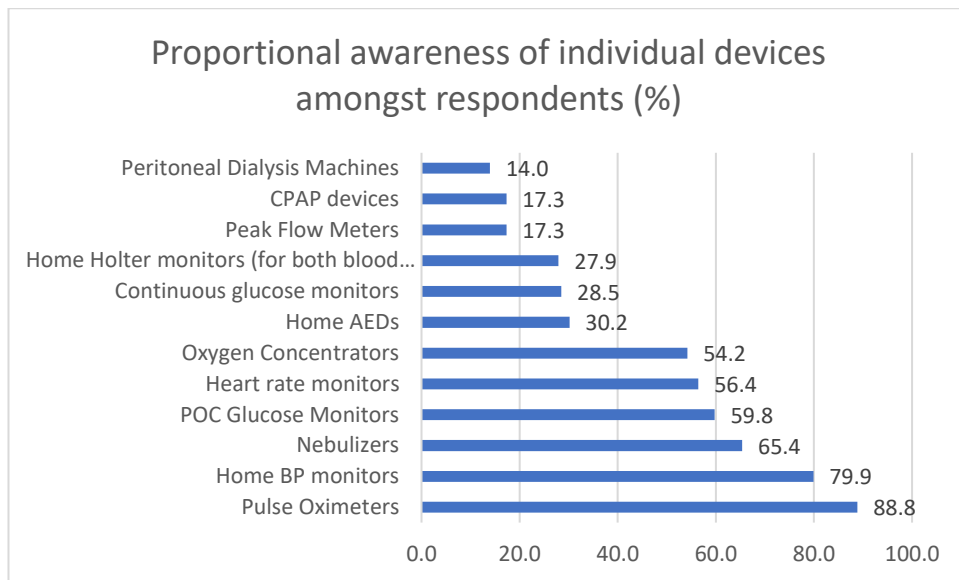


Figure 8: Proportional awareness of individual devices among respondents

Interpretation: Amongst the various devices surveyed, two of the top 5 most-known devices represent those commonly referenced in the context of the care of patients suffering from covid-19 wherein 159 (88.8%) respondents expressed awareness of the availability of pulse oximeters and 117 (65.4%) about nebulizers. The other devices in the top 5 were those used in the context of hypertension (Blood pressure monitors – 79.9%), heart disease (Heart rate monitors – 56.4%) and diabetes (Point of care [POC] glucose monitors – 59.8%).

The main source of information regarding medical devices was the family doctor/a specialist physician.

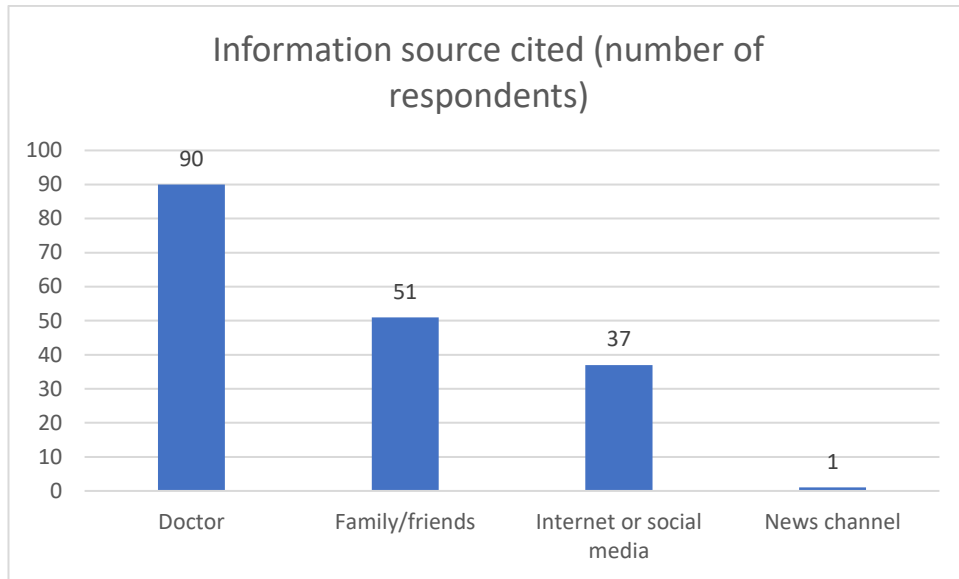


Figure 9: Information sources cited by the respondents

g. Current medical device usage

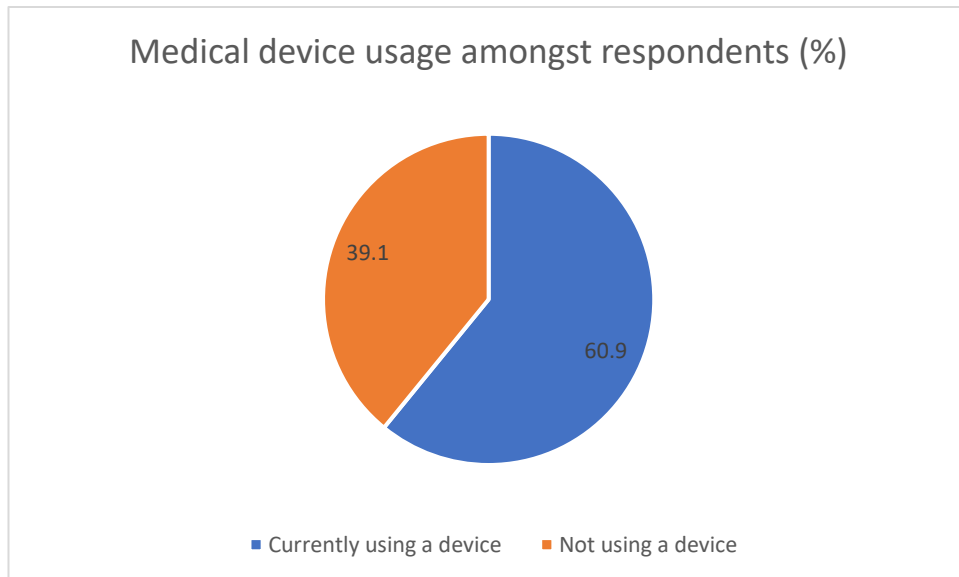


Figure 10: Medical device usage amongst respondents

Interpretation: 109 respondents (60.9%) reported that either they, or a family member used at least one device queried in this survey. 51.4% had bought the device after the onset of the pandemic, whereas 48.6% had purchased them previously.

The five most commonly used devices were: blood pressure monitors (43), pulse oximeters (41), glucometers (18), nebulizers (9) and CPAP machines (4).

h. Perspectives about medical device usage

Respondents were also requested to rate their willingness to purchase a device under current circumstances on a visual analogue scale (1 conveying extreme reluctance and 10 conveying a strong likelihood). They were asked to rate their likelihood to make a similar purchase based on their recollected perspective in 2019.

The scores provided were assessed for normality of distribution. The scores for pre-pandemic willingness were distributed non-parametrically (skewness: -0.198515, kurtosis: -0.314875). The distribution for scores for current willingness (post-pandemic) were also non-normally distributed (skewness: -1.214766, kurtosis: 0.40049). The median score for willingness pre-pandemic was 6 (Quartile 1-3: 5-8). The median and quartiles for current willingness were significantly higher at 10 (Q1-Q3: 7.5-10).

By the Wilcoxon Signed-Rank test, this difference was statistically significant (W-value = 600, z-value = -9.727, $p < 0.0001$).

Table 1: Willingness scores of respondents for the use of medical devices for pre-covid and current period

Sr. No.	Device	Measure	Pre-covid	Current	P-value (by Wilcoxon Signed-Rank test)
1	O2 concentrator	Median	4	7	<0.0001
		Q1	2	3	
		Q3	8	10	
2	Nebulizer	Median	5	7	<0.0001
		Q1	3	3	
		Q3	8	9	
3	Peak flow meter	Median	4	5	<0.0001
		Q1	2	3	
		Q3	7	8	
4	Pulse oximeter	Median	6	9	<0.0001

		Q1	3	4	
		Q3	10	10	
5	Peritoneal Dialysis	Median	3	5	<0.0001
		Q1	1	2	
		Q3	5	8	
6	BP monitoring	Median	7	8	<0.0001
		Q1	3	4	
		Q3	9.5	10	
7	Holter for BP/Rate	Median	5	6	<0.0001
		Q1	2	3	
		Q3	7	9	
8	Heart rate monitor	Median	5	6	0.0004
		Q1	3	3	
		Q3	8	9	
9	Home AED	Median	3	5	<0.0001
		Q1	2	2	
		Q3	7	8	
10	Glucometer	Median	6	8	0.0008
		Q1	3	3	
		Q3	10	10	
11	Continuous glucose monitor	Median	5	7	<0.0001
		Q1	3	3	
		Q3	8	9.5	
12	CPAP	Median	3	5	<0.0001
		Q1	2	2	
		Q3	5	9	

i. Factors influencing perspectives and use:

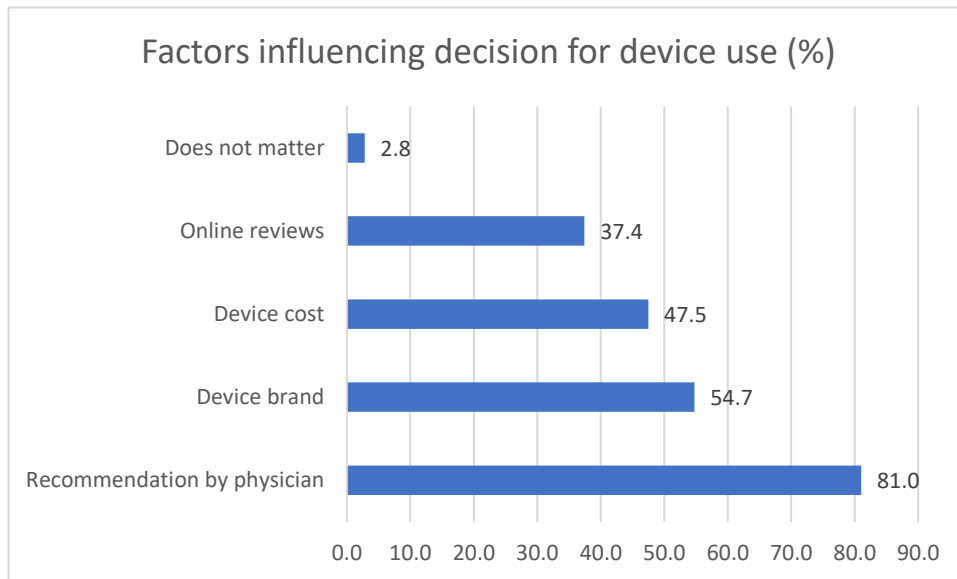


Figure 11: Factors influencing the decision to use medical devices among respondents

Interpretation: The most frequently listed influencing factor was a recommendation by the treating physician, cited by 81 %. device brand (54.7%), device cost (47.5%) and online reviews (37.4%) were other important considerations. The strong influencing role of device brand suggests that, given the high capital investment required, patients would be willing to spend a little bit extra to ensure a well-functioning, reliable medical device.

j. Factors responsible for reluctance to the adoption of medical devices:

Among reasons for reluctance to adopt the use of medical devices in a home healthcare setting, the most prominent one was concerns about the accuracy of devices (52.5%). Concerns about device complexity were low (17.3%), consistent with what would be expected with a highly educated cohort. Perceived lack of long term support from the manufacturer for repair or warranty was another significant factor. Concerns about financial viability was the least cited reason for reluctance to avoiding adoption of these devices, likely reflecting the factoring of the added costs of in-person medical evaluation (10.6%).

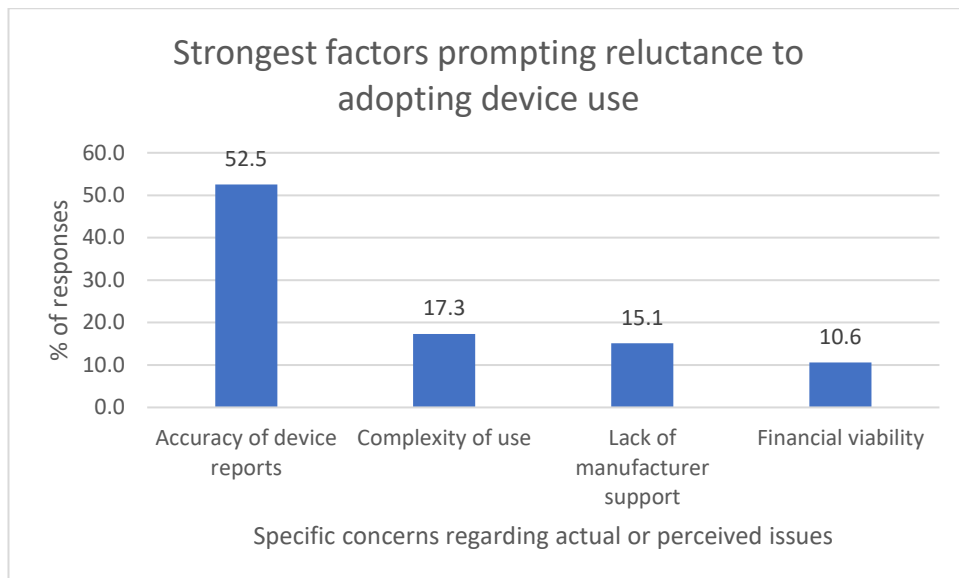


Figure 12: Factors responsible for reluctance of use of medical devices among respondents

Interpretation: Accuracy of devices was the strongest factor influencing the reluctance to buy a medical device for home use followed by complexity of use and lack of manufacturer support.

k. Future prospects:

Participants were also requested to state what they believe will be their preferred mode of seeking healthcare going forward, given the way covid-19 has significantly disrupted every aspect of our lives.

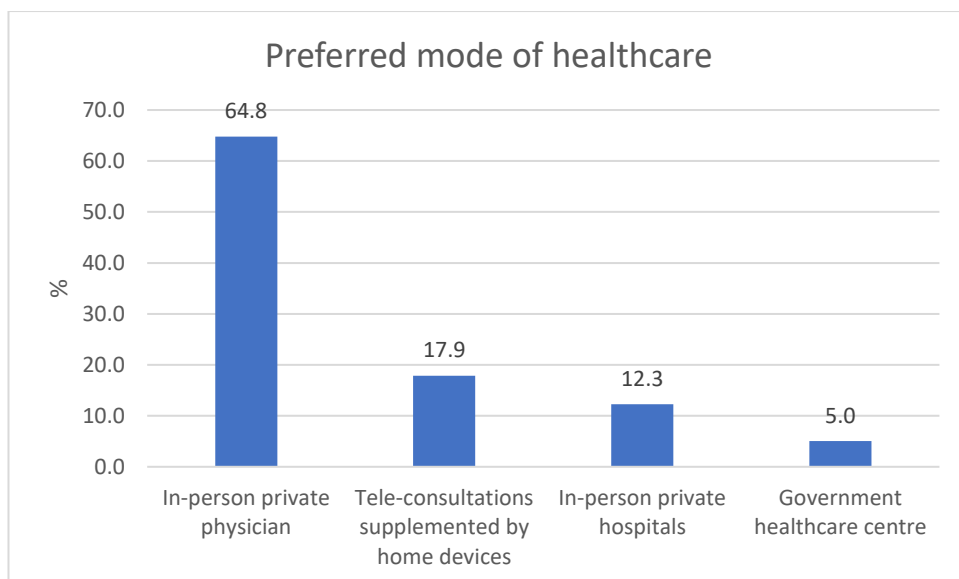


Figure 13: Preferred mode of healthcare post pandemic among respondents

Interpretation: In-person visits to a private doctor, by far, remained the most commonly chosen alternative. However, a significant proportion (17.9 %) listed teleconsultations, supplemented by home healthcare devices, as their preferred mode of seeking care – outperforming visits to a private hospital (12.3%) or a government health centre (5%).

5. DISCUSSION:

The age ranges used in the study were 18-24years, 25-40 years, 41-56 years, 57-66 years, and 67 and above. The age ranges were distributed in a fashion to coincide with the generations, namely, Generation Z, Generation Y or Millennials, Generation X, Baby boomers, and the Silent generation respectively. A majority of the respondents (57.5%) were in the 25-40 years of age group. Millennials or generation Y accounted for a higher share in the working age population of India at 47% and are the chief wage earners of the family [24]. The proportional age representation seen in the study is consistent with this pattern.

63.1% of the respondents possessed a master's degree. As per the census data (2011) only 4.5% of the population has a graduate degree or more, while a staggering 32.6% barely has a primary level education. As the 2021 census has been postponed owing to the ongoing epidemic, current data on the country's educational level is unavailable. The use of convenience sampling in this study limits generalizability.

The study respondents showed a slightly higher representation of females than males (42.5% and 55.9% respectively) and there is a higher representation among the respondents from the healthcare sector than the non-healthcare (57.5% and 42.5% respectively). The difference is not significant and is unlikely to be a confounding factor. The high degree of awareness of medical devices is commensurate with what would be expected of a predominantly young and highly educated pool of respondents. Age, education, and profession were significant influencing factors for awareness.

The five most known devices were pulse oximeters, home BP monitors, nebulizers, point-of-care glucose monitors, and heart rate monitors. It is unsurprising that the most known devices known were:

- a) devices related to covid-19
- b) devices relate to heart diseases
- c) devices related to diabetes

The awareness for specific devices is consistent with what is expected given the prevalence of these diseases in the country at present. Supporting this, information about peritoneal dialysis machines is the least known medical device for home use to the respondents. The proportion of respondents who were least aware of the use of

medical devices at home were between the ages of 41 and 56 years and this value was statistically significant ($p = 0.02$). It is possible that the respondents in the group 41-56 years are not as technology savvy as the millennials and do not frequent the physicians as much as the baby boomers and hence are less aware of medical devices used at home.

90 of the 179 respondents or 50.2% respondents answered that the information about medical devices was provided to them by their doctors. Another prominent source of information was family, and friends at 28.4%, followed by internet at 20.6%. Therefore, the active social and internet savvy age group would have more opportunities for information regarding the use of medical devices, thereby improving their awareness.

60.9% of the respondents are currently using at least one medical device at home. With increasing awareness about management of chronic and non-communicable diseases at home and the ongoing pandemic, the use of medical devices at home has increased.

Due to the ongoing pandemic, there has been a significant change in the nature of access to healthcare, individuals are reluctant to visit their doctors or hospitals due to the fear of contracting covid-19. This has led to people exploring alternative avenues to continue to receive healthcare and a major part in this has been played by telemedicine supported by home use of medical devices. This trend is best reflected in the increase of the median score from 6 to 10, where 6 signified- undecided but leaning towards usage and 10 implying extremely willing to use.

The major reason for the reluctance to use include medical devices was the accuracy of the device used followed by the complexity of use and lack of service or support by the manufacturer. It is unsurprising that cost was not a barrier to the use of these devices as the investment in such devices can help monitor health at home and saves the recurrent cost of travel to the physician, lab tests, consultation fees etc.

It was observed from the responses that a vast majority (64.8%) would like to continue the conventional mode of in-person visits to the doctor. But a high proportion of respondents (17.9%) would prefer teleconsultation with medical device usage, this represents an important area of growth.

6. CONCLUSION:

The incessant rise in the prevalence of non-communicable, lifestyle-modifiable diseases has provided the impetus for people to find ways to monitor health metrics on a regular basis at home. Major disruptions to conventional modes of healthcare monitoring in the wake of the pandemic coupled with the infusion of technology into healthcare, have helped expedite the process of increasing awareness about medical devices.

This study demonstrated that the nature of increased awareness was influenced significantly by device profile in the context of its role in the management of specific diseases, as well as characteristics of the target demographic. For instance, given the prevalence of hypertension and incidence of covid-19, the most commonly known medical devices were, predictably, the pulse oximeter, home BP monitors and nebulizers. Greater awareness was noted in younger, more highly educated individuals. The unexpected windfall coming from the pandemic has been a significant increase in the willingness to adopt the use of such devices at home – to the extent that the use of medical devices coupled with tele-medicine consults emerged as the second-most preferred modality of seeking future healthcare. Respondents identified concerns about device accuracy as the major concern regarding adoption of these devices – a key area on which device manufacturers would benefit from focusing. Summarily, the younger age representation of the respondents of this study and their patterns of preferences suggests that the use of medical devices is likely to be a significant driver of change in the healthcare model of our country, going forward.

7. RECOMMENDATION:

Introductory education about names of devices and their basic functions at the school level itself. Utilizing mass media such as radio, television and social media to propagate information about home healthcare devices targeting individuals without a medical background. Manufacturers should invest in research and testing to reassure potential consumers that accurate information is provided by medical devices used at home. Medical regulatory bodies can include home device usage for doctors at Continued Medical Education (CMEs) seminars to get family doctors to increase the utilization of such devices by patients in need.

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ANNEXURE

Online questionnaire used for the study:

Q1. Age (in years)

18-24

25-40

41-56

57-66

67 and above

Q2. Gender

Male

Female

Prefer not to say

Q3. Education

10th

12th

Bachelor's degree/ Diploma

Master's degree

PhD

Q4. Occupation

Healthcare

Non-Healthcare

Q5. Are you aware that medical devices can be used at home?

Yes

No

Q6. Which of the following medical devices are you aware can be used at home?

- a. Oxygen concentrators
- b. Nebulizers
- c. Peak flow meters
- d. Pulse oximeters
- e. Peritoneal dialysis machines
- f. Home blood pressure monitors
- g. Home Holter monitors (for both blood pressure and heart electrical rhythm monitoring)
- h. Heart rate monitors
- i. Home automatic external defibrillators
- j. Point of care blood glucose monitors
- k. Continuous glucose monitors
- l. Continuous positive airway pressure devices

Q7. Do you or any of your family members use any of the above devices?

Yes

No

If yes, please specify

Q8. How did you become aware of these devices?

General physician or specialist doctor

Family members or friends

Internet or social media

News channels

Newspaper

Q9. Have you bought any medical devices for home use during the pandemic?

Yes

No

Q10. Which parameters are important to you while buying a medical device?

Cost of the device

Devices recommended by your physicians

Online reviews (if the device was purchased online)

Brand of the device

Does not matter

Q11.How likely were you to buy a medical device before the pandemic?

Linear 1-10 scale

1	2	3	4	5	6	7	8	9	10
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1- Extremely unwilling

2- Unwilling

3- Unsure

4-Somewhat unsure

5- Neutral

6- Hesitant but leaning towards usage

7- Somewhat positive

8- Positive

9- Willing

10-Extremely willing

Q12.Willingness to adopt the use of the following medical devices as of 2019 or pre-Covid-19 (1 – unwilling, 5 – undecided, 10 – extremely willing) Choose a number from 1-10.

Device	Willingness score now (1-10)	Willingness score as of 2019 (1-10)
Continuous		

positive airway pressure devices		
Oxygen concentrator s		
Nebulizers		
Peak flow meters		
Pulse oximeters		
Peritoneal dialysis machines		
Home blood pressure monitors		
Home Holter monitors (for both blood pressure and heart electrical rhythm monitoring)		
Heart rate monitors		
Home automatic external		

defibrillators		
Point of care blood glucose monitors		
Continuous glucose monitors		
Electrical thermometers		

Q13.What is the strongest main reason for the reluctance to buy medical devices for home use?

Concerns about financial viability

Complexity of day to day use of the device

Concerns about accuracy of device reports

Concerns about lack of long term support / repair options from manufacturers in the event of device failure

Other

Q14. What mode of medical care would you prefer as an alternative to self-monitoring at home?

Regular follow-up visits to the family physician/GP (private physician)

Regular follow-up visits to specialists for the specific problem (private physician)

Regular follow-up visits to the private hospital visited for most medical problems

Regular follow-up visits to the closest government medical centre

Teleconsultation along with the use of medical devices at home