AWARENESS AND USE OF HOME-BASED MEDICAL DEVICES AMONG PATIENTS WITH CHRONIC DISEASES (HYPERTENSION AND DIABETES) IN PAKISTAN

Research dissertation presented in partial fulfilment of the requirements for the degree of MSc in Medical Device Technology and Business

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CANDIDATE DECLARATION

I, Wajih Ur Rehman Khan, hereby declare that the work presented in this thesis is entirely my own and has been completed in accordance with the regulations and guidelines of Griffith College Dublin. This thesis has not been submitted, in whole or in part, for any other academic degree or qualification at this or any other institution.

I have fully acknowledged and referenced all sources of information and ideas that are not my own. I take full responsibility for the content of this thesis and affirm that it represents my original work.

I would like to express my sincere gratitude to my supervisor, Nicola Rice, for her continuous support, guidance and valuable insights throughout this research process.

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ABSTRACT

This study examined the awareness, usage, and barriers related to Home-Based Medical Devices (HBMDs), such as glucometers and blood pressure monitors, among patients with diabetes and hypertension in Pakistan. The findings indicated that awareness and utilization of HBMDs were generally low, particularly among rural and underserved populations. Semi-structured interviews were conducted with healthcare professionals, including general practitioners, cardiologists, and endocrinologists, who confirmed that patients often lacked the knowledge, training, and confidence required for effective use of these devices. Additionally, the results revealed that the adoption of HBMDs was significantly hindered by cultural resistance, high costs, limited digital literacy, and concerns regarding data privacy. Furthermore, although healthcare professionals were identified as crucial in promoting the use of these devices, many lacked the necessary resources and training to adequately support patients. According to the findings, enhancing the adoption of HBMDs in Pakistan necessitated a coordinated strategy that included focused patient education, affordability-enhancing subsidies, culturally appropriate awareness campaigns, professional development for healthcare professionals and strengthened safeguards for patient data. These findings offer valuable insights for policymakers and healthcare professionals aiming to improve chronic disease management through the use of home-based medical technology.

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ABBREVIATIONS	MEANING
AI	Artificial Intelligence
BP	Blood Pressure
CGM	Continuous Glucose Monitoring
CVS	Cardiovascular System
CVD	Cardiovascular Disease
DM	Diabetes Mellitus
HER	Electronic Health Records
GDPR	General Data Protection Regulation
HCP	Healthcare Providers
HBMDs	Home-Based Medical Devices
IoT	Internet of Things
IDF	International Diabetes Federation
ICT	Information and Communication Technology
mHealth	Mobile Health
NCD	Non-communicable Diseases
NDSP	National Diabetic Survey of Pakistan
NGOs	Non-Governmental Organizations
PECA	Prevention of Electronic Crimes Act
PHRC	Pakistan Health Research Council
SMBG	Self-Monitoring of Blood Glucose
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

1.1 Brief Background:

The prevalence of chronic diseases such as diabetes and hypertension is alarming and is rapidly increasing. The global prevalence of diabetes has risen from 7% in 1990 to 14% in 2022 with an estimated 800 million adults living with the condition, a fourfold increase from 1990 to 2022 (WHO, 2024). Hypertension also poses a global health challenge; 25% of the world population is hypertensive, a figure expected to rise to 29% by 2025 (Elahi *et al.*, 2023). Pakistan is no exception. An estimated 33 million people are diabetic, making it the third-largest diabetic population globally (Hasan and Siddiqui, 2024; Taimur *et al.*, 2024). For hypertension, according to the National Diabetic Survey of Pakistan (NDSP), the latest surveys suggest that 46.2% of people are hypertensive in Pakistan (Elahi *et al.*, 2023).

The home healthcare market is expanding due to the increasing burden of chronic illnesses, advancements in medical technology and a growing preference for self-care. Home-based medical devices are playing a key role in this shift as they help patients reduce hospital visits and manage their health better at home (Farhan *et al.*, 2017; Straits Research, 2024). Home-based medical devices are increasingly acknowledged as effective tools for better patient outcomes, early detection and intervention, real-time health data and reduced burden on health systems (Dhamanti *et al.*, 2023). A cross-sectional study in Pakistan found that while 67.1% of patients owned a blood pressure monitor, only 25% used it consistently for management. This suggests a lack of awareness or concerns about the reliability of home-based blood pressure monitors (Zahid *et al.*, 2017). Similarly, a study in Pakistan found that 59% of the urban population used a glucometer for diabetes management, while usage was significantly lower in rural areas. This difference was linked to socioeconomic factors, education and familiarity with home-based medical devices (HBMDs) (Farhan *et al.*, 2017).

The usage of home-based medical devices like glucometers and BP monitors is crucial for effective self-management of chronic diseases such as diabetes and hypertension. However, their adoption remains low in Pakistan due to factors like limited awareness, low health literacy, cost constraints and lack of training. This study aims to identify the key barriers and explore strategies to increase awareness and usage, eventually enhancing patient health outcomes.

1.2 Purpose of Study:

The purpose of this study is to examine the awareness, usage and challenges associated with home-based medical devices (HBMDs), such as blood pressure monitors and glucometers, among patients with chronic diseases specifically hypertension and diabetes, in Pakistan. The study aims to explore how well patients understand the importance of these devices, how frequently and accurately they use them and what factors influence their adoption. The study also examines how healthcare providers encourage the use of HBMDs. It looks at how they educate, advise and support patients in using these devices at home. In addition, it seeks to identify major barriers to effective use, such as low health literacy, financial burden and lack of user training. By addressing these challenges, the study aims to gather insights that can guide targeted healthcare, financial and educational initiatives. These insights will be valuable to policymakers, healthcare professionals and health educators working to improve the management of chronic diseases and patient outcomes in Pakistan.

1.3 Significance and Justification for the Study:

In Pakistan, chronic diseases, including diabetes and hypertension, rank among the leading causes of morbidity and death. Self-management strategies that allow patients to monitor and manage their illnesses at home are becoming increasingly necessary as the burden on healthcare systems, particularly in low- and middle-income countries, rises. In this context, home-based medical devices (HBMDs), such as blood pressure monitors and glucometers, are essential as they enable routine monitoring, early problem identification, reduced hospital visits and better adherence to treatment plans. Although these devices are available, limited evidence exists regarding their awareness and usage among Pakistani patients. Many patients still don’t understand the importance of regular monitoring or lack the skills, resources or confidence to use these tools effectively. Furthermore, there has been insufficient research on the role of healthcare professionals in promoting the use of HBMDs, despite their crucial role in providing advice and support in managing chronic diseases.

This study is important because it addresses a significant gap in Pakistan’s public health practice and academic literature. By identifying awareness levels, usage trends and adoption barriers, as well as evaluating healthcare professionals' engagement, the research will help guide focused interventions. These could include training healthcare professionals to improve their

support for patient self-management, patient education initiatives and subsidized medical devices. The results will be valuable to anyone working in chronic disease prevention and control, including policymakers, public health officials, healthcare professionals and non-governmental organizations. Ultimately, the study seeks to encourage self-monitoring behaviors with home-based medical devices to improve health outcomes, reduce disease complications and support a more sustainable healthcare system.

1.4 Research Objectives:

1. To assess the awareness and usage of home based medical devices (HBMDs) among patients with chronic diseases (Hypertension and Diabetes) in Pakistan
2. To evaluate the role of healthcare providers in promoting and guiding the use of HBMDs in Pakistan.
3. To identify key barriers to the adoption of HBMD in Pakistan, including education level, affordability and access to training.

1.5 Research Questions:

1. What is the level of awareness and knowledge of using home-based medical devices such as BP monitors and Glucometers among patients with chronic diseases (Diabetes and Hypertension) in Pakistan?
2. How frequently do patients with diabetes or hypertension use glucometers and BP monitors for management in Pakistan?
3. To what extent do healthcare providers encourage and guide the usage of home-based medical devices in Pakistan?
4. What are the key barriers to the adoption of home-based medical devices in Pakistan?
5. What specific educational, financial, and healthcare support strategies could improve the adoption, trust and proper use of home-based glucometers and BP monitors in Pakistan?

1.6 Dissertation Structure Overview:

The dissertation will be composed of five chapters as follows:

1. Chapter 1: Introduces the research topic, including the purpose, significance, justification and the research objectives and questions.

2. Chapter 2: Reviews existing literature on key topics related to the study, such as awareness and knowledge of home-based medical devices (HBMDs), the role of healthcare providers in promoting their use and the barriers to adoption of self-monitoring devices.
3. Chapter 3: Outlines the research methodology, including the research philosophy, approach, strategy, sampling methods, techniques and procedures employed throughout the study.
4. Chapter 4: Presents and discusses the findings from the primary research, including the interviews conducted and the analysis of the data collected.
5. Chapter 5: Discusses and interprets the findings of the research, exploring their implications for the purpose of this study. Additionally, it offers suggestions for potential areas of further research based on the findings.

CHAPTER 2: LITERATURE REVIEW

The rise in chronic diseases like hypertension and diabetes has made home-based medical devices, such as glucometers and BP monitors, more important than ever. Their use promotes self-monitoring, improves patient outcomes and reduces hospital visits (Dhamanti et al., 2023). While these devices are widely adopted in developed countries, their usage in developing countries like Pakistan remains a concern. This literature review investigates the awareness and extent of HBMD usage among patients with chronic diseases in the Pakistani context. Moreover, it examines the role of healthcare providers in guiding patients on the proper use of these devices, explores the barriers to their adoption and proposes strategies to overcome these barriers.

2.1 Introduction to Home-Based Medical Devices:

Home-based medical devices (HBMDs) are increasingly recognized as vital tools for managing chronic diseases, enabling patients to monitor and manage their health comfortably from home. This reduces the need for frequent hospital visits, facilitates timely medical interventions, and contributes to better overall disease management. Common HBMDs include glucometers, blood pressure monitors, pulse oximeters and digital thermometers (World Health Organization, 2016). Continuous monitoring is particularly important for chronic conditions like diabetes and hypertension to prevent complications and improve quality of life. In Pakistan, the prevalence of these conditions is alarmingly high: over 33 million adults have diabetes, according to the International Diabetes Federation (Rajput, 2024) and 46% of individuals over the age of 45 suffer from hypertension, as reported by the Pakistan Health Research Council (Basit *et al.*, 2020). Given these figures, HBMDs play a critical role in enabling early detection of abnormal readings and ensuring prompt medical responses.

Self-monitoring is widely acknowledged as a cornerstone of chronic disease management. Studies have shown that home-based self-monitoring leads to improved health outcomes, greater adherence to treatment plans and reduced healthcare costs (Gianfranco Parati *et al.*, 2010). Moreover, it fosters better communication between patients and healthcare providers, empowers individuals to take control of their health and enhances health literacy (Pickering et al., 2008). Despite these clear benefits, awareness, accessibility and usage of HBMDs remain limited in countries like Pakistan, especially in rural areas (Elahi *et al.*, 2023).

2.1.1 Blood Pressure (BP) Monitors:

One of the most popular HBMDs for treating hypertension is a blood pressure (BP) monitor. For those with essential or secondary hypertension, these devices enable patients to check their blood pressure readings on a regular basis. Digital blood pressure monitors come in two primary varieties: manual (aneroid) and automatic (oscillometric). Because of their simplicity of use and low training requirements, the automatic models are more frequently suggested for domestic usage (Pickering et al., 2008). According to a number of international studies, home blood pressure monitoring is more accurate than clinic readings at identifying masked and white-coat hypertension (Stergiou et al., 2014). Furthermore, comprehensive evaluations show that home blood pressure monitoring greatly improves blood pressure control, particularly when paired with nurse-led interventions or tele monitoring (Uhlig et al., 2013; Tucker et al., 2017).

However, there is currently little domestic use of blood pressure monitors in Pakistan. Just 61% of hypertension patients had a blood pressure monitor and even fewer than 25% used it frequently, according to a 2019 study that was carried out in Karachi's urban and semi-urban districts (Zahid *et al.*, 2017). Lack of knowledge, high cost, inadequate health literacy and cultural views on illness and treatment were among the factors affecting usage. Just 14% of hypertension patients in rural Sindh engaged in regular home blood pressure monitoring, according to a different study by (Jafar *et al.*, 2020) that evaluated self-care practices among these patients. The study cited obstacles such as limited equipment availability and mistrust of digital technology. Furthermore, awareness and use are influenced by socioeconomic circumstances and gender inequities. Because they have less control over healthcare decisions, women may have less access to such technologies, particularly in patriarchal rural settings (Zaidi et al., 2022). The adoption of these devices is further complicated by the possibility that many of the devices offered in local markets may not match international requirements for accuracy (Whelton *et al.*, 2018).

However, experimental projects encouraging digital literacy and community health professional participation have shown promise. For instance, a project from Aga Khan University implemented a mobile health intervention that raised home monitoring in low-income households and enhanced knowledge of hypertension (Mahdi *et al.*, 2022).

2.1.2 Glucometers:

Glucometers are portable devices that enable people to assess their blood glucose levels at home, especially those who have Type 1 or Type 2 diabetes. To maintain ideal glycemic control

and avoid consequences including neuropathy, retinopathy and cardiovascular disease, food, exercise and medication must be adjusted on a regular basis (Arlington and Virginia, 2020). Studies conducted all around the world have repeatedly highlighted how effective Self-Monitoring of Blood Glucose (SMBG) is in lowering HbA1c levels and improving overall diabetes outcomes, particularly when patients are given education regarding how to read and respond to the test results (Polonsky *et al.*, 2011; Malanda *et al.*, 2012). SMBG is an essential part of diabetes treatment in high-income environments. Whereas, in low middle income countries like Pakistan it is still limited.

According to a cross-sectional study conducted in Pakistan by (Basit *et al.*, 2020), less than half of diabetes patients used a glucometer on a weekly basis and only 35% of them possessed one. The expense of test strips, inadequate instruction on how to use them and a lack of support from medical professionals were some of the reasons given for their underutilization. According to another study by (Farhan *et al.*, 2017), usage is considerably lower in rural areas, where many patients only get monthly or quarterly glucose checks at clinics. Moreover, glucometer accuracy, upkeep and reading interpretation present significant difficulties. Unreliable readings result from many patients using expired test strips or failing to calibrate their devices. A study by (Malik *et al.*, 2024) studying SMBG practices in Lahore indicated that many patients misread readings and did not alter their medication correctly, stressing the necessity for formal patient education programs.

In conclusion, despite the fact that glucometers are a useful and efficient tool for managing diabetes, their use is still restricted in Pakistan because of issues with affordability, healthcare assistance and education. In low-resource settings, increasing glycemic control and lowering complications from diabetes depend on expanding access and offering systematic patient training.

2.2. Role of Home-Based Medical Devices (HBMDs) in the Management of Chronic Diseases:

Non-communicable diseases (NCDs) such as diabetes are responsible for 74% of global deaths (WHO, 2025). Managing these conditions requires regular monitoring of key health indicators to prevent complications. Home-based medical devices have become essential tools, allowing individuals to track their health, take timely action and improve disease management (Dhamanti *et al.*, 2023). For diabetes, self-monitoring of blood glucose plays a vital role in maintaining stable blood sugar levels. By providing immediate feedback, it helps individuals

recognize how their diet and physical activity impact glucose levels, leading to better disease control (Xu *et al.*, 2019). Studies suggest that individuals who regularly monitor their blood glucose to achieve lower HbA1c levels tend to improve diabetes management (Schnell *et al.*, 2017). Additionally, the introduction of new digital tools such as continuous glucose monitoring (CGM) systems has greatly contributed to diabetic care through real-time monitoring, readings analysis and allowing proactive decision making (Chaudhury *et al.*, 2017). Furthermore, the integration of mobile health (mHealth) applications and digital tools has also revolutionized diabetic care, enhancing self-management behavior among diabetic individuals. A systematic review by (Greenwood *et al.*, 2017) indicated that mHealth tools, such as smartphone applications and reminder text alerts, have enhanced compliance with monitoring and management of diabetes, resulting in better health outcomes.

Another non-communicable disease (NCD), Hypertension, is one of the leading causes of cardiovascular diseases and requires continuous monitoring to prevent complications such as heart attack, kidney disease and stroke (Mills *et al.*, 2020). Self-monitoring of blood pressure (BP) is widely recognized as a crucial strategy for managing hypertension. Regular home monitoring enables early detection of fluctuations, promotes adherence to prescribed treatments and supports lifestyle modifications essential for long-term BP control (Tucker *et al.*, 2017). Studies show that self-monitoring of blood pressure (BP) at home is more predictive of cardiovascular (CVS) risk than clinic-based BP measurement, indicating an important tool for hypertension management (Stergiou and Bliziotis, 2011).

Moreover, self-monitoring capabilities have been enhanced by recent advancements in wearable technologies, the Internet of Things (IoT) and artificial intelligence (AI). Wearable sensors enable the tracking of diabetes, heart rate and blood pressure, providing real-time data to healthcare professionals for valuable insights into personalized disease management and treatment. This has shifted the patient care approach from reactive to proactive (Luo *et al.*, 2024). Additionally, AI-driven analytics can effectively identify trends and predict risks, ultimately contributing to early intervention and preventing the consequences of untreated diseases (Contreras and Vehi, 2018).

In a nutshell, home-based medical devices are vital tools for self-managing chronic diseases such as diabetes and hypertension. Daily self-monitoring allows individuals and healthcare providers to take proactive steps in preventing disease progression, intervening in

current treatment regimens and reducing hospital visits. With advancements in digital health technologies and the integration of AI and telemedicine, these devices can undoubtedly improve patient health outcomes and enable personalized treatment plans to fight against chronic diseases.

2.3. Awareness and Knowledge of HBMDs among Patients:

The awareness and knowledge of using Home-Based Medical Devices (HBMDs) play a vital role in improving self-management among patients with chronic diseases such as diabetes and hypertension. As the prevalence of non-communicable diseases (NCDs) in low- and middle-income countries is increasing significantly, the use of HBMDs for self-monitoring and management of diabetes and hypertension becomes increasingly important. Research suggests that despite the benefits associated with the use of HBMDs, awareness and knowledge about their availability and proper usage remain low among patients.

According to research, differences in the awareness and usage of Home-Based Medical Devices (HBMDs) exist across different regions. For instance, a study in India found that 62% of people were aware of HBMDs, with 73% of diabetic patients using glucometers, but only 42% of hypertensive patients using BP monitors (Linda *et al.*, 2021). This highlights the knowledge gap and the need for increased awareness efforts. Such variation underscores the need for targeted awareness initiatives, especially for patients with hypertension, who may not fully understand the benefits of self-monitoring. Similarly, a cross-sectional survey in Bangladesh found that knowledge about telehealth, which involves Home-Based Medical Devices (HBMDs), was linked to patients' trust and willingness to use them. However, many still had reservations about these technologies. This suggests that merely having knowledge is not enough; people need a deeper understanding and confidence in using HBMDs for effective self-monitoring, ultimately leading to better patient outcomes (Kabir *et al.*, 2024). The findings highlight the necessity of addressing underlying perceptions and trust concerns in addition to knowledge distribution, which is directly related to *Research Questions 1 and 5*.

In Pakistan, a cross-sectional study conducted in Karachi explored the frequency and influencing factors of glucometer usage among 567 diabetic patients. The results showed that 59% of the patients used glucometers for self-monitoring of blood glucose levels. Contributing factors to usage included high socioeconomic status, access to private healthcare and higher education. In contrast, the obstacles to usage included a lack of awareness and the cost of glucometers. Although

the study offers valuable insights, the urban environment may restrict generalizability because rural populations frequently have different difficulties. Instead of concentrating only on awareness initiatives, it is crucial to look at structural problems like affordability and access. One of the studies highlighted that government-subsidized programs and awareness initiatives could play a crucial role in enhancing the adoption of Home-Based Medical Devices (HBMDs) for self-monitoring (Farhan *et al.*, 2017). This study emphasizes that awareness campaigns alone are insufficient; without addressing affordability and access to these devices, efforts may fall short. The gap between awareness and actual usage is especially pronounced in rural or low-income settings, where the cost and access barriers are more pronounced. Many patients with chronic diseases in Pakistan are not fully aware of or using home-based medical devices (HBMDs) as much as they should. According to a review, telemedicine can be useful in spreading awareness of HBMDs, especially in rural areas. However, challenges like lack of proper implementation and patient education about these devices remain a pressing issue. These challenges require attention, as chronic diseases are on the rise in the country (Mahdi *et al.*, 2022). This implies that there is a knowledge gap as well as a gap in how well that information is executed.

Moreover, a study in Northwest Ethiopia assessed the knowledge and awareness of telemedicine services among healthcare professionals. The findings showed that while healthcare providers recognized its importance, there were no structured awareness or training programs. Although this study focuses on Ethiopia, it highlights similar challenges faced in Pakistan, where the integration of HBMDs and telemedicine into routine healthcare is still in its early stages and requires more attention (Assay *et al.*, 2022). Thus, awareness gaps are not just informational but are deeply embedded in structural inequalities. However, limited research in Pakistan has assessed awareness levels, with anecdotal evidence suggesting that many patients remain uninformed about the availability and advantages of these devices. These findings highlight the urgent need for targeted educational initiatives to bridge the knowledge gap and promote HBMD usage.

Lastly, providing patients with sufficient knowledge about HBMDs is crucial for effectively managing chronic diseases. A review of smart home healthcare for chronic disease management suggests that while self-monitoring at home can be beneficial, patients need proper support to integrate these devices into their daily lives. This includes technical training, education on interpreting health data and guidance on making informed decisions based on readings from

home medical devices (Ekstedt *et al.*, 2023). These results reinforce the need for actionable solutions that go beyond awareness and seek to improve trust, usability and adherence to self-monitoring routines.

2.4. Barriers to the Adoption of Home-Based Medical Devices:

Despite the many benefits of home-based medical devices (HBMDs), several barriers limit their widespread adoption in developing countries, including Pakistan. These barriers can be broadly categorized into three interconnected themes: healthcare access and affordability, digital literacy and training, and socio-cultural and privacy concerns. Rather than existing in isolation, these challenges often reinforce one another, creating complex obstacles for both patients and healthcare providers.

The high cost of home-based medical devices is a major concern for the people of Pakistan. Since approximately 98% of these devices are imported, they are expensive due to import duties, shipping fees and retailer margins. Instead of developing its own medical devices, Pakistan relies on imports, making it difficult for people to afford essential HBMDs like glucometers and blood pressure monitors (GSRRA, 2024). Moreover, bureaucratic hurdles in Pakistan make the import of medical devices very difficult, causing delays and extra costs. This not only increases the price of medical devices significantly but also reduces their availability, making it even harder for people to access them (Junaidi, 2019). These economic challenges are particularly severe in rural and low-income communities, where healthcare services are already under-resourced.

Financial barriers are closely linked with a lack of education and digital literacy, which further hampers the adoption of HBMDs. A large portion of Pakistan's population lacks awareness and knowledge about the importance and benefits of daily self-monitoring for chronic diseases using devices like glucometers and blood pressure monitors. This issue is more common in rural areas, where healthcare facilities and educational resources are limited. Even when patients are able to access HBMDs, they often do not receive proper guidance on how to operate them. This lack of instruction can lead to misuse and incorrect readings, affecting proper disease management. Additionally, healthcare providers may also lack sufficient knowledge or acceptance of telemedicine and related technologies. A survey in Karachi, Pakistan, revealed that while most healthcare providers understood telemedicine, the level of awareness varied, especially between the public and private sectors. It was found that healthcare professionals in the public sector had less knowledge compared to those in the private sector (Wasi Abbas *et al.*, 2024). These gaps in

provider training reduce the effectiveness of patient education and limit confidence in home-based technologies.

Moreover, studies have shown that the adoption of digital health technologies among youth in Pakistan faces several challenges. Complex medical terminology, limited information and communication skill and privacy concerns prevent effective use of these tools. This indicates that digital literacy issues affect both older and younger populations, though in different ways. While older individuals may be unfamiliar or uncomfortable with new technologies, younger individuals may struggle with understanding health-related content or navigating digital platforms effectively (Rahat *et al.*, 2022).

Cultural and societal norms also pose significant barriers to the adoption of HBMDs. These factors discourage individuals, especially the elderly, who are reluctant to adopt new technologies and may prefer traditional or conventional treatment methods (Bilal *et al.*, 2022). In such cases, access and affordability alone are not sufficient, cultural acceptance plays a crucial role in influencing whether people actually use these technologies.

Privacy concerns further complicate the adoption of HBMDs. These devices, which gather and transmit private health information, raise concerns regarding data security and potential misuse. In Pakistan, the lack of adequate data privacy legislation exacerbates this issue. According to a report by the Digital Rights Foundation, a significant amount of patient data is stored digitally without proper consent procedures, making patients susceptible to misuse and unauthorized access to their medical records. Additionally, studies show that Pakistani patients have high expectations for confidentiality and privacy, but healthcare providers are not aware of or do not adhere to privacy norms. This mismatch between patient expectations and actual medical practices undermines trust in digital health solutions. To promote the safe and widespread use of home-based medical devices, strong legal frameworks are needed to protect patient information, guarantee informed consent and build public confidence in digital healthcare technologies (Gerke *et al.*, 2020; Shirazi and Shekhani, 2021; Tribune, 2023).

In conclusion, the challenges to adopting HBMDs in Pakistan are multifaceted and interrelated. High costs, limited digital literacy, insufficient provider training, cultural resistance and privacy concerns do not operate in isolation. Instead, they form a network of barriers that require a holistic and integrated approach to resolve. Addressing one factor without considering

its relationship to the others is unlikely to produce meaningful or lasting improvements in HBMD adoption across the country.

2.5. Role of Healthcare Providers in Promoting the use of HBMDs:

Healthcare providers play a crucial role in promoting home-based medical devices (such as blood glucose meters) by evaluating their clinical utility and recommending those that best support patient self-management. Their guidance helps patients better understand their health data, leading to improved diabetes management and more informed decisions (Greenwood and Grady, 2021). However, while these roles are often acknowledged, there is limited empirical evidence assessing how consistently healthcare providers perform these roles in practice, especially in low-resource settings like Pakistan.

The role of healthcare providers in the adoption and effective use of home-based medical devices (HBMDs) is crucial for patients with chronic diseases such as diabetes and hypertension. Their responsibilities include evaluating clinical benefits, educating patients on proper use and integrating monitoring into long-term care plans. This not only encourages patient self-care but also reduces hospital visits and enhances patient safety. Importantly, providers help ensure the accuracy and appropriateness of devices. For instance, doctors recommend home blood pressure monitors for hypertensive patients who have been tested and proven to be accurate and reliable. Organizations like the American Heart Association (AHA) suggest using properly standardized blood pressure devices with upper arm cuffs at home (Pickering *et al.*, 2008). Yet, in LMICs like Pakistan, it remains unclear how well these guidelines are followed in everyday clinical settings, pointing to a gap that relates directly to *Research Question 3*. When it comes to diabetes care, selecting the best glucometer requires taking into account aspects like portability, data connectivity and convenience of use decisions in which the advice of healthcare professionals is crucial (Kane, 2024). However, the extent to which Pakistani providers are trained or proactive in offering such tailored recommendations remains under-researched. Even with devices accessible, this gap restricts the potential efficacy of HBMDs, underscoring the need for more research on provider education and patient-provider communication.

Healthcare providers play a crucial role in educating and guiding patients with chronic diseases on the proper use of home-based medical devices (HBMDs) to ensure correct readings, monitoring and effective disease management. Proper education and guidance are critical to reducing errors and enhancing the reliability of home monitoring for chronic diseases such as

diabetes and hypertension. For instance, for accurate blood pressure monitoring, healthcare providers must guide patients on proper practices, including avoiding caffeine or tobacco at least 30 minutes before measurement, resting for five minutes before checking blood pressure and ensuring the correct arm position with back support and feet flat on the ground. These instructions help ensure accurate and reliable readings, leading to consistent measurements (Pickering *et al.*, 2008; McKay, 2024). Similarly, in diabetes care, providers advise patients on correct glucometer use, storage of strips and calibration routines. Increasingly, providers are also guiding patients in using continuous glucose monitors (CGMs), which support more precise decision-making. These illustrations highlight the fact that provider participation is not only beneficial but also necessary to guarantee reliability and optimize the advantages of HBMDs (Alysse Dalessandro, 2024).

Beyond technical guidance, healthcare providers influence patient behavior through the quality of their communication and relationships. According to research by (Elizabeth Kinchen *et al.*, 2021), people value openness and trust in their contacts with doctors and desire to be included in health decisions. This relational factor influences patients' readiness to embrace new health behaviours, such as self-monitoring, in addition to their level of happiness. This behavioural factor is rarely examined in Pakistani literature, especially when it comes to the treatment of chronic illnesses, indicating yet another significant research gap.

Lastly, healthcare professionals' behavioural influence also includes promoting long-term self-care. According to a study on heart failure patients, patients who experienced poor communication were less compliant, whereas those who received consistent, sympathetic and responsive care from clinicians were more likely to participate in self-management behaviours (Currie *et al.*, 2015). Despite not specifically addressing diabetes or hypertension, this study supports a more general idea: adherence to chronic disease management techniques, such as the usage of HBMD, is strongly influenced by the quality of the patient-provider relationship. This emphasizes the need of provider assistance not only for technical use but also for encouraging continuous involvement, which strengthens the significance of *Research Question 3*. Although studies conducted internationally highlight the vital role that healthcare providers play in encouraging the use of HBMDs, empirical evidence from Pakistan is notably lacking. This disparity underlines the necessity of doing context-specific research on patient engagement tactics and provider practices in low-resource environments.

2.6. Strategies to facilitate the smooth and effective adoption of Home-Based Medical Devices (HBMDs):

Several important factors contribute significantly to the adoption of home-based medical devices (HBMDs) for self-monitoring including educational programs, financial assistance, user-friendly device design, subsidized government initiatives and training programs for both patients and healthcare providers. Educational programs equip patients with the necessary knowledge and skills to use HBMDs effectively for self-care and disease management, thereby proving to be a potent strategy to enhance the adoption of HBMDs in patient healthcare. Studies indicate that a lack of awareness and knowledge regarding the proper use of these devices results in misuse or underutilization of these technologies. (Madanian *et al.*, 2023) presented that patients who receive structured education on the usage of HBMDs show greater adherence to self-care practices and improved health outcomes. Similarly, a study by (Cimperman *et al.*, 2013) found that digital health literacy plays a significant role in influencing patients' willingness to use medical devices more frequently, particularly among elderly people. In Pakistan, digital literacy remains a major issue, as highlighted by (Saifullah *et al.*, 2024), who advocates for community-based training and education programs for the general public to increase awareness. Educational programs such as m-health applications, instructional videos and one-on-one demonstrations have proven to be effective tools in increasing patients' trust in the use of home-based medical devices.

The cost of home-based medical devices (HBMDs) is another significant barrier to their adoption for self-care, especially in low- and middle-income countries, including Pakistan. Studies emphasize the need for financial assistance programs to make these devices accessible and usable for a wider population. (Fayez *et al.*, 2024) found that Pakistani patients face cost-related challenges due to the unavailability of health insurance and the high prices of imported medical devices, which are often beyond their financial means (Hollander and Carr, 2020). In such instances, government subsidies, microfinance programs and public-private partnerships become essential in bridging affordability gaps within the population. In Pakistan, organizations such as Sehat Kahani have introduced subsidized digital health solutions; however, their reach remains limited. Expanding similar programs and initiatives would facilitate the broader adoption and use of home-based medical devices, ultimately improving healthcare accessibility and patient outcomes (Sehat Kahani, 2024).

One of the barriers to the adoption of home-based medical devices is the usability issue. A study by (Peek *et al.*, 2014) emphasized that medical devices should be designed in a way that is easy to use, with clear-cut instructions, a simple design and consisting of fewer steps so that people don't find it hard to use, considering their varying technical skills. Moreover, if patients are involved in the design of medical devices, it will become easier for others to use them and incorporate home-based medical devices into self-care (Marcilly *et al.*, 2016) In Pakistan, many people aren't comfortable using digital health tools. (Muhammad *et al.*, 2023) added that if voice packs with different languages are added to the medical devices, it would be handy for patients to use and follow the instructions efficiently. Similarly, features like automatic reminders, health apps on phones and picture-based instructions can make the use of home-based medical devices easier and better. Despite these recommendations, limited data exists on the specific usability challenges Pakistani patients face when using HBMDs at home. More context-specific research is needed to evaluate which design features most impact adoption and continued use.

It is necessary to train doctors, nurses and other healthcare providers along with patients, about the proper use of medical devices to ensure effective use and adoption of home-based medical devices. A study by (Torous and Roberts, 2017) focuses on the fact that homecare workers play an essential role in helping patients when they start using these devices and training them on the proper use of the devices. This suggests that if healthcare providers are well-educated and trained regarding the use of medical devices, they are able to educate patients on the right way of using these devices, which helps patients to keep using these devices to manage their chronic diseases efficiently. The results of the (Haleem *et al.*, 2021) study showed that the healthcare workers trained through telemedicine helped in educating patients for self-monitoring in routine care effectively. Also, when family caregivers were well trained at homes with old or sick people, it was found that the use of home-based medical devices increased significantly and worked better for them. However, in Pakistan, there is a noticeable gap in structured training frameworks for both healthcare providers and family caregivers. This calls into question the reliability and quality of care given to patients who are managing chronic illnesses at home.

To conclude, a number of factors, such as patient education, financial aid, device usability and healthcare professional training, affect the acceptance and successful use of home-based medical devices (HBMDs) for self-monitoring of chronic conditions, such as diabetes and hypertension. Even though previous studies have demonstrated the beneficial effects of HBMDs

on illness management, there are still major obstacles preventing their broad use in Pakistan, including low awareness, high costs, lack of proper training, insufficient guidance by the healthcare providers and cultural reluctance to use digital health technologies. User-friendly device designs, financial aid and educational initiatives could promote wider usage and improve disease control. Furthermore, in order to improve patient outcomes, healthcare providers are essential in educating patients and making sure these devices are used correctly. Nevertheless, there is still little data on the awareness and usage of HBMDs in Pakistan, despite the significant attention being paid to their advantages worldwide. This disparity emphasizes how urgently more focused research is needed in Pakistan to better understand the factors that encourage and hinder the adoption of HBMD. This research will help shape strategies for improving patient outcomes through chronic illness self-monitoring.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction:

The aim of this research is to explore the awareness and usage of home-based medical devices (glucometers and blood pressure monitors) among patients with chronic diseases (diabetes and hypertension) in Pakistan. This chapter outlines research philosophy, approach, strategy, sampling methods and data collection techniques and data analysis procedures. The primary research was conducted through interviews with qualified healthcare providers, including general practitioners, endocrinologists and cardiologists across Pakistan.

3.2 Research Design:

The research design refers to the overall structure and logical framework of the research process (Creswell, 2009). It includes the philosophical underpinnings, methodological choices, and practical steps taken to collect and analyze data. It encompassed the following components to address the research objectives effectively:

3.2.1 Research Philosophy:

The study adopted an interpretivist philosophy, as it aimed to assess awareness, usage, barriers and the role of healthcare providers. According to the Research Onion framework proposed by (Saunders *et al.*, 2009), this philosophical stance aligns with a qualitative research approach, which emphasizes understanding human experiences and social contexts. This approach enabled interviews with healthcare providers to uncover challenges, awareness levels, and practical guidance regarding the use of Home-Based Medical Devices (HBMDs). Moreover, the study proposed strategies put forth by the participants to overcome the barriers they had identified, providing useful, experience-based suggestions. The selection of a qualitative, inductive research approach was thus consistent with the interpretivist paradigm, as explained in the next section.

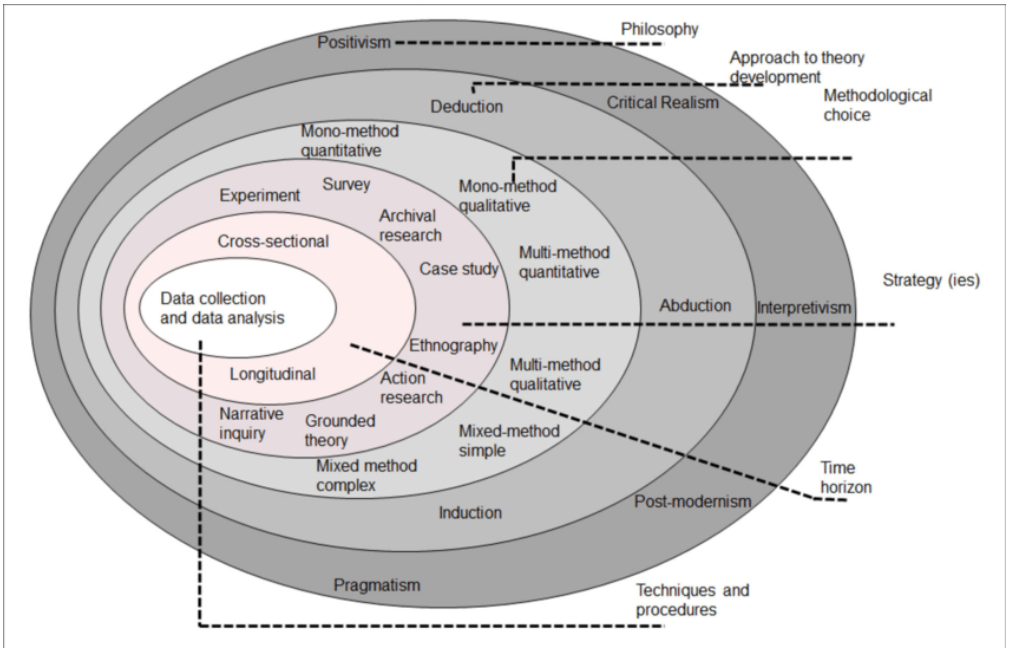

Figure 1 Research Onion (Saunders et al., 2009)

3.2.2 Research Approach:

This study adopted an inductive approach within the interpretivist paradigm, emphasizing the derivation of meaning from empirical data (Bryman, 2016). Through qualitative interviews with healthcare providers, the study explored their experiences to identify recurring themes and patterns. Inductive reasoning is well-suited to this philosophy, beginning with observations and building broader conceptual insights. This enabled the emergence of context-specific findings that contribute meaningfully to the discourse on HBMD usage. The interviews provided a deeper understanding of the challenges and practical experiences associated with devices such as glucometers and blood pressure monitors.

3.2.3 Research Strategy:

While research design refers to the overarching structure of the study, the research strategy outlines the specific plan for data collection aligned with the study's aims. This study employed a qualitative strategy using semi-structured interviews, allowing for flexible yet focused discussions with healthcare providers. The participants, General Practitioners, Cardiologists and Endocrinologists, were selected as subject matter experts in the use of HBMDs. This method was chosen because it allowed participants to share their specific thoughts, helping to gain a better understanding of how patients with chronic conditions use and are aware of devices like blood

pressure monitors and glucometers. It also explored the role of healthcare professionals in promoting and guiding the use of these devices, as well as the barriers to their adoption and potential solutions to overcome these challenges. These interviews provided valuable information that supported the study's overall conclusions. Additionally, this approach was deemed more practical and time-efficient than broader quantitative methods, given the feasibility of recruiting experts within the available timeframe.

3.2.4 Sampling Methods:

The study used purposive sampling instead of random sampling, specifically selecting healthcare professionals with over two years of experience such as cardiologists, endocrinologists, and general practitioners. This approach was deliberately chosen to ensure that participants possessed relevant clinical expertise and hands-on experience in managing chronic conditions like diabetes and hypertension. By focusing on healthcare providers who routinely engage with patients using home-based medical devices (HBMDs), the study intended to gather in-depth, knowledgeable insights that random sampling might not have reliably provided. Participants were drawn from both public and private hospitals across various regions in Pakistan, enabling the research to reflect a diverse range of clinical settings and patient populations. This diversity was critical, given that access to and awareness of HBMDs may differ significantly between urban and rural areas. While purposive sampling may introduce selection bias due to reliance on the researcher's professional network, this was mitigated by clear inclusion criteria and participant diversity.

3.2.5 Techniques and Procedures:

Secondary data was gathered via a comprehensive literature review using databases such as EBSCO, PubMed, ScienceDirect, Springer Link, Google Scholar and others.

Primary data was collected through interviews with nine healthcare professionals, including general practitioners, endocrinologists, and cardiologists, who routinely treat patients with diabetes and hypertension. Participants represented both urban and rural healthcare settings through public hospitals, private clinics and dual-practice professionals. Interviewees were contacted through personal connections from the researcher's previous workplace and interviewed via WhatsApp audio calls. All participants were informed of their rights and assured of confidentiality. Interviews were recorded (with consent) and scheduled based on participant

availability The interview questions were designed to align with the study's research objectives and successfully gathered detailed insights into real-world clinical practices and challenges

3.2.6 Data Analysis Technique:

Data analysis was conducted using thematic analysis, following the framework by Braun and Clarke (2006). This involved stages of familiarization, coding, theme identification and interpretation. This technique's potential to identify trends in qualitative data and to mirror the inductive methodology of the study made it suitable. Interviews were transcribed manually and analyzed by manually coding responses according to recurring themes and patterns such as awareness, patient compliance, device accessibility, usage frequency, rural and urban educational divide, etc. Thematic analysis was guided by the research questions and interview structure, ensuring alignment with the study's objectives and research questions.

3.2.7 Participant Criteria:

- **Inclusion Criteria:**
    1. Must be a general practitioner, endocrinologist, or cardiologist.
    2. Must have more than 2 years of work experience.
- **Exclusion Criteria:**
    1. Speciality other than those mentioned above.
    2. Work experience less than 2 years.

These criteria ensured that participants had sufficient clinical experience and context to contribute meaningfully to the discussion on HBMDS.

3.3 Ethics Considerations:

Ethical considerations were paramount in this study. To ensure compliance, I first completed Griffith College Dublin's Ethics Form, which included my interview questionnaire and responses to various related questions. I then obtained signed approval from my supervisor, granting permission to conduct the interviews. Following this, I obtained a signed consent form from each participant. All procedures were designed in alignment with ethical research standards and the General Data Protection Regulation (GDPR) to ensure participants' privacy, safety and autonomy. Below were some key ethical considerations for my research:

1. **Informed Consent:**
    a. Participants were fully informed of the study's purpose, procedures, potential risks and benefits before consenting.
    b. Provided participants with a consent form that clearly outlined their rights, including the right to withdraw from the study at any time without any consequences.
2. **Confidentiality:** The confidentiality of participants' data was maintained by anonymizing responses and securely storing data. Personal identifiers were not collected to protect participants' privacy.
3. **Voluntary Participation:** Participation in the interview was entirely voluntary. No participant was forced to take part in the study.
4. **Patient Data Confidentiality:** Individual patient records were not accessed, discussed, or included in this study. The research focused on general trends, perceptions, and professional experiences of healthcare providers.
5. **GDPR Compliance and Data Protection:** All personal data was collected, stored, and processed lawfully in line with GDPR. No personally identifiable information was recorded during interviews. Transcripts and recordings were anonymized using pseudonyms, encrypted, and stored on a password-protected device accessible only to the researcher. All data will be securely deleted after the graduation, following institutional and GDPR retention policies.

3.4 Conclusion

This chapter outlined the research methodology used to assess awareness and usage of home-based medical devices among patients with chronic illnesses, focusing on the role of healthcare providers and associated barriers. It also included the research strategy, philosophical approach, ethical considerations and the use of a qualitative method for primary data collection through semi-structured interviews with healthcare providers. The following chapter will present the findings and thematic analysis of the data obtained from the primary research.

CHAPTER 4: FINDINGS AND ANALYSIS

This chapter presents the results obtained from nine interviews conducted with healthcare providers as part of the primary research. It includes summaries of the interviews followed by a thematic analysis of the results.

4.1 Interview Summaries:

4.1.1 Importance and Awareness about Home-Based Medical Devices: (Questions 1-2)

Home-based medical devices (HBMDs), such as glucometers and blood pressure monitors, are important in managing chronic diseases like diabetes and hypertension. Participants underlined how these tools enable patients to monitor their health on a frequent basis, facilitating prompt therapeutic interventions and early problem detection. According to Participant 8, "*Home-based devices are like having a nurse in your home,"* highlighting their function in constant monitoring. The importance of these devices was further emphasized by Participant 5, who said, "You live with your condition every day, but I only see you once a month or two," highlighting the way that routine home monitoring can help fill the time between hospital visits. In addition, participant 5 described a situation in which a trend of elevated blood sugars after meals was discovered through regular glucose monitoring. "*Without the glucometer, we would've missed that*", which led to timely intervention in managing the condition. Participants emphasized that although HBMDs are important, they cannot replace clinician visits or lifestyle modifications. While these tools are crucial for tracking the course of the disease, Participant 3 underlined that "*lifestyle modifications are the first step to treatment*" for long-term, successful management. There are notable differences in awareness of HBMDs according to socioeconomic background, geography, and level of education. As seen in Participant 2's example of a patient from Lahore who maintained thorough blood pressure logs, patients in urban locations with greater literacy rates are typically more accustomed to these devices, allowing for more accurate therapy. Participant 1's account of a diabetic patient who had never used a glucometer despite having the disease for ten years demonstrates how many patients in rural locations are either ignorant of these devices or unclear of how to use them. Inappropriate use is widespread, even among individuals who own these devices. In order to illustrate the need for improved education, participant 5 related the story of an older woman who was afraid of making mistakes when using her glucometer. However, Participant 8's patient's blood pressure monitor helped manage a hypertensive crisis at home, demonstrating

how properly using HBMDs in emergencies can save lives. In summary, although awareness is increasing, especially in urban areas, more education is still needed in rural areas to guarantee that patients have access to HBMDs and know how to use them efficiently and to their maximum potential.

4.1.2 Usage Frequency and Data Sharing Habits: (Questions 3-4)

Although home-based medical devices (HBMDs) are being used more frequently to treat chronic diseases like diabetes and hypertension, there are significant differences in how they are used and how data is shared across urban and rural areas. Participants generally agree that HBMD usage is more prevalent in urban, educated and financially stable populations. For instance, according to Participant 4, patients at private clinics use devices frequently, some monitoring their readings several times a day, especially those who are taking medications like warfarin or managing illnesses like diabetes. However, there are additional issues with affordability and awareness in rural areas. According to participant 3, many patients in rural areas seldom use HBMDS (glucometers and BP monitors), usually solely in response to symptoms like fatigue or dizziness. This restriction is exacerbated by poor data-sharing methods, as patients may not provide structured, regular logs during visits and instead barely recall readings. All participants generally believe that patient education is important in changing usage behaviours, even if urban patients are generally more diligent. For example, Participant 2 stressed the value of describing to patients the significance of routine monitoring, comparing it to a "*health diary*" that aids in condition management for both the patient and the physician. But as Participant 5 noted, regular data-sharing is still a problem despite increased awareness. Although it is still uncommon, some individuals do share their readings (for example, one patient submitted daily images of his glucometer readings). The disparity in usage and sharing is much more noticeable in rural areas, confirmed by Participant 8's experience. Only 50–60% of patients regularly bring their data, even while up to 90–95% of patients use HBMDs after receiving the appropriate training. This implies that even while the advantages of HBMDs are becoming more widely recognized, a sizable percentage of patients still require encouragement and reminders to include these tools into their daily routines. Most individuals accept that HBMDs are a useful tool for managing chronic illnesses, but more training, greater device access and better support are urgently needed to encourage regular use and data exchange, especially in rural regions.

4.1.3 Barriers to the adoption of Home-based Medical Devices (Glucometers and BP monitors): (Questions 7-8)

The adoption of glucometers and blood pressure monitors for self-monitoring is hindered by several key barriers: affordability, lack of training and limited awareness. The majority of participants believed that the biggest obstacle is affordability, especially for patients in rural areas or with low incomes who find it difficult to pay for consumables like test strips and batteries on top of the expensive cost of the devices. Participant 5 highlighted that test strips can cost up to 3000 Rupees (PKR), which is significant money for daily wage earners. This frequently results in patients giving up on their devices or skipping tests because of financial limitations. Another significant barrier is a lack of training. Inaccurate readings and a general mistrust of the devices are the outcomes of many patients' improper use of the devices. Participant 1 gave the example of a patient who stopped using his blood pressure monitor because he was not properly positioning his arm, which resulted in inaccurate readings. Another factor contributing to the issue is a lack of awareness, particularly in rural regions where patients might not completely comprehend the advantages of self-monitoring. According to Participant 3, some patients could believe they don't require the devices and can be monitored with routine clinic visits. Another factor that contributes to the problem is accessibility; in some areas, such devices might not be easily accessible. Patients in some rural villages have pooled together to buy and share a glucometer, indicating the need for self-monitoring as well as the financial challenges. In conclusion, the primary obstacles to the widespread adoption of blood pressure monitors and glucometers are their cost, lack of training and low awareness. Adoption may be greatly enhanced by addressing these issues with subsidies, appropriate training and raised awareness, enabling patients to better manage their health and lessen the complications associated with long-term illnesses.

4.1.4 Role of Healthcare Providers in promoting the use of HBMDs: (Questions 5-6, 10)

All participants encouraged their patients to use glucometers and blood pressure monitors, especially for those with chronic conditions like diabetes and hypertension, however, they all stressed the significance of appropriate use and routine checkups. For example, Participant 1 highlighted their involvement in determining treatment success when they stated, "These devices help us see how well their treatment is working". Whereas, participant 5 underscored the importance of patient education in promoting confidence and participation when she said, "Patients feel empowered when they understand the device isn’t scary, it’s a support tool". Overall, while

these devices are helpful, these should be used with guidance from a medical expert to ensure accurate and effective health management. Most healthcare providers prefer informal, one-on-one training for guiding patients on how to use medical devices like glucometers and blood pressure monitors. This method is thought to be more successful in making sure patients understand how to use the device, particularly in view of time restrictions and the large patient volume. When discussing the importance of customized demos, for instance, Participant 1 said, *"It's more personal and I can answer any questions they might have right away."* Additionally, Participant 2 mentioned that family members can benefit from the demonstration, particularly if the patient is elderly. Many participants noted that informal training techniques are more practical due to limited resources and patients' literacy levels, especially in remote areas. While formal training would be ideal, the complexity of the devices, patients' reading levels, and healthcare setting constraints made it challenging. Respondents believed that their patient population, often from rural or less-educated backgrounds, was better served by informal methods like verbal coaching or group discussions. Participants also highlighted that training materials were often in English, which created difficulties for illiterate or partially literate patients, emphasizing the need for local languages in the materials for better understanding. Despite obstacles including patient opposition and time restrictions, healthcare personnel are crucial in promoting health-monitoring equipment was the general response from all the participants. As Participant 1 noted*, "We explain to patients how helpful they are, but time is a challenge. I give simple instructions for them to take home*". Additionally, Participant 3 said, *"In public setups, we involve nurses or health educators to guide patients".* Healthcare professionals use real-world examples, precise directions and trust-building to get past these obstacles. In busy environments, family participation and team-based strategies facilitate device adoption, enhancing health outcomes and management. In conclusion, continuous patient education and assistance from medical professionals are still crucial to guaranteeing appropriate health management, even though informal training techniques are crucial for efficient device use, particularly in environments with limited resources. Patient confidence and device acceptance are further enhanced by family collaboration and customized demonstrations.

4.1.5 Strategies to Facilitate the Adoption of HBMDs for Self-Monitoring: (Questions 09, 11)

Depending on their viewpoints, participants highlighted several tactics to increase the uptake and efficient use of home-based medical equipment. Many ranked awareness campaigns

first because of its wide reach and simplicity of implementation, with the majority agreeing that they were essential for teaching patients the value of self-monitoring (Participant 1: *"Raising awareness is the most important"*). However, easier access to devices was also considered essential, especially in rural and low-income areas, where affordability and availability remain barriers as highlighted by participant 5: *"Many of my patients, especially from lower-income backgrounds, simply can't afford glucometers or BP machines".* Incentives for usage were viewed as 3rd effective and feasible strategy in some circumstances, especially for urban populations, but not always practical for older patients or in rural areas as emphasized by Participant 2: *"For the elderly, incentives may not work because they have their own mindset".* Whereas mostly believed door to door community programs can be ranked 4th as it was considered to be costly and difficult on large scale as mentioned by Participant 6: *"They are very effective but less feasible on a larger scale".* The most common ranking was awareness campaigns first, followed by easier access to devices, then incentives and lastly, door-to-door programs.

When discussing strategies for collaboration between the government and healthcare institutions to increase awareness, accessibility, and adoption of HBMDs for chronic disease management, the most frequently mentioned strategy was offering financial aid and subsidies to lower the cost of these devices, particularly in urban and rural areas where many patients might not be able to afford them. Enhancing access in underprivileged rural areas was also seen as crucial, with recommendations made for local pharmacies or collaborations with private businesses and non-governmental organizations to distribute devices. To ensure that patients receive sufficient instruction on how to use these devices, it was also considered essential to train healthcare workers, especially physicians, nurses, and support staff, with a focus on overcoming literacy barriers in specific areas. Although telehealth integration is encouraged, some respondents pointed out that while it can be useful for data sharing and remote monitoring in urban settings, it may not be feasible in rural areas due to limited internet connectivity. When asked if they would suggest any other strategies, one participant (Participant 2) recommended using TV and radio in local languages to raise awareness and help people better understand, while another (Participant 8) suggested increasing the number of trained healthcare staff to ensure proper demonstration and use of these devices.

4.2 Thematic Analysis of the Findings:

4.2.1 Theme 1: Awareness and Knowledge of Home-Based Medical Devices (HBMDs) among Patients

The awareness and knowledge of Home-Based Medical Devices (HBMDs) are crucial for empowering patients, especially those with chronic conditions like diabetes and hypertension, to manage their health independently. The significance of educating patients about HBMDs was acknowledged by the study participants, many of whom emphasized that a major obstacle to adoption is limited knowledge of how these devices function and their associated advantages. Despite the availability of these devices, participants noted that patient awareness remains poor, particularly in underserved and rural areas. This observation aligns with the literature, which shows that, despite the established advantages of HBMDs, patients frequently have limited knowledge of them, leading to inadequate usage. The need for more focused awareness efforts is highlighted by studies like the one conducted by (Linda *et al.*, 2021), which revealed that while some patients with diabetes may be familiar with tools such as glucometers, individuals with hypertension often do not know how to use BP monitors. This supports the primary research finding that device-specific knowledge gaps can significantly limit the usefulness of HBMDs among different patient groups.

The primary research participants also emphasized the importance of patient education programs and practical training in addressing this knowledge gap and enabling patients to use HBMDs effectively. Similarly, the literature expresses concerns about knowledge gaps related to HBMD use, stressing the essential role of healthcare providers in informing patients about the benefits of home-based monitoring for chronic diseases. Particularly, (Kabir *et al.*, 2024) point out that patients are more likely to use HBMDs regularly when they feel supported and confident in their abilities to use them; this is a viewpoint shared by several participants who advocated for individualized, hands-on training as part of routine care. Rather than simply listing confidence as a factor, (Kabir *et al.*, 2024) work reinforces the necessity of integrating education into regular health service delivery, particularly in low-resource settings.

Interestingly, the study's participants recommended a more integrated approach, where patient education initiatives and medical personnel function as ongoing support networks for patients. Furthermore, a key gap identified in the primary research but not as prominently emphasized in the literature is the importance of language accessibility in educational materials.

To improve adoption rates, many participants highlighted that providing materials in local languages would ensure that more patients understand and feel comfortable using the technology. This adds a local perspective to the research, since most existing studies focus on things like access to healthcare and basic services, but not on language or cultural issues that people might face.

In conclusion, while the literature has thoroughly discussed the importance of disseminating knowledge about HBMDs, the primary research offers deeper insights into practical implementation strategies that may bridge the awareness gap, particularly in resource-limited settings. These findings emphasize the necessity of multilingual educational materials and structured, continuous training programs for both patients and healthcare professionals in order to broaden the reach and effectiveness of HBMD use. The results of this study may be limited to the viewpoints of healthcare providers rather than patient experiences. The study does not capture patients' knowledge, preferences or difficulties in using HBMDs because they were not actively involved. Furthermore, excluding out other medical professionals like nurses or community health workers could result in the loss of important information about patient support and education outside of hospitals.

4.2.2 Theme 2: Barriers to the Adoption of Home-Based Medical Devices (HBMDs)

Despite the potential advantages of Home-Based Medical Devices (HBMDs) in the treatment of chronic illnesses, several significant obstacles are preventing their widespread use in Pakistan. These barriers include high device costs, low levels of digital literacy and sociocultural resistance, which were frequently mentioned by the study participants. One of the most pressing challenges is the high cost of HBMDs, particularly since most devices are imported, making them unaffordable for large segments of the population. This challenge aligns with the literature, which shows that financial limitations are a major barrier to HBMD adoption, particularly in low-income countries like Pakistan. Many patients cannot afford essential devices such as blood pressure monitors and glucometers due to retailers' markups and import tariffs reflecting findings from studies such as (Farhan et al., 2017), which suggested that subsidized programs could help mitigate the financial burden, participants recommended government involvement or subsidies to reduce costs and improve access.

In addition to cost, participants identified a significant obstacle in rural areas: a lack of digital literacy. Many patients struggle with the technical aspects of operating these devices, and without proper instruction or training, the risk of misuse or inaccurate readings increases,

undermining their effectiveness. This finding is consistent with existing literature that identifies digital literacy as a key barrier to the adoption of HBMDs and telemedicine. Both patients and healthcare practitioners have expressed concerns about their ability to use this technology effectively. For example, (Wasi Abbas et al., 2024) found that healthcare professionals, especially in the public sector, lack adequate knowledge of telemedicine, which limits their ability to support and guide patients in using HBMDs.

Furthermore, participants pointed to cultural resistance as another significant barrier, especially among older individuals who often prefer traditional medical practices and are hesitant to embrace new technologies. This observation is supported by research indicating that cultural beliefs and social norms significantly influence the acceptance of health technologies, particularly in populations with limited exposure to digital health solutions. Many participants expressed a strong inclination towards face-to-face consultations with reliable local professionals, commonly known as "hakeems", as opposed to depending on gadgets or distant systems. This mistrust of technology is linked to wider cultural views in addition to being a result of unfamiliarity.

Additionally, concerns about privacy and the handling of personal health data were commonly noted. Participants were concerned about how their medical information would be utilised and who might have access to it. Participant 5 pointed out: “you don't know who can see the data or what they'll do with it once it's online." The lack of comprehensive data privacy legislation in Pakistan that are particular to health exacerbates this fear. The Prevention of Electronic Crimes Act (PECA, 2016) provides some broad guidelines, however, it is insufficiently detailed to support efficient medical data governance. This regulatory gap presents ethical dilemmas about data ownership, informed consent and liability for misuse. The study highlighted this gap between patient expectations of confidentiality and the lack of legal safeguards, an issue also emphasized by digital rights advocates such as (Gerke et al., 2020).

In conclusion, participants identified a range of interconnected barriers to HBMD adoption. While these barriers reflect broader challenges noted in the literature, the findings also underscore the need for a more comprehensive and integrated approach to address these issues collectively rather than in isolation. This study represents the opinions of healthcare providers employed by both public and private hospitals, which might restrict the range of perspectives found in the larger healthcare system. Not immediately included were patients or other medical professionals like

nurses or technicians. The results might also fall short in capturing end-user experiences or operational difficulties at various levels of care. Moreover, the lack of involvement from legal experts and policymakers limited the analysis of privacy and regulatory concerns.

4.2.3 Theme 3: Role of Healthcare Providers in Promoting the Use of HBMDs

The research participants emphasized the central role of healthcare providers in both initiating and sustaining the use of Home-Based Medical Devices (HBMDs), directly addressing *Research Question 3*. Most participants stressed that healthcare professionals should not only introduce patients to HBMDs but also provide ongoing monitoring and support to ensure correct and consistent usage. Personalized guidance was seen as a powerful motivator for patients, as it can enhance their confidence in using these devices. This aligns with existing literature, which repeatedly demonstrates that provider recommendation and support are key drivers of HBMD adoption. For example, (Kabir *et al.*, 2024) found that patients are significantly more likely to accept and regularly use digital health tools when they are endorsed and explained by a trusted healthcare provider. Moreover, participants noted that the ability of healthcare professionals to fulfill this role depends on their own familiarity and competence with digital health technologies. Several respondents observed that many providers, particularly in the public healthcare system, lack sufficient training in the use of HBMDs. This concern is echoed in the literature; (Wasi Abbas *et al.*, 2024) documented substantial knowledge gaps among healthcare workers regarding telemedicine and home-monitoring technologies, which in turn affects the quality of patient guidance and support. In addition, the study revealed a desire for interdisciplinary collaboration where doctors, nurses and health technologists work together to ensure that patients not only understand how to use HBMDs but also feel supported in doing so. Such collaboration was viewed as essential for building both technical competence and patient trust, especially for those managing chronic conditions like diabetes and hypertension.

In conclusion, the findings confirm that healthcare providers are not merely recommenders but key enablers of HBMD adoption and sustained use. Their role must be strengthened through structured training, continuous education, and coordinated teamwork. Importantly, participants emphasized that provider engagement should move beyond one-time advice to encompass long-term support integrated into chronic disease management. This insight complements and expands upon the literature by suggesting practical strategies for empowering both patients and providers in resource-limited settings. Despite offering insightful information about the role of healthcare

providers in the adoption of HBMD, the study's small sample size of nine healthcare providers, which includes only cardiologists, endocrinologists and general practitioners, may not adequately represent the viewpoints of other medical specialities or professionals.

4.2.4 Theme 4: Strategies to Facilitate the Smooth and Effective Adoption of HBMDs

In response to *Research Question 5*, participants proposed a range of strategies aimed at improving the adoption, trust, and sustained use of Home-Based Medical Devices (HBMDs). These strategies included healthcare provider engagement, government support, patient education and technological infrastructure. One of the most consistently emphasized recommendations was the implementation of structured, ongoing patient education programs. Participants stressed that training should go beyond basic device operation to include guidance on interpreting data and making informed health decisions. This aligns with the literature; for instance, (Ekstedt *et al.*, 2023) highlight that effective patient training is essential to avoid misuse and empower patients in chronic disease management.

Government intervention also emerged as a critical area. Many participants emphasized the importance of subsidies or price regulation to make HBMDs more accessible, particularly in low-income and underserved communities. This recommendation directly responds to the financial barriers identified earlier and reflects findings from (Farhan *et al.*, 2017), who noted that affordable healthcare policies and subsidized devices can significantly improve access to home-monitoring technologies. Additionally, participants advocated for nationwide awareness campaigns, ideally government-led, to complement educational efforts and normalize HBMD use across diverse demographics.

Beyond education and financial support, participants identified technological infrastructure as a fundamental enabler of HBMD adoption. They particularly emphasized the need to strengthen telemedicine systems and internet connectivity, especially in rural areas, to ensure patients can consult healthcare providers remotely and receive timely guidance. This can be seen in the literature, with (Mahdi *et al.*, 2022) reporting that poor infrastructure in rural regions remains a major limitation for digital health solutions.

Participants also suggested a more proactive role for healthcare professionals, emphasizing that continuous engagement through personalized recommendations and consistent follow-up can build patient trust and improve usage patterns. Literature supports this; several studies note that

collaborative efforts between healthcare providers and device manufacturers can lead to more user-friendly designs and better integration of patient support systems.

In summary, these findings reinforce the existing literature while also providing locally grounded recommendations for the Pakistani context. Specifically, they highlight the critical role of telehealth infrastructure, culturally responsive patient education and coordinated provider involvement. To enhance the adoption of HBMDs in Pakistan, a coordinated, multi-stakeholder approach is essential. Healthcare professionals should actively participate in patient education by offering follow-up consultations, continuous assistance and customized training, particularly for patients with low levels of digital literacy. Government agencies can lower costs by regulating prices, providing subsidies and funding telemedicine infrastructure and awareness initiatives, especially in underprivileged areas. To accommodate a range of literacy levels, device manufacturers should focus on creating low-cost, user-friendly gadgets with simplified instructions and multilingual capabilities, designed for low-resource environments. By aligning these efforts, stakeholders can address the economic, educational and technological challenges identified in this study and promote continuous and effective use of HBMDs. However, the lack of input from legislators and specialists in telemedicine infrastructure limited the analysis of important logistical and regulatory issues, particularly those pertaining to the deployment of government-led programs and technical support in remote regions. These limitations suggest that a broader, more inclusive sample, including patients and a wider variety of healthcare professionals, would offer a more comprehensive understanding of the barriers and enablers to HBMD adoption.

4.3 Core Findings:

This chapter concludes by outlining a number of significant obstacles and facilitators to Pakistan's adoption of home-based medical devices. The importance of patient education and awareness is emphasized in Theme 1, which also highlights the necessity of organized training programs to fill in knowledge gaps and enable patients to use HBMDs efficiently. According to Theme 2, overcoming cultural, economic, technological and privacy-related barriers requires a multifaceted strategy that includes government subsidies, digital literacy initiatives, and stricter privacy laws. In addition to advocating for increased interdisciplinary collaboration and continuous training, Theme 3 emphasizes the significance of healthcare provider engagement by suggesting that medical personnel should be at the forefront of patient education and assistance.

Finally, the study emphasizes that in order to improve HBMD adoption, especially in rural and low-resource areas, a concerted, multi-stakeholder effort involving government organizations, healthcare practitioners, and device manufacturers is required. These findings offer practical insights or policymakers and healthcare professionals looking to increase the efficacy and accessibility of HBMDs in Pakistan. The following table presents the barriers and suggested strategies to overcome them, as shared by the participants, along with the stakeholders involved.

Table 1 Summary of Key Barriers and Strategies for Adoption of HBMDs (Author)

Barriers	**Description**	**Suggested Strategy**	**Responsible Stakeholder(s)**
High Cost of Devices	Devices are often unaffordable due to import tariffs and lack of subsidies	Implement subsidies, regulate pricing and offer insurance coverage.	Government
Low Digital Literacy	Patients lack skills to use or interpret devices properly.	Provide structured, hands-on training and support programs.	Healthcare Providers, NGOs
Cultural Resistance	Older adults and rural communities resist new health technologies.	Launch culturally tailored awareness campaigns	Government, Healthcare Providers
Data Privacy Concerns	Fear of misuse of personal health	Develop and enforce robust digital health privacy regulations.	Government, Legal Authorities
Limited Telehealth Infrastructure	Poor connectivity and lack of access in rural areas.	Invest in broadband infrastructure and mobile health services.	Government, Telecom Sector
Lack of Professional Guidance	Healthcare providers are not well-trained in HBMDs.	Train healthcare workers and integrate device use into routine care.	Healthcare Institutions, Medical Training Bodies

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Key Findings:

This study aimed to investigate the awareness, use, provider involvement and key barriers related to Home-Based Medical Devices (HBMDs), specifically blood pressure monitors and glucometers, among Pakistani patients with chronic conditions such as diabetes and hypertension. The results indicate that although HBMDs have the potential to transform chronic disease management through self-monitoring, their practical application in the local context has been significantly limited by several interrelated issues.

First, the study found a lack of awareness and expertise regarding the correct use of these devices, particularly among the rural populations. This lack of awareness presents a significant barrier since, even if devices are available, patients who do not understand how to use them are unlikely to adopt them. Additionally, the study revealed a disparity in device-specific knowledge, with diabetes patients demonstrating greater familiarity with glucometers compared to hypertension patients, who had limited understanding of blood pressure monitors. These knowledge gaps point to a systemic issue in healthcare provider-patient involvement, as well as deficiencies in public health communication.

Second, the study highlighted the complex barriers to HBMD adoption, which included: 1) Cultural resistance, particularly among older adults who prefer traditional treatments and in-person consultations; 2) Economic constraints, such as the high cost of devices and the lack of subsidies, with many devices being imported, making them unaffordable for many patients; 3) A lack of digital literacy in rural areas, contributing to limited device usage and awareness; and 4) Ethical and legal concerns regarding data privacy, with participants expressing worries about who could access their health information and whether adequate regulations existed to protect it. While PECA (2016) provides some basic rights, these were found to be insufficient in addressing the specific sensitivities related to medical data. This lack of clarity hinders the ongoing adoption of HBMDs and reduces trust in digital health technologies.

The study also found that healthcare providers play a crucial role in facilitating the use of HBMDs. Patients used these devices more confidently and consistently when they received tailored advice and guidance from trained professionals. However, the study also revealed that healthcare professionals, particularly in the public sector, lacked engagement and training. The

integration of HBMDs into mainstream healthcare practices was often seen as requiring interdisciplinary collaboration and systematic training for medical staff.

Finally, the study identified several strategies that could support the adoption of HBMDs, including government subsidies, structured patient education, culturally appropriate awareness initiatives and enhanced telehealth services.

5.2 Summary of Key Differences with Literature:

While many of the study's conclusions align with existing literature, particularly concerning obstacles such as cost, digital literacy and the involvement of healthcare providers, some findings were especially relevant to the local context of Pakistan. Specifically:

1. This study places greater emphasis on language accessibility and the need for local language instructional resources than what is typically highlighted in international literature. Studies from other regions often overlook the importance of making health technologies accessible to patients who are not fluent in global languages, such as English. This is particularly important in Pakistan, where language barriers can significantly impact the adoption of home-based medical devices (HBMDs).
2. Cultural resistance, arising from a preference for traditional health practices and in-person care, was notably observed among Pakistani patients. This resistance to digital solutions is often underexplored in global health tech adoption studies, which tend to focus on more general technological barriers without considering the specific cultural contexts that may shape patients' willingness to embrace HBMDs.
3. The perceived absence of local data protection regulations compounded concerns about data privacy and created distrust toward digital health technologies. While global studies often address data privacy, the unique lack of clear local legal frameworks in Pakistan exposes a critical vulnerability in the adoption of HBMDs, which is not as prominently discussed in global contexts.

These findings underscore the importance of considering the local context when developing public health strategies. They also demonstrate that approaches from Western countries may not be as effective in regions like Pakistan where cultural, linguistic and legal differences play a significant role in the successful adoption of digital health solutions.

5.3 Recommendations:

5.3.1 Practical Recommendations:

To enhance the adoption of Home-Based Medical Devices (HBMDs) in Pakistan, the recommendations are as follow:

1. In order to address literacy obstacles, particularly in rural and underserved areas, where patients may not have high levels of health literacy, patient education should emphasize community-based workshops for patients and caregivers that use simplified, multilingual and visual materials.
2. The government should introduce subsidies for HBMDs and encourage health insurance providers to cover these devices for chronic disease management. By subsidizing the cost and incorporating HBMDs into health insurance coverage, the government can reduce financial barriers, making these devices more accessible to a larger portion of the population.
3. To build trust in home-based medical devices, carry out targeted awareness campaigns that align with cultural norms and involve local leaders. This approach helps ensure that the message resonates with the community and is accepted more easily.
4. It is crucial to upgrade digital infrastructure in rural areas, including internet connectivity and telemedicine capabilities in clinics. HBMDs and digital health services are difficult to access in remote locations due to a lack of internet infrastructure. In order to use telehealth services and guarantee the efficacy of HBMDs that depend on digital interfaces, dependable internet connectivity is essential.
5. Comprehensive training in HBMDs and continuous professional development initiatives should be provided to healthcare providers in order to enhance their expertise in digital health. Many medical professionals, especially those in the public sector, lack the skills and training needed to successfully integrate HBMDs into patient care. Healthcare professionals who have received training are guaranteed to be able to explain how to use these devices to patients, analyze the data and offer advice on how to manage long-term diseases.

5.3.2 Academic Recommendations:

1. In order to directly gather end-user experiences, preferences, and operational issues, future research should include patient groups. To improve the design and performance of

HBMDs, it is crucial to understand how patients engage with them and the difficulties they encounter. Direct patient feedback allows researchers to pinpoint particular needs and challenges that may not be evident in theoretical frameworks or professional judgements.

2. It is crucial to conduct research on Pakistan's health data protection legislation's creation and implementation. By ensuring that sensitive medical data is managed securely, such initiatives would contribute to protecting patient privacy and fostering confidence in digital health solutions.
3. To create inexpensive, user-friendly devices that are suited to specific requirements, engineers, healthcare professionals and users should collaborate on research projects. The cost and design of HBMDs are significant obstacles to their smooth adoption, particularly for patients with lower incomes. Engineers, medical professionals, and patients working together on collaborative research can help develop more cost-effective devices that are tailored to the distinctive needs of the Pakistani community.

5.4 Limitations and Contributions of the Study:

This research has limitations, just like any other. By focusing specifically on the perspectives of cardiologists, endocrinologists and general practitioners, it did not incorporate the views of patients or other healthcare providers such as nurses and technicians. It's likely that this confined focus limited the study's capacity to thoroughly examine the practical and everyday behavioral aspects of HBMD use. Similarly, while digital privacy and rights were discussed, these conversations were shaped by the views of medical professionals rather than legal experts. As a result, certain legal and regulatory dimensions of digital health may not have been fully captured and the findings may not fully reflect the patient experience or broader systemic concerns. These limitations suggest opportunities for future studies to build upon this work by incorporating a wider range of stakeholder perspectives, including patients, nurses, legal experts and policymakers.

Nevertheless, the study offers a number of significant insights. It contributes a context-specific perspective to the global conversation on HBMDs by pointing out culturally rooted barriers and suggesting locally appropriate solutions grounded in Pakistan’s healthcare environment. It also highlights the critical role of healthcare professionals in supporting the adoption of HBMDs and underscores the need for collaborative and cross-sector strategies to achieve lasting impact.

5.5 Suggestions for Future Research:

Future studies need to take into account the following opportunities:

1. Conduct qualitative research focused on patients to better understand their expectations, challenges and perceptions regarding the use of HBMDs. This can enhance user involvement and help in the design of better patient-centered solutions.
2. Include a wider variety of healthcare providers, such as nurses, pharmacists and community health workers, to capture a broader range of experiences and insights related to the use and promotion of HBMDs in routine care.
3. Examine the effectiveness of public-private partnerships and pilot subsidy programs to assess how such initiatives might enhance affordability and encourage wider adoption of HBMDs among underserved populations.
4. Examine how the private sector influences HBMD accessibility and affordability. Understanding its role in pricing, distribution and innovation can reveal key opportunities or barriers to expanding device use in underserved areas

5.6 Final Reflection:

Working on this dissertation has been a rewarding and insightful academic journey. It has deepened my understanding of the complexities of digital health in low-resource settings and underscored the significance of context-specific research. Through this study, I gained valuable insights into the daily challenges faced by healthcare providers and the potential for thoughtfully implemented technologies to enhance patient care and health outcomes. I hope this research contributes meaningfully to the broader discourse on improving the accessibility, effectiveness and trust in home-based healthcare solutions in Pakistan.

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APPENDICES

ETHICS APPLICATION FORM:

Innopharma education

GRIFFITH COLLEGE

Ethics Application & Declaration Form

DISSERTATION TITLE: “Awareness and Use of Home-Based Medical Devices among Patients with Chronic Diseases (Hypertension and Diabetes) in Pakistan”

RESEARCHER’S NAME: Wajih Ur Rehman Khan

PROGRAMME OF STUDY: MSc in Medical Device Technology and Business

SUPERVISOR'S NAME: Nicola Rice

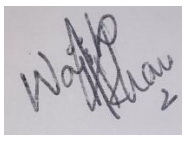
DECLARATION:

The information in this application form is accurate to the best of my knowledge. I undertake to abide by the principles outlined by Innopharma/Griffith College ethics policy in my research dissertation. I confirm that I have completed a full ethics assessment for my research dissertation as per the college guidelines. I will not begin my primary research until such approval from my supervisor and/or ethics Committee has been obtained.

I pledge to carry out my research according to the Innopharma/Griffith College academic integrity standards. Any results presented in my dissertation will be from my own, original research, I will reference and/or acknowledge any material or sources used in its preparation and I will not plagiarise the work of anyone else.

For Student:

STUDENT SIGNATURE:



DATE: 13/3/2025

The research contained within this research dissertation proposal has been approved.

For Supervisor:
Ethics Committee Approval Required: Yes [ ] No [X]

SUPERVISOR SIGNATURE: NR

DATE: 08/04/25

For Ethics Committee (if required):
Ethics Committee Approval Given: Yes [ ] No [ ]

ETHICS COMMITTEE MEMBER SIGNATURE:

DATE:

NOTE: Supervisors are responsible for ensuring their students fill in this form correctly and that all ethical areas have been considered.

SECTION 1: DESCRIPTION OF RESEARCH STUDY

1.1 Purpose of Research Study and Objectives:

The purpose of this research is to assess the level of awareness, usage, and challenges associated with Home-Based Medical Devices (HBMDs) such as glucometers and blood pressure monitors for managing chronic diseases like diabetes and hypertension in Pakistan. With the growing prevalence of chronic diseases, the need for self-management has increased significantly. This study will also explore the crucial role of healthcare providers in encouraging the use of these devices. Additionally, the research aims to suggest strategies to promote the adoption of HBMDs among patients managing chronic diseases.

Objectives:

1. **Assessing the Awareness and Frequency of Usage of HBMDs among Patients with Chronic Diseases (Diabetes and Hypertension):** The objective is to determine the level of awareness and knowledge regarding HBMDs such as glucometers and blood pressure monitors, for the self-management of diabetes and hypertension among Pakistani patients. Additionally, to assess the frequency of usage and the practice of recording readings for further medical action. The findings will help to identify existing gaps and serve as a foundation for targeted adoption strategies for these devices in Pakistan.
2. **Evaluating the Role of Healthcare Providers in Promoting the Use of HBMDs:** Given that patient behaviour is significantly influenced by healthcare providers (HCPs), the objective is to examine how HCPs guide patients in using HBMDs to enhance professional support systems and improve patient compliance.
3. **Identifying Barriers to the Adoption of HBMDs:** The objective is to identify the major barriers hindering the use of HBMDs for self-management. By understanding these obstacles, strategies can be developed to overcome them and facilitate the smooth adoption of HBMD usage.

4. **Suggesting Strategies to Enhance the Adoption and Effective Use of HBMDs:** Based on the findings, this study aims to propose strategies such as providing subsidies and financial assistance, offering proper usage training and conducting door-to-door campaigns to facilitate the easy adoption and effective use of HBMDs.

1.2 Research methodology:

This study will employ a qualitative method for collecting primary data. Interviews will be conducted with healthcare providers, including general practitioners, endocrinologists, and cardiologists with over two years of practice experience. These interviews will be carried out via WhatsApp or Zoom calls, using personal connections from previous workplaces. A total of 8 to 10 semi-structured interviews will be conducted to gain in-depth insights aligned with the research questions while maintaining flexibility for participants to share their experiences and insights.

The findings will be analyzed using thematic analysis, focusing on key themes such as the level of awareness and frequency of HBMD usage, the role of healthcare providers (HCPs) in guiding the use of these devices, barriers to their adoption, and strategies to overcome these obstacles to facilitate the adoption and effective usage of HBMDs. This analytical approach will allow the extraction of meaningful insights from the participants' experiences and perspectives. The findings will be instrumental in proposing strategies to improve the adoption and effective use of HBMDs in managing chronic diseases in Pakistan.

SECTION 2: POSSIBLE ETHICAL ISSUES

Answer 'yes' or 'no' to the following questions.

SUBJECT MATTER	
Does the research proposal involve:	
Research into specific company activities that would be deemed sensitive or confidential	No
Research into politically and/or racially/ethnically and/or commercially sensitive areas	No
Sensitive, personal, professional or corporate issues	No
RESEARCH PROCEDURES	
Does the research proposal involve:	
Research that might damage the reputation of companies or participants	No
Research that may negatively affect the reputation of Griffith College/Innopharma	No
Use of personal records without consent	No
Use of company data without consent	No
The offer of any inducements to participate	No
Audio or visual recording without consent	No
Using a language other than English	No
PARTICIPANTS	
Does the research proposal involve:	
People who are not competent and/or fluent in English	No
Does your research group include any of the following vulnerable groups	No

(Adults with psychological impairments; Adults with learning difficulties; Adults under the protection/control /influence of others (e.g. in care/prison); Relatives of ill people (e.g. parents of sick children); Hospital or GP participants recruited in a medical facility; persons under the age of 18)

If you have answered NO to ALL questions, please go straight to Section 4.

If you have answered YES to ANY question in SECTION 2, you must fill in SECTION 3.

SECTION 3: STEPS TAKEN TO AVOID ETHICAL ISSUES

3.1. If your ethics relates to ***Subject Matter***, outline your action plan to work around any sensitive issues.
3.2. If your ethics relates to ***Research Procedures***, outline your action plan to deal with possible ethical issues in your research procedures.
3.3. If your ethics relates to ***Participants***, outline how you will protect vulnerable persons or those that do not have English as their first language.

SECTION 4: ABOUT YOUR PARTICIPANTS

4.1. The participants of interest for this research are General Practitioners, Endocrinologists, and Cardiologists with a minimum of two years of professional experience in treating chronic diseases such as diabetes and hypertension. These participants have been selected due to their direct connection with patients and their expertise in the treatment and management of chronic conditions. Their knowledge and experience make them ideal sources for assessing the level of awareness, usage, and challenges associated with the use of Home-Based Medical Devices (HBMDs), such as glucometers and blood pressure monitors, in Pakistan and to propose strategies to promote adoption and effective use of HBMDs.

4.2 Participants will be contacted through personal connections from past work experiences, ensuring trust and a comfortable environment for conducting semi-structured interviews.

SECTION 5: INFORMATION, CONSENT AND CONFIDENTIALITY

5.1 **Participant Information Letter (PIL) for participants**

Please confirm below that your information letter covers:	
Description of the research topic and method	Yes
Details of what participation will involve	Yes
Rights to anonymity	Yes
Confidentiality	Yes
Rights to withdraw from the research	Yes
The contact details of the researcher and supervisor (if necessary)	Yes

5.2 **Informed Consent Form (ICF) for participants**

Please indicate below if your research requires a signed consent form by selecting the relevant option only:

Yes: my research requires signed consent and I have attached an ICF in the appendices of my application.

SECTION 6: STORAGE OF DATA

6.1. The data will be stored on the researcher's password-protected laptop and will be kept for a period of one year after the qualification has been received. All procedures will comply with GDPR regulations to ensure the privacy and security of the data.

SECTION 7: NON-DISCLOSURE AGREEMENT & STUDENT CONSENT

7.1 **Non-Disclosure Agreement (NDA)**
Will the final dissertation contain any information pertaining to any source what would warrant the use of a Non-Disclosure Agreement (NDA) e.g. industry-based research?

No

7.2 **Student consent**
If a Non-Disclosure Agreement (NDA) is not required, does the Student consent to allow their completed dissertation to be held/published by Innopharma/Griffith College?

Yes

SECTION 8: RECORDING AND RETENTION OF DISSERTATION VIVA

8.1 **Viva Recording**
The Dissertation viva will be recorded. This recording may be used to facilitate assessment by Innopharma staff, a third reader if necessary and/or if requested by the external examiner for the Programme. The recording will be held in line with current GDPR guidelines and will not be made publicly available.

SECTION 9: DOCUMENT CHECKLIST

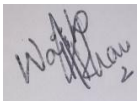
NOTE: Applicants must attach the following documents in electronic format to the appendix.

Which documents are added to the appendix? Please tick N/A if not applicable:

9.1 Participant Information Letter (PIL) for participant	Yes
9.2 Informed Consent Form (ICF) for participant	Yes
9.3 Questions/survey for interviewees/focus groups etc *(can be in draft form)*	Yes
9.4 Any other documents e.g. Non-Disclosure Agreement	N/A

I confirm that this application is complete and all required documents are included in the appendix.

For Student:

STUDENT SIGNATURE: 

DATE: 13/3/2025

PARTICIPANT INFORMATION LETTER (PIL):

Participant Information Letter

[TITLE OF THE STUDY]: ***"Awareness and Use of Home-Based Medical Devices among Patients with Chronic Diseases (Hypertension and Diabetes) in Pakistan"***

I would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Ask questions if anything you read is not clear or if you would like more information. Take time to decide whether or not to take part.

WHO I AM AND WHAT THIS STUDY IS ABOUT

My name is Wajih Ur Rehman Khan and I am final year student of Griffith College Dublin studying MSc in Medical Device Technology and Business. I am carrying out this study as part of my final year dissertation. The aim of this study is to explore the level of awareness and usage of home-based medical devices (HBMDs) among patients with chronic diseases (hypertension and diabetes) in Pakistan. This study also aims to examine the role of healthcare providers in promoting and guiding the use of these devices, as well as to identify potential barriers to their adoption and suggest solutions to overcome them.

WHAT WOULD TAKING PART INVOLVE?

Participation in this study will involve a short interview with questions about the awareness and frequency of using the Home-Based Medical Devices (glucometers and blood pressure monitors). The interview will also explore the role of healthcare providers in guiding patients on using these devices. Additionally, participants will be asked about the barriers to adopting HBMDs and possible strategies to overcome them. All participants in this study will remain completely anonymous. The interview will be audio recorded for transcribing once the interview has concluded.

WHY HAVE YOU BEEN INVITED TO TAKE PART?

You have been invited to participate in this interview because healthcare providers, including general practitioners (GPs), endocrinologists, and cardiologists, have been selected as subject matter experts for this study. As a healthcare provider, you are directly involved in managing patients with chronic diseases such as diabetes and hypertension. Your experience and knowledge surrounding this topic may be of great importance for the purpose of this study.

DO YOU HAVE TO TAKE PART?

Participation in this interview is completely voluntary and you have the right to refuse participation, refuse to answer any questions and withdraw at any time without any consequences.

WHAT ARE THE POSSIBLE RISKS AND BENEFITS OF TAKING PART?

Participating in this study may help assess the level of awareness and usage of Home-Based Medical Devices (glucometers and BP monitors) among patients with chronic diseases such as diabetes and hypertension in Pakistan. It will also identify the role of healthcare providers in guiding patients on the use of these devices, explore barriers to their usage, and propose strategies to overcome these challenges to facilitate the smooth adoption of HBMDs for self-monitoring in Pakistan. As previously mentioned, all participants in this study will remain completely anonymous.

WILL TAKING PART BE CONFIDENTIAL?

All participants in this study will remain completely anonymous, no names or areas will be revealed in the findings or conclusions of this study. Audio recordings collected during the interview stage of the study will be stored for a period of 1 year and then deleted when no longer needed.

HOW WILL INFORMATION YOU PROVIDE BE STORED AND PROTECTED?

Signed consent forms and audio recordings of the interview will be stored in the primary data folder on the ‘Moodle’ website until after my MSc degree has been conferred. It can be accessed by Innopharma staff and myself for this duration. A transcript of the interviews (in which all personal identifying information has been removed will be retained for a further two years after this time. Under the freedom of information legislation you are fully entitled to access the information you have provided at any time.

WHAT WILL HAPPEN TO THE RESULTS OF THE STUDY?

The plans for the dissemination of this study is to submit it as my dissertation only. All dissertation research projects and their content will be made available in the college library and may potentially be made available in online e-journals or repositories.

WHO SHOULD YOU CONTACT FOR FURTHER INFORMATION?

Researcher Name: *Wajih Ur Rehman Khan*

Phone Number: *+353 874794378*

Email: *wajih.khan7@gmail.com*

Affiliation: *Innopharma / Griffith College Dublin*

Degree Program: *MSc in Medical Device Technology and Business*

[THANK YOU]

PARTICIPANT CONSENT FORM

Consent to take part in research

Title: ***"Awareness and Use of Home-Based Medical Devices among Patients with Chronic Diseases (Hypertension and Diabetes) in Pakistan"***

The researcher retains one copy signed by both themselves and the participant. The participant should also receive a copy of the consent form as a record of what they have signed up to.

- I _____ voluntarily agree to participate in this research study.
- I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind
- I understand that I can withdraw permission to use data from my interview within two weeks after the interview, in which case the material will be deleted.
- I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study
- I understand that participation involves taking part in an interview and answering all questions truthfully. The information gathered from this interview may be used as primary research data for this dissertation.
- I understand that I will not benefit directly from participating in this research
- I understand that all information I provide for this study will be treated confidentially
- I understand that in any report on the results of this research my identity will remain anonymous. This will be done by changing my name and disguising any details of my interview which may reveal my identity or the identity of people I speak about.
- I agree to my interview being audio-recorded.
- I understand that disguised extracts from my interview may be quoted in the dissertation.
- I understand that if I inform the researcher that myself or someone else is at risk of harm, they may have to report this to the relevant authorities - they will discuss this with me first but may be required to report with or without my permission
- I understand that signed consent forms and original audio recordings will be retained in the primary data folder on the Moodle website. Innopharma staff and a third accessor if

needed and/or if requested by the external examiner for the programme, will have access to the data until the 1st of May 2026 or until such time it is no longer required.

- I understand that a transcript of my interview in which all identifying information has been removed will be retained for two years from the date of the exam board.
- I understand that under freedom of information legalisation I am entitled to access the information I have provided at any time while it is in storage as specified above.
- I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

Researcher Details

Name: *Wajih Ur Rehman Khan*

Degree Programme: *MSc in Medical Device Technology and Business*

College Details: *Innopharma/ Griffith College Dublin*

Contact number: *+353 874794378*

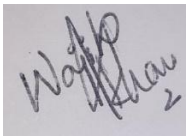
Contact mail: *Wajih.khan7@gmail.com*

Signature of participant

---------- ---------- Date

Signature of researcher

I believe the participant is giving informed consent to participate in this study



---------- ---------- Date

Signature of researcher

Semi-Structured Interview Questionnaire for Healthcare Providers:

SET 1: Level of Awareness and Understanding

1. In your professional opinion, how important are home-based medical devices (HBMDs), such as glucometers and blood pressure monitors, in managing chronic diseases like diabetes and hypertension? How would you compare their effectiveness to other management methods, such as clinical visits and lifestyle modifications?
2. Based on your interactions with patients, how aware are they of the availability and benefits of these devices? Could you share specific examples or patient stories that reflect their level of awareness and understanding?

SET 2: Usage and Frequency

3. In your professional opinion, how commonly do patients use these devices for managing their chronic conditions? Is it widespread or relatively limited?
4. How often do your patients use HBMDs, and how frequency do they share their readings with you? Please provide insights on both usage frequency and data-sharing habits.

SET 3: Role of HCPs in training and guiding patients

5. Do you encourage your patients to use glucometers and blood pressure monitors? If yes, how do you explain their advantages and possible limitations to them? If no, what are the reasons for not recommending them?
6. Do you provide any training or guidance to your patients on how to use these devices effectively? If yes, is the training formal (e.g., structured programs, printed materials) or informal (e.g., verbal guidance, one to one demonstrations)? Please describe the methods you use.

SET 4: Barriers to Adoption

7. What challenges do your patients typically face while using HBMDs? What kind of general feedback do you receive from them regarding their experience? Are these related to external factors such as cost and accessibility or internal factors such as lack of education and trust in these devices?
8. In your opinion, what are the most significant barriers to the widespread adoption of glucometers and blood pressure monitors for self-monitoring? Does affordability, lack of training or limited awareness play the biggest role? Could you share examples from your practice that illustrate how these barriers impact patients?

SET 5: Solutions and Strategies

9. Which of the following strategies would you suggest to improve the adoption and effective use of home-based medical devices among patients? Please rank them in order of effectiveness and feasibility (1 = most effective and feasible, 4 = least effective and feasible):

   (a) Awareness campaigns

   (b) Incentives for usage

   (c) Easier access to devices

(d) Door-to-door community programs

10. Do you believe that healthcare professionals play a crucial role in promoting the adoption of these devices? If so, how do you balance patient education and encouragement with practical challenges such as time constraints, resource limitations or patient resistance?

11. In which of the following ways can the government and healthcare institutions contribute to increasing awareness, accessibility, and adoption of HBMDs for chronic disease management? How would you like to see better support or collaboration with these institutions to improve adoption in your practice? Please select one or more options that you believe would be most effective, and feel free to rank them if you have preferences. Furthermore, you may suggest any other strategies not listed.

    (a) Subsidies and financial assistance

    (b) Training of healthcare professionals

    (c) Integration of HBMDs with telehealth services

    (d) Easier and increased access in rural or underserved areas