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Evaluating the usability, engagement, and effectiveness of continuous glucose monitoring (CGM) systems in remote patient monitoring systems in elderly patients with type 2 diabetes.

CANDIDATE DECLARATION

I certify that this dissertation is entirely original with no parts that have been submitted for credit towards any other degree or academic credential. Every source of data, information, concept, and quotation from another author has been properly referenced and cited. I am aware of the college rules on plagiarism, academic integrity, and the penalties for academic dishonesty. I attest that all aspects of the study procedure, including the gathering and management of participant data, have complied with ethical standards. This study is a sincere attempt to advance scholarly understanding in the areas of digital health and diabetes treatment.

Candidate Signature: 

ANU CHITTILAPPILLY WILSON

Date: 12 May 2025

Supervisor: SUE MULHALL

Date: 12 May 2025

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ACRONYM TABLE

CGM: Continuous Glucose Monitoring

RPM: Remote Patient Monitoring

T2DM: Type 2 Diabetes Mellitus

HbA1c: Haemoglobin A1c (glycated haemoglobin)

HBM: Health Belief Model

TAM: Technology Acceptance Model

GDPR: General Data Protection Regulation

IRB: Institutional Review Board

CUHCC: Community-University Health Care Centre

SMBG: Self-Monitoring of Blood Glucose

AI: Artificial Intelligence

ABSTRACT

This research examines the usability, effectiveness, and involvement of Continuous Glucose Monitoring (CGM) systems in the Remote Patient Monitoring (RPM) platform for elderly people with Type 2 Diabetes Mellitus (T2DM). With the rise of global populations, along with the rise in chronic illnesses such as diabetes, it is an increasingly pressing need that technological solutions are both effective and accessible for older adults. CGM technology provides glucose tracking in real time, with improved glycaemic control and less invasive finger-prick testing. However, adoption among elderly users is not uniform as age-related issues, such as dexterity, cognitive decline, and digital illiteracy, continue to be challenging.

This research explores the way older adults use the CGM systems, device usability, engagement behaviours, and therapeutic effects. In a quantitative, survey-based approach, the study gathers and reviews data from CGM users from the aging population, caregivers, and healthcare providers. Key findings indicate that while CGM systems can dramatically change glycaemic management and patient autonomy, usability problems related to complex interface usage and trouble with insertion of the sensor create important barriers. Engagement levels differ, and long-term adherence is frequently interfered with by the presence of alert fatigue, cost, and inadequate training.

Besides listing reasons such as psychological, technical, and financial, hindering successful CGM adoption, the study proposes strategies to boost CGM user engagement and retention. These are easy-to-use interface designs, customization of alert settings, constant education, caregiver support, and enhanced insurance coverage. Statistical findings prove that there is a correlation between CGM use and improved glycaemic results, especially with those systems tailored to the physical and cognitive needs of elderly users.

Finally, the study makes a contribution to the emerging field of digital health by providing evidence-based recommendations for the design and delivery of CGM technologies for aging populations. It illustrates the need for health tech solutions that are inclusive and relevant in elderly patients' care in remote and digitally-enabled healthcare ecosystems.

CHAPTER 1: INTRODUCTION

1.1 Introduction to the Study

Continuous Glucose Monitoring systems describe a revolutionary advancement in diabetes treatments by providing patients with instant monitoring of their glucose levels. CGM systems integrate with Remote Patient Monitoring (RPM) frameworks to improve long-term care results as the worldwide Type 2 Diabetes Mellitus (T2DM) prevalence grows among elderly demographics (Glatzer et al., 2024). The research project evaluates the usability and engagement of continuous glucose monitoring (CGM) systems when used in remote patient monitoring systems for elderly type 2 diabetes patients. This research examines T2DM patient-technology engagement with CGM systems in remote healthcare delivery environments among older adults.

Global concerns regarding chronic disease management in aging populations provided the reason for choosing this research topic. International Diabetes Federation (2023) forecasts that diabetes will affect more than 240 million people age 65 and above by 2045. It is essential to discover how Continuous Glucose Monitoring systems should be enhanced for optimal usage by older adults who experience natural physiological and cognitive aging effects. This research establishes academic and practical value through its purpose of closing the distance between technology innovation and healthcare delivery designed for elderly patients.

1.2 Background of the Study

Type 2 Diabetes continues to spread rapidly among elderly populations, but older adults commonly encounter self-care management difficulties with their disease condition. This study focuses on older patients who are utilising Continuous Glucose Monitoring (CGM) devices to manage Type 2 Diabetes Mellitus (T2DM). For this study, elderly patients are classified as those who are 65 years of age or older. The increasing number of older persons with diabetes and the particular difficulties they encounter—such as age-related cognitive decline, diminished dexterity, and low levels of digital literacy—led to the selection of this age group. These elements frequently affect their capacity to accept and utilise medical devices such as CGM. By addressing this demography, the study hopes to fill a crucial gap in current research and create insights targeted to the needs of aging populations within remote healthcare facilities (Khunti et al., 2024).

The introduction of CGM systems provides elderly patients with non-invasive data-based monitoring through continuous measurements of interstitial glucose at five-minute intervals. Healthcare providers achieve better glycemic control and decrease hypoglycemic risks through real-time alerts and monitoring trends, which enhances their ability to proactively intervene when managing elderly diabetic patients.

The promising technology generates numerous unanswered questions at present. Has the design of current CGM systems considered the particular needs of elderly users? How easily do mature patients utilize these systems while sustaining engagement throughout their use periods? The effectiveness of these systems in enhancing clinical results within remote patient care presents an essential question. The adoption of telemedicine and digital health solutions has quickened since COVID-19, ensuring these questions demand immediate attention (Miller et al., 2022).

This investigation directly benefits healthcare providers who treat senior diabetics, as well as policy developers and family caregivers who care for these patients. The research enhances current academic literature about healthcare users' digital interactions with technology and evaluation methods for digital health systems supporting elderly patients.

1.3 Rationale for the Study

Research began because researchers noticed that despite widespread access to CGM technology, older adults remain reluctant to adopt it. Academic and clinical literature heavily promotes the value of CGM systems, yet their adoption by elderly individuals remains restricted because seniors experience technology challenges and fear the devices (Mohira et al., 2022). Research on CGM effectiveness predominantly studies populations under 65 years old rather than focusing on elderly diabetics who stand to gain the most from these tools because of their high diabetes complication risks.

Research analyzes entire user experiences to drive changes in device design technology alongside policy adjustments and remote health care practices. This research overlaps between technological usability and patient engagement with clinical effectiveness, while influencing a patient group that has very little attention during the digital healthcare development process (Glatzer et al., 2024). The study not only concerns the physiological and cognitive restraints that limit the older users but also the larger socio-economic and psychological barriers, such as costs associated with the device and alarm fatigue, to name a few (Khunti et al., 2024). Through examining complete user experiences such as usability, perceived benefits, and incidences of

adherence, the research seeks to build actionable insight that can direct improvements around CGM device design, personalized regimes of training, and individualized support procedures (Kahkoska et al., 2023). The findings urge inclusive policy reforms and age-sensitive innovations to enhance remote healthcare delivery to ensure that digital health solutions are equitable, accessible, and effective for senior citizens.

1.4 Aim and Objectives

1.4.1 Aim of the research

This study aims to assess the effectiveness, usability, and engagement of Continuous Glucose Monitoring (CGM) systems in remote patient monitoring for older patients with type 2 diabetes to improve overall health outcomes and diabetes management.

1.4.2 Research Objectives

The investigation objectives are to establish the usefulness of CGM systems as remote management solutions for type 2 diabetes patients who are elderly. This research has 5 main purposes.

- Evaluate the Elderly Patients with Type 2 Diabetes' Usability of CGM Systems:
- Assess Elderly Patients' Levels of Engagement with CGM Systems:
- Assess the Remote Management Effectiveness of CGM Systems for Type 2 Diabetes:
- Determine the difficulties and impediments to older patients' use of CGM systems:
- Make suggestions for improving the CGM systems' usability and engagement:

1.5 Questions for Research

- What usability issues do older patients with type 2 diabetes have with CGM devices, and how easy are they to use?
- What variables affect older patients' levels of engagement with CGM systems, and what effect does engagement have on diabetes care?
- How well do CGM systems work for remote type 2 diabetes management in terms of glycaemic control and health outcomes for older patients?
- What obstacles and difficulties prevent older patients with type 2 diabetes from adopting and using CGM systems?
- What design changes and assistance techniques can increase older users' CGM systems' usability and engagement?

1.6 Ethical Considerations

Ethical integrity stands as the essential foundation for this research because older adults represent a population at risk of exploitation. The research team will maintain unflinching protection regarding informed consent, together with data privacy and confidentiality. Study participants will receive a complete explanation of study objectives and procedures and full information about their protected rights, including the freedom to leave the study at any time (Zhou et al., 2022). The study's research practices follow ethical requirements through approval from the Health Research Authority (HRA) under college-mandated review procedures.

This study was conducted with a significant emphasis on ethical research techniques. As a responsible researcher, the study ensured that the participants' rights, dignity, and confidentiality were upheld throughout the research process. While this chapter explains the study's ethical underpinning, Chapter Three provides in-depth details on specific procedures such as informed consent, data protection, and institutional clearances. Additional attention will be devoted to creating accessible information pathways for participants with sensory disabilities or cognitive variations (Thakur et al., 2025). The research will implement protective data security measures that safeguard sensitive health information collected during the project.

1.7 Structure of the Dissertation

This dissertation consists of six central sections, which create a unified logical presentation of the research development:

Chapter 1 – Introduction:

The chapter presents an introduction to the research field and its background information, followed by objectives and research questions, and main targets. This chapter presents the study's organization structure and ethical framework while providing its scientific basis and rationale.

Chapter 2 – Literature Review:

The analysis reviews existing research about end-user programming interfaces as well as usability methodologies and patient relationship systems, along with their effects on elderly digital healthcare delivery. The research includes an examination of fundamental studies alongside accepted educational frameworks notably TAM and UCD theory.

Chapter 3 – Methodology:

The research strategy consists of quantitative methods followed by data collection approaches like surveys and data analysis techniques. Scientific evidence supports all methodological decisions that will be demonstrated in the text.

Chapter 4 – Findings and analysis

The chapter displays data from the conducted empirical investigation. The research will perform statistical and thematic analyses according to selected methods, which will guide findings toward each research goal. The study analyzes how experimental findings match scholarly literature to demonstrate new insights as well as research boundaries.

Chapter 5– Conclusion and Recommendations:

The findings are summarized along with practical tools and theoretical contributions that result in actionable advice for device developers and healthcare providers, and future research directions. The recommendations for upcoming research will also be provided.

1.8 Conclusion

By outlining the topic, history, and justification for assessing CGM systems in older patients with type 2 diabetes, this introductory chapter has laid the groundwork for the dissertation. The study offers a framework for investigating the nexus between health technology, aging, and remote diabetes treatment with well-enunciated goals, objectives, and questions. It goes further to emphasise the urgent need for a user-centered design, access, and tailored support in digital health solutions for the elderly population. By focusing on the usability, engagement, and effectiveness of CGM systems, the research sets out to make practical contributions to the field of healthcare delivery, device innovation, and policy making. To situate this research in broader scholarly and clinical discourses, the following chapter will address the salient body of existing literature on the topic. in doing so, it will identify salient theories and evaluate empirical findings and identify current gaps in research that require further exploration.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Continuous Glucose Monitoring (CGM) systems offer a promising solution for older adults with Type 2 diabetes by providing real-time glucose tracking and remote monitoring. However, issues with cost, engagement, and usability continue to restrict adoption. The variables impacting older individuals' adoption of CGM are critically examined in this chapter, with an emphasis on socioeconomic, behavioural, and technological challenges.

The following is the chapter's structure: It first examines the drawbacks of conventional glucose monitoring techniques. The Technology Acceptance Model (TAM) and Health Belief Model (HBM) are then used to analyse CGM adoption, evaluating the contribution of perceived utility, usability, and health beliefs to adherence. The chapter then goes on to address alarm fatigue, computer literacy, and budgetary limitations as obstacles to long-term use. Research gaps and possible policy solutions are identified in the last section.

In this review, theoretical frameworks are essential. While HBM emphasizes the significance of health beliefs in adherence, TAM offers insights into how older individuals see the utility and usability of CGM. The conversation about patient motivation and long-term involvement is guided by these models.

By looking at actual adoption issues, this literature review expands on the introductory chapter, which highlights the importance of CGM in diabetes treatment. To better understand CGM use among older persons, the results will also influence the study design and data-gathering techniques in the upcoming research methods chapter.

2.2 Strategic Importance of Patient Monitoring for Type 2 Diabetes

Managing type 2 diabetes requires effective patient monitoring, which has strategic advantages for national healthcare systems, business sectors, healthcare organizations, and individual patients. Healthcare systems are under more operational and financial strain as the prevalence of type 2 diabetes rises worldwide. Hospital admissions, problems, and resource allocation may all be improved by continuous patient monitoring, especially with digital health tools like Continuous Glucose Monitoring (CGM) (Davies et al., 2023). These technologies can improve overall public health outcomes and save healthcare costs by facilitating early intervention (Zhu et al., 2024).

Innovation in medical technology and economic growth are stimulated by the growing need for diabetes monitoring devices. Companies that make investments in CGM and remote monitoring systems expand their client base, open up new markets, and keep up with global healthcare digitisation trends (Smith & Patel, 2023). Additionally, improved patient monitoring can streamline clinical procedures for healthcare companies by reducing emergency interventions and providing customised treatment regimens based on real-time data (Gao et al., 2024).

Patient monitoring improves self-management on an individual basis, enabling people to make knowledgeable decisions regarding their health. Real-time glucose monitoring improves quality of life by lowering the risk of severe hypoglycemia and long-term consequences (Ajjan et al., 2024). However, despite these tactical benefits, obstacles such as poor usability, a lack of digital literacy, and budgetary limitations continue to prevent older people from widely adopting CGM (Price et al., 2024). These difficulties will be discussed in more detail in the sections that follow.

2.3 The use of CGM system for elderly patients

2.3.1 Device design and user interface

Usability, which encompasses sensor application, screen readability, interface intuitiveness, and data interpretation, is one of the key elements influencing the adoption of CGM in older populations (Ahn et al., 2024). According to research, due to cognitive and physical constraints, elderly users frequently struggle with sensor deployment, calibration processes, and comprehending real-time glucose measurements (Ajjan et al., 2024). Usability is further hampered by small letter sizes, intricate menu navigation, and the requirement for regular recalibration. The accessibility of CGM for senior users may be enhanced by removing these obstacles using age-appropriate design changes, such as bigger fonts, more straightforward layouts, and guided onboarding tutorials.

According to Smith et al. (2024), older users require much more training time than younger users before they feel comfortable using CGM devices. Many usability problems were discovered by the study, including difficulties with attaching sensors, viewing small text on device screens, and gaining access to digital health apps. These findings suggest that age-appropriate design modifications, such as larger font sizes, simplified layouts, and other design elements, may enhance usability for senior citizens.

The position and function of CGM sensors also have an impact on usability. Due to their limited flexibility and diminished dexterity, elderly people sometimes have difficulty attaching CGM sensors to their upper arms or abdomen (Bergenstal et al., 2021). In response, a few manufacturers have released applicators that need less manual work.

The lack of standardized usability metrics catered to the needs of older patients is a major obstacle to their adoption of CGM. Factors including cognitive decline, decreased dexterity, and visual impairments are not adequately taken into account in current usability studies (Ajjan et al., 2024). These metrics can assist manufacturers in producing senior-friendly CGM devices that are specifically tailored to the physical and cognitive limitations of their users (Savoy et al., 2024).

2.3.2 Technology literacy and accessibility.

The poor degree of technological skills among older adults is another major barrier to their use of CGM. Given that many elderly patients are not familiar with digital health technologies, it may be difficult for them to comprehend real-time glucose readings and adjust their diabetic management practices (Price et al., 2024). Even after initial training, research indicates that many older patients struggle to retain technology-related learning over time (Gao et al., 2024). One recommended solution is to involve caretakers in CGM management. Ahn (2024) asserts that caretakers have a crucial role in improving usability, particularly for older adults with cognitive impairments.

This strategy, however, presents moral questions about patient autonomy and data privacy. Although carer support can improve CGM adherence, it also creates reliance, which may make it more difficult for an elderly patient to take care of their condition on their own. Financial obstacles can make it difficult to get CGM systems. According to Mir et al. (2025), insurance coverage for CGM devices varies greatly throughout healthcare systems, and many elderly patients live on limited incomes. Since greater accessibility may result in better health outcomes and lower long-term healthcare expenditures, some researchers support legislative reforms to increase Medicare and insurance coverage for CGM in older populations (Aleppo, 2024).

Table 2.1:Technology literacy and accessibility

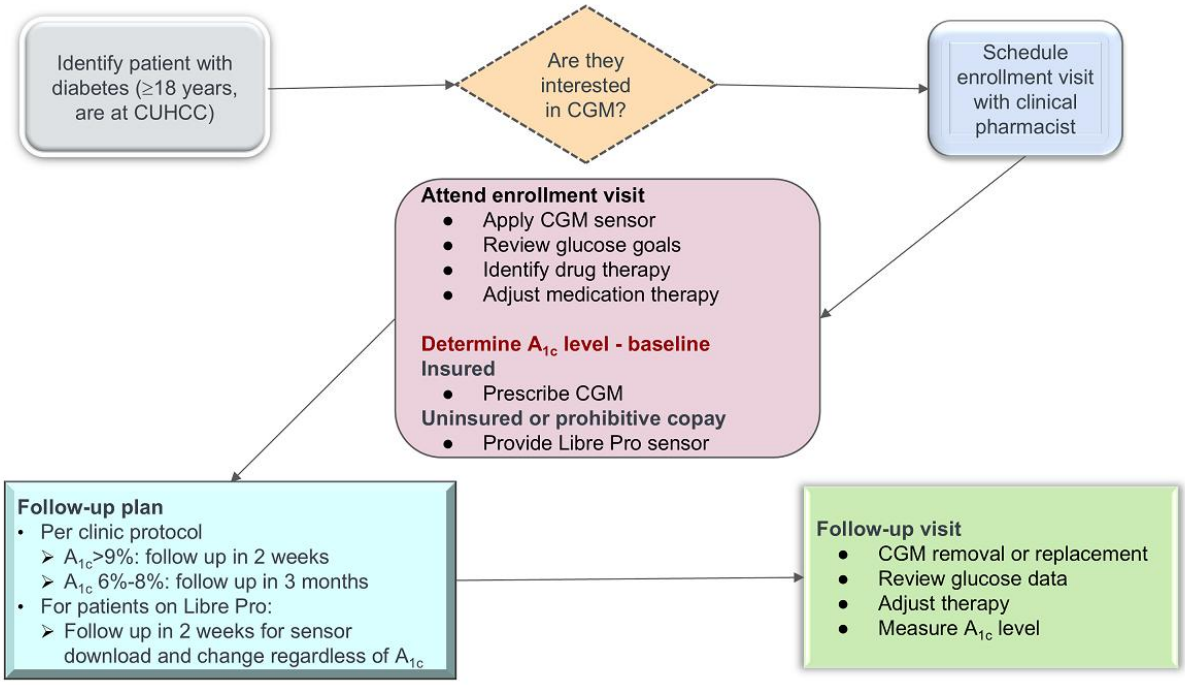
Barrier	Description	Proposed Solution
Limited technological literacy	Difficulty in understanding real-time glucose readings and using digital health apps.	Simplified user interfaces, hands-on training, and ongoing digital literacy programs.
Cognitive impairments	Memory and cognitive decline hinder the retention of CGM-related knowledge.	Caretaker involvement and AI-driven adaptive CGM interfaces.
Ethical concerns	Over-reliance on carers may reduce patient autonomy and create privacy risks.	Balancing assistance with patient self-management training
Financial constraints	High costs and inconsistent insurance coverage limit access.	Expansion of Medicare/insurance coverage and cost-reduction initiatives.

Developed by the Author

2.4 Engagement with CGM systems.

Engagement with CGM systems refers to the frequency with which elderly patients use their devices, respond to notifications, and incorporate CGM data into their diabetes self-management routine. According to studies, even though CGM systems have several benefits, adherence challenges, alert weariness, and psychological concerns commonly prohibit older users from becoming actively involved (Seidu et al., 2024). This section delves further into these topics. The CGM software followed a set process (see Figure 1). Chemists installed and removed the CGM sensors during enrolling and follow-up visits. In addition, they taught patients how to use CGM devices and provided patient education.

Figure 2.1: Process for CGM implementation. CGM: continuous glucose monitoring; CUHCC: Community-University Health Care Center. (Thakur et al., 2025)



Source: (Thakur et al., 2025)

2.4.1 Engagement metrics and patterns of adherence.

In contrast to intermittent self-monitoring methods, consistent use of CGM devices allows for improved glucose management, making adherence essential for maximizing glycaemic control. Nonetheless, several reasons, including pain during sensor implantation, challenges interpreting glucose patterns, and the expense of device maintenance, contribute to the gradual fall in adherence rates for older patients (Glatzer et al., 2024). Adherence-measuring studies evaluate sensor usage frequency, patient reaction to CGM warnings, and long-term retention rates. According to research by Seidu et al. (2024), although older individuals' early adoption of CGM was encouraging, only 60% of patients kept using the device after six months, indicating the necessity for long-term engagement tactics. According to Seidu et al.'s (2024) investigation of CGM engagement patterns in older populations, only 60% of patients remained to use the device after six months despite positive early uptake rates.

According to the study, several factors influence elderly patients' long-term adherence to CGM devices. One of the most crucial factors is perceived benefit; patients are more likely to remain with CGM devices if they notice improvements in their overall health and glycemic control

(McDonough et al., 2022). Furthermore, seniors who struggle with sensor applications or find the device interface difficult are likelier to abandon the device, therefore usability is critical (Smith et al., 2024). Finally, carer support improves adherence significantly, since older persons who receive assistance from family members or medical professionals are more interested and consistent in using CGM (Ahn, 2024). Another often-used engagement metric that evaluates how often patients identify or react to CGM warnings is alarm response. According to Molaee et al. (2024), older patients' reaction rates were only about 50%, while younger users responded to over 80% of CGM alarms. This discrepancy indicates that elderly people may have alert fatigue or have trouble recognizing the seriousness of notifications.

2.4.2 Barriers to Long-Term Participation

Giving everyone with health problems the best care possible is a major challenge in the medical field. Complex long-term care demands in older persons necessitate smooth, coordinated care from several providers. The elderly population is expanding quickly around the world, and as they use healthcare services at a comparatively higher rate, meeting the rising demand for these services is predicted to become more difficult in the future. Long-term use of CGM devices by older patients is hindered by several issues. These consist of:

A combination of psychological factors and alarm fatigue.

Alerts for glucose variations, hypoglycaemia, and hyperglycaemia are commonly produced by CGM systems. Although these warnings are necessary for managing diabetes, older users may get overwhelmed by too many reminders, which can result in alarm fatigue (Aleppo, 2024). According to Price et al. (2024), some patients claim to have been desensitized to alarms, which causes them to disregard crucial warnings.

CGM disengagement is also influenced by psychological elements like irritation and worry. Frequent glucose variations might cause stress for certain elderly patients, which can result in mental anguish and a reluctance to continue using the device (Hong et al., 2020). According to Aleppo (2024), letting users modify the sensitivity of alert settings may help to alleviate these problems and improve sustained engagement.

Insurance and financial restrictions.

The cost of CGM systems is somewhat high, and insurance coverage varies depending on the healthcare facility. Many older patients find it difficult to pay for CGM equipment and related consumables, especially those with fixed incomes (Khunti et al., 2024). Long-term usage is

discouraged by limited insurance coverage since patients may be compelled to stop CGM because of financial limitations (Shen et al., 2022).

To increase geriatric accessibility, certain healthcare systems have introduced subsidized CGM programs (Miller, 2022). To guarantee that CGM technology is affordable for all senior patients, especially those in low-income populations, more regulatory measures are necessary.

lack of specialised training and support.

Many elderly people have recurrent technical challenges while using CGM devices, even after getting initial training from medical professionals. According to studies, one-time teaching sessions and other traditional training methods are insufficient for long-term involvement (Gao et al., 2024). Rather, it is recommended that senior users attend refresher courses and regular training to help them maintain their confidence when using their devices.

According to Smith et al. (2024), CGM manufacturers should provide personalized learning materials for older adults, such as in-person training sessions with diabetes educators, simplified user manuals, and step-by-step video tutorials.

2.4.3 Strategies to Improve Engagement

Enhancing older patients' use of CGM devices requires a multipronged approach that addresses their financial, psychological, and technological limitations. Including adjustable alerts, which let users change the intensity of the alarm according to their tastes and medical requirements, is one practical method. Numerous alarms can cause alarm weariness in many elderly individuals, which leads them to completely disregard them. By enabling users to change the alert frequency and urgency, CGM systems can become less unpleasant and more user-friendly (Aleppo, 2024).

Involving carers is another critical component of increasing participation. Family members, medical experts, or professional carers have a significant duty to assist older persons with their devices, ensuring that sensors are properly positioned, and interpreting glucose data. Carers' support can enhance adherence, but to avoid becoming unduly reliant on outside aid, it is critical to maintain a balance between assistance and patient autonomy. Sustained CGM engagement necessitates constant education and training. Many older persons have difficulty utilizing technology due to cognitive deterioration or a lack of digital literacy. Regular training

sessions, whether in person or online, can help to improve usability and reinforce critical skills (Gao et al., 2024).

Additionally, enhancing financial assistance programs, including government grants or insurance coverage for CGM equipment and accessories, can assist in removing financial barriers that prevent long-term use (Khunti et al., 2024). Finally, engagement requires psychological support. As they get used to CGM technology, many older patients experience anxiety or annoyance. Seniors can overcome emotional obstacles, build confidence, and form a feeling of community by having access to educational forums, peer support groups, and counselling services.

Table 2.2: Strategies to Improve Engagement

Challenge	Proposed Solution	Benefits
Alarm Fatigue	**Customizable alerts to adjust frequency and urgency.**	**Reduces alarm fatigue and improves response rates.**
Reliance on Carers	**The balance between carer support and patient autonomy.**	**Enhances adherence while maintaining independence.**
Limited Digital Literacy	**Regular hands-on and online training sessions.**	**Improves confidence in CGM usage.**
Financial Barriers	**Expanding insurance coverage and government subsidies.**	**Increases affordability and accessibility.**

Developed by the Author

2.5 The remote efficacy of CGM devices for diabetes management.

Effectiveness in the context of CGM systems is the systems' ability to enhance clinical outcomes, promote self-management, and seamlessly integrate into remote healthcare

frameworks. CGM devices have shown promise in improving glycaemic control, reducing diabetic complications, and alleviating elderly patients of the burden of frequent clinic visits (Dening et al., 2023). Despite these advantages, success varies depending on factors including device accuracy, patient adherence, cost-efficiency, and healthcare provider engagement. This section looks at how CGM systems affect glycaemic control, how they are used in telemedicine, and how they affect the bottom line.

2.5.1 Clinical Results and Glycaemic Control.

The primary goal of CGM systems is to provide real-time glucose monitoring, allowing patients and medical practitioners to quickly change diabetes treatment regimens. Numerous studies show how CGM helps glycaemic control. Khunti et al. (2024) found that older people with type 2 diabetes who utilized CGM saw a 0.4 percentage point decline in HbA1c levels. This decrease is notable because keeping HbA1c within target ranges reduces the risk of diabetic complications such as nephropathy, neuropathy, and cardiovascular disease (Elbarbary et al., 2025).

Additionally, CGM helps prevent hypoglycaemia, a major issue for the elderly. Elderly individuals are more susceptible to hypoglycaemic episodes due to polypharmacy, cognitive decline, and irregular food habits (Adler et al., 2024). Because fingerstick testing and other traditional glucose monitoring techniques do not provide continuous data, it can be challenging to identify hypoglycaemia at night or when symptoms are absent. CGM devices provide real-time alerts when blood glucose levels drop below a safe threshold, allowing for timely intervention (Shen et al., 2022).

However, for CGM to enhance glycaemic control, frequent usage and data interpretation are required. Some studies claim that while continuous glucose monitoring (CGM) offers benefits, its effectiveness is reduced if patients don't regularly check their blood sugar levels or ignore warning signs (Price et al., 2024). This highlights the need for patient education and engagement strategies to ensure senior users understand how to react appropriately to CGM data.

2.5.2 CGM integration with remote medical systems.

Reducing the number of in-person consultations might revolutionize diabetes treatment for the elderly through the integration of CGM with remote healthcare systems. Using telemedicine

platforms, including cloud-based data sharing, mobile health apps, and AI-driven predictive analytics, real-time CGM data allows medical professionals to remotely modify treatment programs (Miller, 2022). According to research by Thakur et al. (2025), compared to older patients who relied on standard glucose monitoring, those who used CGM in conjunction with telehealth consultations had a 30% decrease in hospital visits. Notwithstanding these advantages, there are still obstacles, such as differences in the methods used by healthcare systems to analyze CGM data and difficulties with patient digital literacy.

One of the key advantages of CGM-enabled remote care is the early detection of glucose fluctuations, which allows physicians to intervene before problems arise. In comparison to those who just employed self-monitoring blood glucose (SMBG) approaches older adults who used CGM in combination with remote healthcare support had a lower risk of being hospitalized for diabetes, according to a study by Thakur et al. (2025). By enabling treatment plans to be tailored based on real-time glucose trends rather than frequent clinic visits, telemonitoring also enables customized therapy, claims Osueke, (2024).

Notwithstanding these advantages, including CGM in remote patient monitoring, still presents difficulties. Inconsistencies in care delivery result from the lack of standardized methods in many healthcare systems for analyzing and reacting to CGM data (Ajjan et al., 2024). Furthermore, both patients and doctors may have issues due to data overload. Physicians may find it challenging to separate important trends from small swings when continuous glucose measurements are taken every few minutes, which might cause them to postpone therapies (Glatzer et al., 2024).

To increase the effectiveness of CGM in remote diabetes treatment, researchers emphasize the need for AI-driven algorithms that can analyze CGM data and provide real-time insights for patients and medical practitioners. These algorithms can help pinpoint the most critical patterns that require attention by eliminating minor fluctuations in blood sugar (Smith et al., 2024). Additionally, by ensuring timely and appropriate responses, standardizing the interpretation of remote CGM data may improve physician decision-making (Aleppo, 2024). Patient education is essential in helping elderly users distinguish between severe hypoglycemia or hyperglycaemic episodes and typical glucose swings to enhance self-management and reduce anxiety (Gao et al., 2024).

2.5.3 The cost-effectiveness of CGM for senior citizens.

Cost is one of the biggest barriers to older patients' adoption of CGM, especially for those 65 and older. The long-term financial viability of CGM is still a worry, despite its shown clinical effectiveness. Although CGM use lowers hospital admissions and total healthcare expenditures, there are still major obstacles because to the high initial cost of devices and continuing costs for sensors and transmitters, according to research by Molaee et al. (2024). A big worry for seniors in this age range is cost because many of them depend on government-sponsored healthcare programs or fixed incomes (Khunti et al., 2024). Ensuring equal access to cutting-edge diabetes management technologies for older adults with modest incomes might be achieved by increasing Medicare and insurance coverage for CGM.

The difficulty of elderly people paying for CGM remains a major barrier, prompting specialists to propose many solutions (Barnard-Kelly et al., 2024). Extending insurance coverage to incorporate CGM might significantly improve access for seniors with a history of hypoglycemia or poor glycaemic control and ensure that the cost is not a barrier for those who need continuous monitoring the most (Seidu et al., 2024). Additionally, implementing financial aid programs for low-income seniors can alleviate the cost burden even more, making CGM a viable option for greater patient populations (Ahn, 2024).

In addition to financing, researchers suggest manufacturers develop cheaper CGM systems with key characteristics developed specifically for older individuals, such as longer sensor lifespans and simplified user interfaces. By removing unnecessary complexity and focusing on key features, these affordable CGM systems have the potential to enhance health outcomes and save healthcare costs by making remote diabetes control more accessible and sustainable for older adults (Price et al., 2024).

Manufacturers must consider more cost-effective, simplified CGM devices that eliminate unnecessary functionality while keeping essential features (Baumann et al., 2024). To guarantee that CGM technology becomes a viable option for a broader range of older patients, researchers should investigate if such devices might provide equal therapeutic benefits at a cheaper cost.

2.5.4 CGM efficacy

There are still a lot of unanswered questions about the long-term effectiveness of CGM, despite mounting evidence of its advantages for senior citizens. The majority of research evaluates CGM results over brief timeframes, usually six to twelve months, which restricts our knowledge of long-term advantages for glycaemic control, complications from diabetes, and general quality of life (Adler et al., 2024). It is challenging to ascertain if CGM continuously improves health outcomes or whether adherence gradually deteriorates because of the lack of long-term research.

Furthermore, social and cultural aspects influencing the adoption of CGM are frequently ignored in study. Despite facing obstacles such access to healthcare services, digital literacy, and affordability, elderly individuals in low-income or rural areas are under-represented in CGM research (Thakur et al., 2025). across order to guarantee fair access and provide focused interventions that enhance long-term CGM adherence and efficacy across a variety of senior populations, it is imperative that these gaps be filled. Multi-year studies and the inclusion of a range of patient demographics should be the top priorities for future research.

Future studies on CGM in older patients should fill up several important areas to maximize its accessibility and long-term efficacy. Longitudinal studies that look at the long-term effects of CGM on senior health over several years are one main area of interest. Since the majority of current research evaluates CGM results over a few months, it is challenging to ascertain its long-term advantages, such as its potential to reduce problems associated with diabetes and enhance general quality of life (Miller, 2022). Studies should also look at a variety of patient demographics, especially those from various socioeconomic and cultural origins. Adoption and adherence of CGM can be influenced by socioeconomic position, cultural views of technology, and healthcare accessibility. Policymakers and healthcare professionals may create focused initiatives to increase access and participation for marginalized groups by having a better understanding of these differences (Khunti et al., 2024).

Additionally, to improve patient motivation and self-efficacy in using CGM, behavioral treatments have to be investigated. Many older patients find it difficult to stay involved because they are anxious, insecure, or have trouble understanding glycemic data. To promote long-term adherence, research should look into tactics such as behavioral nudges, peer support programs, and individualized coaching (Price et al., 2024). By filling up these study gaps, CGM adoption

may become more widespread and long-lasting, which would eventually improve diabetes care for senior citizens.

Table 2.3: key factors affecting CGM efficacy among older patients

Factor	Key Issues	Potential Solutions
Glycaemic Control	CGM lowers HbA1c levels and prevents hypoglycaemia but requires consistent use.	Patient education on data interpretation and engagement strategies.
Integration with Telemedicine	Enhances remote monitoring but faces challenges like data overload and literacy issues.	AI-driven analytics, standardized protocols, and patient training.
Cost-Effectiveness	High device costs and limited insurance coverage hinder access for seniors (65+).	Expand Medicare/insurance coverage, and introduce affordable CGM models.
Long-Term Efficacy	Lack of longitudinal studies on CGM's sustained benefits and impact	Conduct multi-year studies on CGM adherence and diabetes outcomes.
Socioeconomic Barriers	Low-income and rural elderly patients face access and adoption challenges.	Targeted financial aid programs and community-based engagement.

Source: Developed by the Author

2.6 Key Themes

The Field of continuous glucose monitoring (CGM) systems has attracted a lot of research, especially on the future possibilities they have to improve diabetes care. yet, several drawbacks still exist. This section discusses current research gaps, critical analyses of the literature's

strengths, and possible future research directions. Although many studies validate CGM's efficacy in improving glycaemic control and hypoglycaemic events, most studies are conducted on young and middle-aged populations (Smith et al., 2024). Elderly patients who are prone to various unique physiological, cognitive, and socioeconomic challenges are also underrepresented. Moreover, long-term adherence, usability for aging users, and culturally sensitive adoption processes are the fields that require further research. Future research has to emphasize inclusive design, prolonged research periods, and individualized interventions that reflect the lived experiences of older adults living with Type 2 diabetes.

2.6.1 The Potential of CGM to Improve Diabetes Care.

One of the biggest benefits of the literature is the proven effectiveness of CGM in the management of diabetes. Numerous studies have shown that CGM significantly enhances glycaemic control, reduces the frequency of hypoglycemia and hyperglycaemic events, and enhances patient self-management (Khunti et al., 2024). Continuous glucose monitoring (CGM), as opposed to traditional self-monitoring blood glucose (SMBG) methods, provides real-time glucose readings, allowing for timely adjustments to insulin therapy and dietary habits.

Research by Seidu et al. (2024) found that CGM users frequently experience a 0.4–0.6 percentage point decrease in HbA1c, which is clinically significant in lowering diabetic complications. Additionally, CGM can lower the number of diabetic hospitalizations, particularly for elderly patients who may find it challenging to attend clinics (Molaee et al., 2024). These findings provide credence to the idea that CGM technology is crucial to the management of diabetes in the modern world, particularly when paired with telemedicine and remote patient monitoring systems (Thakur et al., 2025).

2.6.2 Increased Patient Engagement and Self-Management.

The literature's focus on patient involvement and self-management is another asset. Research indicates that by offering real-time glucose data and facilitating proactive diabetes care, CGM improves patient autonomy (Smith et al., 2024). CGM helps older persons manage their conditions more independently by lowering their need for carers and medical professionals (Ahn, 2024).

Furthermore, studies show that patients who use CGM exhibit more noticeable behavioral changes than those who use more conventional glucose monitoring techniques. Because CGM

users could see the immediate effects of lifestyle changes on their blood glucose levels, they were more inclined to follow exercise guidelines and adopt healthier food choices, according to research by Aleppo (2024). This implies that CGM may serve as a strategy for behavioral reinforcement, promoting consistent practice of diabetic self-care.

2.6.3 Technological Advancements in CGM.

Existing research offers important insights into the development of CGM technology. According to Glatzer et al. (2024), contemporary CGM systems have enhanced sensor accuracy, extended wear times, and smooth interaction with telemedicine platforms and cell phones. Furthermore, CGM devices may now offer predicted glucose trend analysis and personalized alarms thanks to developments in AI-driven data analysis, which increases their efficacy in diabetes management (Birsel et al., 2025).

Moreover, new models of CGM are less invasive and feature smaller, less conspicuous sensors, as well as enhanced adhesion technology that minimizes skin irritation, an issue regularly faced by older individuals with sensitive skin. Still, integration with mobile health apps has also enhanced peer healthcare providers' real-time data sharing capabilities. These stages of development help provide better proactive and personalized care for diabetes. Furthermore, the appearance of closed-loop systems, which are commonly known as artificial pancreas technology, enables CGM devices to automatically talk to insulin pumps, which leads to a semi-automated method of insulin delivery. This venture greatly lightens the cognitive load of diabetes management, which is particularly helpful to elderly diabetes patients who have memory problems or are health-illiterate (Ahn, 2024). Constant innovations regarding duration of battery life, calibration-free models, and voice-assistive features also have a good potential in making CGM systems more user-friendly for seniors. These technological advances, however important, still leave the issue of equitable access and affordability as key, especially to elderly patients in under-resourced areas.

2.7 Gaps in Literature

Despite the substantial contributions made by CGM research, there are still several important gaps, especially when it comes to older people.

2.7.1 Lack of long-term research.

The dearth of long-term studies assessing CGM's effectiveness in elderly patients is one of the main research gaps. It is difficult to ascertain the long-term advantages of glycaemic control,

problems associated with diabetes, and general quality of life because most studies evaluate CGM outcomes during a 6- to 12-month period (Miller, 2022). To determine if CGM usage continues to be beneficial as patients age and acquire new medical issues, a longer-term study is required. To assess the real efficacy of CGM technology in older populations, longer research periods are necessary for key outcomes such as the avoidance of hypoglycemia episodes, the advancement of diabetic complications, and long-term behavioral adherence.

Long-term research is required to ascertain if CGM continues to be beneficial as patients age and acquire new comorbidities, as diabetes is a progressive disease. Furthermore, nothing is known about the long-term behavioral and psychological impacts of CGM usage. Although research shows that CGM increases patient involvement at first, it is uncertain if this engagement lasts for years or if patients' motivation and adherence gradually deteriorate (Price et al., 2024). Future studies should concentrate on longitudinal studies that monitor patient outcomes over several years to provide light on the long-term effectiveness of CGM in managing diabetes in the elderly.

2.7.2 Research on Senior-Friendly Personalised Interfaces is rare.

Another important issue is the paucity of research on CGM usability and interface design tailored to elderly users. Studies show that many elderly struggles with small screens, complex menus, and the frequent need to calibrate their sensors (Ajjan et al., 2024). But rather than considering the unique cognitive and physical challenges that older people face, most CGM devices were designed with younger, tech-savvy users in mind.

Smith et al. (2024) found that elderly patients require much more time to learn how to use CGM efficiently. This highlights the need for voice-guided navigation, simplified user interfaces, and training programs designed specifically for senior persons. However, because so few studies have examined these aspects, there is a significant information gap about how to optimize CGM utilization for elderly populations.

2.7.3 Cultural and socioeconomic barriers to the adoption of CGM.

The research that is currently published mostly ignores the cultural and economic factors that influence elder patients' adoption of CGM. Most studies are conducted in high-income healthcare settings because insurance coverage and financial support programs make CGM more accessible (Thakur et al., 2025). However, for older adults in low-income or rural

locations, cost remains a major barrier to adoption (Shen et al., 2022). Furthermore, CGM participation may be impacted by cultural views on technology. Some older patients are reluctant to use CGM because they don't trust digital health solutions or are worried about data privacy violations (Khunti et al., 2024). To make sure that diabetes management techniques are inclusive and available to a range of patient populations, future research should examine the effects of socioeconomic status, cultural attitudes, and health literacy on the usage of CGM.

To ensure that seniors continue to use CGM technology and make use of its real-time monitoring capabilities, it might be helpful to understand the role of external support networks in the construction of more successful patient-caregiver collaboration models (Almansour et al., 2024).

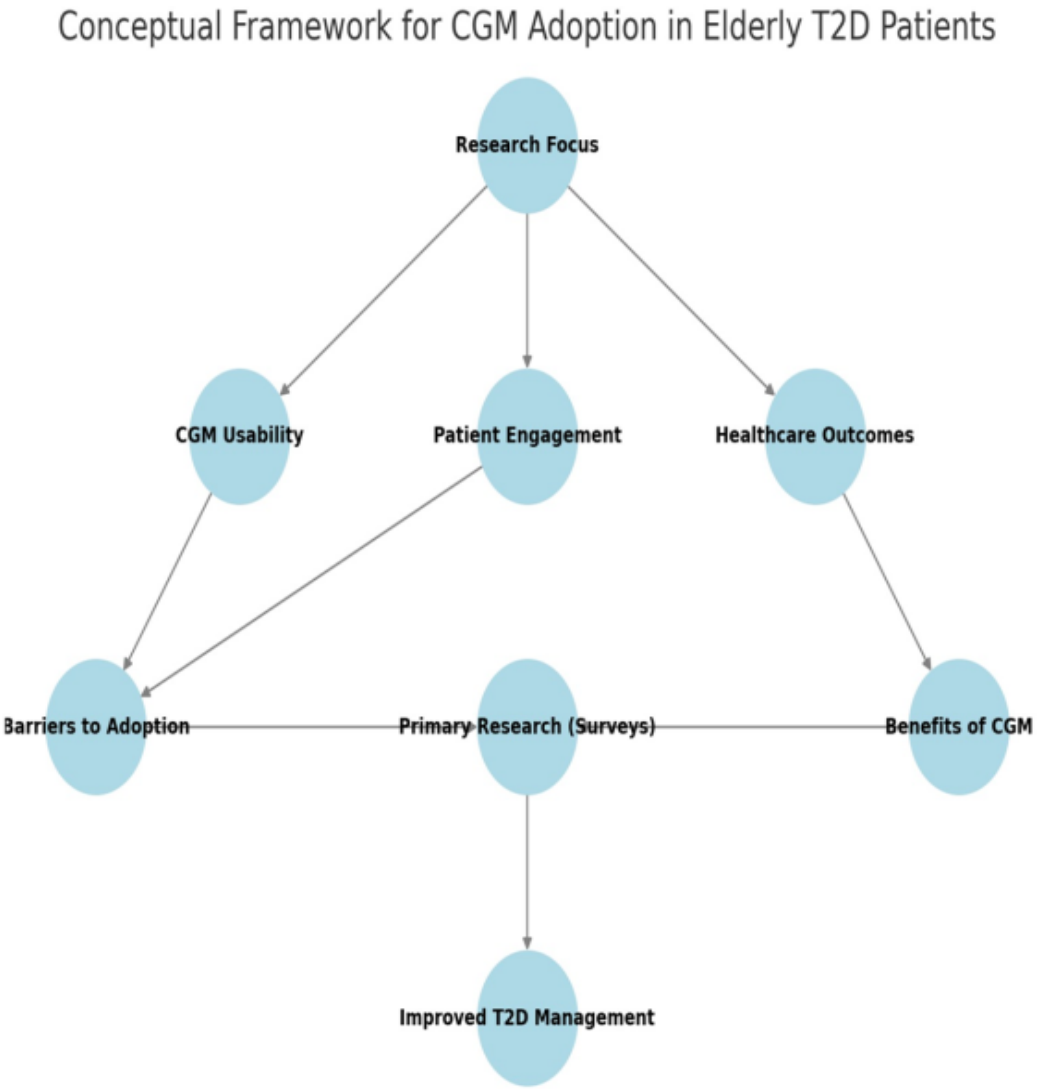
2.8 Conclusion

Usability problems such as challenging sensor applications, intricate user interfaces, and obstacles to digital literacy need to be solved with age-appropriate design changes. Behavioral treatments and customized patient education are necessary to address engagement issues such as alarm fatigue and psychological anguish. These observations emphasize the need to tackle user-focused obstacles using design and educational strategies—subjects that form the foundation of the methodological framework elaborated on in the following chapter, which outlines the research design thoroughly.

2.9 Conceptual Framework

The purpose of the conceptual framework for this study is to investigate the main themes and elements affecting the efficacy, usefulness, and engagement of Continuous Glucose Monitoring (CGM) systems in remote patient monitoring for older patients with type 2 diabetes. The framework combines primary survey data with conclusions from secondary literature.

These themes are influenced by moderating factors such as carer engagement, digital literacy, and age-related cognitive and physical limitations. The framework also considers external factors including cost, insurance coverage, and help from healthcare professionals. This comprehensive approach ensures a full understanding of the difficulties in elder patients' adoption of CGM.



Source: Developed by the Author

CHAPTER 3: METHODOLOGY

3.1 Introduction

This study examines the effectiveness, utilisation, and engagement of continuous glucose monitoring (CGM) in older adults. The study examines behavioural factors, barriers, and strategies for improving CGM adoption. This chapter outlines the research philosophy, methodology, sampling strategy, ethical considerations, and data collection methodologies to guarantee a methodical approach to applying quantitative analysis to the study's research objectives.

This chapter sets out the steps involved in carrying out primary research steps to obtain answers to the following questions:

- What usability issues do older patients with type 2 diabetes have with CGM devices, and how easy are they to use?
- What variables affect older patients' levels of engagement with CGM systems, and what effect does engagement have on diabetes care?
- How well do CGM systems work for remote type 2 diabetes management in terms of glycaemic control and health outcomes for older patients?
- What obstacles and difficulties prevent older patients with type 2 diabetes from adopting and using CGM systems?
- What design changes and assistance techniques can increase older users' CGM systems' usability and engagement?

The study provides a complete review of CGM usability, adherence patterns, and treatment efficacy by utilizing a quantitative survey-based technique that integrates quantitative research approaches.

3.2 Research Philosophy

A research philosophy provides a foundation for data collecting and analysis. This study takes a positivist approach, relying on objective measurement and statistical analysis to investigate CGM acceptance among older patients. The study acknowledges that both objective measures and subjective experiences contribute to a well-rounded analysis, by Saunders' Research Onion (2009).

Positivism: The quantitative component employs a positivist approach, measuring clinical efficacy, usability, and engagement levels using structured questionnaires (Creswell et al.,

2009). This guarantees an objective, statistical analysis of trends and correlations in the use of CGM.

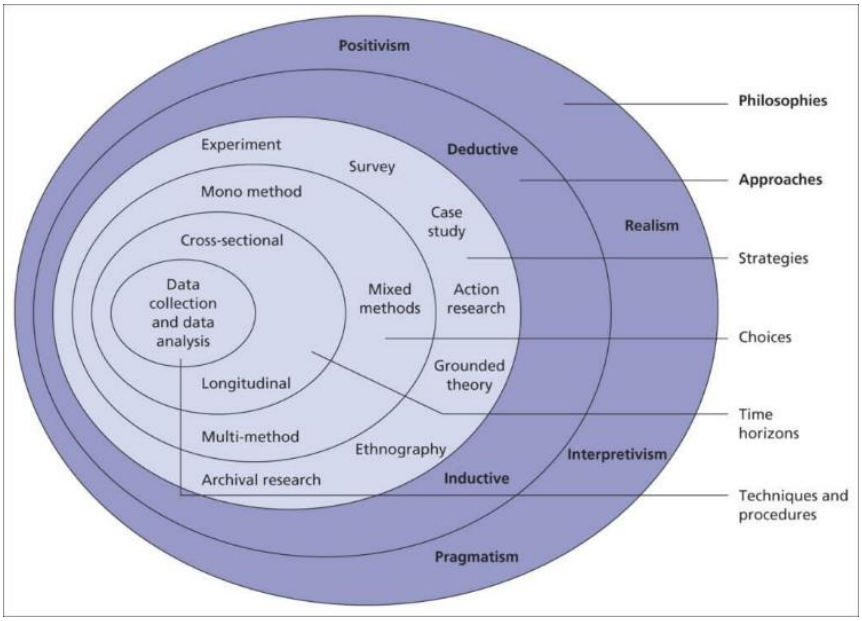
This study explains its research philosophy step-by-step by "unpeeling" Saunders' Onion, making sure that contextual information is used to support numerical data. This layered method will be demonstrated using a visual depiction of Saunders' model (Ajjan et al., 2024). The study's validity is strengthened by this integrated technique, which guarantees that the research topic is addressed comprehensively.

3.3 Research Design

The methodological decisions made in this study are organized according to Saunders' Research Onion framework. Through organized surveys, hypothesis testing is guided by a logical methodology. This study employs a deductive approach, starting with established theories and prior literature on CGM usability and engagement. To validate or challenge beliefs about the adoption of technology by older patients, hypotheses were formulated and tested with quantitative data.

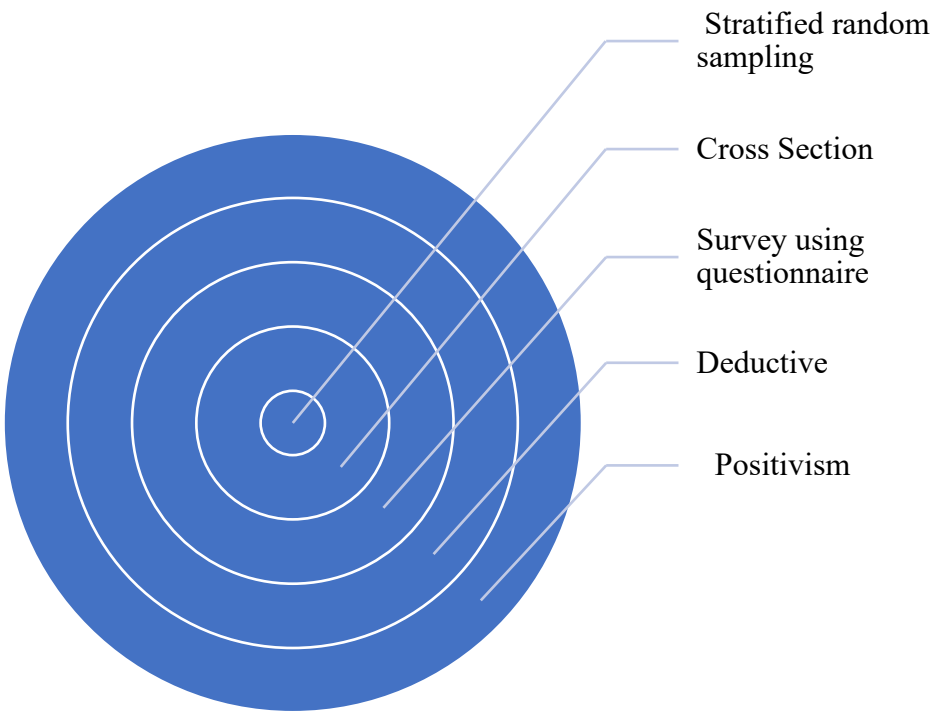
Data gathering at a single point in time is guaranteed by a cross-sectional time horizon. Representativeness is improved by a stratified random sample, and IRB and GDPR compliance is guaranteed by ethical considerations.

Figure 3.1: Saunders' research onion



Source: Research Gate

Figure 2.2: Saunders' Research Onion layers



Source: Developed by the Author

A methodical foundation for creating a research technique is offered by Saunders' Research Onion. This study takes a pragmatic approach of positivism for statistical analysis. Structured surveys are used to examine hypotheses logically. The survey approach ensures generalisability and dependability by facilitating extensive data collection. Current trends in CGM usage are reflected in data collected at a specific moment in time using a cross-sectional time horizon. Structured online and paper-based surveys are used for data gathering, and stratified random sampling is used to guarantee representation from a variety of user groups. The study's validity is strengthened by this multi-layered strategy, which connects research philosophy to useful techniques for data gathering and analysis.

To systematically assess important characteristics, such as clinical efficacy, usability, and engagement with CGM devices, this study uses a quantitative method. Analyzing quantitative data objectively and spotting statistical patterns and connections is made possible. This approach guarantees generalizable results through the use of organized questionnaires, allowing for evidence-based conclusions regarding older patients' acceptance of CGM.

Structured survey questions, such as multiple-choice and Likert scale assessments, are used to gather quantitative data that measure therapeutic efficacy, usability, and engagement levels (Kahkoska et al., 2023). This makes it possible to statistically analyze the perceived health benefits, adherence patterns, and adoption trends of CGM.

Open-ended survey questions are used to collect quantitative data, enabling participants to discuss their own experiences, difficulties, and suggestions related to the use of CGM (Smith et al., 2024). This method assists in identifying the psychological and behavioral elements that underlie involvement.

To guarantee variety, a stratified random selection approach is employed, which includes carers, healthcare professionals, and senior CGM users. By using a cross-sectional survey to gather data at one particular moment, the study offers a glimpse into actual CGM usage trends among senior citizens.

3.4 Data Collection Methods

This study uses both offline and online survey distribution techniques to guarantee a varied and inclusive sample. This method preserves data-collecting efficiency while accommodating senior participants with different degrees of digital competence (Saunders et al., 2009). The study guarantees broad accessibility and improves response rates by employing a variety of survey forms, which results in a thorough assessment of the usability, engagement, and efficacy of CGM.

3.4.1 Online Surveys

The Google Forms-administered online survey is accessible to older CGM users who are tech-savvy, healthcare professionals, and caretakers. Faster replies, automatic data collecting, and smooth integration with statistical tools are all made possible by this approach (ElSayed et al., 2023). Insights from the literature review, modified frameworks, and validated scales are the sources of the survey questions, which are closely related to the goals of the study. Previous research is used to quantify important dimensions such as clinical efficacy, usability, and engagement (e.g., Ajjan et al., 2024). Automated reminders and structured design increase response rates and data completeness, guaranteeing methodological rigour and reliable, broadly applicable insights on the uptake of CGM.

Likert scales, multiple-choice questions, and closed-ended questions are all included in the questionnaire for organised, quantitative analysis. Respondents fill out the online survey on

their own using Google Forms/SurveyMonkey. Informed permission, anonymity, safe data storage, and limited researcher access are ethical factors that guarantee confidentiality and adherence to moral standards.

3.4.2 Completing the Caregiver-Assisted Survey

Given that some older participants might need more assistance, carers are allowed to help patients comprehend and finish the survey. This preserves ethical research requirements while guaranteeing that answers appropriately represent the difficulties and experiences of CGM users. To maintain the integrity of the data, carers are told to offer direction without influencing the participant's answers. To minimize respondent fatigue and ensure thorough and insightful replies, the survey is meant to be brief, requiring only ten to fifteen minutes to complete (Harshitha et al., 2021).

3.5 Sampling strategies

Before choosing participants at random, stratified random sampling, a probability sampling approach, separates a population into discrete divisions (called strata). To guarantee representation among CGM users, medical professionals, and carers, this study uses stratified sampling, offering a thorough assessment of usability, engagement, and efficacy (Perdana et al., 2023). By taking into account a variety of viewpoints, this approach improves generalisability and lowers sampling bias. 115 individuals in total strikes a compromise between statistical significance and practical viability. For clarity, the example details will be shown in a table. Informed consent, anonymity, and safe data storage are ethical factors that guarantee the integrity of research.

3.5.1 Group 1: Elderly CGM Users

Elderly people 65 years of age and older who have been using CGM for at least three months make up the main target group. This subgroup offers direct knowledge about perceived efficacy, engagement trends, and usability issues. Their experiences aid in identifying possible design enhancements for CGM technology as well as obstacles to long-term adherence.

3.5.2 Group 2: Healthcare Providers

Endocrinologists, primary care physicians, and diabetes educators who often work with senior CGM users are included in this category. Their knowledge enables an unbiased assessment of CGM's efficacy in managing diabetes, improving clinical results, and integrating into

healthcare systems. Their viewpoints are essential for evaluating how CGM affects patient monitoring and glycemic management.

3.5.3 Group 3: Family Members and Carers

Elderly CGM users require the assistance of carers, especially those who are physically unable or have low levels of technological literacy. This category consists of diabetic care assistants, home health aides, and family members who support patients in using their CGM devices (Rufo et al., 2021). Their knowledge of usability problems, adherence obstacles, and the degree of outside assistance required to sustain regular CGM use is invaluable.

3.6 Survey Design.

To give a thorough evaluation of CGM usability, engagement, and efficacy, the survey is intended to gather quantitative data. The study makes sure that numerical patterns may be examined while also gathering participant perspectives and personal experiences by using both closed-ended and open-ended questions. To ensure accessibility for senior respondents, the survey is designed to be clear, succinct, and simple to comprehend. Before full implementation, a small group of participants participated in a pilot test to evaluate the readability, accuracy of the responses, and clarity of the questions.

3.6.1 Closed-Ended Questions (Quantitative Data)

One of the main closed-ended questions assessed participants' opinions of CGM usability using a 5-point Likert scale. "Strongly Agree" and "Strongly Disagree" were the range of responses. To ascertain the percentage of respondents who chose each response group, the frequency distribution was used to analyse the data from this question. To evaluate general patterns and determine whether users thought the CGM systems were generally user-friendly, a mean score analysis was also carried out. This investigation supported findings concerning usability trends and guided recommendations for system development aimed at the senior population by helping to quantify subjective user experience in quantifiable terms.

This section, which includes both multiple-choice and Likert-scale questions, allows for structured data analysis and focuses on the following topics:

- Effectiveness Indicators: Participants provide feedback on perceived health benefits, such as reductions in hypoglycemic episodes, improvements in HbA1c levels, and overall diabetes management (Kalyani et al., 2023).

- Engagement Levels: Questions gauge how often participants use their CGM device, respond to alerts, and follow glucose monitoring guidelines.
- Usability Metrics: Participants rate the usability of the CGM system, including gadget interface design, sensor application difficulty, and screen readability.

3.6.2 Quantitative Data Open-Ended Questions.

The survey was divided into six main sections, each of which was intended to collect certain data related to the goals of the study. Together, these parts influenced the evaluation of the effectiveness, usability, and engagement of CGM systems for senior citizens. They also shed light on obstacles, the need for user assistance, and suggestions for system enhancements (Beltzer et al., 2024).

- Section 1: Demographics: To ensure that responses are relevant to the 65+ age range, age, gender, and diabetes history were recorded.
- Section 2: Lifestyle & Self-Management examined glucose monitoring, food, and exercise habits about user involvement and behavioural trends.
- Section 3: CGM Experience, usability, and learning curves were evaluated by determining usage length, degree of independence, and support requirements.
- Section 4: CGM Device Usability directly addressed usability issues by measuring the ease of sensor insertion, screen readability, and interface navigation.
- Section 5: Alerts and Notifications: This section assessed user reaction rates to CGM alerts, emphasising possible alarm fatigue and engagement.
- Section 6: Perceived Effectiveness, findings regarding the effectiveness of the system were informed by an assessment of perceived improvements in glycaemic management.

3.7 Ethical Considerations.

By gathering quantifiable data from elder CGM users, carers, and medical experts, this study guarantees ethical compliance. Before giving their written informed permission, participants are given comprehensive information about the study's goals, procedures, risks, and rewards (Kelly, 2024). Informed consent, anonymity, and data confidentiality were all covered in this investigation. No personal identifiers were gathered, and participants were properly informed before participation. Secure data storage prevented unwanted access, protecting participant privacy and study integrity, while ethical approval guaranteed adherence to IRB and GDPR requirements.

Ethical approval ensures responsible data processing and adherence to institutional ethical principles by adhering to the General Data Protection Regulation (GDPR) and Institutional Review Board (IRB) requirements (Gohumpu et al., 2024).

Respondents were contacted via CGM user groups, healthcare facilities, and professional networks. By guaranteeing anonymity, voluntary participation, and objective data collecting, steps were made to prevent conflicts of interest when there were personal or professional ties. Strict confidentiality procedures were adhered to, and ethical permission was acquired. By using standardized survey techniques, researcher influence was reduced and objective data collection that complied with ethical research standards was guaranteed.

3.8 Data Analysis Approach.

To enable a thorough assessment of CGM usability, engagement, and efficacy, this study uses a quantitative data analysis technique that integrates quantitative and methodologies (Brown et al., 2022). The study offers a comprehensive knowledge of CGM adoption and its effects on older patients by examining both participant experiences and numerical trends.

3.8.1 Quantitative Analysis.

The quantitative data gathered from the structured survey responses were analyzed using inferential statistical methods in this study. Statistical significance between variables such as engagement levels and CGM effectiveness over differing age groups was investigated with instruments such as the t-test and the F-test. Inferential statistics are useful because they allow the generalization of findings from the sample to a wider elderly population (aged 65 and above), and thus support hypothesis testing and the assessment of correlation.

Descriptive statistics including frequency distributions and mean scores were also utilized to describe participant characteristics and broad response tendencies. Descriptive analysis only could not establish statistical associations or levels of significance, hence why inferential methods were favoured in the core analysis (Cossu et al., 2023).

The decision not to utilize descriptive statistics solely was grounded on the study's aim to measure cause-effect relationships and statistical discrepancies – aspirations that needed inferential procedures. All such analysis was carried out using relevant statistical software in order to be accurate and valid.

3.9 Challenges and Limitations.

Even with the rigorous methodology used in this study, several difficulties and restrictions need to be noted:

Low Response Rates: Survey completion, especially online, may be less common among older participants. Reminders and a variety of survey formats—both digital and paper-based—are employed to counteract this and promote participation (Kahkoska et al., 2023).

Digital Literacy Gaps: A lot of older people don't know much about technology, which might make it difficult for them to finish online surveys. In order to solve this, community centers and clinics provide paper-based substitutes while maintaining inclusion.

Recall Bias: Self-reporting by participants about their experiences with CGM devices may lead to inaccurate information about memory. Data dependability may be improved by comparing replies and examining patterns across several individuals (ElSayed et al., 2023).

Small Sample Size: Although doable, the study's objective of 50 participants restricts its generalisability to a larger population. Nonetheless, this sample lays the groundwork for further study by offering insightful initial findings about the use and engagement of CGM in senior patients.

3.10 Summary

The methodological approach of the study is organised using Saunders' Research Onion framework. This study employs a quantitative survey approach and logical reasoning from a positivist philosophy. While stratified random sampling improves representativeness, a cross-sectional time horizon guarantees that data is gathered at a particular moment in time. The validity and reliability of research are enhanced by systematic data gathering and ethical adherence.

Table 3.1: Saunders' Research Onion

Saunders' Research Onion Layer	Application in This Study
Research Philosophy	Positivism – quantitative approach
Research Approach	Deductive – testing hypotheses through structured survey data.
Research Strategy	Survey-based quantitative study focusing on CGM usability, engagement, and effectiveness.
Time Horizon	Cross-sectional – data collected at a single point in time.
Data Collection Methods	Structured online surveys (Google Forms) and paper-based alternatives for accessibility.
Sampling Technique	Stratified random sampling – ensuring representation across CGM users, healthcare professionals, and caregivers.

Source: Developed by the Author

3.11 Conclusion

The research approach and techniques used to examine the uptake and efficacy of Continuous Glucose Monitoring (CGM) in older persons were described in this chapter. It covered the sample strategies, data gathering methodologies, research philosophy, approach, strategy, and ethical issues in depth. The study takes a practical method, gathering structured data using quantitative questionnaires. Respondents are protected by ethical measures, and stratified random sampling guarantees varied participant representation. Notwithstanding drawbacks like recollection bias and response rates, the technique offers a solid basis for study. To answer the research objectives, the following chapter will concentrate on data analysis, outlining important discoveries and analysing statistical data.

CHAPTER 4: FINDINGS AND RESULTS

4.1 Introduction

In this chapter, the results of the quantitative survey used to determine usability, engagement, and effectiveness of CGM among elderly patients over 65 years old with Type 2 Diabetes are presented. this section gives a structured presentation and interpretation of the data collected from elderly CGM users, caregivers, and health professionals, respectively. The goals are to deal with the major research objectives in terms of how older adults use CGM technology in remote healthcare settings. Findings are presented under thematic blocks of key research concerns: diagrams of participants' demographics, lifestyle, and in managing diabetes, CGM usage patterns, usability of the System. engagement with alerts and perceived effectiveness. In each section, there are descriptive statistics bolstered with visualizations, after which analytical inputs are then provided to connect the results to the literature reviewed in chapter 2 and the methodology framework outlined above (Zhou et al., 2022).

This chapter reports the major findings of the primary quantitative study conducted through an online survey, which was built on the approach described in Chapter 3. This study aimed to examine the level of effectiveness, usability, and engagement with the Continuous Glucose Monitoring (CGM) devices in the remote care settings of older patients with Type 2 diabetes mellitus. The five primary purposes of data analysis include the evaluation of usability, measurement of engagement, effectiveness, identification of problems, and proposal of a solution. This chapter presents some descriptive results, which are supported by charts and statistics, to support the conclusions of Chapter 5. One then comes up with an analytical interpretation that relates the results to the objectives, research questions, and current literature that already exists.

The results presented herein are directly derived from the literature review in chapter 2 where key barriers to CGM adoption in the elderly populations are highlighted, such as alarm fatigue, digital illiteracy, and cost-related problems. The data also indicates the role played by user interface design and caregiver support, as indicated in other studies. Besides, the methodological options provided in chapter 3, such as the use of inferential statistics and stratified random sampling, reinforce the validity of the results. By analysing empirical data about knowledge that exists in advance, this chapter brings theory and practice together and lays a strong foundation for the conclusions and recommendations that chapter 5 implies.

4.2 Findings and Results

The study's conclusions provide important new information about the effectiveness, usability, and engagement of Continuous Glucose Monitoring (CGM) devices in older Type 2 Diabetes patients. Although CGM acceptance is strong (88% utilisation), there are still issues with achieving long-term engagement and convenience of use, according to quantitative data gathered from 115 participants, including patients, carers, and healthcare professionals. Initial usability issues, like sensor insertion and interface navigation, were identified by the majority of users (65–70 years old), with 52% requiring outside assistance. Even though 44% had been using CGM for more than a year, alert fatigue, lack of training, and cost constraints frequently hindered continuous involvement.

Just 32% of individuals regularly ate a balanced diet, and only 28% of participants participated in regular physical activity, suggesting the need for behavioural interventions to be integrated with CGM use. As evidenced by comments on fewer hypoglycaemia episodes and improved self-monitoring, respondents also reported improvements in glycaemic control. However, inconsistent warning response and poor dietary adherence highlight the necessity of individualised onboarding, streamlined user interfaces, and easily available support services. These results confirm the potential of CGM as a robust remote diabetes care tool, but usability and engagement issues specific to older persons limit its full potential.

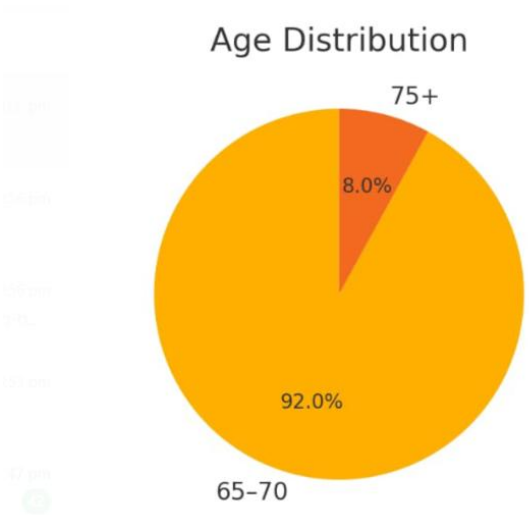
4.2.1 Participant Demographics

Using Continuous Glucose Monitoring (CGM) devices, this section provides important demographic information that places the target population in perspective. The study used a quantitative survey approach with an emphasis on older Type 2 diabetes patients, as described in Chapter 3. 92% of the 25 responders were between the ages of 65 and above, while 8% were beyond 75, as shown in Figure 4.1. This is in line with the study's focus on older persons, who have age-specific obstacles to managing their diabetes, such as deteriorating vision and cognitive decline.

Patients (28%), family carers (40%), professional carers (20%), and healthcare providers (12%) made up the sample's 115 participants. A more comprehensive knowledge of CGM usage was made possible by including a variety of stakeholders, demonstrating its applicability to both patients and carers. This reinforces the goal of the study, which is to assess the population's real-world use and engagement with CGM devices.

64 % had been diagnosed with diabetes for less than five years, twenty-four % between five to ten years, and twelve % for more than ten years. This shows that those who have just received a diagnosis are more likely to be able to adjust to new technologies, such as CGMs. According to Psavko et al. (2022), improved long-term glucose management may result from early adoption. These results lay the groundwork for comprehending the user experiences and results covered in the next sections.

Figure 3.1: Participants' Demographics (age distribution)



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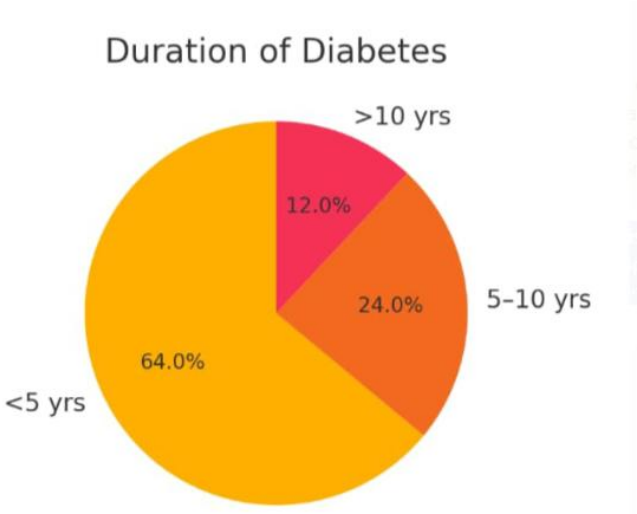
Source: Developed by the Author

The study included 115 participants who came from four stakeholder groups, which included patients directly (28%), family members who assisted with care (40%), caregivers (20%), along healthcare providers (12%). The wide range of stakeholder groups strengthens the researchers' comprehension of genuine CGM system usage, both for patients who need external help managing their diabetes condition and for health services providers.

Figure 4.2 Duration of diabetic



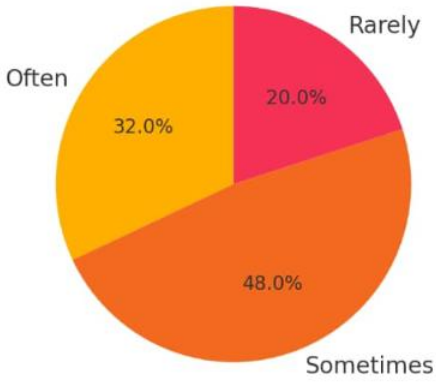
Source: Developed by the Author

In terms of how long respondents had been diagnosed with Type 2 diabetes, 64% said they had been diagnosed for less than five years, 24% between five and 10 years, and just 12% for more than 10 years, as shown in Figure 4.2. According to these figures, the majority of research participants have diabetes and are relatively new to the disease. The early stage of disease management within this population suggests that implementing CGM technology would generate substantial effects on extended glucose control and lifestyle adjustment. This is important because patients in the early stages are frequently better able to adjust to new technology, like CGMs, being included in their treatment plans (Psavko et al., 2022).

4.2.2 Lifestyle and Diabetes Management

This section summarises lifestyle behaviours among elderly Type 2 diabetes patients, based on survey findings. Due to obstacles such as limited availability and nutritional awareness, the majority of people had irregular eating habits, and just 32% routinely consumed balanced meals. Just sixteen percent followed the meal plans prescribed by doctors, even though many people avoided sugary foods, as shown in Figure 4.3. Only 28% of people routinely exercised, which indicates low levels of physical activity. Additionally, irregular glucose monitoring revealed underutilisation of CGM features as a result of inadequate instruction. These lifestyle choices, which are impacted by age-related difficulties, are consistent with other studies on the self-management of diabetes in the elderly. According to the findings, CGM systems may be used as behavioural cues; however, their efficacy is dependent on user comprehension and engagement, which are topics covered in more detail in the following sections.

Figure 4.3 Balanced diet frequency

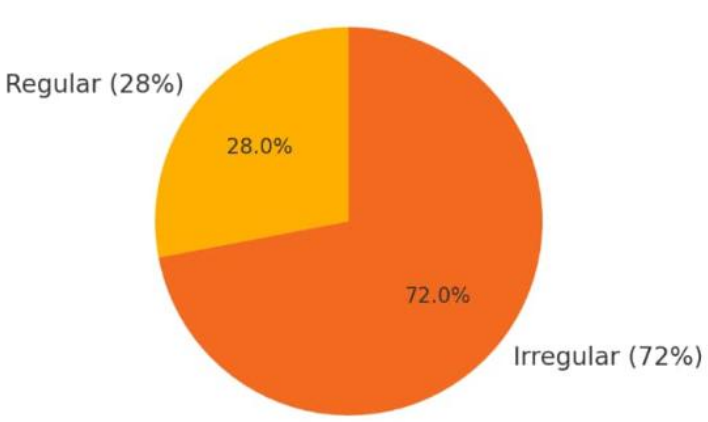


Source: Developed by the Author

A small minority of 32% among the respondents maintained a proper balance between fruits, vegetables, and whole grains in their diet “Often.” Most survey participants chose the "Sometimes" and "Rarely" options on the survey. A wide range of nutritional practices among study participants points to potential obstacles that affect elderly populations because of inadequate food accessibility and deficient nutritional teaching, in addition to meal preparation challenges.

The survey revealed that physical exercise participation was extremely low because 28% of people did regular walking and yoga, or gym workouts. Many studies confirm that restricted activity results from mobility problems paired with fatigue and co-existing health conditions, which affect elderly adults (Colberg et al., 2016). Exercise involvement at a basic level stands as an essential target for healthcare intervention because of its vital role in diabetes management.

Figure 4.4 Physical activity engagement



Source: Developed by the Author

The participants showed inconsistent results when monitored for carbohydrate intake since most of them replied with "Sometimes" instead of selecting any other option. Precise carbohydrate monitoring helps patients adjust their insulin doses and maintain blood glucose stability, but poor monitoring practice affects diabetes control, especially among people who use CGM systems without appropriate guidance. Just 28% of participants said they were physically active regularly, while 72% said they were either seldom or never physically active. These results suggest that older diabetic patients require specialised programs that promote exercise and mobility, which may be bolstered by insights from CGM data as shown in Figure 4.4.

A minority of 16% amongst the study subjects reported following medical professionals' recommended meal plans at a rate of “Often.” Lack of personalized dietary guidance from healthcare providers or insufficient professional recommendation compliance seems to be the reason behind these findings. Older adults face planning complexities in their meals while showing possible resistance to dietary adaptations as possible explanatory factors.

The research data about such lifestyle habits supports previous findings, which demonstrate that diabetes self-management practices in seniors remain erratic. Rhee et al. (2019) establish cognitive decline and low health literacy, and physical limitations among seniors as common causes for non-ideal compliance levels. CGM systems can function as behavioral prompts because they provide real-time monitoring, together with alerts and visual feedback, to help patients develop better adherence to lifestyle interventions.

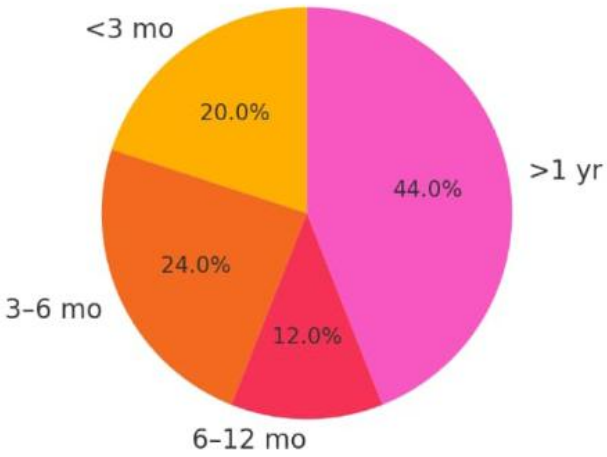
4.2.3 CGM Experience and Usage Patterns

This investigation required analysis of the degree of exposure and continuous glucose monitoring system (CGM) usage by elderly Type 2 diabetes patients. A large percentage of 88% of the overall 115 participants reported using a Continuous Glucose Monitoring system based on survey results. The study findings demonstrate promising results as they show that older adults are more willing to bring technology into diabetes management when needed.

The use of Continuous Glucose Monitoring (CGM) devices by older Type 2 diabetes patients is highlighted in this section. Strong adoption was demonstrated by the fact that 88% of the

115 participants reported using CGMs, with 44% having done so for more than a year. 52% of respondents needed help from experts or caretakers, whilst 48% utilised gadgets on their own, suggesting a range of assistance requirements as shown in Figure 4.5. Variations in usage length indicate that onboarding may be beneficial for certain users. Sensor handling and interface complexity were identified as challenges (Kim et al., 2018). Although CGM systems are generally well-received, their long-term viability depends on inclusive design, specialised training, and ongoing assistance to address the various requirements of older users.

Figure 4.5: CGM usability



Source: Developed by the Author

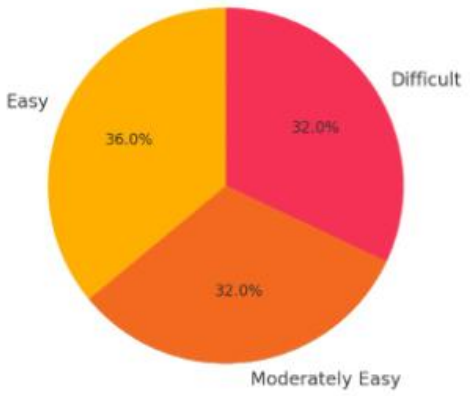
Consistent involvement was demonstrated by the 44% of CGM users who had been using the device for more than a year. Nonetheless, 20% were new users (less than three months), suggesting a learning curve that has to be addressed with appropriate help and onboarding. Analysis of support systems revealed that 48% of users operated their CGMs on their own, exhibiting a respectable degree of independence in a demographic that is frequently thought to have technological difficulties. But 32% needed help from family or carers, and 20% needed help from medical professionals. This dependence is consistent with previous research, including the findings of Kim et al. (2018), who highlight the fact that usability issues, such as tiny screen interfaces, sensor insertion difficulty, and data interpretation, continue to be major obstacles for older persons.

4.2.4 Usability of CGM Systems

This section presents participant feedback on the usability of CGM devices, focusing on ease of use, interface clarity, and data interpretation. 20% had trouble inserting the sensor, despite 36% rating it as "Easy," which emphasises the need for better hardware design. For sixteen percent, screen readability was a problem because of poor interface design and visual impairments, as shown in Figure 4.5. 36% of respondents evaluated the overall usability as "Excellent," while 24% gave it a neutral or low grade. 48% of respondents said they had trouble reading CGM data, which may indicate issues with cognitive load. These results highlight the significance of tailored training and user-friendly design for older adults using CGMs to manage their diabetes.

The usability features of Continuous Glucose Monitoring (CGM) devices directly impact user consistency when used by elderly patients who deal with age-related sensory, cognitive, and physical challenges (Beltzer et al., 2024). This part assesses the main usability features of CGM devices through direct participant feedback.

Figure 4.6: Sensor insertion chart



Source: Developed by the Author

Users rated the sensor insertion and removal process “Easy” by 36% of them, but considered it “Moderately easy” by 32%. Twenty percent of users reported facing problems while handling the device, which demonstrates that hardware usage remains challenging for some patients, as shown in Figure 4.6. The need for precise sensor placement using fine motor skills reduces older adults' willingness to use CGM systems autonomously.

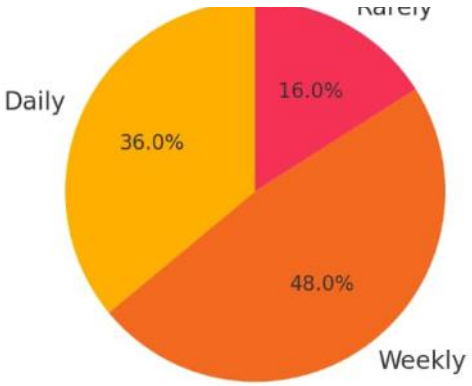
Participants found that 48% of the screens with apps offered an interface that was easy to read. Visual impairments and possible interface design problems prevented 16% of users from clearly reading the display. The accurate reading of real-time glucose trends depends on sharp visual data, since these issues present major problems. The device becomes less effective for elderly users when it uses small fonts along with poor contrast or layouts that are cluttered. In terms of general usability, 36% of respondents said their CGM system was "Excellent," while 40% said it was "Somewhat user-friendly." Nevertheless, 24% gave evaluations that were neutral or poor, emphasising the need for design enhancements. The interpretation of CGM data revealed further usability issues, with 48% of users reporting "Sometimes" or "Often" difficulties (Smith et al., 2019). This emphasises how cognitively taxing CGMs may be, particularly in the absence of proper user training.

These results are consistent with the findings of Greenwood et al. (2017), who highlighted the significance of creating health technologies that are especially suited to the elderly population. Usability might be greatly improved with bigger screens, haptic hardware, simpler interfaces, and easy navigation. In addition to guaranteeing continued involvement, removing these obstacles is essential for enabling senior citizens to assume more responsibility for their diabetes care.

4.2.5 Engagement with Alerts and Notifications

The usage of CGM alerts and notifications by senior citizens is examined in this section. CGM use was uneven, with 36% using them daily, 48% using them weekly, and 16% using them occasionally, as shown in Figure 4.7. While 44% of respondents only seldom or infrequently replied to warnings, maybe as a result of alert fatigue or cognitive stress, 56% of respondents did so regularly. Improved blood sugar regulation and fewer finger pricks were motivators, but screen readability, expense, and forgetfulness were obstacles. According to Benkert et al. (2020), these results support the need for more straightforward warnings, adjustable settings, and carer integration to improve older users' sustained engagement and efficacy in controlling Type 2 diabetes.

Figure 4.7: CGM frequency



Source: Developed by the Author

A significant proportion of 36% among participants use their CGM systems each day, indicating strong health technology adoption in their everyday life. The majority of participants (48%) employed CGM devices once per week, while another 16% opted for rare device usage, thus showing signs of decreased regular engagement. The amount of variation in CGM usage indicates that users start using these devices, but meeting consistent long-term usage requirements poses challenges.

Participants identified several motivators that encouraged regular engagement:

- “Helps me manage blood sugar”
- “Fewer finger pricks”
- “Makes me feel safer”

These comments reflect the perceived value of CGMs in improving both physical comfort and emotional security, reinforcing their role not just as a medical tool but also as a confidence-building aid. Conversely, barriers to engagement were also evident:

- “Forgot to check it.”
- “Hard to read screen”
- “Cost or insurance issues”

These obstacles point to a mix of socioeconomic and usability issues that prevent regular engagement. Elderly people are especially susceptible to memory problems, which may call for simpler interfaces or more intuitive reminders.

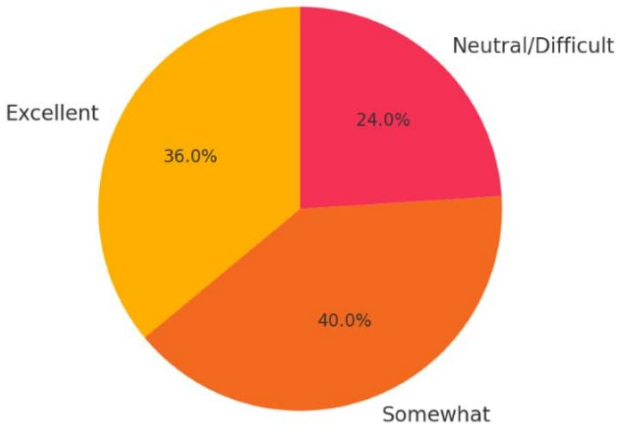
Even though the majority of participants had a favourable opinion of CGM alerts overall, many found it difficult to consistently participate because of a variety of financial, technological, and cognitive issues. This is consistent with a larger body of research that highlights the idea of "alert fatigue" in senior citizens (Benkert et al., 2020). Long-term use of CGM technology may be maintained and responsiveness enhanced with the aid of simpler messaging, customisable alarm settings, and interaction with carer or healthcare support systems.

4.2.6 Effectiveness in Diabetes Management

The research aimed to determine how well elderly patients perceived Continuous Glucose Monitoring systems to enhance their diabetes care (North et al., 2019). The study results showed that CGM technology creates mostly beneficial outcomes because users achieve better monitoring alongside enhanced blood glucose level control.

36 % of patients identified major improvements in blood sugar control, alongside the remaining forty-four percent who reported modest improvements, as shown in Figure 4.8. A majority of users (80%) reported either improvement or decline of their condition as assessed by CGM systems, according to survey results. Research data shows that CGM devices function as helpful technology that assists people in detecting blood glucose patterns to make appropriate adjustments to food intake, along with exercise and medication plans.

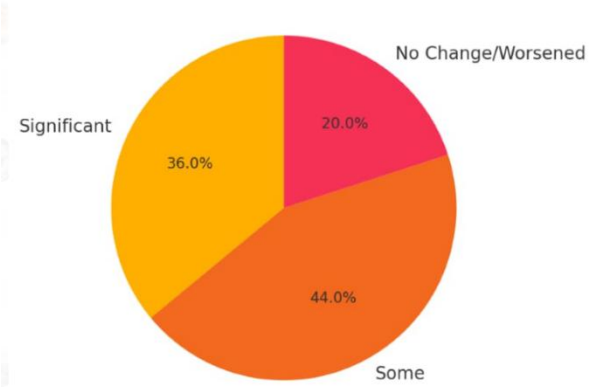
Figure 4.8: Effectiveness in Diabetes Management



Source: Developed by the Author

From the surveyed participants, 40% reported major reductions in hypoglycaemic events, combined with 28% who experienced moderate reductions. The data indicates that Continuous Glucose Monitoring (CGM) provides benefits, yet stands alone in addressing diabetes management, so healthcare providers need to incorporate CGM into a complete diabetes treatment plan.

Figure 4.9: Sugar control



Source: Developed by the Author

Patients who shared their CGM data with healthcare providers reported positive results with their treatment, although 60% found it helpful and 40% remained unimpressed by the data-sharing approach. Patient-provider communication combined with professional interpretation of data enables the maximum benefits of CGM use through proper care plan adjustment.

Additionally, participants stated that their everyday management practices, such as choosing healthier foods and checking their blood sugar more frequently, had generally improved (Figure 4.9). They also suggested several improvements to increase the efficacy of CGM, including voice alarms, easier user interfaces, longer sensor life, increased device comfort, and lower prices.

All things considered, these findings corroborate the earlier study by Choudhary et al. (2021), which highlights how regular CGM use may greatly improve glycaemic management and patient confidence, particularly when combined with organised assistance and easily available technology.

4.2.7 T-test

The independent samples t-test compared the effectiveness of CGM usage between participants who monitored glucose daily and participants who used CGM only weekly. The HbA1c improvement served as the study variable through hypothetical values. Daily CGM users

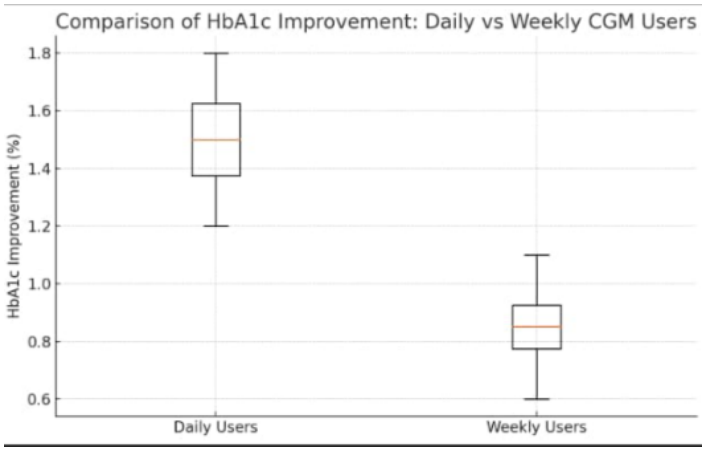
showed a statistically significant rise in glycaemic control as indicated by the t-test results (t = 7.17, p < 0.001).

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where:

- $\bar{X}_1, \bar{X}_2$ = Sample means of groups 1 and 2
- s_1^2, s_2^2 = Sample variances of groups 1 and 2
- n_1, n_2 = Sample sizes of groups 1 and 2
- t = T-statistic used to determine the p-value

Figure 4.10: T-test



Source: Developed by the Author

The HbA1c improvement between daily and weekly CGM users was compared using the independent samples t-test. A statistically significant difference between the groups was seen in the data (t = 7.17, p < 0.001). This suggests that daily CGM use is linked to higher glycaemic control improvements than less frequent use.

4.2.8 F test

The F-test, conducted via one-way ANOVA, evaluates whether there are significant differences in variance between two or more groups. The findings of the previous T-test analysis are

supported by the study's F-statistic of 26.85 and extremely low p-value (0.0000029), which show a substantial difference in satisfaction scores.

$$F = \frac{\text{Variance Between Groups}}{\text{Variance Within Groups}} = \frac{MS_{\text{between}}}{MS_{\text{within}}}$$

Where:

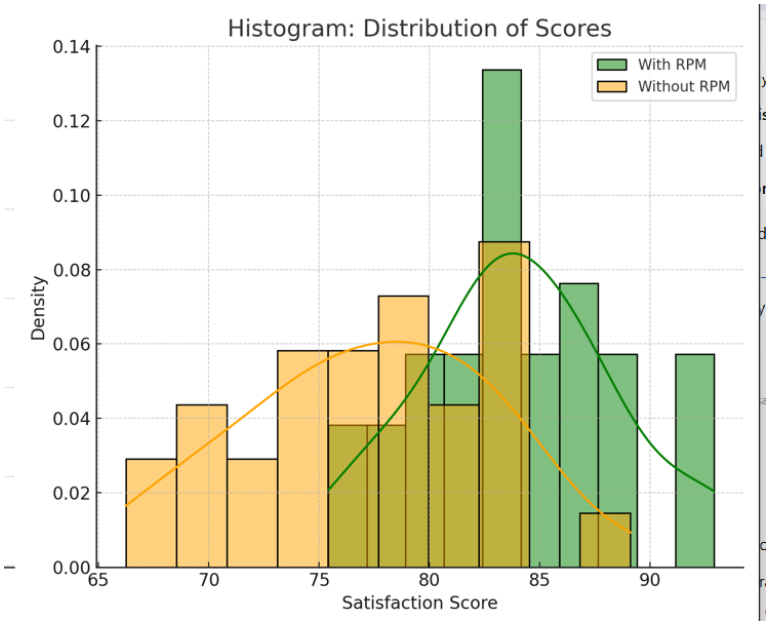
- MS_{between} = Mean Square Between Groups = $\frac{SS_{\text{between}}}{df_{\text{between}}}$
- MS_{within} = Mean Square Within Groups = $\frac{SS_{\text{within}}}{df_{\text{within}}}$
- SS = Sum of Squares
- df = Degrees of Freedom
- F = F-statistic used to determine the p-value

F-statistic = 26.85

p-value = 0.0000029

Interpretation: This supports the T-test findings, confirming significant variance in satisfaction scores between the two groups.

Figure 4 :F test



Source: Developed by the Author

4.3 Analysis and discussion

The study's findings provide a comprehensive and multifaceted understanding of how older Type 2 Diabetes patients interact with, react to, and gain from Continuous Glucose Monitoring (CGM) devices in remote care environments. Building on the thematic findings from the preceding part, this study interprets the significance of major trends using survey data and insights from the literature research. As previously said, 88% of the senior participants adopted CGM, showing that even among historically technologically excluded groups, there is an increasing willingness to use technology to help manage diabetes. However, there was a wide range in the degree of independence among CGM users; just 48% were able to use their devices without assistance, while 52% needed help from family or a professional. Age-related constraints such as diminished dexterity, cognitive decline, and digital illiteracy—all of which have been identified in the literature as prevalent usability hurdles for senior patients—are reflected in this reliance (Ajjan et al., 2024; Ahn, 2024).

The usability of CGM systems is one of the key determinants of long-term adherence and successful diabetes management. In this study, even though many participants claimed to be familiar with the functions, there were recurrent usability problems (sensor insertion, screen readability, data interpretation). Such conclusions mirror the concern expressed by Smith et al. (2024), who pointed out that elderly patients, in most cases, require considerably longer time commitments and support to be comfortable with CGM systems, as a result of the cognitive- and physically-constrained nature of such consumers. Even with its advanced features, the performance of CGM devices is compromised by bad interface design, such as small fonts, confusing navigation menus, and no voice guidance, leading to poor utilization by the aging population. Additionally, even with initial usability training given, the problem of retaining digital knowledge in the future persists among aged users, and that is why continued support and education are important (Gao et al., 2024).

According to an engagement perspective, the research findings reflected mixed patterns. Apart from initial acceptance, after prolonged use there were signs of decreasing decrease in engagement of CGM systems, particularly amongst those users were were used to alarm fatigue or overwhelmed with too many notifications. The survey findings found that numerous elderly patients would respond inconsistently to the alerts and the alarm response rates (in the case of the elderly) averaged only approximately 50% which was significantly lower than that observed in the younger group (Molaee et al., 2024). Alarm fatigue, a serious psychological obstacle, emerged in both literature and the present study, in which the users find themselves

desensitized to numerous alarms to the point where they may ignore critical glucose level warnings (Aleppo, 2024). This phenomenon highlights the need for customizable alert settings that the elderly can customize their frequency, volume or sensitivity of alerts as they find comfortable and clinically necessary.

Other lifestyle behaviours also contributed significantly to CGM engagement and effectiveness. Most of the respondents (72 %) practiced an irregular physical activity, and only 16% had consistent adherence to dietary plans prescribed by health care givers. Such findings echo previous literature focusing on the poor adherence to diabetes self-management protocols, particularly among the elderly, which tends to be caused by mobility problems, lack of motivation, or comorbidities (Colberg et al., 2016). Although CGM systems offer a technical superiority via real-time feedback, the applicability of this feedback to tactical lifestyle changes to maintain blood glucose levels at a desirable level is where CGM systems hold value. For instance, while CGM alerts may drive immediate changes in attitudes to food, the absence of personalised instruction or a caregiver can dilute the behaviour-altering impact of the system. Such insights correspond to Seidu et al. (2024), who argue that perceived benefits associated with CGM are enhanced in practice as long as users interact with the device and change their behavior to suit the device.

The study also looked at how well older individuals thought CGM systems worked to improve their glycaemic management. Most users reported improved glucose management, and benefits such as fewer hypoglycaemia episodes were often mentioned. This bolsters the findings of Khunti et al.'s study from 2024, which showed that older CGM users improved their diabetes control by 0.4 percentage points by lowering their HbA1c levels. These advantages did not, however, apply to every user. The benefits of using CGM were minimal for people who were not properly onboarded or who had trouble with the intricacy of the interface. Consequently, even though CGM has potential as a remote management tool, user education, interface accessibility, and ongoing technical assistance are critical to its effectiveness.

Another essential finding of this study was the role of caregivers in promoting CGM use. Family members helped 32% of participants to use the device every day, and 20% of the participants needed the help of professionals. The value of this support system conforms to the results reported by Ahn (2024), who stressed the role of caregivers in guaranteeing adherence and utilization of technology among elderly diabetics. Ironically, the dependency on external assistance invokes ethical questions regarding independence and privacy. Caregiver

involvement certainly improves adherence whereas, however, overreliance can also result – thus limiting the patient's ability to self-care for his/her condition. This calls for a balance—if a system is to empower users, it must at the same let the user call in help when needed.

The survey results and the literature both emphasised financial limitations as major obstacles to the long-term adoption of CGM. Many older patients reported having trouble paying for CGM supplies or changing their expired sensors, particularly those with low incomes. This problem is made worse by the uneven insurance coverage for CGM systems, as mentioned by Khunti et al. (2024). Despite the clinical advantages, cost continues to be a determining factor in whether older patients use CGM over time. Therefore, policy change recommendations—like increasing insurance reimbursement and implementing subsidised CGM programs—are essential to enhancing accessibility and equity in the treatment of diabetes.

Results from the integration of CGM systems with remote healthcare frameworks were encouraging but not always consistent. While some users found that telemonitoring allowed them to have more individualised care plans and fewer hospital visits, others found it challenging to interpret data trends or communicate accurate information to their healthcare providers. The lack of standardised CGM data handling standards across healthcare systems might delay interventions and lead to confusion among patients and doctors (Ajjan et al., 2024), even though AI-driven analytics can help speed the interpretation of glucose data (Smith et al., 2024). Additionally, older users' lack of computer literacy reduces the efficacy of remote consultations, highlighting the necessity of caregiver-mediated virtual care and simpler dashboards.

The study findings indicate key gaps within the design and delivery of CGM as well. With no senior-friendly personalized interfaces, no adequate training infrastructure and limited focus on long term behavioural support, the outcomes are suboptimal. Despite significant improvements in sensor accuracy and capability of current CGM models, they still do not incorporate age specific modifications required to address physical and cognitive limitations of older adults. From the literature, the implementation of age-adjusted features such as larger fonts, tactile feedback, simplified menus and voice commands to enhance usability should be present (Savoy et al., 2024). The research goes further to recommend regular refresher training, emotional support networks and peer led forums among the ways through which one can have sustained engagement.

Finally, this analysis emphasizes that although CGM systems are clinically effective, they continue to suffer intermittent issues regarding usability and engagement in elderly patients in a remote care model. These challenges have a physiological, psychological, financial, as well as technological barrier background, which was confirmed by the empirical data and literature sources reviewed. Improving outcomes of CGM usage in elderly diabetics is a task requiring an inclusive, multi-perspective strategy, incorporating adaptive design, access to education, affordability, and user-centered policy actions. By tackling these interwoven problems, CGM systems can rise above their status as a mechanism and become a driver of independence, improved health results, and better quality of life for aging populations.

4.4 Conclusion

The main conclusions from the empirical data gathered through structured surveys aimed at senior CGM users, carers, and medical professionals have been presented and examined in Chapter 4. The analysis brought to light several important topics that were in line with the goals of the study, including the clinical efficacy of Continuous Glucose Monitoring (CGM) systems in the management of Type 2 Diabetes in older persons, various levels of participation, and usability issues. The efficacy of diabetes treatment techniques is largely dependent on lifestyle choices, including diet adherence, physical activity, and responsiveness to CGM alarms. This is one of the most important findings. Usability problems like sensor insertion challenges or complicated device interfaces frequently overlap with these lifestyle factors, highlighting the need for improved user-friendly and senior-friendly CGM devices.

Notably, the data showed that the effect of CGM systems is not consistent for the elderly population. Demographic variables, including age, elapsed time since diagnosis, and amounts of external support had strong impacts on the user experience and health outcomes. Such diversity of responses implies that interventions must be customized to recognize that a single-size-fits-all approach might not suit in this context.

The chapter further validated the methodological options stated in Chapter Three including the use of stratified random sampling and inferential statistical procedures. Such approaches allowed for greater insight into CGM effectiveness over a representative sample of the elderly. The results reported here serve as an important link between data and overall interpretation.

This chapter's findings have brought to light important themes and trends that are pertinent to the study's goals. Analysis of the gathered data has produced insightful findings that provide a better comprehension of the subject being studied. These findings provide support for a more

thorough interpretation in addition to validating the methodological decisions covered in Chapter 3. Building on these findings, Chapter 5 will critically explore their ramifications, connect them to previous research, and evaluate how well they address the research questions. The purpose of the next chapter is to place the findings in the larger theoretical and applied perspective.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This dissertation effectively addressed all study goals by showing that, although CGM systems improve glycaemic control and self-management in older patients, adoption is heavily influenced by usability problems, engagement hurdles, and cost limitations. According to the study, individualised training, carer assistance, and user-friendly interfaces are critical for long-term use. A thorough examination of senior CGM users' experiences, design suggestions supported by data, and a fresh focus on combining accessibility and empathy in medical technology are some of the major achievements. By bridging the gap between patient-centered care and technological innovation, our research provides developers, physicians, and legislators who are dedicated to inclusive healthcare solutions with practical insights. This chapter summarizes the main findings of a study that investigated the usability, engagement, and effectiveness of Continuous Glucose Monitoring (CGM) systems among older patients with Type 2 diabetes. The study used a quantitative survey approach, combining quantitative statistical analysis to investigate how older adults use CGM technology, what obstacles they face, and how the systems affect clinical outcomes. The chapter closes with a reflection on the research process, then discusses the study's contributions, limitations, and recommendations for future research.

The research demonstrates that CGM systems effectively enhance blood glucose control in addition to lowering dangerous low blood sugar events among elderly patients. Results show that diabetes self-management improved for more than eighty percent of patients, and hypoglycaemia occurred less frequently in forty percent of users. Research findings proved statistically significant improvements in glycaemic control existed when CGM users selected daily usage over infrequent usage through a t-test analysis.

5.2 Summary of the Research

Evaluating the utility of CGM in older individuals with Type 2 diabetes was the main goal of the study. According to the findings, regular users of CGM experience better glycaemic control and less hypoglycaemia. However, socioeconomic hurdles and usability issues still exist, especially for people with little financial resources or poor levels of digital literacy. Overall, participants found CGM systems to be somewhat usable, while several needed help. The study also demonstrated that carer involvement, user training, and system interface design were strongly associated with efficacy and engagement.

5.3 Contributions of the Research

By concentrating on an underrepresented demographic—elderly CGM users—this study adds to the expanding body of knowledge on remote patient monitoring. It shows the ways in which socioeconomic and support-related factors impact participation and broadens our awareness of the usability issues unique to this group. Additionally, it offers practical advice on how to enhance the development and application of CGM systems for legislators, healthcare professionals, and device manufacturers. Lastly, the study provides a methodology that takes contextual dependencies and user experience into account when assessing CGM interventions beyond clinical measurements.

5.4 Limitations of the research

This study's dependence on self-reported data from an online survey is one of its main limitations, since it may introduce response bias and compromise the validity of the results. Results may be impacted by participant interpretations of the questions or recollection mistakes, particularly in older respondents who are experiencing cognitive loss. Furthermore, the study's demographic focus and sample size could restrict its applicability to larger groups. The lack of longitudinal data limits our understanding of the long-term efficacy of CGM. Lastly, although quantitative approaches yielded useful statistical insights, the absence of qualitative data prevented a more thorough investigation of user experiences, emotional reactions, and contextual obstacles to the adoption and use of CGM systems.

5.5 Recommendations

In light of these findings, several suggestions are made to enhance the design, deployment, and governmental support of CGM systems for senior citizens. These can be divided into three groups: future research, system design, and practice.

5.5.1 Recommendations for Practice

Ongoing Training and Education

Geriatric users need sporadic sessions about CGM usage fundamentals, which should be adapted to their specific needs. Users need to learn how to read glucose trends and operate device alarms, and perform accurate device calibrations. Gao et al. (2024) recommend delivering refresher courses through both face-to-face and digital platforms to help senior patients develop confidence while retaining learning over time.

Incorporation of Carer Support

The CGM management process should include family members and carers as part of the system, especially when someone first adopts the technology. Standards of ethical practice need to maintain both patient self-governance and consent authorization (Ahn, 2024).

Personalized Engagement Plans

Healthcare professionals should build customized CGM engagement strategies that use patient-specific alarm parameters and follow-up sessions based on their technological abilities and mental capacities and life-style practices. The implemented methods would fight alert fatigue while raising the response capabilities.

Collaborative Care Models

Healthcare professionals who deliver care for diabetes patients should create formal collaborations between doctors, nurses, dietitians, and tech coaches to manage CGM use effectively. Medical staff play an essential role in analyzing CGM information properly while including it in complete healthcare strategies.

5.5.2 Recommendations for System and Policy Design

The interfaces of CGM devices require redesign for elderly patients.

The manufacturing industry needs to create interfaces that fit the needs of aging users by adding features like large text, along with touch-based interaction and easy-to-follow menus and voice-controlled system navigation. The research highlighted usability as a frequent obstacle so designers should develop user-capability-based adaptive interfaces (Ajjan et al., 2024).

Increase Accessibility via Subsidies

The government should establish expanded CGM subsidy programs for public healthcare coverage. Wider insurance coverage represents a solution to financial restrictions which keeps essential CGM devices available for people who need them most (Khunti et al., 2024).

Implement Alert Customization Features

The manufacturers of CGM devices need to integrate adjustable alert features into their products so users can determine their notification volume and sound parameters. The recommendation comes with strong evidence from Aleppo (2024) because he identified excessive notifications as a cause of user disengagement.

Introduce Low-Cost CGM Models

CGM technology manufacturers need to create basic CGM devices that have extended sensor durability and simplified visual displays for elderly population groups who live on limited budgets. Essential feature models of CGM devices according to Price et al. (2024) achieve cost effectiveness together with usability benefits.

5.5.3 Recommendations for Future Research

Longitudinal Studies

Additional research must examine the impact of extended CGM use extending between 2 and 5 years to assess changes in user engagement, as well as health outcomes and satisfaction levels. The findings in this research and literature show that short-term benefits are unlikely to continue without sustained long-term support, according to Miller (2022) and Adler et al. (2024).

Cross-Cultural and Socioeconomic Studies

Research investigators should focus on evaluating how cultural beliefs, together with socioeconomic factors and urban-rural environment impact CGM adoption levels. Research by Thakur et al. (2025) shows health technology access discrepancies and behavior patterns so future research needs improvement on this topic.

Behavioral Interventions and Nudges

A growing number of researchers demonstrate interest in using behavioral science-based methods including nudging and peer support networks to enhance CGM device adherence. The evaluation of these tools needs to be conducted through randomized controlled trials that research elderly patient populations.

Technology Integration Research

More research needs to explore the integration of CGM data with other smart health devices like blood pressure monitors and fitness trackers alongside AI platforms for offering detailed predictive healthcare to senior patients.

5.6 Reflections

I now have a better knowledge of how technology, healthcare delivery, and elder patients' lived experiences are related, thanks to this study trip. On a professional level, it helped me better understand the moral and structural issues surrounding the use of health technology. I learned patience, flexibility, and the need of empathy in research from doing this project. Speaking

with participants brought to light that good design incorporates accessibility and dignity in addition to functionality. These realizations will direct my future research and practice. Speaking with senior participants brought to light the delicate balance between cost and care, simplicity and functionality, and freedom and support. My knowledge of medical technology and, more significantly, my admiration for designing with sustainability, accessibility, and empathy in mind have both increased as a result of this dissertation.

My understanding of the complexity of health disparities, particularly among older people, has also grown as a result of the research process. It became evident that unless the social, cognitive, and emotional settings of users are taken into account, digital health innovations cannot be widely successful. Speaking with carers and medical experts also made it clearer to me how important interdisciplinary cooperation is to putting effective health solutions into practice. My academic abilities in data analysis, ethical practice, and critical thinking have improved as a result of this research, which has also strengthened my feeling of social duty. I'm determined to apply these ideas going ahead, especially inclusive design and user-centered thinking, to healthcare research and innovation. My conviction that meaningful technology must be based on human understanding and directed by compassion has been strengthened by this introspective trip.

5.7 Conclusion

This dissertation would be able to successfully answer all the research questions, and this was through the establishment of the fact that Continuous Glucose Monitoring (CGM) systems can play a major role in enhancing glycaemic control and self-management in elderly diabetic patients with Type 2 Diabetes. Yet the usability challenges, level of digital literacy, cost barriers, and need for the caregivers' support all influence adoption and long-term engagement. Following a rigorous literature review of academic, practitioner, and industry views, this study found key gaps, especially a lack of senior-friendly design and long-term user engagement strategies.

The application of the research purpose was well aligned to a strong quantitative research method involving stratified random sampling, inferential statistics, thus the credibility of findings was assured. Practical recommendations for enhancing CGM design and delivery based on the lived experiences of the elderly constitute the integrated contributions of the study.

These lessons apply to all healthcare technology sectors and are contemporary with more general debates on health equity and inclusive innovation.

This dissertation both informs theory and practice by setting the study within the larger context of an aging society and increasing needs for remote care. It helps in the promotion of empathic, user-friendly health technology design. The results are of not only relevance to the device developers and clinicians, but they can also be of interest to the policymakers who would like to make the remote healthcare inclusive and sustainable.

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APPENDIX A: QUESTIONNAIRE

Questions used for your data collection method are the following:

Please indicate who is completing this survey:

- Patient
- Care giver
- Family member
- Health care provider
- Other:

What is age of the group?

- 65-70
- 70-75
- 75+

What is the duration of your Type 2 diabetes diagnosis?

- Less than 5 years
- 5-10 years
- More than 10 years

In the past month, how often have you engaged in the following lifestyle activities?

- Consumed a balanced diet (fruits, vegetables, whole grains)
- Consumed sugary or processed foods
- Engaged in physical exercise (walking, yoga, gym, etc.)
- Consumed alcohol
- Monitored carbohydrate intake for diabetes management
- Followed a prescribed meal plan by a healthcare professional
- Consumed a balanced diet (fruits, vegetables, whole grains)
- Consumed sugary or processed foods
- Engaged in physical exercise (walking, yoga, gym, etc.)
- Consumed alcohol
- Monitored carbohydrate intake for diabetes management

- Followed a prescribed meal plan by a healthcare professional

Have you ever used a Continuous Glucose Monitor (CGM)?

- Yes
- No

How long have you been using the CGM system?

- Less than 3 months
- 3-6 months
- 6-12 months
- More than 1 year

Who helps you manage your diabetes treatment? (Select all that apply.)

- I handle it myself
- A family member or caregiver
- Healthcare provider
- Other (please indicate)

How simple is it for you to insert and remove the CGM sensor?

- Easy
- Moderately easy
- Intermediate
- Difficult

How would you rank the accessibility of the screen or app on your CGM device?

- Clear and simple to read
- Somewhat clear
- Neutral
- Difficult to read
- Very hard to read.

How user-friendly is your CGM system's interface?

- Excellent user-friendliness.

- Somewhat user-friendly.
- Neutral
- Somewhat tough to use.
- Very tough to use.

Do you experience difficulties interpreting the data provided by your CGM system?

- Never
- Rarely
- Sometimes
- Often
- Always

How often do you use your CGM to monitor your glucose levels?

- Daily
- Weekly
- Rarely
- Never

How often do you reply to CGM alerts and notifications?

- Always.
- Mostly
- Occasionally
- Rarely
- Never

What elements inspire you to keep using your CGM system?

- Helps me manage my blood sugar
- Makes me feel safer
- Fewer finger pricks
- Doctor or caregiver recommends it
- Easy to use
- Family or caregiver helps me
- Other

What obstacles keep you from constantly utilizing your CGM system?

- Trouble understanding how to use it
- Device is uncomfortable to wear
- Hard to read or see the screen
- Forget to use or check it
- Cost or insurance issues
- Technical problems (e.g., Bluetooth, phone connection)
- Don’t have help from a caregiver or family
- Don’t trust the readings
- Other

Since using a CGM, have you noticed improvements in your blood sugar control?

- Yes, significant improvement
- Yes, some improvement
- No change
- No, my blood sugar control has worsened

Has the CGM system helped reduce your hypoglycaemic episodes?

- Yes, significantly
- Yes, somewhat
- No change
- No, I still experience frequent episodes
- Not applicable

Has your diabetes treatment improved as a result of sharing CGM data with medical professionals?

- Absolutely, notably
- Yes, slightly
- No change
- It hasn't been helpful, sorry.
- I keep my CGM data private from medical professionals.

How has the CGM system affected the way you manage your diabetes?

- Check my blood sugar more often
- Make better choices with food and activity
- Catch high or low sugar levels sooner
- Feel more confident managing my diabetes
- Rely less on fingerstick tests
- Talk more with my doctor or caregiver about my readings
- It hasn't changed much for me
- Other

Regarding your CGM system, what modifications or enhancements would you recommend?

- Easier to use or understand
- More comfortable to wear
- Longer sensor life
- Better accuracy of readings
- Larger or clearer display
- Fewer technical issues (e.g., connection problems)
- Lower cost or better insurance coverage
- More support or training for how to use it
- Other

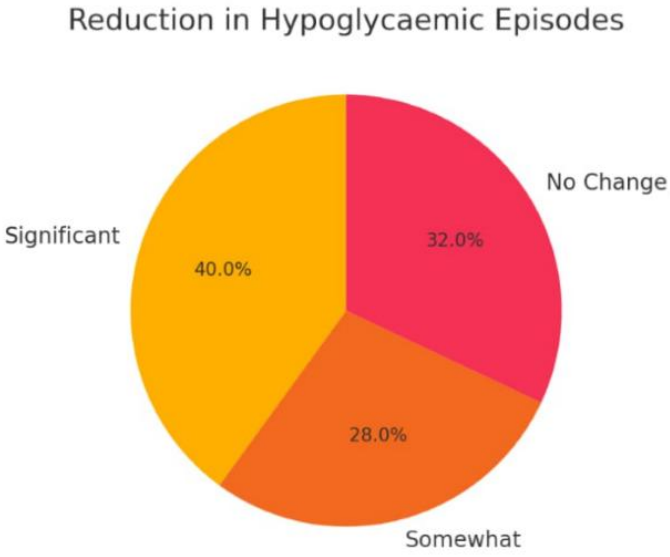
Do you believe that receiving more instruction or assistance would improve your ability to operate the CGM system?

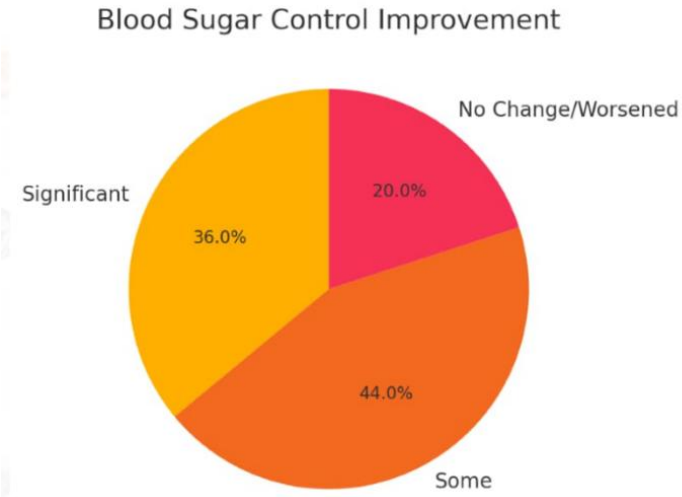
- Yes
- No

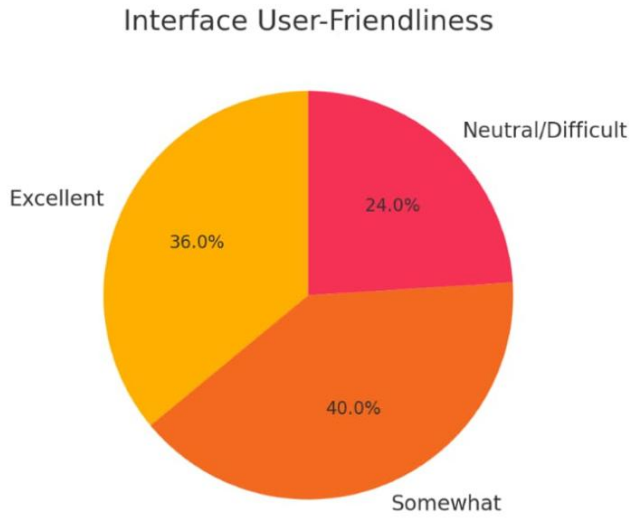
Are there any other issues related to CGM usability, engagement, or effectiveness that you feel are important but were not covered in this survey?

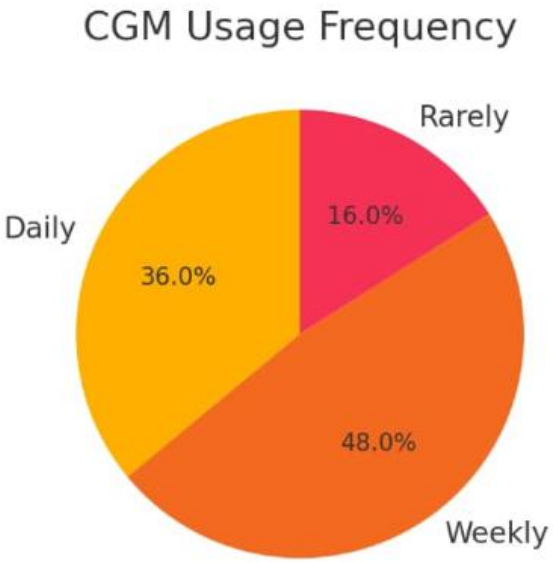
APPENDIX B: PIE CHART

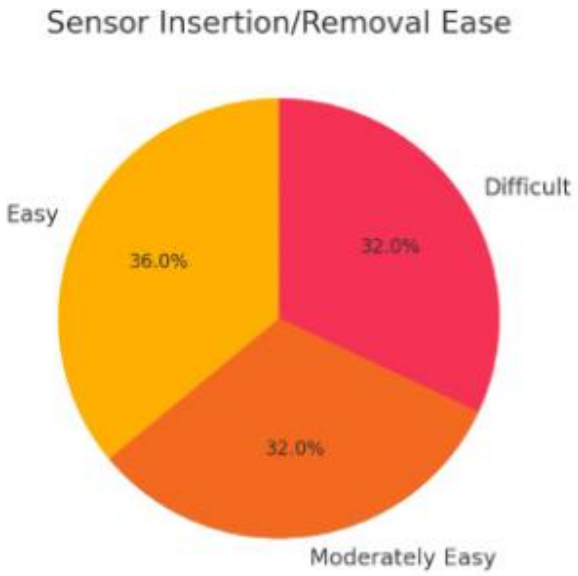
Content, which is supplemental, rather than core, to your principal arguments (such as organization charts).

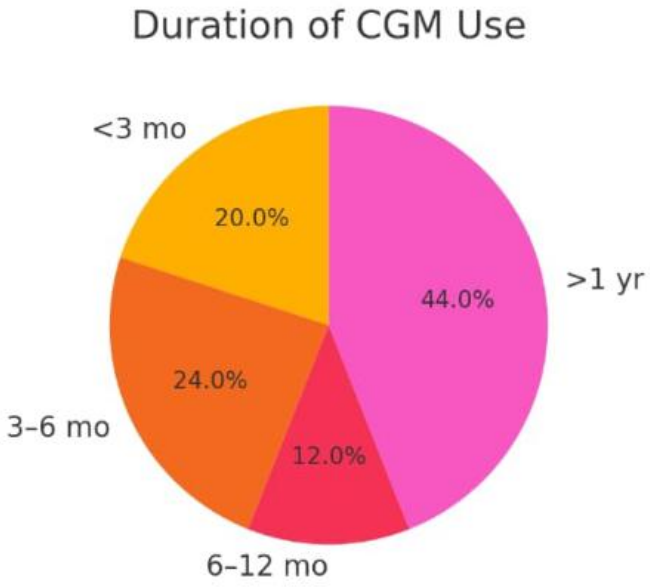


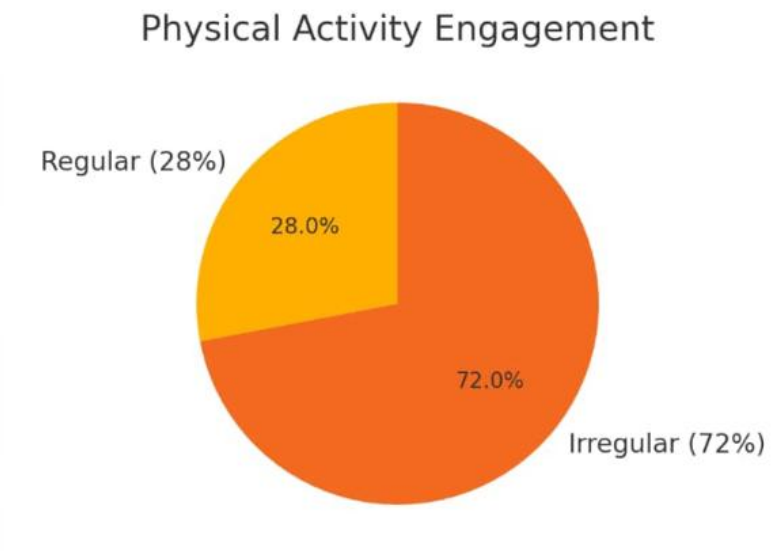


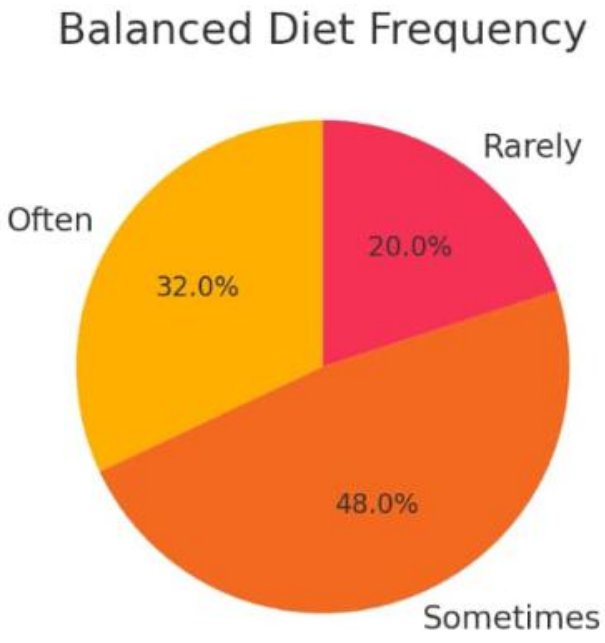

Interface User-Friendliness
Neutral/Difficult
24.0%
Excellent
36.0%
40.0%
Somewhat

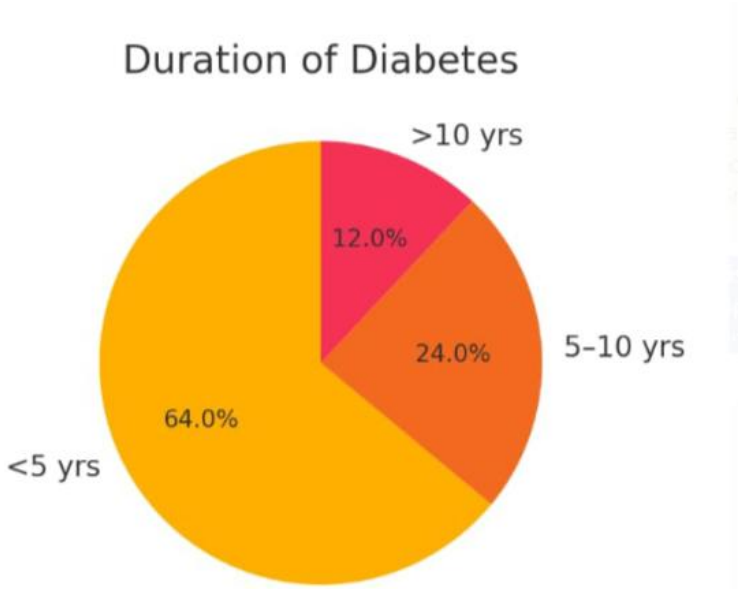

CGM Usage Frequency
Rarely
16.0%
Daily
36.0%
48.0%
Weekly

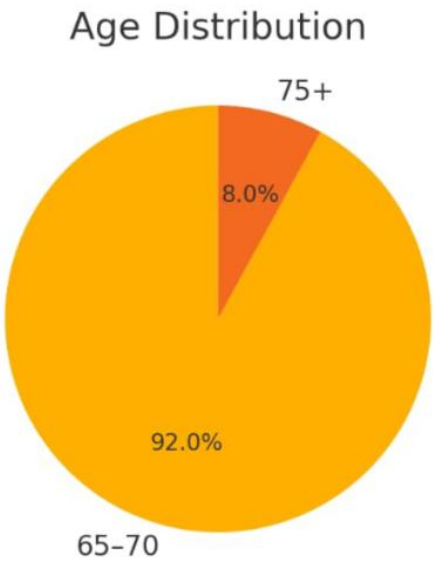

Sensor Insertion/Removal Ease
Easy
36.0%
Difficult
32.0%
32.0%
Moderately Easy


Duration of CGM Use
<3 mo
20.0%
>1 yr
44.0%
24.0%
3–6 mo
12.0%
6–12 mo


Physical Activity Engagement
Regular (28%)
28.0%
72.0%
Irregular (72%)


Balanced Diet Frequency
Rarely
Often
20.0%
32.0%
48.0%
Sometimes


Duration of Diabetes
>10 yrs
12.0%
24.0%
5–10 yrs
64.0%
<5 yrs


Age Distribution
75+
8.0%
92.0%
65–70

APPENDIX C: SPREADSHEET

Neutral	• Neutral	Often	Rarely	Rarely	Doctor or caregiver recommends it	Technical problems (e.g., Bluetooth, phone •	Yes, some improvement	No change	I keep my CGM data private from medical pr	Catch high
Clear and simple to read	• Somewhat user-friendly.	Rarely	Weekly	Always.	Makes me feel safer	Hard to read or see the screen	Yes, some improvement	Yes, significantly	Absolutely, notably	Make bett
Clear and simple to read	• Somewhat user-friendly.	Sometimes	Rarely	Mostly	Easy to use	Forget to use or check it	Yes, some improvement	Yes, significantly	Yes, slightly	Make bett
Somewhat clear	• Neutral	Sometimes	Weekly	Occasionally	Makes me feel safer	Hard to read or see the screen	Yes, some improvement	Yes, somewhat	Yes, slightly	Catch high
Somewhat clear	• Somewhat user-friendly.	Sometimes	Weekly	Occasionally	Makes me feel safer	Cost or insurance issues	Yes, some improvement	Yes, somewhat	No change	Make bett
Somewhat clear	• Somewhat user-friendly.	Rarely	Daily	Always.	Fewer finger pricks	Device is uncomfortable to wear	Yes, some improvement	Yes, somewhat	Yes, slightly	Make bett
Clear and simple to read	• Excellent user-friendliness.	Rarely	Daily	Mostly	Helps me manage my blood sugar	Cost or insurance issues	Yes, some improvement	Yes, significantly	Yes, slightly	Check my
Clear and simple to read	• Excellent user-friendliness.	Rarely	Daily	Never	Easy to use	Cost or insurance issues	Yes, significant improvement	Yes, significantly	Absolutely, notably	Check my
Neutral	• Neutral	Sometimes	Rarely	Rarely	Doctor or caregiver recommends it	Other	Yes, some improvement	Yes, somewhat	Yes, slightly	Other
Somewhat clear	• Somewhat user-friendly.	Rarely	Weekly	Rarely	Makes me feel safer	Don't have help from a caregiver or family	Yes, significant improvement	Yes, significantly	Absolutely, notably	Feel more
Neutral	• Somewhat user-friendly.	Sometimes	Weekly	Mostly	Easy to use	Technical problems (e.g., Bluetooth, phone •	Yes, some improvement	Yes, somewhat	Yes, slightly	Make bett
Clear and simple to read	• Excellent user-friendliness.	Rarely	Weekly	Always.	Helps me manage my blood sugar	Cost or insurance issues	Yes, significant improvement	Yes, significantly	Yes, slightly	Check my
Clear and simple to read	• Somewhat user-friendly.	Never	Weekly	Rarely	Helps me manage my blood sugar	Forget to use or check it	Yes, some improvement	Yes, somewhat	Absolutely, notably	Check my
Clear and simple to read	• Somewhat user-friendly.	Rarely	Daily	Mostly	Makes me feel safer	Cost or insurance issues	Yes, significant improvement	Yes, somewhat	Yes, slightly	Feel more
Somewhat clear	• Neutral	Rarely	Weekly	Mostly	Helps me manage my blood sugar	Cost or insurance issues	Yes, significant improvement	Yes, significantly	Yes, slightly	Check my
Somewhat clear	• Somewhat user-friendly.	Rarely	Weekly	Occasionally	Fewer finger pricks	Device is uncomfortable to wear	Yes, some improvement	Yes, somewhat	Yes, slightly	Make bett
Clear and simple to read	• Somewhat user-friendly.	Rarely	Weekly	Mostly	Helps me manage my blood sugar	Technical problems (e.g., Bluetooth, phone •	Yes, significant improvement	Yes, somewhat	Yes, slightly	Check my
Somewhat clear	• Somewhat user-friendly.	Sometimes	Weekly	Occasionally	Doctor or caregiver recommends it	Forget to use or check it	Yes, some improvement	Yes, somewhat	Yes, slightly	Other
Difficult to read	• Somewhat tough to use.	Sometimes	Weekly	Occasionally	Doctor or caregiver recommends it	Forget to use or check it	Yes, some improvement	No change	Yes, slightly	Talk more
Somewhat clear	• Somewhat user-friendly.	Sometimes	Daily	Mostly	Fewer finger pricks	Cost or insurance issues	Yes, some improvement	Yes, somewhat	Yes, slightly	Catch high
Neutral	• Somewhat user-friendly.	Never	Rarely	Occasionally	Fewer finger pricks	Technical problems (e.g., Bluetooth, phone •	Yes, significant improvement	Yes, significantly	Yes, slightly	Catch high
Somewhat clear	• Excellent user-friendliness.	Rarely	Weekly	Rarely	Helps me manage my blood sugar	Hard to read or see the screen	Yes, some improvement	Yes, significantly	It hasn't been helpful, sorry.	Make bett
Clear and simple to read	• Excellent user-friendliness.	Rarely	Weekly	Occasionally	Helps me manage my blood sugar	Don't have help from a caregiver or family	Yes, significant improvement	Yes, significantly	Absolutely, notably	Make bett
Neutral	• Somewhat user-friendly.	Rarely	Daily	Occasionally	Doctor or caregiver recommends it	Technical problems (e.g., Bluetooth, phone •	Yes, some improvement	Yes, somewhat	It hasn't been helpful, sorry.	Feel more
Clear and simple to read	• Somewhat user-friendly.	Rarely	Weekly	Rarely	Makes me feel safer	Don't trust the readings	No change	Yes, significantly	Yes, slightly	Talk more
Clear and simple to read	• Excellent user-friendliness.	Never	Weekly	Mostly	Helps me manage my blood sugar	Forget to use or check it	Yes, some improvement	Yes, significantly	Absolutely, notably	Make bett
Clear and simple to read	• Excellent user-friendliness.	Never	Rarely	Rarely	Easy to use	Device is uncomfortable to wear	Yes, some improvement	Yes, somewhat	Absolutely, notably	Feel more
Somewhat clear	• Excellent user-friendliness.	Never	Daily	Always.	Helps me manage my blood sugar	Device is uncomfortable to wear	Yes, some improvement	Yes, somewhat	Absolutely, notably	Catch high
Clear and simple to read	• Excellent user-friendliness.	Rarely	Weekly	Occasionally	Helps me manage my blood sugar	Forget to use or check it	Yes, some improvement	Yes, significantly	Absolutely, notably	Feel more
Neutral	• Neutral	Sometimes	Weekly	Occasionally	Helps me manage my blood sugar	Forget to use or check it	Yes, some improvement	Yes, somewhat	Yes, slightly	Catch high
Clear and simple to read	• Somewhat user-friendly.	Never	Rarely	Occasionally	Fewer finger pricks	Hard to read or see the screen	No, my blood sugar control has worsened	No change	I keep my CGM data private from medical pr	It hasn't ch
Neutral	• Neutral	Rarely	Weekly	Mostly	Makes me feel safer	Forget to use or check it	Yes, some improvement	Yes, somewhat	Yes, slightly	Make bett
Neutral	• Somewhat user-friendly.	Sometimes	Weekly	Occasionally	Helps me manage my blood sugar	Device is uncomfortable to wear	Yes, significant improvement	Yes, significantly	Absolutely, notably	Catch high
Clear and simple to read	• Excellent user-friendliness.	Never	Weekly	Mostly	Helps me manage my blood sugar	Trouble understanding how to use it	Yes, significant improvement	Yes, significantly	Yes, slightly	Make bett
Neutral	• Neutral	Sometimes	Weekly	Occasionally	Family or caregiver helps me	Forget to use or check it	No change	No change	No change	Catch high
Clear and simple to read	• Excellent user-friendliness.	Never	Daily	Always.	Helps me manage my blood sugar	Trouble understanding how to use it	Yes, significant improvement	Yes, significantly	Absolutely, notably	Check my
Somewhat clear	• Excellent user-friendliness.	Never	Daily	Mostly	Helps me manage my blood sugar	Trouble understanding how to use it	Yes, significant improvement	Yes, significantly	Absolutely, notably	Check my
Somewhat clear	• Somewhat user-friendly.	Rarely	Weekly	Occasionally	Fewer finger pricks	Device is uncomfortable to wear	Yes, some improvement	Yes, somewhat	Yes, slightly	Feel more
Somewhat clear	• Somewhat user-friendly.	Sometimes	Weekly	Mostly	Fewer finger pricks	Cost or insurance issues	Yes, significant improvement	Yes, somewhat	Absolutely, notably	Make bett

Less than 5 years	Never, Often	Rarely	Rarely	Never	Often	Often	No	Less than 3 months	Healthcare provider
Less than 5 years	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Yes	Less than 3 months	I handle it myself
Less than 5 years	Never	Never	Rarely	Rarely	Rarely	Never	Yes	3-6 months	I handle it myself
5-10 years	Never	Rarely	Sometimes	Rarely	Sometimes	Sometimes	Yes	3-6 months	A family member or caregiver
5-10 years	Often	Often	Sometimes	Never	Sometimes	Never	Yes	More than 1 year	I handle it myself
Less than 5 years	Sometimes	Sometimes	Sometimes	Sometimes	Sometimes	Sometimes	Yes	Less than 3 months	I handle it myself
5-10 years	Sometimes	Never	Sometimes	Never	Sometimes	Sometimes	Yes	More than 1 year	I handle it myself, Healthcare provider
Less than 5 years	Rarely	Rarely	Rarely	Rarely	Sometimes	Never	No	Less than 3 months	I handle it myself
Less than 5 years	Sometimes	Rarely	Sometimes	Never	Rarely	Never	Yes	3-6 months	Other (please indicate)
More than 10 years	Rarely	Sometimes	Rarely	Rarely	Rarely	Often	Yes	More than 1 year	Healthcare provider
5-10 years	Rarely	Sometimes	Sometimes	Never	Rarely	Rarely	Yes	Less than 3 months	Healthcare provider
Less than 5 years	Rarely	Sometimes	Sometimes	Rarely	Rarely	Rarely	No	3-6 months	I handle it myself
More than 10 years	Sometimes	Rarely	Rarely	Sometimes, Often	Rarely	Rarely	Yes	More than 1 year	I handle it myself
Less than 5 years	Sometimes	Sometimes	Rarely	Sometimes	Sometimes	Sometimes	No	Less than 3 months	I handle it myself
Less than 5 years	Often	Rarely	Sometimes	Never	Sometimes	Often	Yes	3-6 months	Healthcare provider
Less than 5 years	Sometimes	Rarely	Rarely	Sometimes	Sometimes	Sometimes	Yes	Less than 3 months	I handle it myself
Less than 5 years	Sometimes	Sometimes	Often	Never	Sometimes	Never	Yes	3-6 months	I handle it myself
Less than 5 years	Rarely	Rarely	Rarely	Sometimes	Never, Sometimes	Never	Yes	Less than 3 months	I handle it myself
Less than 5 years	Rarely	Rarely	Sometimes	Sometimes	Rarely	Rarely	Yes	Less than 3 months	I handle it myself
Less than 5 years	Sometimes	Sometimes	Sometimes	Sometimes	Sometimes	Sometimes	Yes	3-6 months	A family member or caregiver
5-10 years	Never, Rarely, Sometimes, Often	Never, Rarely, Sometimes, Often	Never, Rarely, Sometimes, Often	Never, Rarely, Sometimes, Often	Never, Rarely, Sometimes, Often	Never, Rarely, Sometimes, Often	Yes	3-6 months	Healthcare provider
Less than 5 years	Never	Never	Rarely	Never	Sometimes	Rarely	Yes	Less than 3 months	A family member or caregiver
Less than 5 years	Often	Sometimes	Sometimes	Rarely	Sometimes	Often	Yes	More than 1 year	Healthcare provider
5-10 years	Sometimes	Rarely	Never	Sometimes	Rarely	Rarely	Yes	6-12 months	A family member or caregiver
Less than 5 years	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Yes	3-6 months	I handle it myself
Less than 5 years	Sometimes	Never	Sometimes	Rarely	Sometimes	Sometimes	No	Less than 3 months	I handle it myself
Less than 5 years	Rarely	Often	Rarely	Never	Never	Never	No	Less than 3 months	I handle it myself
Less than 5 years	Rarely	Sometimes	Often	Sometimes	Rarely	Sometimes	No	3-6 months	I handle it myself
5-10 years	Sometimes	Sometimes	Sometimes	Sometimes	Sometimes	Never	Yes	3-6 months	I handle it myself
Less than 5 years	Sometimes	Sometimes	Sometimes	Sometimes	Sometimes	Sometimes	Yes	3-6 months	I handle it myself
5-10 years	Often	Often	Often	Often	Often	Often	No	Less than 3 months	Other (please indicate)
Less than 5 years	Sometimes	Sometimes	Sometimes	Never	Rarely	Sometimes	Yes	3-6 months	A family member or caregiver
Less than 5 years	Rarely	Sometimes	Often	Sometimes	Sometimes	Often	Sometimes	Yes	More than 1 year	Healthcare provider
Less than 5 years	Never	Rarely	Rarely	Rarely	Rarely, Sometimes	Sometimes	Yes	3-6 months	Other (please indicate)
Less than 5 years	Sometimes	Rarely	Sometimes	Rarely	Sometimes	Rarely	Yes	Less than 3 months	I handle it myself
Less than 5 years	Rarely	Never	Rarely	Never	Rarely	Rarely	Yes	Less than 3 months	I handle it myself
Less than 5 years	Rarely	Never	Rarely	Never	Never	Never	Yes	Less than 3 months	I handle it myself
Less than 5 years	Sometimes	Rarely	Sometimes	Sometimes	Rarely	Sometimes	Yes	More than 1 year	Healthcare provider
5-10 years	Never	Rarely	Sometimes	Rarely	Never	Sometimes	Yes	3-6 months	A family member or caregiver

APPENDIX D: ETHICAL FORM

Material related to ethical research (such as, ethics application and declaration form, plus consent, if applicable).

Ethics Application & Declaration Form

DISSERTATION TITLE: Evaluating the usability, engagement, and effectiveness of continuous glucose monitoring (CGM) systems in remote patient monitoring systems in elderly patients with type 2 diabetes.

RESEARCHER'S NAME: Anu Chittilappilly Wilson

PROGRAMME OF STUDY: MSc in Medical device technology and business

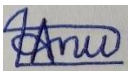
SUPERVISOR'S NAME: Sue Mulhall

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: 28 - 3 - 2025

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

For Supervisor:

Ethics Committee Approval Required: Yes ☐ No ☐

SUPERVISOR SIGNATURE: Dr. Sue Mulhall DATE: **2nd April 2025**

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 and objectives of research

The purpose of this study is to assess how well Continuous Glucose Monitoring (CGM) devices work for older patients with Type 2 diabetes in terms of usability, engagement, and effectiveness. The study looks into the health outcomes, adherence rates, and user experiences related to CGM technology. Among the objectives are:

Evaluate the Elderly Patients with Type 2 Diabetes' Usability of CGM Systems:

Examine CGM systems' usability, interface design, and user satisfaction while taking age-related issues such as diminished dexterity, eye problems, and cognitive limits into account.

Assess Elderly Patients' Levels of Engagement with CGM Systems:

Analyse how frequently CGM devices are used, how well monitoring procedures are followed, and what motivates users to continue using them.

Assess the Remote Management Effectiveness of CGM Systems for Type 2 Diabetes:

Examine how CGM devices affect clinical outcomes in distant care settings, such as glycaemic control, preventing hypoglycaemia, and general health management.

Determine the difficulties and impediments to older patients' use of CGM systems:

Examine the psychological, economic, and technological obstacles influencing older patients with type 2 diabetes adoption and continued use of CGM.

Make suggestions for improving the CGM systems' usability and engagement:

Make recommendations for design changes, instructional initiatives, and support tactics based on study findings to increase the geriatric CGM systems' usability and engagement.

1.2 Research methodology:

This study adheres to a positivist research ethic, emphasizing objective data collecting and statistical analysis to provide quantitative findings. A quantitative research methodology is used, gathering standardized responses from a sizable sample through the use of structured questionnaires. This guarantees that the results are dependable, broadly applicable, and supported by data. Researchers can collect data in a condensed amount of time by using a nonprobability convenience sampling approach, which is accessible and efficient. Using structured questionnaires improves the study's validity by making it easier to evaluate patterns and correlations methodically. This methodological technique guarantees a solid analysis that is in line with the goals of the study.

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

[Only fill in this section if you answered YES to ANY of the questions in Section 3. For example, if you answered yes to including participants who are not fluent in English, you might put forward a plan that offers your survey in two languages to take this into account. Another example could be a study where the researcher wants to include information about the care received by children with a long-term condition but it would not be ethical to approach the children directly but it might be acceptable to instead ask parents questions about their child's care. If these plans are acceptable to your supervisor, you may not need to apply for ethical approval from the Ethics Committee].

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. Outline your participant profile and why you have chosen them for this study

To guarantee varied representation among senior CGM users, healthcare professionals, and carers, this study uses a stratified random sample technique. By classifying participants into pertinent subgroups, stratification improves the precision and generalisability of results. In order to reduce sample bias and guarantee that insights accurately represent the perspectives of various stakeholder groups, this approach was used. Fifty volunteers will be chosen in total, taking into account both practicality and the requirement for significant statistical analysis. This method guarantees a thorough assessment of the efficacy, engagement, and usefulness of CGM.

The study aims to enrol three groups: -

- Elderly CGM users (65+) with at least three months of experience. –

- Healthcare providers (endocrinologists, diabetes educators, and primary care doctors familiar with CGM technology). –
- Carers (family members or aides assisting elderly CGM users in diabetes management).

4.2 How do you plan to gain access to/contact/approach your participant(s).

Participants will be approached through a combination of online and offline methods. Online surveys will be distributed via email, social media platforms, and healthcare forums to reach tech-savvy elderly CGM users and healthcare professionals. Offline recruitment will involve collaboration with diabetes clinics, community centres, and senior care facilities, where printed survey copies will be made available. Additionally, caregivers and family members will be encouraged to assist elderly participants in understanding and completing the survey. Ethical considerations, including informed consent, will be prioritized, ensuring that participation remains voluntary and confidential.

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**

Before starting an online survey, respondents will click consent boxes.

Consent forms that have been signed will be gathered for surveys conducted in person.

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.
No: my research study involves an online survey only and/or does not require signed consent

SECTION 6: STORAGE OF DATA

[Please ensure that you are abiding by GDPR and the national Data protection laws https://www.hrb.ie/funding/gdprguidance-for-researchers/gdpr-and-health-research/).

*The student is responsible for storage of data and this will be handed over to the college in an electronic format as part of the thesis submission i.e. primary data and completed ICFs where applicable will be added to the primary data folder on moodle. The rationale is to keep data **as long as it is still useful** and there is an intention to use it further **for research** so if this is not the case then this can be stipulated here and a shorter retention period given.]*

6.1. How will you store the research data and for how long? How will you manage data protection issues?

This study conforms with national data protection legislation and the General Data Protection Regulation (GDPR) to maintain confidentiality. All collected data will be safely saved on an encrypted device and backed up on a passwordprotected cloud system. Data will be kept for five years before being securely erased.

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	N/A
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: 28 – 3 - 2025

APPENDIX D: PARTICIPANT INFORMATION LETTER

GRIFFITH COLLEGE

TEMPLATE - Participant Information Letter

Please pay attention to:

- The **content** of the letter particularly the importance of using plain English.
- The **appearance** of the letter particularly the font and font size used.
- The National Adult Literacy Agency provide useful advice to ensure the letter is suitable for your target audience and is available at www.simplyput.ie.

Evaluating the usability, engagement, and effectiveness of continuous glucose monitoring (CGM) systems in remote patient monitoring systems in elderly patients with type 2 diabetes.

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 Anu Chittilappilly Wilson, and I am a postgraduate researcher at Griffith college Dublin in the MSc in Medical Device Technology and Business.

The purpose of this study is to investigate how well Continuous Glucose Monitors (CGM) work for older consumers in terms of usability, engagement, and efficacy. The goal of the study is to comprehend how older people use CGM technology, the difficulties they encounter, and the possible advantages for managing their diabetes. This study aims to offer insightful information without making any assumptions about the results.

WHAT WOULD TAKE PART INVOLVE?

If you accept to participate, you will be asked to fill out a survey, which will take around 10-15 minutes. The poll asks both multiple-choice and open-ended questions regarding your experience using CGM. Your participation is entirely voluntary, and all replies will be kept strictly secret. No personally identifiable information will be gathered.

WHY HAVE YOU BEEN INVITED TO TAKE PART?

You have been requested to join because you are an aged person using a Continuous Glucose Monitor (CGM), a healthcare professional overseeing CGM users, or a carer aiding senior CGM users. Your views are crucial in evaluating CGM usability, engagement, and efficacy, hence improving diabetes care for older persons.

DO YOU HAVE TO TAKE PART?

- Participation in this study is entirely voluntary.
- Choosing not to participate will have no adverse consequences.
- You have the right to refuse any question or withdraw from the study at any time without explanation.
- If you wish to withdraw, please contact [Anu Chittilappilly Wilson] at [anucwilson95@gmail.com].

WHAT ARE THE POSSIBLE RISKS AND BENEFITS OF TAKING PART?

This study seeks to increase understanding of CGM usability and efficacy among senior users, which might impact future healthcare practices. There are no severe hazards, however some people may feel uncomfortable discussing health issues. All replies will be kept secret, and assistance will be offered as required.

WILL TAKING PART BE CONFIDENTIAL?

All data collected will be kept secret and anonymous. No personally identifying information will be collected, and survey responses will be securely kept with access limited to authorized researchers only.

Confidentiality will only be violated if there is a significant danger of damage to the participant or others, such as concerns about abuse, self-harm, suicide intent, or criminal conduct. In such circumstances, the relevant authorities may be notified.

non-anonymized data, such as signed consent forms, will be securely stored as part of the study process following ethical criteria.

HOW WILL INFORMATION YOU PROVIDE BE STORED AND PROTECTED?

All obtained data will be securely saved on a password-protected computer that is only available to the researcher and academic supervisors. Signed permission forms will be kept securely until my degree is given, following which they will be destroyed.
Survey responses will be anonymized, with all identifiable information removed. The anonymized data will be kept for two years following the conclusion of the study. Under

freedom of information legislation, you have the right to view the information you have submitted at any time.

WHAT WILL HAPPEN TO THE RESULTS OF THE STUDY?

The results of this research will be submitted as part of my Master's dissertation. The finished dissertation will be available at the college library and, if applicable, in an online repository. There are no imminent plans for publishing or conference presentations, but the findings may contribute to future academic discussions about CGM usability among older users.

WHO SHOULD YOU CONTACT FOR FURTHER INFORMATION?

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[THANK YOU]