USER-CENTRED DESIGN OF ADAPTIVE GARMENTS FOR BEDRIDDEN PATIENT

April 2025

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B.Sc. (F.C.Sc.)

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A dissertation submitted in partial fulfilment of the requirement for the degree of Masters of Family and Community Sciences

By

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CERTIFICATE

This is to inform you that the research work presented in this dissertation entitled "**User-centred Design of Adaptive Garments for Bedridden Patient**" in pursuit of partial fulfilment of the Master's Degree in Clothing and Textiles is the original Bonafide work of the student Kashish Panchal.

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ABSTRACT

Clothing plays a fundamental role in human life, providing protection, comfort, and self-expression. However, for bedridden patients, conventional garments often fail to meet essential needs such as ease of movement, accessibility, and hygiene. This study, *User-Centred Design of Adaptive Garments for Bedridden Patients*, addresses the lack of adaptive clothing in government hospitals in Vadodara, where caregivers struggle with dressing and undressing patients due to unsuitable garments.

The research adopts a User-Centred Design (UCD) approach, focusing on the needs of both patients and caregivers. A total of 40 participants (acute bedridden patients and their caregivers) from SSG Hospital and GMERS Medical College were included in the study. Through a mixed-method research design—including surveys, interviews, and wear trials—key challenges such as discomfort, difficulty in dressing, and fabric limitations were identified. To address these issues, six adaptive garment prototypes were developed: three for orthopaedic patients and three for surgical patients. These garments were designed with features such as strategic openings (side and front fastenings), breathable fabrics, minimal seams, and adaptive closures (buttons, tie strings) to enhance both patient comfort and caregiver efficiency.

The final fabric selection consisted of a white and green striped cotton-viscose blend (75 per cent cotton, 25 per cent viscose), chosen for its softness, breathability, durability, and affordability. Wear trials with selected patients and caregivers provided qualitative feedback, confirming improved comfort, ease of dressing, and enhanced medical accessibility. Cost analysis revealed that each garment could be produced for ₹556, making the solution both affordable and scalable for public healthcare settings.

Findings from the study highlight that adaptive garments significantly improve patient well-being and caregiving efficiency. The research recommends further optimization of garment designs for enhanced mobility and durability, the incorporation of antimicrobial and moisture-wicking fabrics for improved hygiene and expanded user trials to refine usability. By developing cost-effective, functional, and patient-friendly adaptive clothing, this study contributes to better healthcare solutions, ultimately improving the quality of life for bedridden patients and reducing the burden on caregivers

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Chapter I
INTRODUCTION

Clothing has been an essential aspect of human civilization, evolving from primitive materials such as fur, leather, grass, and leaves to highly specialized garments tailored for different needs. Beyond its basic function of covering the body and providing protection from environmental elements, clothing serves as a means of self-expression, social acceptance, and comfort. In healthcare settings, particularly for bedridden patients, clothing takes on an even more critical role—offering not just modesty but also accessibility, comfort, and ease of movement. Unfortunately, conventional hospital gowns and standard home-use garments often fail to address these specific needs, resulting in challenges for both patients and caregivers. This gap in functional clothing solutions highlights the necessity of User-Centred Design (UCD) in the development of adaptive garments.

User-Centred Design (UCD) is a design methodology that prioritizes the needs, preferences, and limitations of end users throughout the development process. Unlike conventional design approaches, which focus primarily on aesthetics and standard functionality, UCD ensures that products are developed with direct input from those who will be using them. In the healthcare sector, where patient comfort and caregiver efficiency are critical, UCD becomes even more essential. For acute bedridden patients, clothing is not just a means of covering the body; it serves a functional role in ensuring ease of dressing, preventing discomfort, and maintaining hygiene. Traditional hospital gowns or standard home-use garments often fail to address these specific needs, leading to difficulty in dressing and undressing, lack of mobility support, and an increased risk of skin issues such as pressure sores. By implementing UCD principles in the design of adaptive garments, this research aimed to create clothing solutions that enhance both patient well-being and caregiver efficiency, making daily care routines smoother and less stressful.

Adaptive garments are designed to improve accessibility, ease of wear, and overall comfort, making them essential for individuals with limited mobility or long-term hospitalization needs. Conventional hospital clothing has seemingly neglected the diverse needs of bedridden patients for adjustable, breathable, and soft-textured fabrics. A user-focused design approach allowed for the inclusion of features that directly address common challenges, such as strategically placed fastenings, side openings, and

least seams construction to minimize pressure points and skin irritation. The combination of sensory comfort (fabric softness and breathability) and movement comfort (easy adjustability and caregiver-friendly design) would possibly ensure that these garments are not only functional but also enhance the overall patient experience.

A significant issue identified in this study was the lack of availability of adaptive garments in government hospitals in Vadodara. This gap in accessibility often forced caregivers and families to modify regular clothing or struggle with inappropriate garments, leading to added stress, increased caregiver workload, and decreased patient comfort. Addressing this issue required an approach that considered not just the medical requirements but also the practical aspects of garment usage, ensuring that adaptive clothing was affordable, widely available, and suitable for large-scale implementation in public healthcare facilities.

In order to develop an effective user-centred adaptive garment, this study involved data collection from relevant stakeholders to understand the key challenges in dressing bedridden individuals. Based on these insights, adaptive garment prototypes were developed and subjected to wear trials to evaluate their effectiveness in terms of movement, comfort, sensory experience, and ease of use. Special attention was given to the selection of fabric, garment structure, and fastening mechanisms to ensure that the final product meets the needs of both patients and caregivers.

By integrating comfort, accessibility, and user opinion into the design process, this research aimed to bridge the gap between medical requirements and functional design, ensuring that bedridden patients received practical, comfortable, and dignified clothing. The findings are expected to contribute to the development of cost-effective and accessible adaptive garments, with the potential for implementation in government hospitals and healthcare facilities to improve patient care standards. Ultimately, this study strives to set a precedent for the importance of user-centred innovation in hospital clothing, demonstrating how thoughtful design can lead to better patient outcomes and more efficient caregiving practices.

1.1. Statement of the problem

The study was conducted with the aim to address the inadequacies of conventional clothing for bedridden patients, which often compromised their comfort, mobility, and sense of independence.

Caregivers and healthcare providers also encounter difficulties in managing clothing for bedridden patients, as traditional garments lack features that facilitate easy dressing and undressing. These challenges increased caregiver workload, causing physical strain, and complicated routine patient care, particularly when working around medical equipment.

To bridge this gap, the study explored the development of adaptive garments that integrated accessible design features to enhance patient well-being and improve caregiving efficiency. By prioritizing user-centred design, the research aimed to create functional clothing solutions that supported patient comfort, independence, and dignity while reducing the physical and logistical burdens on caregivers.

1.2. Purpose of the study

Conventional clothing often lacks features that accommodate limited mobility, medical equipment access, and ease of dressing, leading to discomfort, dependency, and increased caregiver burden. This study is an attempt to bridge this gap by designing ergonomic, functionally adaptive garments that incorporate accessible closures, adjustable fits, and fabric choices tailored to the specific needs of temporarily bedridden patients.

By adopting a user-centred design approach, the research prioritizes patient well-being and caregiver efficiency, ensuring that the garments not only enhance quality of life but also align with the practical demands of hospital and home-based care settings. The study contributes to the growing need for inclusive and responsive healthcare apparel, promoting independence, ease of use, and dignified patient care.

1.3.Specific Objectives of the study

1.3.1. To identify specific issues faced by the bedridden patients and their caregivers.

1.3.2. To create garment with features like comfort and accessibility simplifying caregiver's task.

1.3.3. To evaluate the comfort and accessibility of the constructed garment.

1.4.Delimitation of the study

This study was limited to two government hospitals of Vadodara

Designs were made considering the present admitted patients during the research period.

Chapter II

REVIEW OF LITERATURE

The review of literature is a summary of all the reviews from various research literatures related to the current study carried out by a researcher.it helped to discover what was already known about the research problem and what more has to be done.

2.1. Theoretical Review

2.1.1. User-Centred Design

2.1.2. Adaptive Clothing

2.1.3. Comfort for Bedridden patients

2.1.4. Physiological and Psychological Needs of Bedridden Patients

2.1.5. Bedridden patients, types and issues

2.1.6. Caregivers and Challenges

2.2. Research Review

2.2.1. User-Centred Design Approaches for bedridden patients

2.2.2. User-Centred Design Approaches in Healthcare

2.2.3. Clothing practices for special needs

2.2.4. Comfort: Sensory comfort and movement comfort

2.1. Theoretical Review

2.1.1. User Centred Design

User-Centred Design (UCD) is a design approach that focuses on the needs, preferences, and limitations of the end users throughout the development process. It emphasizes involving users in every stage of the design, from initial research to final product testing, ensuring that the final product is tailored to their specific requirements. For adaptive garments designed for bedridden patients, UCD is particularly valuable as it helps create clothing that not only addresses the functional needs of patients but also enhances their comfort, dignity, and overall well-being.

1. Key Principles of User-Centred Design

UCD involves several core principles that are essential when designing adaptive garments for bedridden patients:

- Early and Continuous User Involvement: Engaging patients, caregivers, and healthcare professionals early in the design process helps to gather critical insights about the needs and challenges faced by bedridden patients. Continuous feedback throughout the design cycle ensures that the garment design evolves in response to actual user experiences.

- Understanding the User Context: It is crucial to understand the physical, emotional, and social context in which bedridden patients live. This includes considering the patient's medical conditions, mobility limitations, and the caregiving environment. A comprehensive understanding of these factors enables designers to create garments that meet the specific needs of this user group.
- Iterative Design and Prototyping: The UCD process is iterative, involving multiple cycles of prototyping, testing, and refinement. By creating prototypes and testing them with real users, designers can identify and resolve usability issues early in the design process, leading to more effective and comfortable adaptive garments.
- Accessibility and Usability: Ensuring that the garments are easy to use for both patients and caregivers is critical. This includes designing for different levels of dexterity and mobility, considering the ease of donning and doffing, and integrating features that simplify caregiving tasks such as dressing and hygiene maintenance.

Norman, D. (2013) in his book "The Design of Everyday Things," emphasizes designing products with a deep understanding of the user's needs, capabilities, and preferences. Norman advocates for a design process that prioritizes the user at every stage, ensuring that products are intuitive, easy to use, and aligned with human behavior Norman outlines several principles that constitute good design, all of which revolve around making products more intuitive and user-friendly. His emphasis on usability, discoverability, feedback, and consistency has become foundational in creating intuitive and user-friendly products. By focusing on the user's needs, capabilities, and context, designers can create products that are not only functional and efficient but also enjoyable and satisfying to use.

2.1.2. Adaptive Clothing

Adaptive clothing refers to garments specifically designed to accommodate the unique needs of individuals with disabilities, limited mobility, or other physical challenges. These garments incorporate specialized features that enhance functionality, comfort, and ease of use, making dressing and undressing simpler for both the wearer and their caregivers. Adaptive clothing is particularly beneficial for people who have difficulty with traditional clothing due to conditions like arthritis, spinal cord injuries, muscular dystrophy, cerebral palsy, or any other physical condition that affects mobility or dexterity. Adaptive clothing provides numerous benefits to individuals with disabilities, their caregivers, and healthcare professionalsSome common features of adaptive clothing include Easy Closures, Adjustable Features, Open-Back or Overlap Designs, Accessibility for Medical Device,Enhanced Comfort and Safety

McKinney, E. (2023) in his book "Adaptive Apparel Design" referred to the creation of clothing that was specifically tailored to meet the needs of individuals with disabilities, limited mobility, or other physical challenges. Unlike traditional clothing, adaptive apparel incorporates specialized features

such as easy-to-use fastening, adjustable fit, and materials that accommodate various physical conditions. The goal of adaptive apparel design is to provide individuals with clothing that not only meets their functional needs but also promotes comfort, independence, and self-esteem.

While adaptive apparel design offers numerous benefits, McKinney and Eike also highlight several challenges and considerations that designers must navigate: Balancing Functionality and Aesthetics, Cost and Accessibility, User Diversity.

2.1.3. Comfort for Bedridden patients

Comfort is a fundamental aspect of care for bedridden patients, as prolonged immobility can lead to severe physical discomfort, skin complications, and emotional distress. The inability to change positions frequently puts patients at risk of pressure ulcers, muscle stiffness, and circulation issues. Addressing comfort holistically involves fabric selection, garment design, temperature regulation, and hygiene management to ensure optimal well-being.

Fabric Choice

The selection of appropriate fabric is crucial in maintaining comfort for bedridden patients. Soft, breathable, and hypoallergenic materials such as cotton and bamboo help reduce skin irritation and allow air circulation, preventing excessive sweating and moisture buildup. Moisture-wicking fabrics aid in keeping the skin dry, reducing the risk of infections and pressure sores. Additionally, seamless garments and those with minimal pressure points prevent discomfort caused by extended contact with bedding.

Functional Garment Design

Adaptive clothing should prioritize ease of use and movement for both the patient and caregiver. Key design elements include:

- Open-back designs for effortless dressing and undressing without excessive movement.
- Velcro or magnetic closures instead of traditional buttons and zippers, allowing for quick and easy fastening.
- Loose-fitting and stretchable fabrics to accommodate medical equipment and facilitate unrestricted movement.
- Flat seams and tag-free construction to prevent irritation and discomfort, particularly for patients with sensitive skin.

Temperature Regulation

Maintaining an optimal body temperature is critical, as bedridden patients often have limited ability to adjust their clothing according to environmental conditions. Temperature-regulating fabrics, such

as those with moisture-wicking and thermal insulation properties, help balance body temperature. Layered clothing options allow caregivers to adjust garments easily based on changes in room temperature or patient needs, ensuring continued comfort without frequent repositioning.

Psychological and Emotional Well-Being

Comfort extends beyond physical factors to psychological well-being. Wearing aesthetically pleasing, well-fitted, and dignified clothing can improve a patient's self-esteem and emotional state. Providing choices in clothing fosters a sense of autonomy and normalcy, which is especially important for long-term bedridden patients who may feel a loss of independence. Personalized or familiar clothing can offer a sense of identity and belonging, contributing positively to mental health.

Hygiene and Maintenance

Hygiene plays a crucial role in the comfort of bedridden patients. Clothing should be easy to clean, durable, and resistant to bacterial growth. Fabrics with antimicrobial treatments can help prevent infections, especially for patients with compromised immune systems. Quick-drying materials and easy-wash properties ensure cleanliness while reducing the burden on caregivers. Adaptive clothing designed with detachable or easy-access panels simplifies the changing process, ensuring that hygiene needs are met without excessive patient movement.

Kolcaba's Theory (2003) of Comfort defines comfort as a fundamental need for relief, ease, or transcendence in stressful healthcare situations. It emphasizes that comfort enhances health-seeking behaviors for patients, families, and caregivers. The theory integrates physical, psychospiritual, social, and environmental aspects to reduce stress and improve patient outcomes. For bedridden patients, Kolcaba's theory highlights the importance of providing physical relief through proper positioning, pressure ulcer prevention, and adaptive clothing that minimizes discomfort. Psychospiritual comfort can be achieved by fostering dignity and emotional support, while social comfort involves maintaining connections with family and caregivers. Environmental comfort focuses on creating a soothing and hygienic setting.

Florence Nightingale, a pioneer in nursing, also recognized the importance of comfort in patient care. She highlighted the role of the environment, cleanliness, and compassionate care in ensuring patient well-being. Jean Watson, through her Theory of Human Care, emphasized the holistic nature of comfort, advocating for emotional and spiritual support as essential elements of healthcare.

Originally derived from Watson's Theory of Human Care, Kolcaba's theory has been widely tested in studies on various patient groups, including those with chronic illnesses and end-of-life care needs. Its application to bedridden patients reinforces the need for holistic, patient-centred interventions that promote dignity, reduce suffering, and improve overall well-being.

2.1.4. Physiological and Psychological Needs of Bedridden Patients

Bedridden patients have both physiological and psychological needs that must be addressed to ensure their well-being. Physiologically, they require proper positioning, skin care, and pressure ulcer prevention to avoid complications like bedsores and muscle atrophy. Adequate nutrition, hydration, and pain management are also essential to maintain bodily functions and comfort. Psychologically, bedridden patients often face isolation, anxiety, and depression, making emotional support, social interaction, and cognitive engagement crucial. Providing a comfortable environment, compassionate care, and mental stimulation can significantly improve their quality of life.

Townsend and Morgan (2017) in "**Psychiatric Mental Health Nursing: Concepts of Care in Evidence-Based Practice"** patient care should incorporate evidence-based strategies to mitigate the physical and mental health challenges associated with prolonged immobility. Physiological needs form the foundation of patient care and include fundamental aspects such as nutrition, hydration, skin integrity, and respiratory health. Townsend and Morgan (2017) emphasize the importance of preventing pressure ulcers through frequent repositioning and the use of specialized bedding to maintain skin integrity. Additionally, proper nutrition and hydration are essential to prevent malnutrition, dehydration, and associated complications such as muscle atrophy and weakened immunity. Maintaining respiratory function is also critical, as prolonged immobility increases the risk of pneumonia and other respiratory issues. Proper breathing exercises and physiotherapy interventions help minimize these risks (Townsend & Morgan, 2017).

The psychological well-being of bedridden patients is equally crucial, as they often face challenges such as depression, anxiety, social isolation, and cognitive decline. Townsend and Morgan (2017) highlight the impact of limited mobility on mental health, noting that a lack of social engagement can lead to emotional distress and a sense of helplessness. Interventions such as counselling, cognitive stimulation, and structured social interactions can alleviate these issues. Moreover, fostering a sense of independence through adaptive tools and involving patients in decision-making can improve their psychological state

2.1.5. Types and Issues of Bedridden Patients

Bedridden patients are individuals confined to bed for extended periods due to medical, physical, or psychological reasons. Prolonged immobility poses a host of challenges for both the patient and their caregivers, ranging from physical complications to emotional and social impacts. This theoretical review delves into the various types of bedridden patients and the common issues they face, shedding light on the complexities of their care and management.1. 2.1.5.1. Types of Bedridden Patients:

- Acute Bedridden Patients: These patients are temporarily bedridden due to an acute illness, surgery, or injury (e.g., fractures, post-operative recovery). With proper treatment and rehabilitation, they often regain mobility.

- Geriatric Bedridden Patients: Patients in this category suffer from long-term conditions like advanced cancer, stroke, multiple sclerosis, or severe dementia. They may be bedridden for months or even years.

- Terminally Ill Patients: Individuals in the late stages of terminal illnesses such as cancer or organ failure are often confined to bed due to extreme weakness and inability to perform daily activities. Palliative care is often needed.

The Handbook of Clinical Nursing: Medical-Surgical Nursing (2017) is a comprehensive resource designed for recently graduated registered nurses and those transitioning to medical-surgical units. It offers essential information on common clinical problems and issues encountered in nursing practice today. This handbook provides fundamental coverage of various clinical topics pertinent to nurses working in medical-surgical units. It serves as a valuable reference for understanding patient care, including considerations for bedridden patients. While it may not explicitly define "acute bedridden patients," it offers insights into managing patients with acute conditions that may lead to temporary immobility.

Erikson,E. and Erikson, J. (1 997) in their book "**The Life Cycle Completed***"* does not specifically categorize types of bedridden patients but provides a framework for understanding aging, illness, and end-of-life experiences. The book expands on Erikson's Psychosocial Development Theory, particularly the final stage: Integrity vs. Despair, which is highly relevant to bedridden geriatric and terminally ill patients.

Application to Types of Bedridden Patients:

1. **Geriatric Bedridden Patients**

o Erikson describes aging as a time of reflection, where individuals assess their life's meaning.

o Bedridden elderly patients may experience integrity (a sense of fulfilment) or despair (regret, depression).

o Care should focus on dignity, social interaction, and mental well-being.

2. **Terminally Ill Bedridden Patients**

o Facing mortality, patients confront their psychosocial legacy—how they are remembered.

o Joan Erikson introduced the concept of a "Ninth Stage", where frailty and extreme dependency test an individual's resilience.

o Emotional and spiritual comfort become essential for peaceful end-of-life care.

While Erikson's work does not directly define categories of bedridden patients, his insights help shape psychosocial care approaches for elderly and terminally ill individuals.

2.1.5.2. Issues Faced by Bedridden Patients:

The Handbook of Clinical Nursing: Medical-Surgical Nursing (2017) offers essential information for nurses in medical-surgical settings, delves deeply into the specific issues faced by bedridden patients. However, understanding these challenges is crucial for providing comprehensive care.

Physical Challenges:

I. Pressure Ulcers: Prolonged immobility can lead to pressure ulcers, which are injuries to the skin and underlying tissue resulting from sustained pressure. These ulcers not only cause significant discomfort but also increase the risk of serious infections. Regular repositioning and specialized support surfaces are vital preventive measure.

II. Muscle Atrophy and Contractures: Lack of movement can cause muscles to weaken and shrink, leading to atrophy. Additionally, joints may become stiff, resulting in contractures that limit mobility and cause pain. Implementing passive range-of-motion exercises can help mitigate these effects.

III. Respiratory Complications: Immobility can lead to decreased lung expansion, increasing the risk of pneumonia and other respiratory issues. Encouraging deep-breathing exercises and, when possible, elevating the head of the bed can promote better lung function.

Psychological Challenges:

I. Depression and Anxiety: The loss of independence and social isolation often experienced by bedridden patients can contribute to feelings of depression and anxiety. Providing psychological support and facilitating social interactions are essential components of care.

ii. Cognitive Decline: Limited stimulation and engagement can lead to cognitive deterioration. Incorporating activities that stimulate mental function, such as reading or puzzles, can be beneficial.

Social Challenges:

I. Isolation: Being confined to bed can result in reduced social interactions, leading to feelings of loneliness. Encouraging visits from family and friends, as well as utilizing technology to maintain connections, can help alleviate this issue.

II. Dependence on Caregivers: Relying on others for daily activities can affect a patient's self-esteem and sense of autonomy. Promoting as much independence as possible and involving patients in decision-making can enhance their sense of control.

Addressing these multifaceted challenges requires a holistic approach that combines medical interventions with psychological and social support to enhance the overall quality of life for bedridden patients

2.1.6. Caregivers and Challenges

Caregivers play a crucial role in providing physical, emotional, and sometimes medical support to bedridden patients. Whether family members or professional healthcare providers, caregivers face numerous challenges that can affect both their well-being, and the quality of care provided. This review highlights the main challenges faced by caregivers and the impact on both the patient and caregiver.

Physical Strain: Constantly helping bedridden patients with mobility tasks, such as turning or repositioning to prevent bedsores, can lead to physical exhaustion and musculoskeletal injuries for caregivers.

Emotional and Psychological Stress: Long-term caregiving, especially for patients with chronic or terminal illnesses, can lead to emotional exhaustion or caregiver burnout. This may manifest depression, anxiety, or a sense of helplessness.

Inadequate Training and Resources: Family caregivers, in particular, may lack the medical knowledge and skills required to manage a patient's complex needs, such as administering medication, managing feeding tubes, or dealing with pressure sores

Abbit, L. (2017) in his book *"***The Conscious Caregiver: A Mindful Approach to Caring for Your Loved One Without Losing Yourself***"* provides a comprehensive exploration of the difficulties faced by caregivers and offers strategies to mitigate the associated burdens. She emphasizes a mindful approach to caregiving, advocating for self-care alongside patient care to ensure sustainability and well-being.

One of the primary challenges caregivers encounters is emotional and psychological stress. Abbit highlights that long-term caregiving responsibilities often lead to burnout, anxiety, and depression. The emotional toll can be overwhelming, especially when caregivers prioritize the needs of their loved ones while neglecting their own. This aligns with Kolcaba's Theory of Comfort, which underscores the necessity of maintaining well-being for both caregivers and patients.

Another critical issue is financial strain, as many caregivers face economic hardships due to reduced work hours, increased medical expenses, and lack of adequate support. Abbit stresses the importance of financial planning and seeking available resources to alleviate financial pressures.

Communication difficulties also pose significant challenges in caregiving. Abbit discusses how conflicts may arise between caregivers, family members, and care recipients due to differing expectations and misunderstandings. Effective communication strategies, including active listening and open dialogue, are essential in managing these challenges and ensuring that caregiving responsibilities are shared fairly.

Furthermore, Abbit underscores the importance of self-care and mindfulness techniques in preventing burnout. She advocates for stress management strategies such as meditation, breathing exercises, and setting healthy boundaries to maintain a balance between caregiving duties and personal well-being. By incorporating mindfulness, caregivers can enhance their resilience and provide more effective care without compromising their health.

2.2. Related Research Review:

2.2.1. User Centred Design Approaches for Healthcare

2.2.2. User-Centred Design Approaches for bedridden patients

2.2.3. Clothing practices for special needs

2.2.4. Sensory comfort and movement comfort

Paul, S. (2006) in the study "A Study to Assess the Knowledge on Self Care Abilities Among CVA Patients Attending the Neuro OPD of a Selected Hospital, Bangalore**"** The study assessed the self-care knowledge of 30 cerebrovascular accident (CVA) patients in Bangalore, using a descriptive survey. Results showed an overall knowledge score of 60.76%, with higher understanding in areas like mobility and communication. Knowledge levels were significantly associated with income, media exposure, diet, health status, marital status, duration of illness, and associated diseases, but not with age, sex, or education. The study highlights the need for educational.

De Vito Dabbs, A. et.al (2009) in the study "User-centred design and interactive health technologies for patients**"** Despite the importance of involving patients in the design of health technologies, few guidelines exist for doing so effectively. User-centred design (UCD) is an approach that incorporates end-users throughout the development process to ensure that technologies are easy to use and meet their needs. This paper highlights UCD principles through the development of the Pocket Personal Assistant for Tracking Health (Pocket PATH), an interactive health technology. By involving patients in the design and testing phases, the project enhanced the technology's functionality and usability, increasing its potential to achieve desired health outcomes.

Naves, L. B. (2013) in the study **"**The contribution of fashion design to the development of alternative medical clothing" This research focused on developing paediatric antimicrobial and sustainable clothing for hospital use, specifically for children underwent chemotherapy. The clothing aimed to provide thermoregulation, comfort, and protection against infections like Staphylococcus aureus. Two knit fabrics, 100% cotton and 100% hemp, were treated with antimicrobial agents (Agiene®, Bionyl®, and Chitosan) using different application methods. The best performance was achieved with 100% hemp treated with Chitosan using the pad batch method. Based on these findings, a gown prototype was produced.

Poonia, N. (2020) in the study **"**Adaptive clothing for disabled people Disabilities" depicted that can affect various aspects of life, but physical disabilities specifically impact mobility and dexterity. Adaptive clothing is designed to accommodate these limitations, minimizing joint movement and pain during dressing or undressing. This type of clothing also reduces the need for assistance from caregivers. By offering functional and stylish options, adaptive clothing enhances the quality of life for individuals with physical disabilities**.**

Esmail, A., et.al, (2020) in the study "The role of clothing on participation of persons with a physical disability: A scoping review**"** Depicted how clothing impacted the participation of individuals with physical disabilities, using data from 57 articles and 88 websites. It was found that clothing significantly affects mobility, self-care, and personal factors, and was a key environmental factor influencing overall health and participation. Essential design features for adaptive clothing were highlighted in 49 percent of the articles. The review emphasized the need for future research to explore collaborative approaches across sectors to better address these issues.

Imbesi, S., & Scataglini, S. (2021) in the study "A user centred methodology for the design of smart apparel for older users**"** This paper discussed a user-centred design approach for creating smart garments that monitor physical and physiological functions. The authors proposed a methodology like a simplified quality function deployment tool, focusing on evaluating users' acceptance and preferences. This approach helped designers balance user needs with technological requirements, aiding in the creation of smart apparel that older users are more likely to adopt. The method streamlined the design process by correlating quantitative and qualitative factors to evaluate and compare design solutions.

Clayton, L.(2022) in the study **"**An investigation into adaptive formal clothing available for people with disabilities, with a focus through case studies and design development on men's shirts" The research aimed to create formal shirts tailored for three men with different disabilities and evaluate their impact on usability and accessibility. Surveys and interviews revealed that many people with disabilities struggle to find suitable formal wear, often avoiding events requiring such attire. The adapted shirts, featuring magnets and Velcro, were found to be more comfortable and functional than previous options. Despite improvements, challenges remain in the accessibility, cost, and awareness of adaptive clothing. The study highlights the significant benefits of well-designed adaptive clothing in enhancing comfort and independence for individuals with disabilities.

Pavithra Shen, et al, (2022) in the study "A Study on Comfort Related Properties of Adaptive Clothing" examined the evolution of various disabilities, including mental, locomotor, physical, communicational, emotional, mobility, and situational disabilities. It focused on the impact of physical limitations on clothing needs, particularly for individuals with restricted movement, dexterity, or stamina. As a vital part of society, individuals with physical disabilities faced challenges in mobility,

which adaptive clothing aimed to address. Designed for functionality and ease, adaptive clothing helped reduce joint movement and pain during dressing or bathing, improving overall comfort and accessibility. Clothing practices for special needs

Choudhury, S. **(2024)** in the study **"**Adaptive Clothing for the Elderly of India: Analysis of the Current Market Scenario" Clothing has historically been vital for self-expression, but fashion often focuses on narrow beauty standards, neglecting the needs of the elderly who require adaptive, functional, and stylish apparel. While international brands offer adaptive clothing for the elderly, the Indian market is still developing, with only a few brands addressing this need. Research analyzed five Indian brands' adaptive clothing offerings via social media, revealing limited product variety and sizes. With the growing elderly population in India, there is significant potential for expanding this market by understanding consumer needs and developing suitable products.

2.2.2. User-Centred Design Approaches for bedridden patients

Diana, A. and Chinyere, A. (2017) in the study **"**Functional garment designing and development in relation to activities of bedridden females in Benue state, Nigeria**"** The study focused on designing functional garments for bedridden females (BF) in Benue State, Nigeria, by assessing their activities and garment needs. It involved determining the activities BF engaged in, like donning garments, brushing, bathing, cooking, and operating electronics. A total of 72 basic block patterns were created for small, medium, and large sizes, and 12 prototype garments were developed. The study used questionnaires, measurement charts, and observation checklists for data collection, and the garments received high satisfaction ratings.

Buffagni, A. (2019) in the study "Designing Smart Clothing for Fall Prevention in Older Adults. A brief overview on the current status" The analysis of the data showed that Falls were a leading cause of injury-related deaths among people over 70, and they posed significant health and financial challenges. While much research has focused on fall prevention through gait analysis, physical activity, fall detection, and injury protection, smart clothing remains underexplored. Smart clothes, embedded with electronics, can continuously monitor physiological and motion data, offering dynamic responses like posture adjustments and injury protection. This paper reviewed the current landscape of smart clothing designed for the elderly, including smart suits, footwear, and wearable airbags, and discussed their potential to enhance safety and support in an aging global population.

Grant, S. (2019) in his study "Adaptive Clothing for Bedridden Elderly: Easier Dressing in Bed"**,** explains that Adaptive clothing was designed to make dressing easier and more comfortable for people with limited mobility or who are bedridden. It included features like easy closures, loose fits, sturdy zippers, and specialized accessories to assist with dressing. These clothes helped individuals maintain dignity, avoid feeling exposed, and look good while dressing. Adaptive clothing supports independence and enhances comfort for those with disabilities or mobility challenges

Fuji, N. (2019) in the study "The art of clothes design for hospitalised patients "depicted that Most people will need to stay in a hospital at some point in their lives, with some experiencing extended stays. Hospital gowns were usually designed for ease of use by healthcare professionals, often ignoring patient comfort and dignity, leading to feelings of embarrassment. Dr. Naoko Fujii emphasized the need to create hospital clothing that balances practicality for medical staff with the comfort and preferences of patients.

Esmail, A. (2019) in the study "Research and Industry Practices in Designing Clothes for Optimal Participation of Persons with a Physical Disability" The analysis of the data showed Research and industry practices in designing clothes for persons with physical disabilities focused on creating garments that enhance comfort, functionality, and ease of use. This involved integrating adaptive features like easy closures, adjustable fits, and fabrics that accommodate different mobility needs. Design practices prioritized user involvement to ensure that clothing not only fulfilled practical requirements but also supported the wearer's dignity and personal style. Innovations in this field aimed to empower individuals with disabilities by enabling greater independence and participation in daily activities. The industry was increasingly adopting inclusive design principles to address the diverse needs of people with physical disabilities.

Rêgo, A., et al. (2023) in the study **"**Development of smart clothing to prevent pressure injuries in bedridden persons and/or with severely impaired mobility: 4NoPressure research protocol**"** outlines the development of smart clothing designed to prevent pressure injuries (PIs) in individuals with reduced mobility or who are bedridden. The project consists of eight phases, covering product specifications, textile and design studies, sensor technology exploration, manufacturing adaptations, and clinical trials. It aims to introduce innovative smart health textiles with properties like thermoregulation, pressure relief, humidity control, and antibacterial features. The goal is to improve pressure relief and personalize care through new materials and designs that enhance the cutaneous microclimate's thermo-physiological control.

2.2.3. Clothing Practices for special needs

Clothing plays a critical role in addressing the unique needs of individuals with physical limitations, sensory sensitivities, and medical conditions. In hospital settings, where patients may be bedridden for extended periods, clothing must prioritize comfort and ease of dressing/accessibility. Research on adaptive clothing highlights the importance of designing garments that reduce caregiver burden while ensuring patient dignity and well-being. The following theoretical perspectives provide a foundation for understanding clothing practices for special needs populations, particularly in hospital environments.

Lamb and Kallal (1992) in the article **"**A conceptual framework for apparel design" examined the clothing needs of wheelchair users by analysing global literature and developed a classification system

to map these needs comprehensively. Through a three-tier screening, content analysis, and statistical evaluation, eight key attributes were identified, including functional needs, fit, fabric choice, safety, aesthetics, self-expression, quality of life, and extrinsic factors. These attributes were grouped into physical challenges and psychological desires, highlighting both practical barriers and personal preferences in clothing selection. The findings provide valuable insights for designing inclusive apparel that enhances comfort, mobility, and self-expression for wheelchair users.

Tuteja, S. and Nigam, V. (2017) in the study "Functional Clothing for Individuals with Special Needs" explores the critical need for functional clothing tailored to individuals with cerebral palsy (spastic type), recognizing the challenges they face in dressing due to limited mobility and dexterity. Through personal interviews and questionnaires, the research identifies specific clothing difficulties and integrates these needs into garment design. The final constructed garments, assessed through wear trials, were found to be highly acceptable and effective, demonstrating the importance of adaptive clothing in enhancing comfort, independence, and self-expression for individuals with disabilities. This study underscores the necessity of inclusive fashion that considers both functionality and aesthetics.

McBee-Black and Ha-Brookshire (2018) in the Article "Exploring Clothing as a Barrier to Workplace Participation Faced by People Living with Disabilities" highlighted that societal barrier, rather than disabilities themselves, hinder inclusion. This study, grounded in the social model of disability, examines how the lack of appropriate clothing exacerbates workplace challenges by increasing stigma and reducing self-efficacy. Through qualitative semi-structured interviews, six sub-themes emerged, including occupational typecasting and the role of clothing in shaping self-perception. Findings suggest that inaccessible clothing limits workplace participation, reinforcing stigma and reducing confidence. The study contributes to theory, policy, and community engagement, emphasizing the need for inclusive clothing solutions to support workplace inclusion for PLWD.

2.2.4. Comfort: Sensory comfort and movement comfort

Comfort is a fundamental aspect of healthcare that encompasses physical, psychological, social, and environmental well-being. It is defined as a state of ease, relief, and transcendence, where an individual feels free from distress or discomfort. Katharine Kolcaba's Theory of Comfort emphasizes that comfort is a holistic experience, which is particularly crucial for bedridden patients who are vulnerable to physical pain, psychological distress, and sensory deprivation. The ability to provide comprehensive comfort care ensures better health outcomes, improved quality of life, and reduced complications related to prolonged immobility.

Sensory Comfort

Sensory comfort refers to the stimulation or regulation of the senses to enhance relaxation and well-being while preventing discomfort caused by sensory deprivation. For bedridden patients, sensory

experiences are often limited or overwhelming, leading to conditions such as anxiety, agitation, depression, or cognitive decline. Care strategies aimed at improving sensory comfort include:

- Optimizing Environmental Factors – Adjusting lighting, sound levels, and room temperature to create a soothing atmosphere. Soft, natural lighting and peaceful sounds can help regulate circadian rhythms and improve mood.
- Tactile Stimulation – Using soft bedding, comfortable clothing, and gentle touch therapies such as massage to improve circulation, reduce stress, and enhance relaxation.
- Aromatherapy and Olfactory Stimulation – Introducing mild, pleasant scents (such as lavender or chamomile) to alleviate stress and promote emotional well-being.
- Engagement in Sensory Activities – Providing visual stimulation (e.g., nature views, soft colors), auditory therapy (e.g., calming music, guided relaxation), and activities that engage touch (e.g., hand therapy, textured objects) to maintain cognitive function and reduce sensory deprivation.

By incorporating sensory comfort interventions, healthcare providers can prevent sensory isolation and enhance the emotional and psychological well-being of bedridden patients.

Movement Comfort

Movement comfort focuses on minimizing discomfort related to immobility and ensuring proper body positioning and assisted mobility to prevent musculoskeletal and circulatory complications. Patients who are bedridden for extended periods face risks such as muscle atrophy, joint stiffness, contractures, pressure ulcers, and circulatory issues like deep vein thrombosis (DVT). Effective movement comfort interventions include:

- Proper Positioning and Support – Using ergonomic pillows, pressure-relief cushions, and alternating pressure mattresses to prevent bedsores, nerve compression, and postural discomfort.
- Passive and Active Range-of-Motion Exercises – Encouraging gentle movements, even with assistance, to maintain joint flexibility, improve circulation, and reduce the risk of muscle contractures.
- Repositioning Techniques – Frequently adjusting the patient's position to relieve pressure on vulnerable areas such as the back, heels, and elbows, reducing the likelihood of pressure ulcers.
- Physical Therapy and Mobilization – Engaging in therapist-assisted mobility interventions, including guided stretching, mechanical lift-assisted repositioning, and muscle stimulation techniques to prevent muscle atrophy and promote circulation.
- Use of Assistive Devices – Implementing mobility aids such as adjustable hospital beds, air mattresses, and body slings to facilitate comfort while reducing strain on the patient and caregiver.

Smith et al. (2020) in "**The impact of prolonged immobility on patient health outcomes: A meta-analysis. Clinical Nursing Perspectives**" emphasized that sensory and movement comfort were vital for bedridden patients, as prolonged immobility can lead to complications like pressure ulcers, muscle atrophy, and circulatory issues. Their research highlighted the importance of repositioning, specialized support surfaces, and range-of-motion exercises in preventing these risks. Additionally, sensory stimulation, including controlled lighting, auditory engagement, and tactile therapies, plays a crucial role in reducing anxiety and improving neurological function. They conclude that a multidisciplinary approach integrating movement facilitation and sensory-enriching environments is essential for optimizing patient comfort and preventing secondary health complications.

Miller, T., & Lee, R. (2018) in "**The role of tactile stimulation in pain management for bedridden patients"** suggested that customizing sensory interventions to match individual patient preferences significantly enhanced mood, improves sleep quality, and reduces agitation, especially in long-term care patients. Their research highlighted the effectiveness of personalized approaches, such as controlled lighting, soothing sounds, aromatherapy, and tactile stimulation, in promoting emotional well-being and minimizing distress. They conclude that integrating patient-specific sensory strategies into routine care can lead to better psychological and physiological outcomes for bedridden individuals.

Johnson et al. (2017) in "**Preventing immobility-related complications in long-term care patients: A systematic review"** highlight that immobility leads to pain, stiffness, circulation issues, and an increased risk of deep vein thrombosis (DVT). Their research emphasizes the effectiveness of movement-based interventions in preventing complications and enhancing physical comfort. Key strategies include frequent repositioning every two hours to prevent pressure sores, passive and active range-of-motion exercises to maintain joint flexibility and muscle strength, and the use of ergonomic support and assistive devices, such as adjustable beds and pressure-relief cushions, to improve comfort and reduce caregiver strain. They conclude that implementing these interventions is essential for promoting the well-being of bedridden patients.

OPERATIONAL DEFINITION

Adaptive garments:

Adaptive garments are clothing designed for individuals who experience difficulty dressing due to a limited range of motion. This includes bedridden patients who require assistance with dressing due to various health conditions.

Comfort:

Comfort in clothing, for bedridden patients, refers to the satisfaction derived from an appropriate fit, a soft and flexible feel, and temperature-friendly materials. It also includes minimal or no irritation from selected textures and seams, while ensuring ease of dressing and care for their caregivers.

Bedridden Patient:

A bedridden patient is an individual temporarily confined to bed due to acute medical conditions such as illness, injury, or post-surgical recovery, resulting in limited physical movement. Examples include fractures or recovering from an operation. With the right treatment, they can heal over time and have the potential for recovery and a return to normal activity.

Caregiver:

A caregiver is a person who assists individuals who are unable to dress themselves due to acute medical conditions.

Accessible clothing:

Accessible clothing is designed to simplify the dressing process for individuals with disabilities or limited mobility.

Chapter III

METHODOLOGY

The study "User centred design of adaptive garments for bedridden patients" began with a preliminary survey to understand the current status and need for user centred garments in local government hospitals of Vadodara, which was further reinforced with review of literature collected from various sources. The insights gained from the survey helped in making the objectives of the study and hence the procedure followed to achieve these objectives under different phases is covered under the following heads:

1.1. Preliminary survey

1.2. Research design

1.3. Need gap identification

3.3.1. Sample selection

3.3.2. Preparation of the tool

3.3.3. Data collection

3.3.4. Data analysis

3.4. Design and Development of user centred adaptive garments

3.4.1. Design brief and user profile

3.4.2. Concept building and designing

3.4.3. Selection of design

3.4.4. Material sourcing

3.4.5. Development of specification sheet

3.4.6. Pattern making and construction of prototypes

3.4.7. Bill of Materials (BOM)

3.5. Evaluation of designed prototypes of adaptive garments

3.5.1. Participant selection and planning of wear trial schedule

3.5.2. Preparation of Evaluation Metrics

3.5.3. Prototype Wear trials

3.5.4. Collection of feedback

3.5.5. Analysis of feedback

3.5.6. Reporting and recommendations

3.1. Preliminary survey

The preliminary research combined secondary and primary data collection methods to guide the design of adaptive garments for bedridden patients. Secondary research involved reviewing books, academic papers, dissertations, and credible online sources to explore existing adaptive clothing solutions, their limitations, and advancements in textile technology. Primary data was gathered through hospital visits, open and close ended questionnaires which were self-administered, interviews with the caregivers, and observational studies in hospitals. These methods provided valuable insights into user needs and practical difficulties, forming the foundation for a user-centred design approach.

3.2. Research design

The research design (Figure 3.1, 3.1a, 3.1b, 3.1c) included a systematic approach to exploring the challenges faced by bedridden patients and their caregivers in dressing them. This framework ensured the reliability of insights and aligned the design process with user needs, ultimately, guiding the development of practical, user-centred adaptive garments. It employed a mixed method approach, incorporating both qualitative and quantitative data collection methods, including literature review, field visits, semi structured questionnaires, interviews, and observational studies. The investigator utilized resources from the Clothing and Textile Department Library, Faculty of Family and Community Sciences, and Smt. Hansa Mehta Library at The Maharaja Sayajirao University of Baroda, Vadodara.

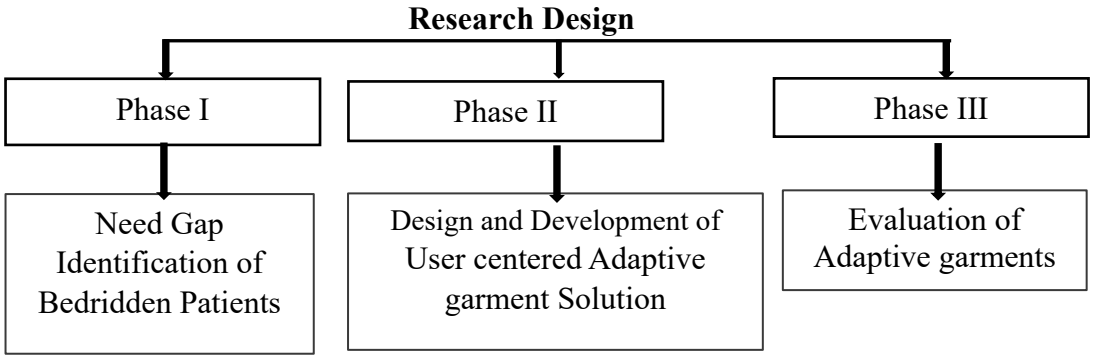


Figure 3.1: Research Design flowchart showing three phases of Applied Research

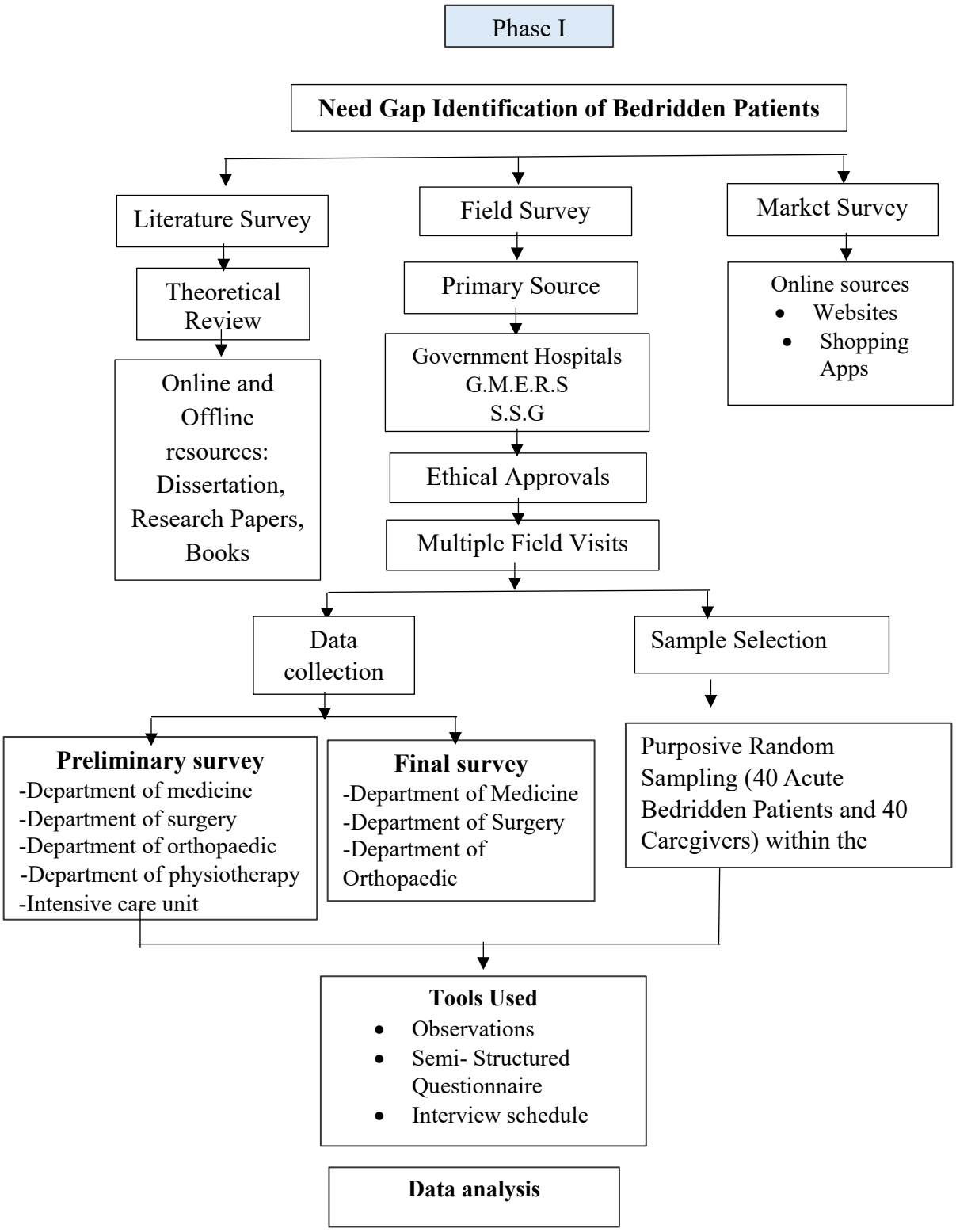


Figure 3.1a: Flow chart showing Phase I of Applied Research Design

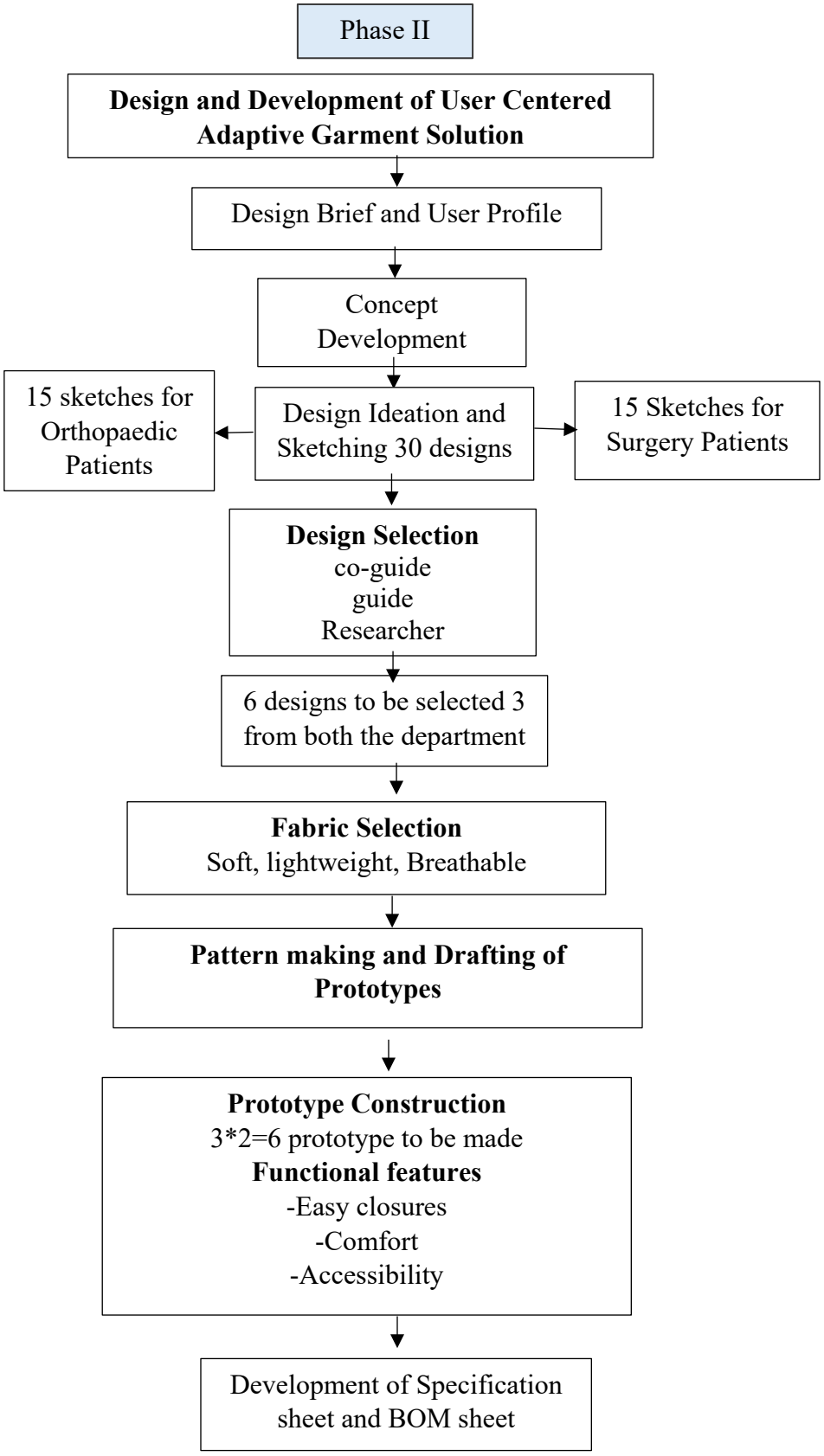


Figure 3.1b: Flow chart showing Phase II of Applied Research Design

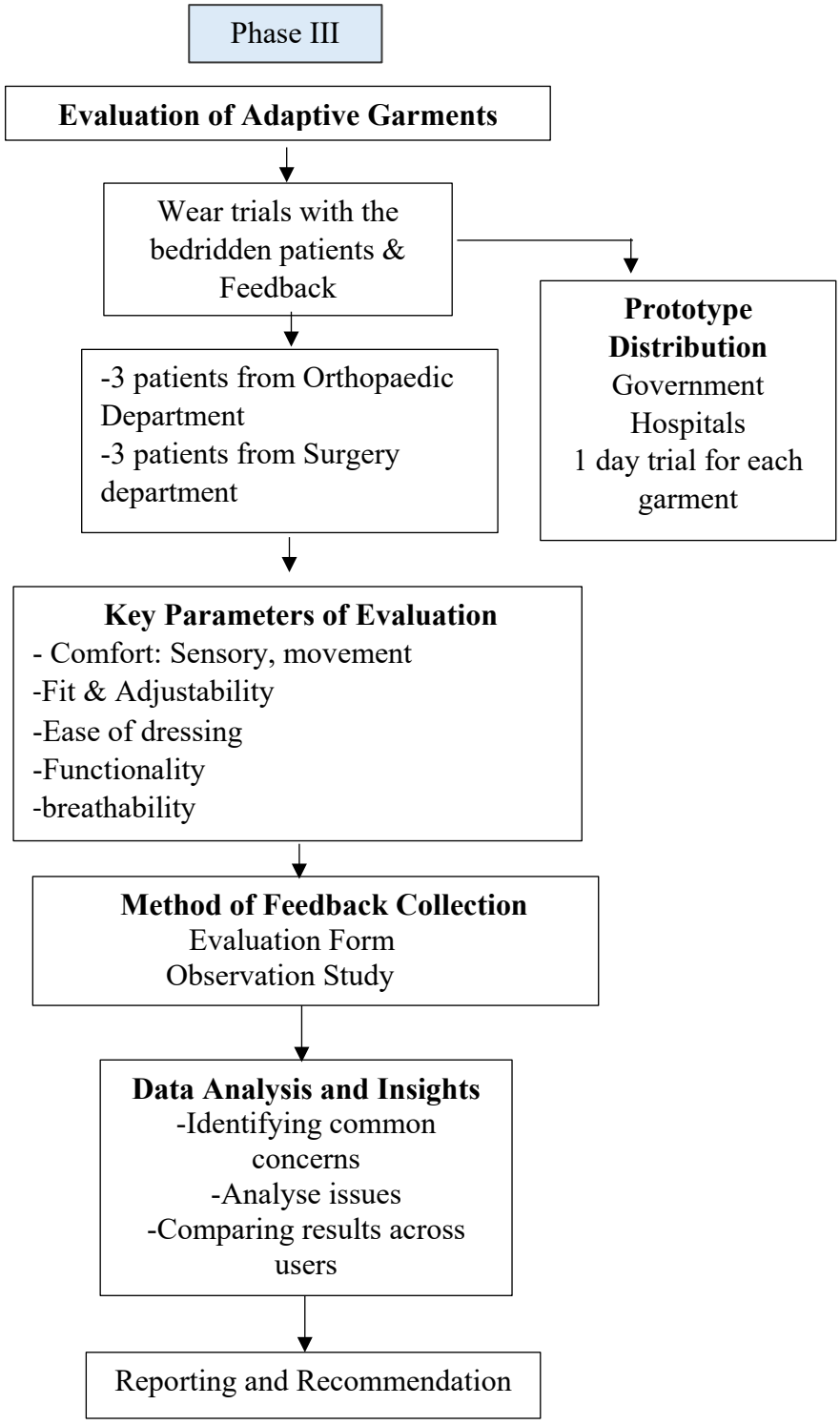


Figure 3.1c: Flow chart showing Phase III of Applied Research Design

3.3. Need Gap identification

This stage involved understanding the specific challenges faced by bedridden patients and their caregivers when using conventional clothing. It aimed to identify gaps in existing garment solutions, focusing on issues like ease of dressing, comfort, and accessibility. These unmet needs were crucial in informing the design of adaptive garments. To achieve this a detailed survey was conducted including multiple field visits, semi structured questionnaires with the patients and their caregivers, interview schedules with caregivers and observations of current clothing options available for the acute bedridden patients. The hospitals selected for this study were:

1. S.S.G. Hospital (Shri Sayajirao Gaekwad Hospital)
2. G.M.E.R.S. Hospital (Gujarat Medical Education and Research Society Hospital)

Ethical Approvals and Research Permissions

To ensure compliance with ethical guidelines and institutional regulations, the researcher obtained formal permissions (*Annexure 1,2*) before conducting the study at GMERS Hospital and SSG Hospital.

At GMERS Hospital, the approval process (Figure 3.2) began with the researcher submitting a formal research request to Dr. Anup Kumar Chandani, the Superintendent. Dr. Chandani then directed the researcher to Dr. Sandeep Joshi, the Head of the Psychology Department and Secretary of the Ethics Committee, for further guidance. Dr. Joshi provided detailed information on the necessary documentation and referred the researcher to Mr. Mayurbhai, who assisted in understanding the paperwork requirements. After gathering the required documents, the researcher submitted the ethical approval form to Mr. Mayurbhai and the Ethics Committee. The research proposal was reviewed in an Ethics Committee meeting, and upon approval, the researcher received formal permission (*Annexure 2*) to conduct the study. Additionally, Dr. Amul Bhedi, the Head of the Surgery department was assigned as the co-guide.

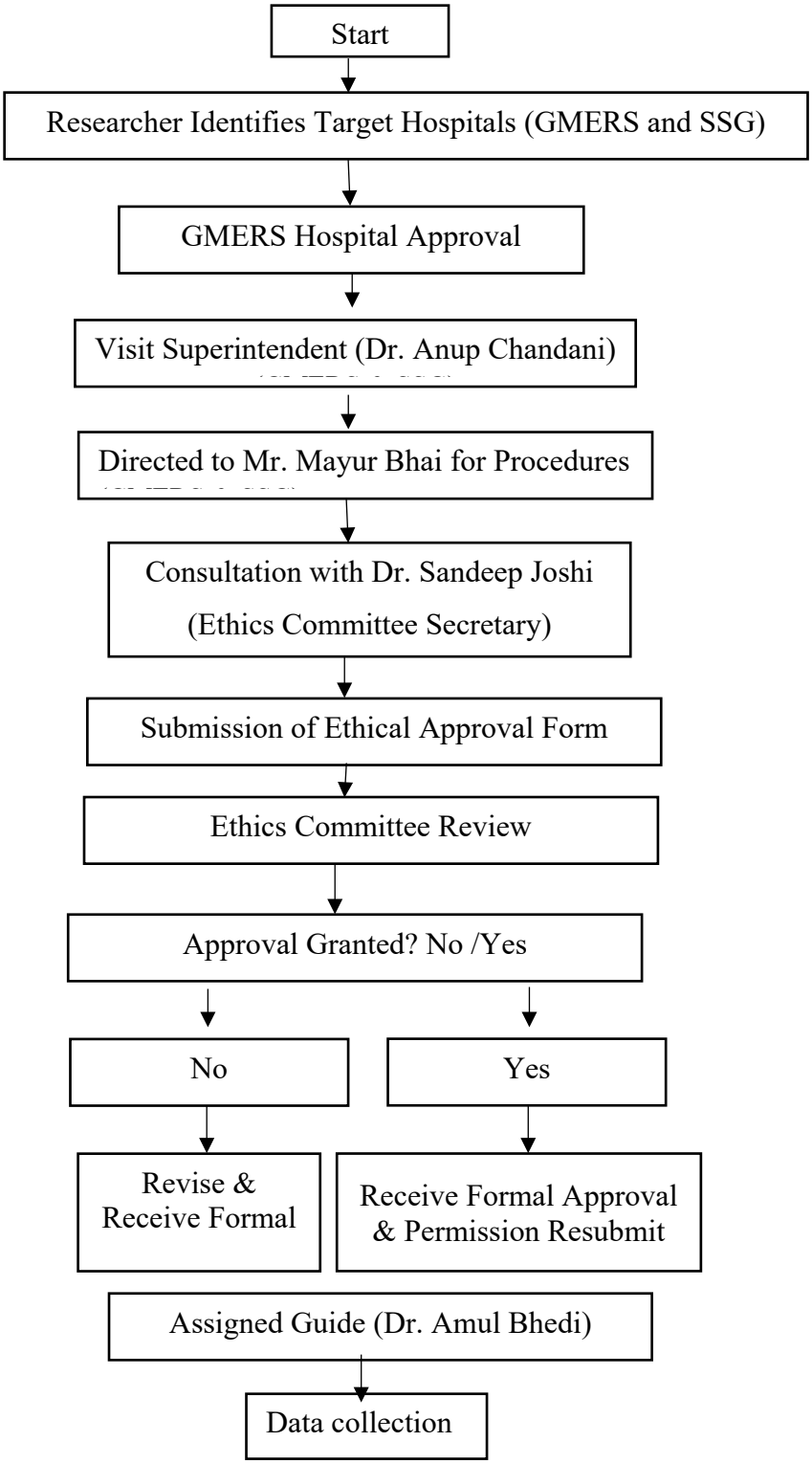


Figure 3.2: Stepwise Approval Process for Research and Ethics at GMERS Hospital

At SSG Hospital, the researcher followed a structured institutional protocol to obtain research permission (Figure 3.3). A formal permission letter (*Appendix 1*) was submitted to the Superintendent's office, where Mr. Raju Verma, the Personal Assistant to the Superintendent, provided guidance on the approval process. After reviewing the request, the Superintendent approved and signed the permission letter. The researcher was then assigned to the surgery Department, medicine department and orthopaedic department where a meeting was held with the Head of Departments (HOD's) following discussions regarding the study details, the HOD granted formal permission for data collection in the department.

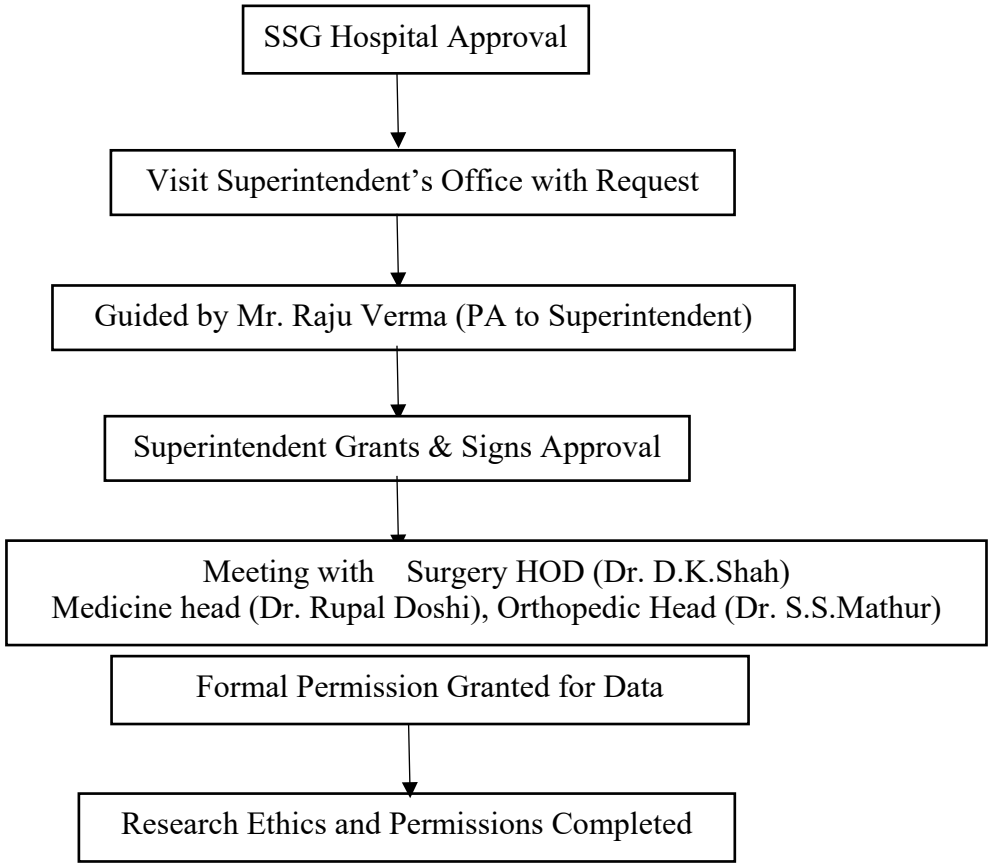


Figure 3.3: Stepwise Approval Process for Research and Ethics at S.S.G Hospital

By adhering to these institutional procedures, the researcher ensured compliance with ethical standards and hospital regulations while maintaining participant confidentiality and informed consent protocols (*Appendix 3,4*).

3.3.1. Sample Selection

40 Participants were selected for this study which were from two different groups, this included patients recovering from acute medical conditions such as surgeries, or fractures as well as their caregivers responsible for daily dressing and undressing tasks.

Inclusion criteria:

-**Acute Bedridden patients and their caregivers from:**

S.S.G hospital (10 from each department=30 patients and their caregivers)

G.M.E.R.S. hospital (10 from Surgery department only=10 patients and their caregivers)

-Patients admitted in the hospital for more than 3 days and less than one month.

-Conscious and semi-conscious bedridden patients

3.3.1.1. Acute Bedridden patients from:

Hospital 1: S.S.G Hospital

Surgery Department-10 Bedridden patient and 10 Caregivers of the patients

Orthopaedic Department-10 Bedridden patient and 10 Caregivers of the patients

Medicine Deartment-10 Bedridden patient and 10 Caregivers of the patients

Hospital 2: G.M.E.R.S. Hospital

Surgery Department-10 Bedridden patient and 10 Caregivers of the patients

Sampling Method*:* Purposive Random sampling method was used to select 40 acute bedridden patients and their caregivers within the inclusion criteria to gather in-depth insights for the study.

Table 3.1: Patients selection from hospitals

n=80

Hospital	Department	Number of Patients	Caregivers
SSG Hospital	Surgery	10	10
SSG Hospital	Medicine	10	10
SSG Hospital	Orthopaedics	10	10
GMERS Hospital	Surgery	10	10
Total		40	40

3.3.2. Preparation of the tool

The tool was prepared to gather qualitative as well as quantitative data. Tool in the form of semi-structured questionnaire (*Appendix 5*), semi-structured interview (*Appendix 6*) was prepared to gather information on the challenges and preferences related to clothing for bedridden patients. The tool covered areas like:

Demographic details, Current clothing comfort, Ease of dressing and undressing, Fabric preferences, Dignity, Care needs, enabling the systematic collection of qualitative and quantitative data.

3.3.3. Data collection

Data were collected through surveys, observations of patients and caregivers. This stage provided detailed insights into clothing-related challenges, including garment restrictions, discomfort, and the impact of improper clothing on patients and also caregiving tasks. The information gathered was essential for designing adaptive garments

3.3.4. Data Analysis

A mixed-method approach was employed, incorporating both qualitative and quantitative data collection. Descriptive statistical analysis was performed using frequency and percentage distributions.

3.4 Design and Development of User-Centred Adaptive Garments

The design process focused on creating user-centred adaptive garments tailored to the needs of bedridden patients, ensuring comfort and ease of use for both patients and caregivers. Insights from the need-gap identification phase guided the development, ensuring that the garments effectively addressed real-world challenges.

3.4.1. Design brief and user profile

A detailed design brief was developed, outlining the key requirements for adaptive garments based on the identified user needs. This included a user profile of bedridden patients and their caregivers, detailing their physical conditions, daily activities, and specific dressing challenges encountered during recovery.

These concept sketches were reviewed for practicality and functionality. Through data collected it was analysed that the medicine department requires least adaptability for user centred design and so only surgery and orthopaedic department were chosen for garment designing.

3.4.2. Concept Building and Designing

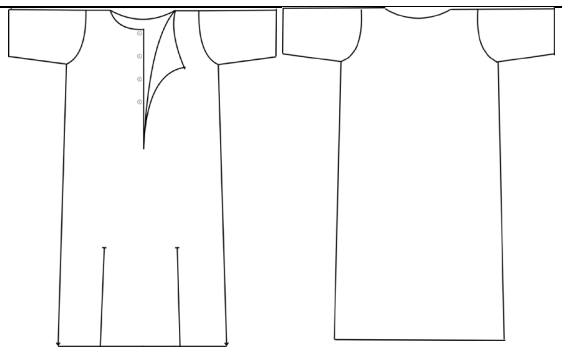
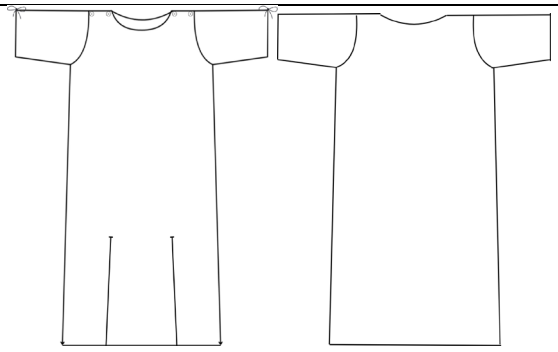
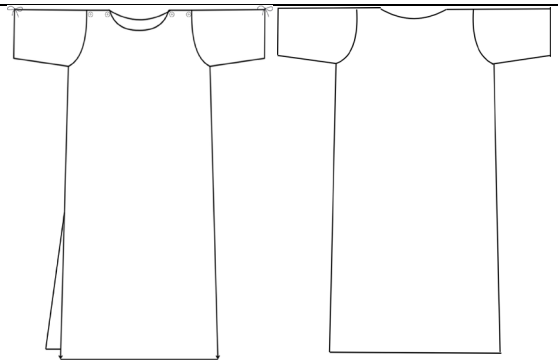
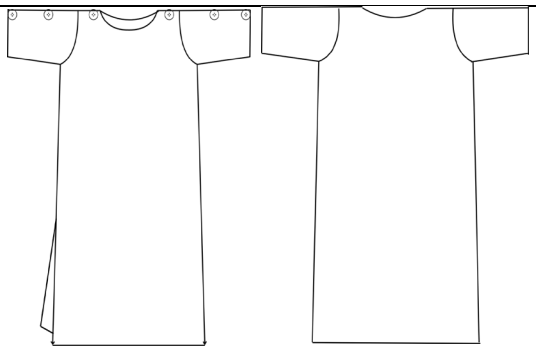
The design concepts were developed with a primary focus on enhancing ease of dressing, ensuring comfort, allowing mobility, and addressing specific care needs of bedridden or post-surgical patients. Various innovative ideas were explored to integrate functional features such as:

- Openings for medical devices – to accommodate IV lines, catheters, and monitoring equipment without requiring complete garment removal.
- Easy closure systems – incorporating buttons and tie strings for ease of access.
- Breathable and skin-friendly fabrics – to minimize the risk of pressure sores, reduce moisture build-up, and ensure comfort for prolonged wear.
- Adjustable fit – using elastic panels, stretchable inserts, and adaptive sizing to accommodate weight fluctuations, bandages, or medical braces.

A total of 30 design sketches were created, with 15 concepts tailored for the orthopaedic department and 15 for the surgery department (*Annexure 3*). The orthopaedic department designs emphasize supportive structures, as the braces for support are used, fit to aid in mobility and healing. The surgery department designs focus on ease of access, soft closures, and protective layering to accommodate post-surgical care requirements.

To visualize these concepts effectively, the designs were **digitally illustrated using the Canva app by the researcher**. This method allowed for precise detailing, colour variations, and clear representation of garment features, ensuring an accurate depiction of the proposed adaptive clothing solutions. The digital illustrations provide a comprehensive visual reference for understanding the design functionality and usability from both a patient and caregiver perspective

Table 3.2: Design Illustration for Orthopaedic patients

Designs	Description
 1. Front Back	**Unisex Gown:** -One piece calf length gown -Above elbow sleeves -Round neckline -front opening -Front slits -**Closures:** Buttons
 2. Front Back	**Unisex Gown:** -One piece calf length gown -Above elbow sleeves -Round neckline -front opening -Front slits -**Closures:** Tie strings Buttons
 3. Front Back	**Unisex Gown:** -One piece calf length gown -Above elbow sleeves -Round neckline -front opening -side slits -**Closure:** Tie strings Buttons
 4. Front Back	**Unisex Gown:** -One piece calf length gown -Above elbow sleeves -Round neckline -front opening -side slits -**Closures:** Buttons

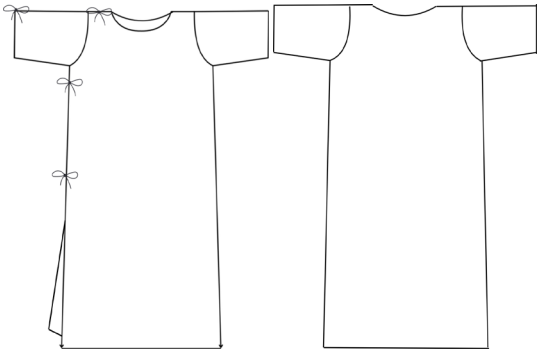
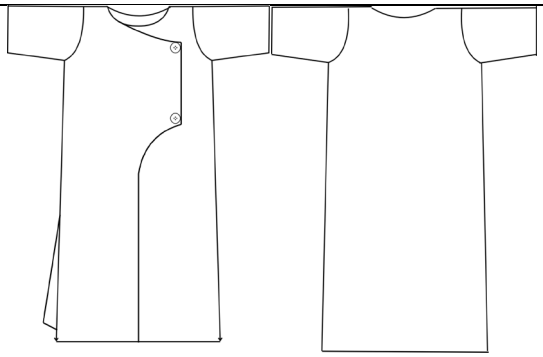
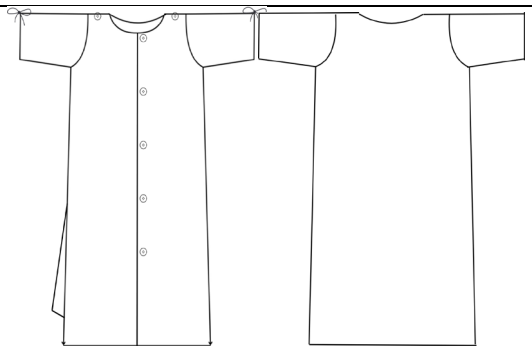
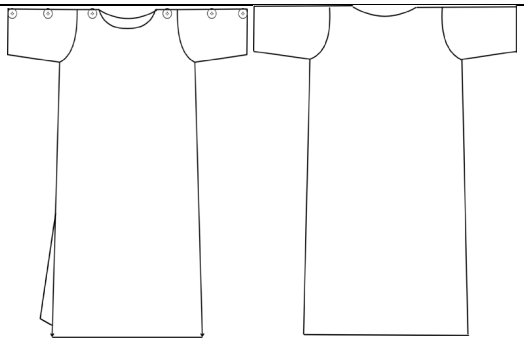
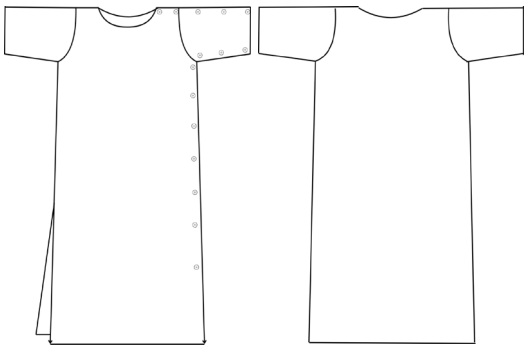
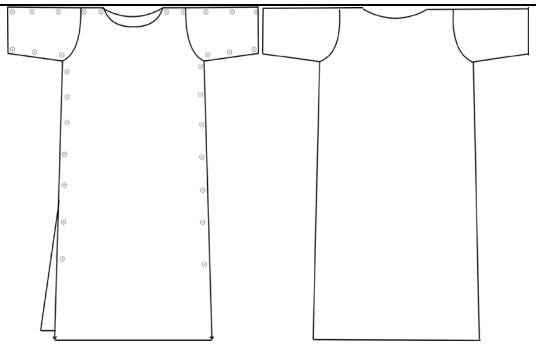
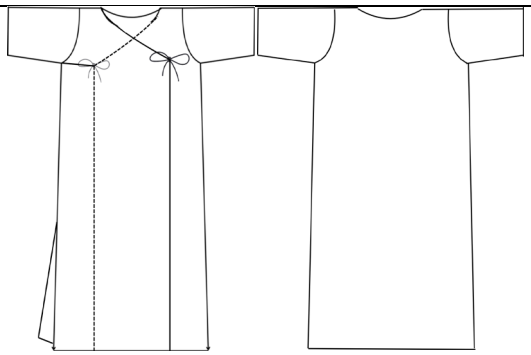
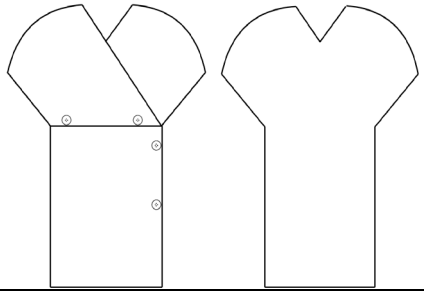
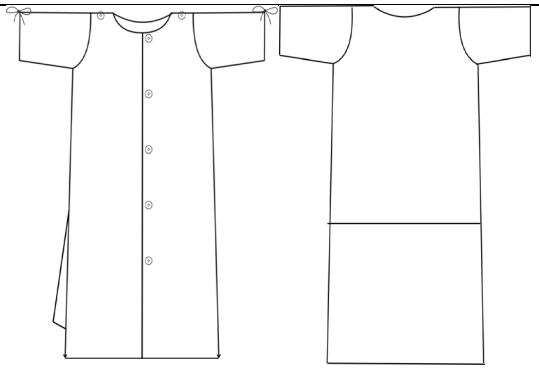
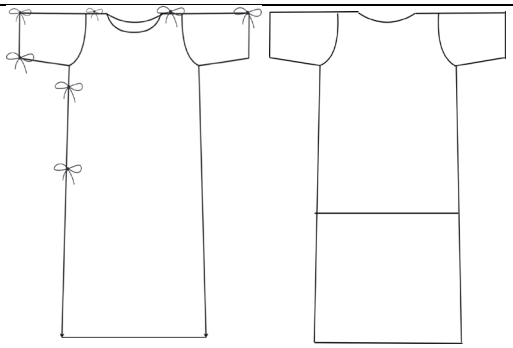
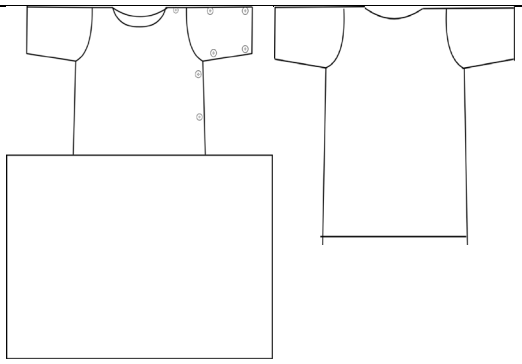
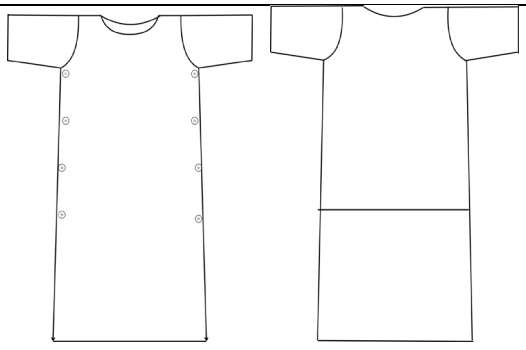
Designs	Description
 5. Front Back	**Unisex Gown:** -One piece calf length gown -Above elbow sleeves -Round neckline -Side opening -Side slits -**Closures:** Tie strings
 6. Front Back	**Unisex Gown:** -One piece calf length gown -Above elbow sleeves -Round neckline -Front opening -Front slits -**Closures:** Buttons
 7. Front Back	**Unisex Gown:** -One piece calf length gown -Above elbow sleeves -Round neckline -front opening -side slits -**Closure:** Tie strings Buttons
 8. Front Back	**Unisex Gown:** -One piece calf length gown -Above elbow sleeves -Round neckline -front opening -side slits -**Closures:** Tie Strings Buttons

Table 3.3: Design Illustration for Surgery patients

Designs	Description
 1. Front Back	**Unisex Gown:** -One piece calf length gown -Above elbow sleeves -Round neckline -Side opening -Side slits -**Closures:** Buttons
 2. Front Back	**Unisex Gown:** -One piece calf length gown -Above elbow sleeves -Round neckline -Side opening -Side slits -**Closures:** Buttons
 3. Front Back	**Unisex Gown:** -One piece calf length gown -Above elbow sleeves -Round neckline -front opening -side slits -**Closure:** Tie strings
 4. Front Back	**Unisex Gown:** -One piece Wrap around gown -Above elbow sleeves -Round neckline -front opening -**Closures:** Buttons

Designs	Description
 1. Front Back	**Unisex Gown:** -One piece calf length gown -Above elbow sleeves -Round neckline -Front opening -Side slits -**Closures:** Tie strings Buttons
 2. Front Back	**Unisex Gown:** -One piece calf length gown -Above elbow sleeves -Round neckline -Side opening -Side slits -**Closures:** Tie strings
 3. Front Back	**Unisex Gown:** -One piece shirt and cloth -Above elbow sleeves -Round neckline -Side opening -**Closure:** Buttons
 4. Front Back	**Unisex Gown:** -One piece Wrap around gown -Above elbow sleeves -Round neckline -Side opening -Side slit -**Closures:** Buttons

3.4.3. Selection of Design

The most feasible and user-friendly 12 design concepts (6 per department) were selected by the researcher and guide. The final designs 6 designs (3 per department) were then finalized by the co-guide in the hospital. The chosen designs effectively met user needs, ensuring comfort for patients and ease of use for caregivers, while also considering aesthetic appeal and cost-effectiveness.

3.4.4. Material Sourcing

Soft, durable, and breathable materials were sourced for constructing the adaptive garments. Special attention was given to selecting fabrics that minimized the risk of skin irritation and pressure sores while providing flexibility for easy dressing and undressing. For this local market including Nava Bazaar, Mangal bazaar and various shops in Fatepura was visited. Various fabric samples were collected, and the most suitable fabric was selected based on its lightweight, softness, durability, and affordability to meet the requirements of the government hospital.

3.4.5. Development of Specification Sheet

A detailed specification sheet was created, listing measurements, fabric types, trims, and other essential components for garment construction.

Table 3.4: Table showing the framework to capture the data Specification sheet

Features	Description	Purpose
Fabric Type		
Fabric Weave		
Fabric Pattern		
Fasteners		
Opening Style		
Stitching Type		
Size		
Tailoring Method		
Usage		

Table 3.5: Table showing the framework of Measurement sheet (common for all)

Feature	Measurement (Inches)	Description
Garment Type		
Length		
Sleeve Length		
Shoulder Width		
Sleeve Round		
Chest Width		
Lower Width		

Table 3.6: Table showing the framework of Specification sheet for adaptive garment (format)

Styles:		**Date:**	
Description and user need			
Use			
User			
Material and fabric description			
Fabric	**Width**	**Content**	**Properties**
Design feature			
Closure Type			
Sleeve Length			
Opening			
Trims and fasteners			
Garment code			
Fabric swatch			
Feature		**Technical sketch**	

Table 3.7: Table showing framework for Key Details prototypes

Details	Garment 1	Garment 2	Garment 3	Garment 4	Garment 5	Garment 6
Garment name						
Garment code						
Fabric Type						
Closure Type						
Size Range						

Table 3.8: Table showing framework of Material Costs (For 6 Garments)

Item Description	Total Quantity (6 units)	Unit Cost (₹)	Total Cost (₹)	Cost per Garment (₹)
Fabric (m)				
Trims -Buttons				
Total Material Cost				

Table 3.9: Table showing framework of the Final Cost Calculation

Cost Component	Total Cost ($)	Cost per Garment ($)
Total Material Cost		
Total Labor Cost		
Total Production Cost (6 garments)		

3.4.6. Pattern making and Construction of Prototypes

After the design finalization and fabric selection, the next stage was prototype construction. This involved pattern making and garment construction, where the researcher drafted patterns for the final prototypes.

To ensure cost-effectiveness and timely completion, local tailors in Vadodara were assessed based on labor charges and construction time. A tailor was selected for their affordability and ability to meet deadlines without compromising quality. The researcher provided detailed instructions on stitching techniques and adaptive features to ensure the prototypes aligned with the intended functionality

Garment O1-Gown with front slits with shoulder opening

Square lines from 0, on a four-layer fold, with folds at 2-0 and 5-0.

Front :1-0 = one-fourth chest plus 1.5 cm

2-0 = length plus 1.5 cm less frill width.

3-0 = one-twelfth chest plus 1 cm.

4-0 = same as 3 to 0 plus 1.5 cm. Shape neck 4-3.

5-0 = one-fourth chest less 1 cm, or shoulder plus 1 cm.

Square down from 5 to 6.

7-5 = 1.5 cm.

Join 3-7.

8-1 = one-fourth chest plus 4 cm

9-6 = 2.5cm (1”).

Shape scye 7-9-8.

10-2 = same as 8 to 1 plus 4 cm (1’’).

Join 8 10.

11-10 = 1.5 cm.

Shape bottom 2-11 as shown

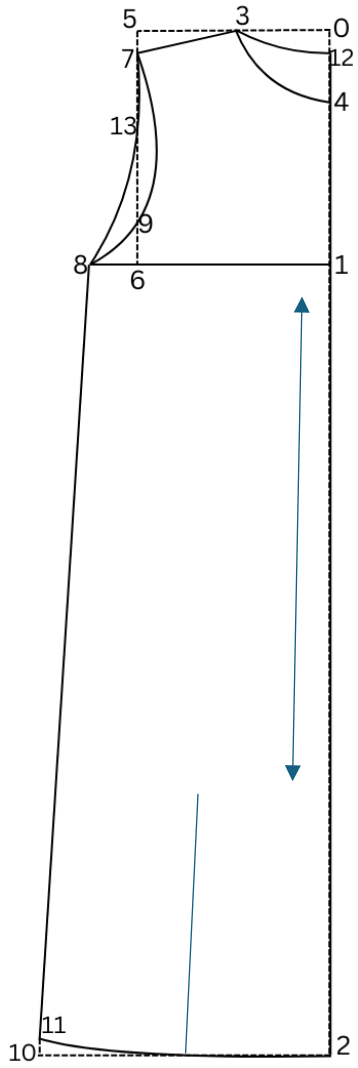


Plate 3.1: Gown 01 draft

Sleeve Drafting

Square lines from point 0, with a fold at 2-0.

Later for the pattern of open sleeve cut at the point 0-2

1-0 = One-eighth of the chest measurement + 6.5 cm (2½") ease.

2-0 = Sleeve length + 1 cm (¼") ease.

3-2 = Same as 1-0. Join 3-1 to complete the initial structure.

4-1 = One-eighth of the chest measurement.

5-0 = 2.5 cm (1") ease. Join 4-5 smoothly.

6 is midway between 4 and 5.

7-6 = 2 cm (¾") ease.

Shape the back side of the sleeve smoothly from 4-7-5.

Square up from 4 to 8.

8-4 = 5 cm (2")

Join 8-5 smoothly.

Take 1 cm (¼") above point 4, then shape the front side of the sleeve smoothly through 4-8-9-0.

10-2 = Half sleeve round + 1.5 cm (½") ease.

Join and shape 4-10 smoothly.

Keep 3 cm (1¼") turn-in at 10-2 for hemming.

Keep 2 cm (¾") seam allowance at 10-4.

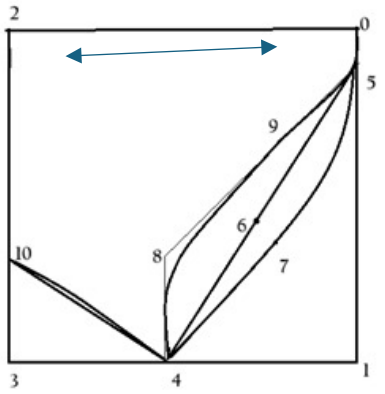


Plate 3.2: Sleeve O1 draft

Garment O2-Gown with side slits with middle opening

Square lines from 0, on a four-layer fold, with folds at 2-0 and 5-0.

mark a cut from 4-2 for opening without fold

Front :1-0 = one-fourth chest plus 1.5 cm

2-0 = length plus 1.5 cm less frill width.

3-0 = one-twelfth chest plus 1 cm.

4-0 = same as 3 to 0 plus 1.5 cm. Shape neck 4-3.

5-0 = one-fourth chest less 1 cm, or shoulder plus 1 cm.

Square down from 5 to 6.

7-5 = 1.5 cm.

Join 3-7.

8-1 = one-fourth chest plus 4 cm

9-6 = 2.5cm (1”).

Shape scye 7-9-8.

Mark a cut from 11-14 for slit

10-2 = same as 8 to 1 plus 4 cm (1’’).

Join 8 10.

11-10 = 1.5 cm.

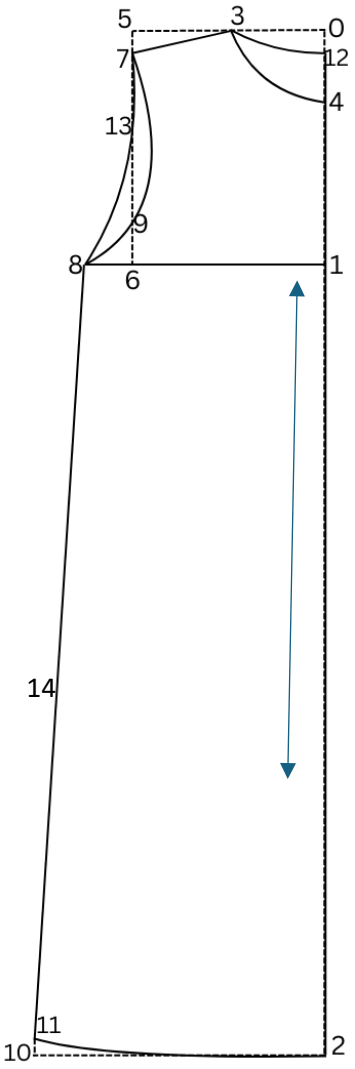


Plate 3.3: Gown O2 draft

Shape bottom 2-11 as shown

Sleeve Drafting

Instructions

Square lines from point 0, with a fold at 2-0.

Later for the pattern of open sleeve cut at the point 0-2

1-0 = One-eighth of the chest measurement + 6.5 cm (2½") ease.

2-0 = Sleeve length + 1 cm (¼") ease.

3-2 = Same as 1-0. Join 3-1 to complete the initial structure.

4-1 = One-eighth of the chest measurement.

5-0 = 2.5 cm (1") ease. Join 4-5 smoothly.

6 is midway between 4 and 5.

7-6 = 2 cm (¾") ease.

Shape the back side of the sleeve smoothly from 4-7-5.

Square up from 4 to 8.

8-4 = 5 cm (2")

Join 8-5 smoothly.

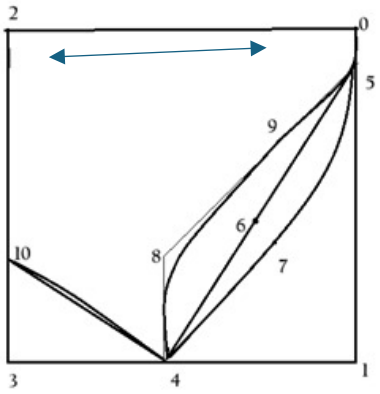


Plate 3.4: Sleeve O2 Draft

Take 1 cm (¼") above point 4, then shape the front side of the sleeve smoothly through 4-8-9-0.

10-2 = Half sleeve round + 1.5 cm (½") ease.

Join and shape 4-10 smoothly.

Keep 3 cm (1¼") turn-in at 10-2 for hemming.

Keep 2 cm (¾") seam allowance at 10-4.

Garment O3-Gown with side slits with shoulder opening

Square lines from 0, on a four-layer fold, with folds at 2-0 and 5-0.

Front :1-0 = one-fourth chest plus 1.5 cm

2-0 = length plus 1.5 cm less frill width.

3-0 = one-twelfth chest plus 1 cm.

4-0 = same as 3 to 0 plus 1.5 cm. Shape neck 4-3.

5-0 = one-fourth chest less 1 cm, or shoulder plus 1 cm.

Square down from 5 to 6.

7-5 = 1.5 cm.

Join 3-7.and cut for shoulder opening

8-1 = one-fourth chest plus 4 cm

9-6 = 2.5cm (1”).

Shape scye 7-9-8.

Mark a cut from 11-14 for slit

10-2 = same as 8 to 1 plus 4 cm (1’’).

Join 8 10.

11-10 = 1.5 cm.

Shape bottom 2-11 as shown

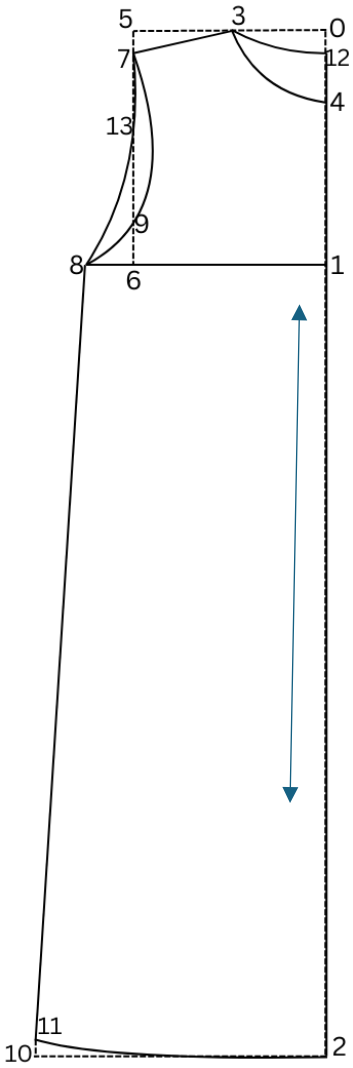


Plate 3.5: Gown O3 Draft

Sleeve Drafting

Instructions

Square lines from point 0, with a fold at 2-0.

Later for the pattern of open sleeve cut at the point 0-2

1-0 = One-eighth of the chest measurement + 6.5 cm (2½") ease.

2-0 = Sleeve length + 1 cm (¼") ease.

3-2 = Same as 1-0. Join 3-1 to complete the initial structure.

4-1 = One-eighth of the chest measurement.

5-0 = 2.5 cm (1") ease. Join 4-5 smoothly.

6 is midway between 4 and 5.

7-6 = 2 cm (¾") ease.

Shape the back side of the sleeve smoothly from 4-7-5.

Square up from 4 to 8.

8-4 = 5 cm (2")

Join 8-5 smoothly.

Take 1 cm (¼") above point 4, then shape the front side of the sleeve smoothly through 4-8-9-0.

10-2 = Half sleeve round + 1.5 cm (½") ease.

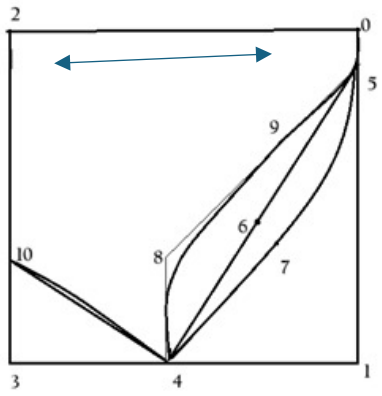


Plate 3.6: Sleeve O3 draft

Join and shape 4-10 smoothly.

Keep 3 cm (1¼") turn-in at 10-2 for hemming.

Keep 2 cm (¾") seam allowance at 10-4.

Garment S1-Gown with Front Tie String

Square lines from 0, on a four-layer fold, with folds at 2-0 and 5-0.

Front :1-0 = one-fourth chest plus 1.5 cm

2-0 = length plus 1.5 cm less frill width.

3-0 = one-twelfth chest plus 1 cm.

4-0 = same as 3 to 0 plus 1.5 cm. Shape neck 4-3.

From point 4 extend 10 cm at 4a

Square down 4b

5-0 = one-fourth chest less 1 cm, or shoulder plus 1 cm.

Square down from 5 to 6.

7-5 = 1.5 cm.

Join 3-7.

8-1 = one-fourth chest plus 4 cm

9-6 = 2.5cm (1").

Shape scye 7-9-8.

Mark a cut from 11-14 for slit

10-2 = same as 8 to 1 plus 4 cm (1'').

Join 8 10.

11-10 = 1.5 cm.

Shape bottom 2-11 as shown

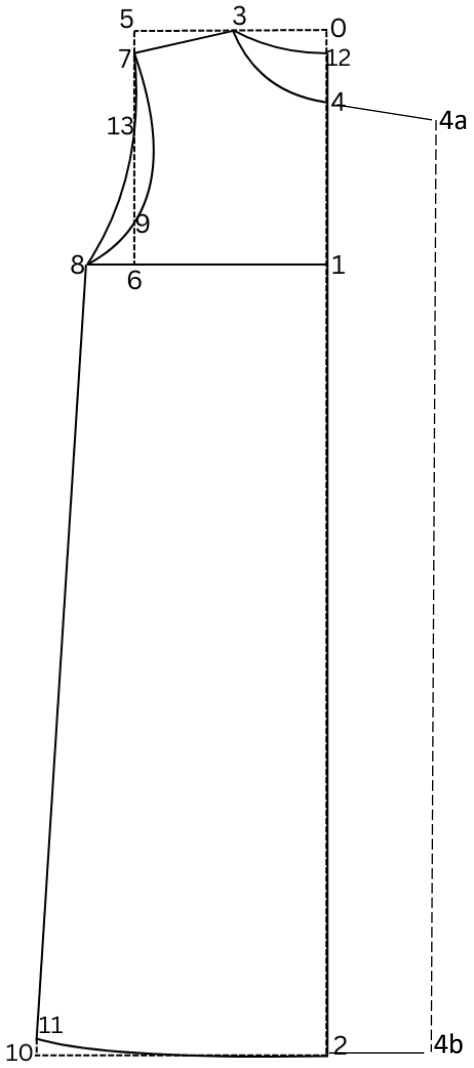


Plate 3.7: Gown S1 draft

Sleeve Drafting

Instructions

Square lines from point 0, with a fold at 2-0.

1-0 = One-eighth of the chest measurement + 6.5 cm (2½") ease.

2-0 = Sleeve length + 1 cm (¼") ease.

3-2 = Same as 1-0. Join 3-1 to complete the initial structure.

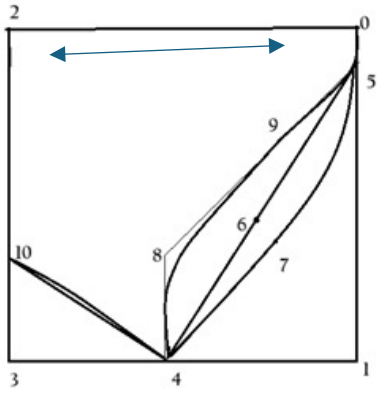


Plate 3.8 Sleeve S1 draft

4-1 = One-eighth of the chest measurement.

5-0 = 2.5 cm (1") ease. Join 4-5 smoothly.

6 is midway between 4 and 5.

7-6 = 2 cm (¾") ease.

Shape the back side of the sleeve smoothly from 4-7-5.

Square up from 4 to 8.

8-4 = 5 cm (2")

Join 8-5 smoothly.

Take 1 cm (¼") above point 4, then shape the front side of the sleeve smoothly through 4-8-9-0.

10-2 = Half sleeve round + 1.5 cm (½") ease.

Join and shape 4-10 smoothly.

Keep 3 cm (1¼") turn-in at 10-2 for hemming.

Keep 2 cm (¾") seam allowance at 10-4.

Garment S2-Gown with one side opening

Square lines from 0, on a four-layer fold, with folds at 2-0 and 5-0.

Front :1-0 = one-fourth chest plus 1.5 cm

2-0 = length plus 1.5 cm less frill width.

3-0 = one-twelfth chest plus 1 cm.

4-0 = same as 3 to 0 plus 1.5 cm. Shape neck 4-3.

5-0 = one-fourth chest less 1 cm, or shoulder plus 1 cm.

Square down from 5 to 6.

7-5 = 1.5 cm.

Join 3-7.

8-1 = one-fourth chest plus 4 cm

9-6 = 2.5cm (1”).

Shape scye 7-9-8.

Mark a cut from 11-14 for slit

10-2 = same as 8 to 1 plus 4 cm (1’’).

Join 8 10.

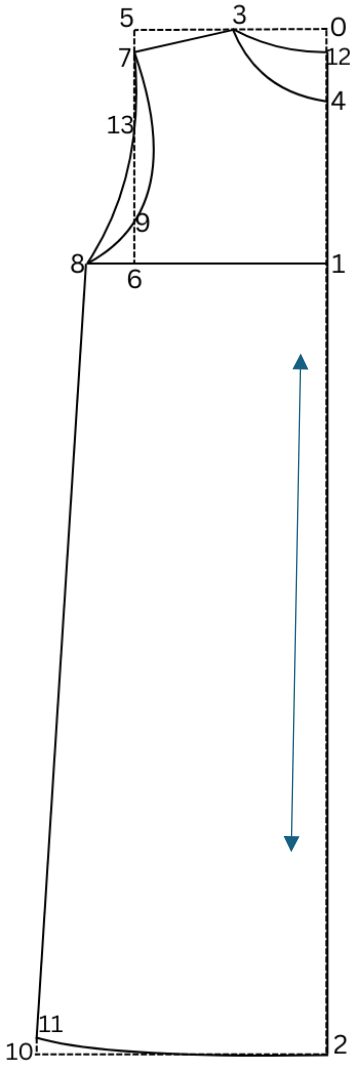


Plate 3.9: Gown S2 draft

11-10 = 1.5 cm.

Shape bottom 2-11 as shown Join and shape 4-10 smoothly.

Keep 3 cm (1¼") turn-in at 10-2 for hemming.

Keep 2 cm (¾") seam allowance at 10-4.

Sleeve Drafting

Instructions

Square lines from point 0, with a fold at 2-0.

1-0 = One-eighth of the chest measurement + 6.5 cm (2½") ease.

2-0 = Sleeve length + 1 cm (¼") ease.

3-2 = Same as 1-0. Join 3-1 to complete the initial structure.

4-1 = One-eighth of the chest measurement.

5-0 = 2.5 cm (1") ease. Join 4-5 smoothly.

6 is midway between 4 and 5.

7-6 = 2 cm (¾") ease.

Shape the back side of the sleeve smoothly from 4-7-5.

Square up from 4 to 8.

8-4 = 5 cm (2")

Join 8-5 smoothly.

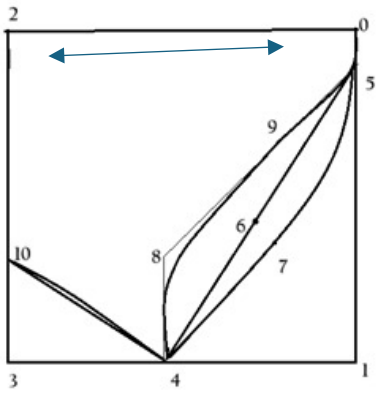


Plate 3.10: Sleeve S2 draft

Take 1 cm (¼") above point 4, then shape the front side of the sleeve smoothly through 4-8-9-0.

10-2 = Half sleeve round + 1.5 cm (½") ease.

Join and shape 4-10 smoothly.

Garment S3-Detachable gown

Square lines from 0, on a four-layer fold, with folds at 2-0 and 5-0.

Front :1-0 = one-fourth chest plus 1.5 cm

2-0 = length plus 1.5 cm less frill width.

3-0 = one-twelfth chest plus 1 cm.

4-0 = same as 3 to 0 plus 1.5 cm. Shape neck 4-3.

5-0 = one-fourth chest less 1 cm, or shoulder plus 1 cm.

Square down from 5 to 6.

7-5 = 1.5 cm.

Join 3-7.

8-1 = one-fourth chest plus 4 cm

9-6 = 2.5cm (1”).

Shape scye 7-9-8.

Mark a cut from 11-14 for slit

10-2 = same as 8 to 1 plus 4 cm (1’’).

Join 8 10.

11-10 = 1.5 cm.

Shape bottom 2-11 as shown Join and shape 4-10 smoothly.

Keep 3 cm (1¼") turn-in at 10-2 for hemming.

Keep 2 cm (¾") seam allowance at 10-4.

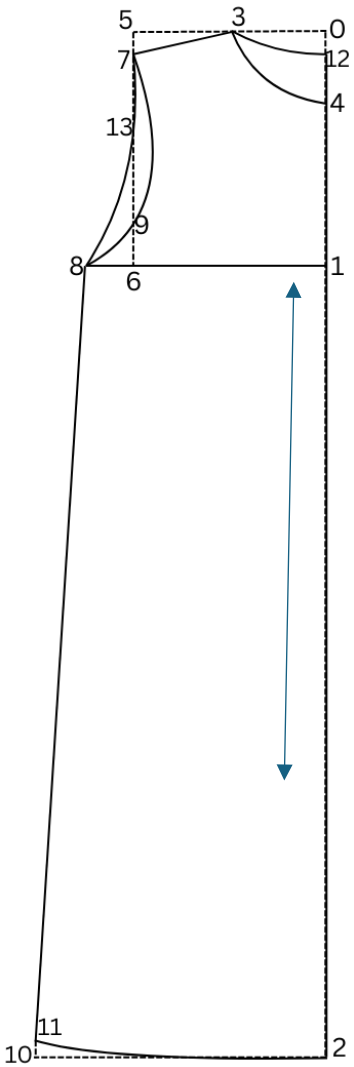


Plate 3.11: Gown S3 draft

Sleeve Drafting

Instructions

Square lines from point 0, with a fold at 2-0.

1-0 = One-eighth of the chest measurement + 6.5 cm (2½") ease.

2-0 = Sleeve length + 1 cm (¼") ease.

3-2 = Same as 1-0. Join 3-1 to complete the initial structure.

4-1 = One-eighth of the chest measurement.

5-0 = 2.5 cm (1") ease. Join 4-5 smoothly.

6 is midway between 4 and 5.

7-6 = 2 cm (¾") ease.

Shape the back side of the sleeve smoothly from 4-7-5.

Square up from 4 to 8.

8-4 = 5 cm (2")

Join 8-5 smoothly.

Take 1 cm (¼") above point 4, then shape the front side of the sleeve smoothly through 4-8-9-0.

10-2 = Half sleeve round + 1.5 cm (½") ease.

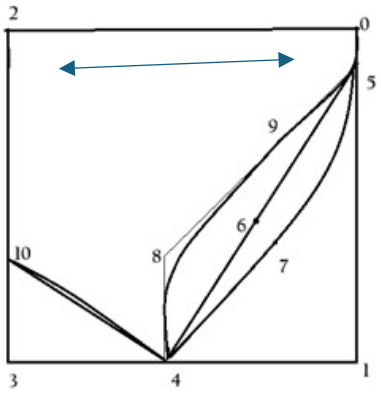


Plate 3.12: Sleeve S3 draft

3.4.6.1. Selection of Tailors and Artisans

Local tailors with expertise in stitching hospital garments and adaptive clothing were identified through privileged observer information and snowball technique, for the prototype development. Their experience in working with medical textiles and functional clothing was ensured to achieve precision in construction. The tailors were provided with detailed specification sheets, patterns, and sewing guidelines to maintain consistency in design execution and to ensure compliance with the design brief and usability requirements while developing the prototypes.

3.4.7. Bill of Materials (BOM)

A Bill of Materials (BOM) was developed, outlining the quantity and cost of materials required for production, ensuring that the design remained cost-effective.

Table 3.10: Table showing the framework to capture the data for Bill of Materials

Sr. No.	Material Description	colour and pattern	width/ thickness	content	Quantity	Unit	Purpose	cost / unit
1	The Fabric							
2	Thread							
3	Buttons							

3.5 Evaluation of Designed Adaptive Garments

The evaluation phase involved testing the prototypes with actual users to ensure they addressed the identified needs of bedridden patients and caregivers. This phase assessed the comfort, accessibility, and ease of use of the garments in real-world settings.

3.5.1 Participant Selection

A group of patients and caregivers meeting the inclusion criteria for wearing adaptive garments was selected for the wear trials. Three patients from each department (orthopaedic and surgery) were chosen, ensuring diverse feedback from individuals experiencing different types of acute bedridden conditions.

3.5.2. Preparation of Evaluation Metrics

Evaluation metrics were developed to assess various aspects of the adaptive garments, including

Comfort (fit, breathability, skin-friendliness)

Ease of dressing and undressing (for both patients and caregivers)

Overall satisfaction (user perception and usability).

The metrics were designed to capture both subjective feedback from patients and caregivers and objective assessments based on garment accessibility through 5 point Likert scale.

3.5.3. Wear Trials of Prototypes

Participants wore the adaptive garment during their daily routines over a period of 10 hours, allowing for real-world evaluation of their functionality. The wear trials followed a structured rotation system (Table below….) to ensure all garments were tested across different users.

This structured testing ensured each selected patient (they were selected through purposive random sampling and informed consent forms (*Appendix 3,4*) were given to both the patient and their caregiver considering their willingness to participate in the study) had the opportunity to wear and evaluate all three garment designs.

Table 3.11. Details about the wear trial of prototypes to patient for both the Departments

Day 1	Day 2	Day 3
Patient 1-Garment 1	Patient 1-Garment 2	Patient 1-Garment 3
Patient 2-Garment 2	Patient 2-garment 3	Patient 2-Garment 1
Patient 3-Garment 3	Patient 3-garment 1	Patient3 -Garment 2

3.5.4. Collection of Feedback

Feedback from patients and caregivers was collected through evaluation form (*Appendix 7*), direct observations, during and after the wear trials. The feedback collection process involved both qualitative and quantitative methods to assess the effectiveness of the adaptive garments. Qualitative feedback was obtained through patients and caregivers, providing insights into their experiences and challenges with the garments. The focus areas for feedback included:

Comfort and Fit: Did the garment feel comfortable for prolonged wear?

Ease of Use: Was dressing and undressing simple for both patients and caregivers?

Fabric Performance: Did the material cause any irritation, discomfort, or overheating?

Functionality: Were the adaptive features effective in aiding patient care?

Quantitative data was gathered using Likert scale ratings to measure key aspects such as ease of use, comfort, and adaptability.

3.5.5. Analysis of Feedback data

The collected feedback was systematically analysed to evaluate the performance of adaptive garments in comparison to traditional hospital wear.

Descriptive Statistics and Attribute Evaluation

The quantitative analysis of adaptive clothing prototypes was conducted using descriptive statistical methods, including mean (average score) calculation, frequency distribution, and percentage analysis. A structured 5-point Likert scale was utilized to evaluate key performance parameters such as fabric softness, comfort, ease of movement, adaptability, and medical accessibility.

The mean score for each parameter was calculated using the formula:

Mean=∑ X/N

where X represents individual Likert scale responses, and N is the total number of responses.

Additionally, frequency distribution and percentage analysis were used to determine the proportion of respondents selecting each rating. The percentage for each score was calculated as:

Percentage=

(Total responsesFrequency of responses at a given scale point×100/Total responses

Frequency of responses at a given scale point)

For instance, if 80 per cent of respondents rated fabric softness as 5 (excellent), it indicated a high level of satisfaction in that category. The combination of these methods ensured an objective, data-driven evaluation of the garments' effectiveness in meeting the needs of bedridden patients.

In addition to the quantitative analysis, a qualitative assessment was conducted to gain deeper insights into the user experience with the adaptive garments. Open-ended responses were collected from caregivers and patients, focusing on aspects such as overall comfort, ease of use, garment functionality, and any suggestions for improvement

3.5.6. Reporting and Recommendation

The research report provided key insights for healthcare providers, designers, and manufacturers, emphasizing the design, evaluation, and effectiveness of adaptive garments for bedridden patients. It highlighted comfort, ease of dressing, and caregiver accessibility, offering specific recommendations for optimizing garment design

Chapter IV

RESULTS AND DISCUSSION

This study aimed to design and develop adaptive garments for bedridden patients using a user-centred design approach. The goal was to create clothing that enhanced patient comfort, caregiver efficiency while addressing the specific challenges of dressing and undressing immobile individuals. The garments incorporated features such as open-side and front designs, loose fit garment, soft-breathable fabric and easy-access fastenings to improve comfort and accessibility.

The study was conducted in three phases. The first phase involved data collection through semi structured questionnaires and caregiver interviews to identify key challenges and garment requirements. The second phase focused on design and prototype development, incorporating user feedback to refine the garment features. The final phase involved evaluating the adaptive garments through caregiver trials to assess their functionality, ease of use, and patient comfort.

4.1 Need gap identification of bedridden patients

4.1.1. Demographic details of patients and caregivers.

4.1.2. Existing environment and clothing of the users

4.1.3. Key insights from data analysis regarding patient needs

4.1.4. Findings of market survey of existing adaptive garment

4.2 Design and development of user-centred adaptive garments

4.2.1. Design brief and user profile

4.2.2. Conceptualization and selected design features based on user Feedback

4.2.3. Final design selection

4.2.5. Preparation of the specification sheet

4.2.6. Prototype construction

4.2.7. Bill of Materials

4.3 Evaluation of designed adaptive garments

4.3.1. Wear trial outcomes: usability, comfort, and accessibility

4.3.2. Data analysis results

4.4. Reporting and Recommendation

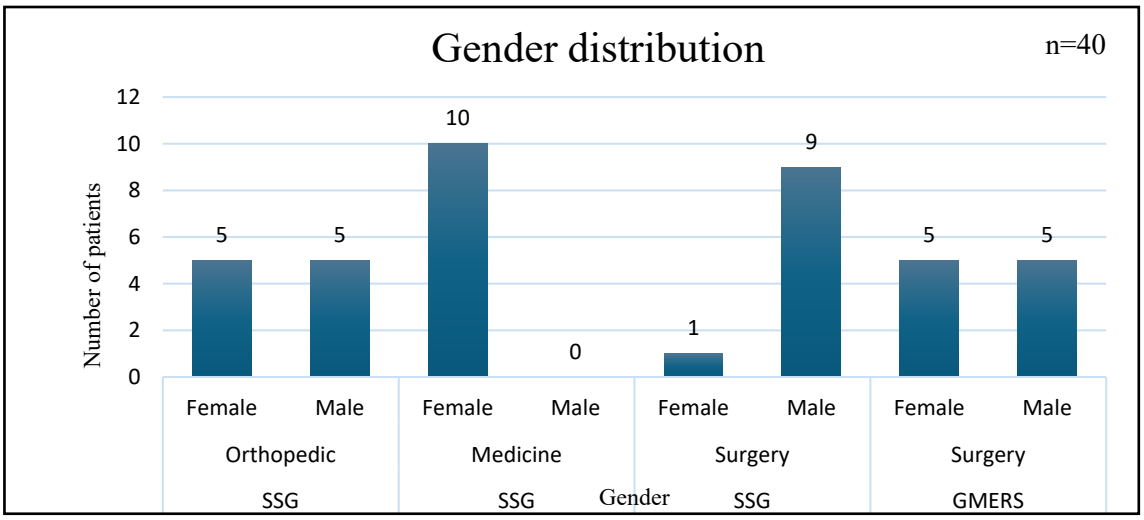
4.1 Need Gap Identification of Bedridden patients

The study was conducted in Vadodara city and two government hospitals were selected namely S.S.G Hospital and G.M.E.R.S. Hospital to identify the problems faced by the Acute Bedridden patients and their caregivers in terms of dressing and undressing the patient and to collect data from the patients including the Comfort, Mobility, accessibility, current clothing options available in the hospital, satisfaction level in current clothing and specific issues.

4.1.1. Demographic Details of Patients and Caregivers

The Information regarding the Demographic details of the Patients and their Caregivers were important to understand the present scenario in terms of their current clothing options, their environment, comfort, accessibility, ease of dressing undressing, satisfaction levels for current clothing, their needs and preferences for user centred design and for that a total of 40 samples were selected and this was important for the fulfilment of Objective I which is to identify and address specific issues faced by the caregivers of bedridden patients.

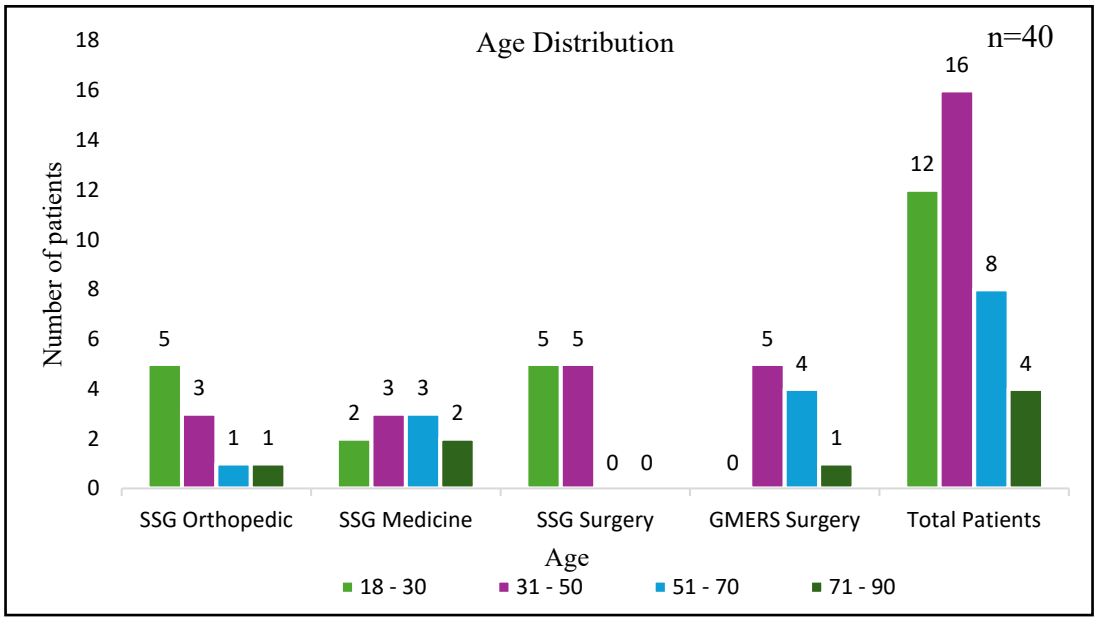
4.1.2.1. Gender



Graph 4.1: Distribution of patients according to Gender in different departments at SSG and GMERS

Out of 40 bedridden patients, 26 (65 per cent) were female. The SSG Medicine department had all 10 patients (100 per cent) female, while the SSG Orthopaedic (50 per cent), SSG Surgery (10 per cent), and GMERS Surgery (50 per cent) had varying distributions. This highlighted the need for a unisex adaptive garment that ensured comfort, inclusivity, and functionality for all patients while simplifying hospital clothing management.

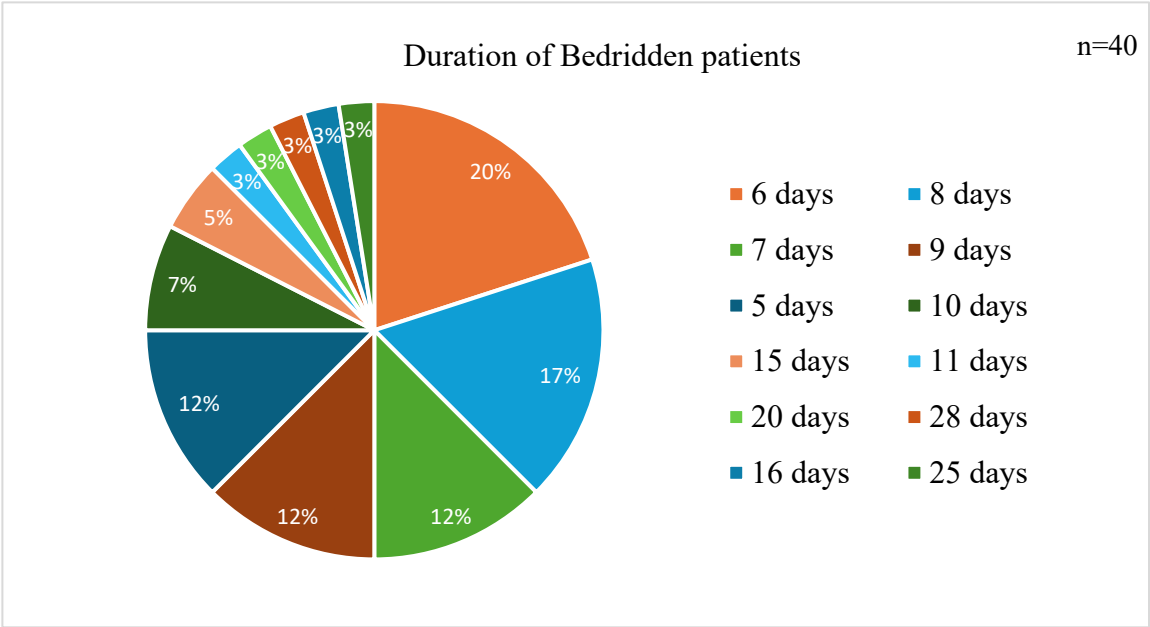
4.1.2.2. Age



Graph 4.2: Distribution of patients according to age in different departments at SSG and GMERS

The graph shows that 40 per cent of bedridden patients were aged 31-50, 30 per cent were 18-30, 20 per cent were 51-70, and 10 per cent were 71-90. SSG Medicine had the widest age range, while SSG and GMERS Surgery had more younger patients. This data is useful for designing adaptive garments that suit different age-related needs, ensuring comfort and ease of use.

4.1.2.3. Time duration

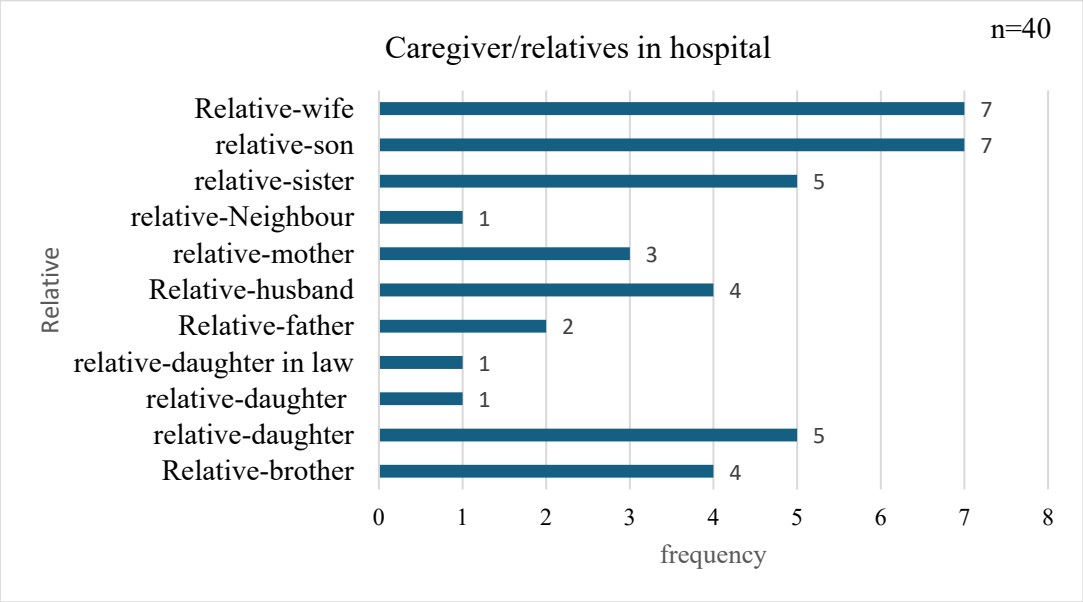


Graph 4.3: Duration of bedridden period in Hospital in different departments

The chart shows that 6 days (20 per cent) were the most common bedridden duration, followed by 8 days (17 per cent). About 36 per cent of patients were bedridden for 7-10 days, indicating a short-term trend, while longer durations (20-28 days) were less frequent (3-5 per cent). This data was useful for designing adaptive garments that accommodated both short-term and long-term bedridden patients, ensuring ease of dressing, comfort, and caregiver efficiency

4.1.2.4. Caregivers of the patients:

The caregivers in the selected hospital were the relative of the patients themselves and not the professionals but used to assist whenever required.



Graph 4.4: Caregiver/relatives in hospital

The chart shows the frequency of different relatives involved. Relative-wife, relative-son, relative-sister, and relative-daughter are the most common, each at 22 per cent (7 out of 32 total counts). Relative-husband and relative-brother follow at 13 per cent (4 each). Relative-mother accounts for 9 per cent (3), while relative-father, neighbour, and daughter-in-law have lower involvement at 3-6 per cent (1-2 each). This suggests that immediate family members, particularly wives, sons, and daughters, are the primary caregivers or involved individuals and no professionals were involved in assistance.

4.1.2.5. Reasons of being Bedridden:

Table 4.1: Details about reasons of being bedridden in each Department n=40

Department	Reason for Being Bedridden	Count
Orthopaedic	Fracture in leg	8
	Fracture in both legs	1
	Fracture in both hands and legs	1
Total (Orthopaedic)		**10**
Medicine	Decrease in blood, cough, fever	3
	Muscle contraction	1
	Vomiting due to diabetes	1
	Vomiting, dizziness	1
	Fever, urine infection	2
	Paralysis	1
	Bypass surgery, breathing problem	1
Total (Medicine)		**10**
Surgery	Accident + leg injury + pus discharge	1
	Head injury	2
	Surgery in upper limbs due to swelling	1
	Gallbladder infection	1
	Cyst in pancreas	1
	Leg surgery due to burn	1
	Injury in stomach	1
	Hernia	2
	Intestine operation	1
	Leg operation	1
	Operation in spinal cord (upper)	1
	Operation in lower back	1
	Surgery of hips	3
	Brain surgery (brain haemorrhage)	1
	Head surgery	1
	Stomach surgery	1
Total (Surgery)		**20**

The analysis of 40 bedridden patients revealed that Orthopaedic cases (25 per cent) were primarily due to fractures, while Medicine cases (25 per cent) resulted from infections, blood-related issues, and paralysis. Surgical cases (50 per cent) were caused by injuries, organ-related conditions, and major operations. Mobility impairments from fractures and surgeries were the leading causes of bedridden status. This suggested that the Medicine department required the least adaptability in garments, whereas the Surgery and Orthopaedic departments had the greatest need for user-centred adaptive clothing to support patient comfort and ease of caregiving.

4.1.3. Key insights from data analysis regarding patient needs

-Comfort level with the current clothing options in each department:

4.1.3.1. Orthopaedic department

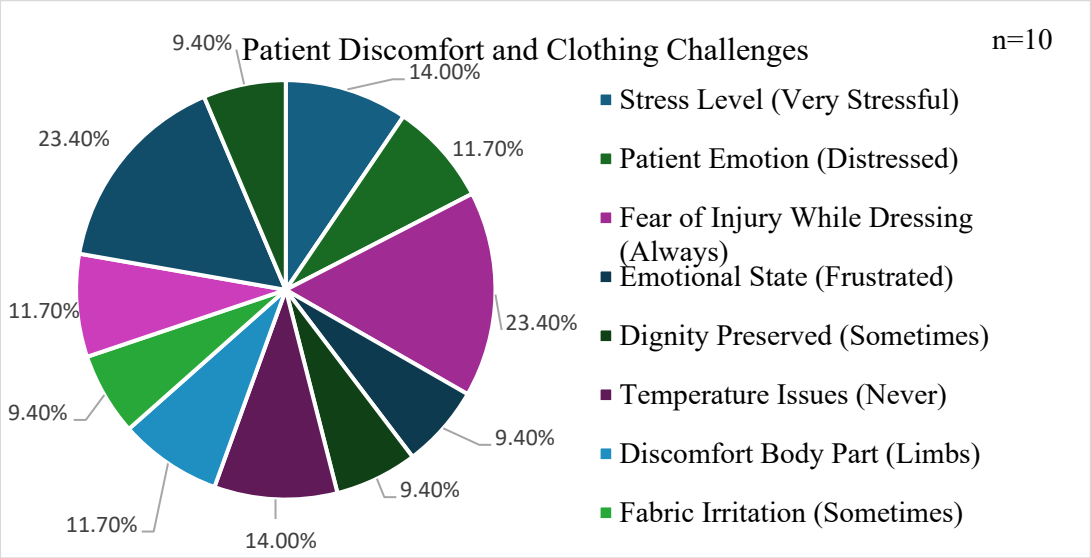
4.1.3.2. Medicine department

4.1.3.3. Surgery department

4.1.3.4. Preferences of Orthopaedic patients

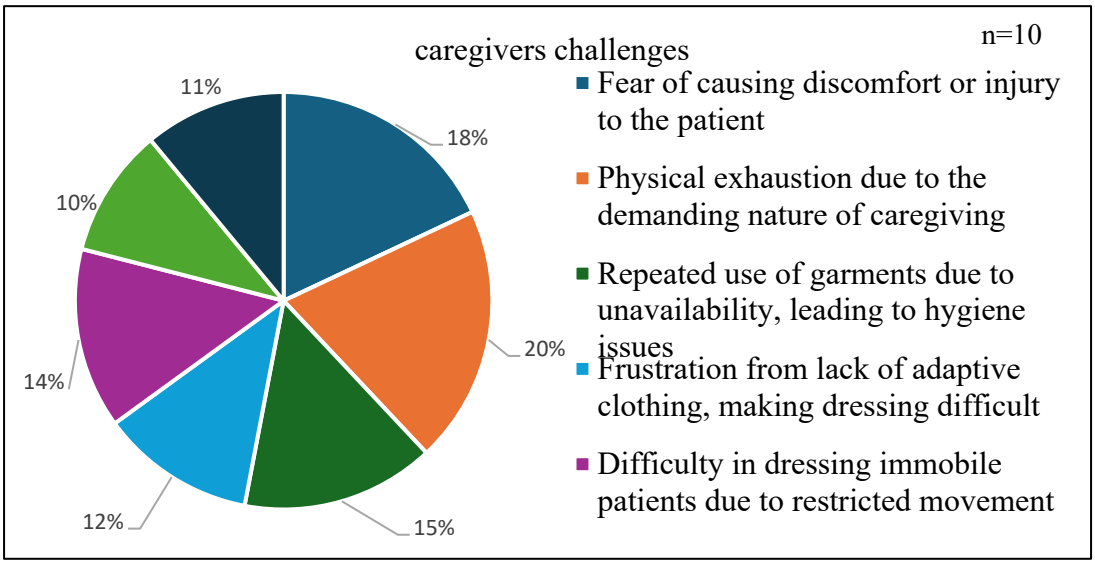
4.1.3.5. Preferences of Surgery patients

4. 1.3.1. Orthopaedic department ((n=10 patient, n=10 caregiver))



Graph 4.5: Patient Discomfort and Clothing Challenges in Orthopaedic Department

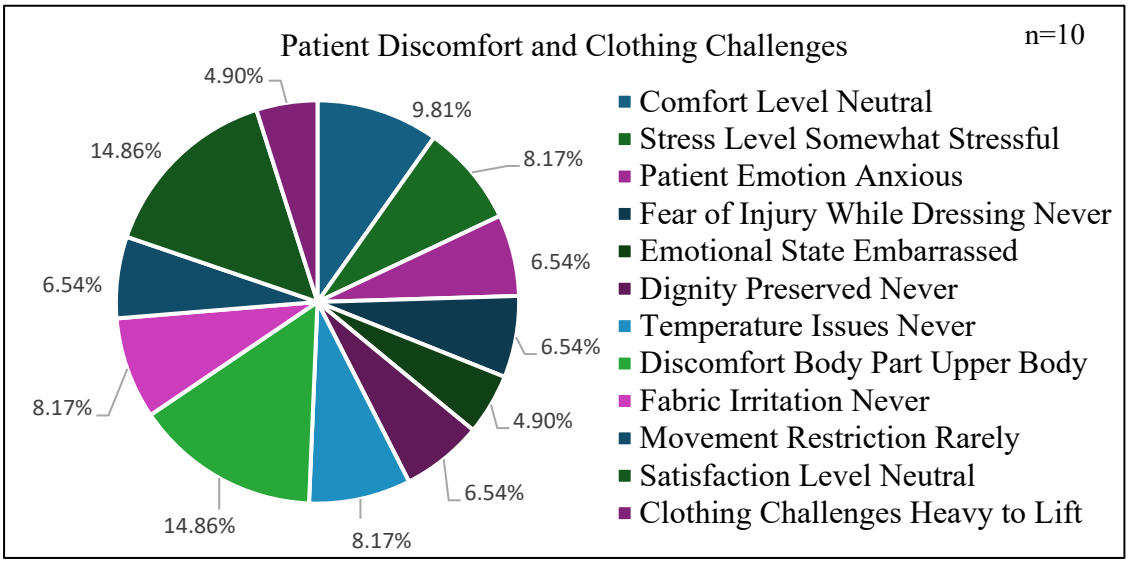
The pie chart highlighted key clothing challenges for orthopaedic patients, with fear of injury and temperature issues (23.4 per cent each) as top concerns. Stress (14 per cent) and dignity preservation (14 per cent) were also significant, along with emotional distress, frustration, fabric irritation, movement restriction, and limb discomfort. The findings underscored the need for adaptive clothing to enhance comfort, reduce stress, and improve mobility.



Graph 4.6: Caregivers challenges in Orthopaedic Department

Caregivers face significant challenges, including physical exhaustion (20 per cent), fear of causing injury (18 per cent), and hygiene issues due to garment unavailability (15 per cent). Dressing immobile patients (14 per cent), frustration from lack of adaptive clothing (12 per cent), emotional stress (11 per cent), and the time-consuming dressing process (10 per cent) further add to their burden, emphasizing the need for adaptive clothing.

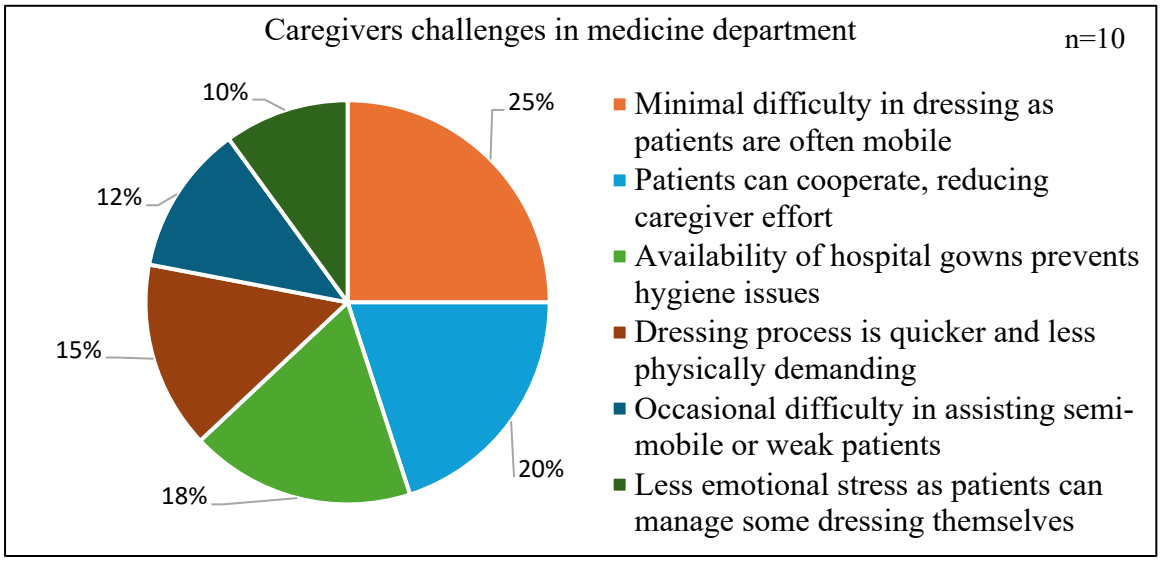
4.1.3.2. Medicine department (n=10 patient, n=10 caregiver**)**



Graph 4.7: Patient Discomfort and Clothing Challenges in Medicine Department

The pie chart highlights patient discomforts and clothing challenges, with notable concerns like neutral comfort (9.81 per cent), somewhat stressful experience (8.17 per cent), and

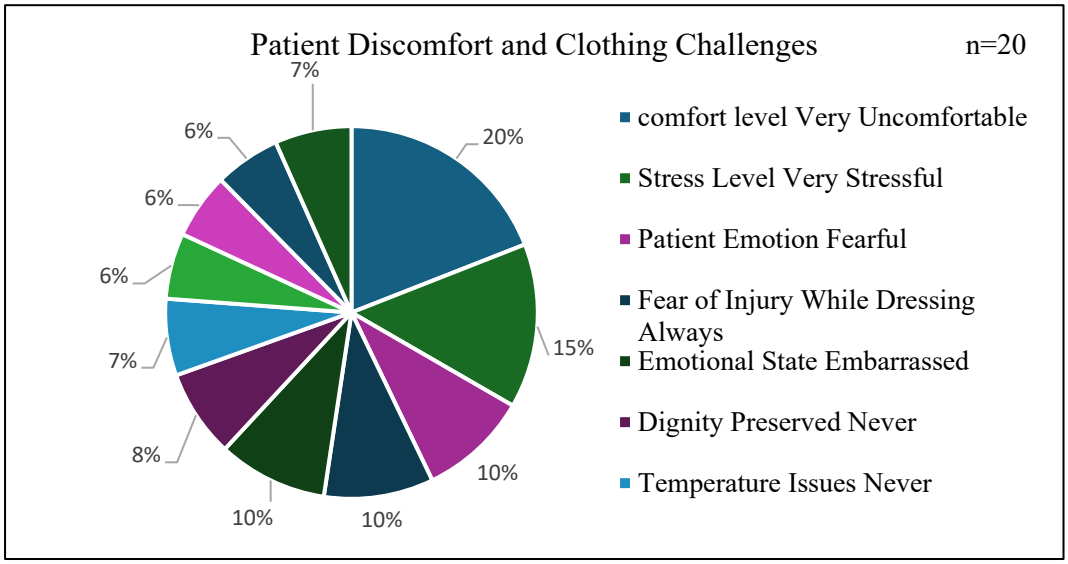
anxiety (8.17 per cent). Major issues include heavy-to-lift clothing (14.86 per cent) and dignity not preserved (6.54 per cent). Fear of injury, temperature issues (6.54 per cent each), and movement restriction (4.90 per cent) are less frequent. Overall, while challenges exist, they may not strongly justify the need for adaptive garments



Graph 4.8: Caregivers challenges in Medicine Department

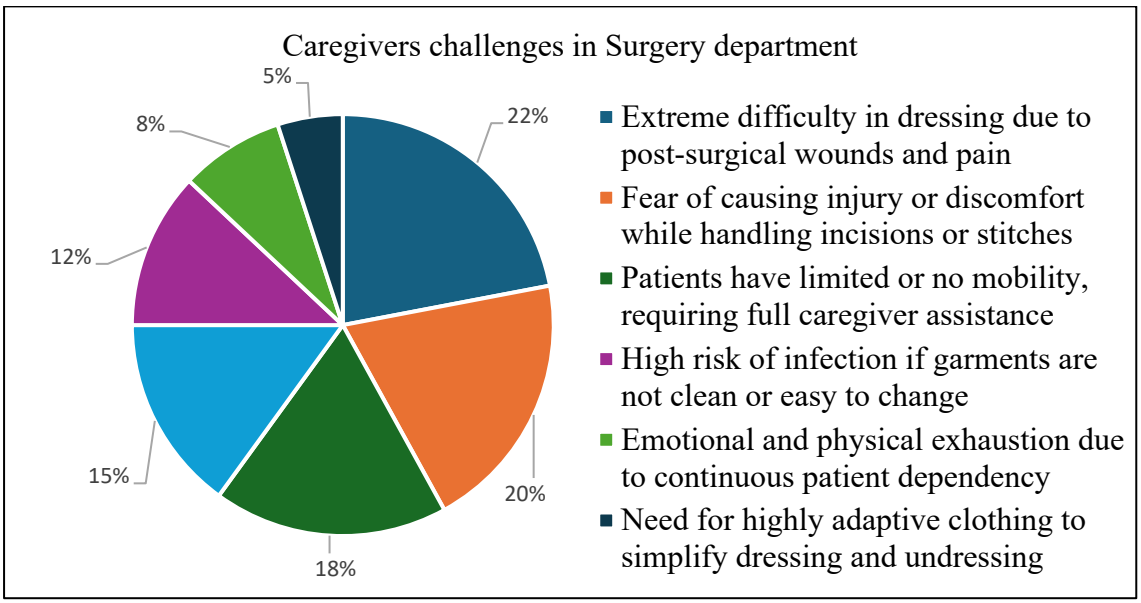
The pie chart showed restricted movement (25 per cent) and pain while dressing (25 per cent) as the main challenges for bedridden patients, along with discomfort (20 per cent), difficulty in wearing garments (15 per cent), and fabric irritation (15 per cent). These findings highlighted the need for adaptive clothing, with the Surgery department requiring it most due to mobility limitations and post-operative care needs.

4.1.3.3. Surgery department (n=20 patient, n=20 caregiver**)**



Graph 4.9: Patient Discomfort and Clothing Challenges in Surgery Department

The chart shows that 20 Per cent of patients feel very uncomfortable, and 15 Per cent experienced high stress due to clothing. 10 Per cent fear injury while dressing, while 10 Per cent feel embarrassed. 8 Per cent report dignity concerns, 7 Per cent face temperature issues, and 6 Per cent each struggle with upper body discomfort, fabric irritation, movement restrictions, and dissatisfaction.

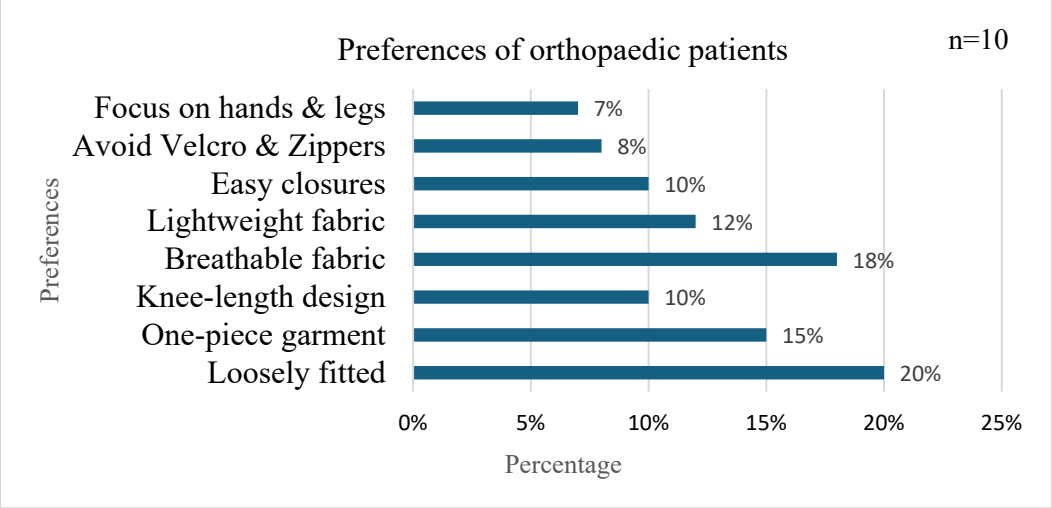


Graph 4.10: Caregivers Challenges in Surgery Department

The main challenges in the surgery department include extreme difficulty in dressing (22 per cent), fear of causing injury (20 per cent), and mobility limitations requiring full caregiver assistance (18 per cent). Frequent dressing changes (15 per cent) and infection risk from unclean garments (12 per cent) add to the workload. Emotional and physical exhaustion (8 per cent) is also a concern, while the need for adaptive clothing (5 per cent) highlights potential solutions for easing dressing challenges.

The findings indicate that surgery and orthopaedic patients have the greatest need for adaptive garments due to their limited mobility, fear of injury, and severe post-surgery conditions. The high levels of discomfort, stress, and movement restrictions highlight the necessity of clothing that enhances ease of dressing, ensures comfort, and minimizes risks associated with movement and pressure on affected areas. Adaptive garments can significantly improve the overall well-being and recovery experience for these patients.

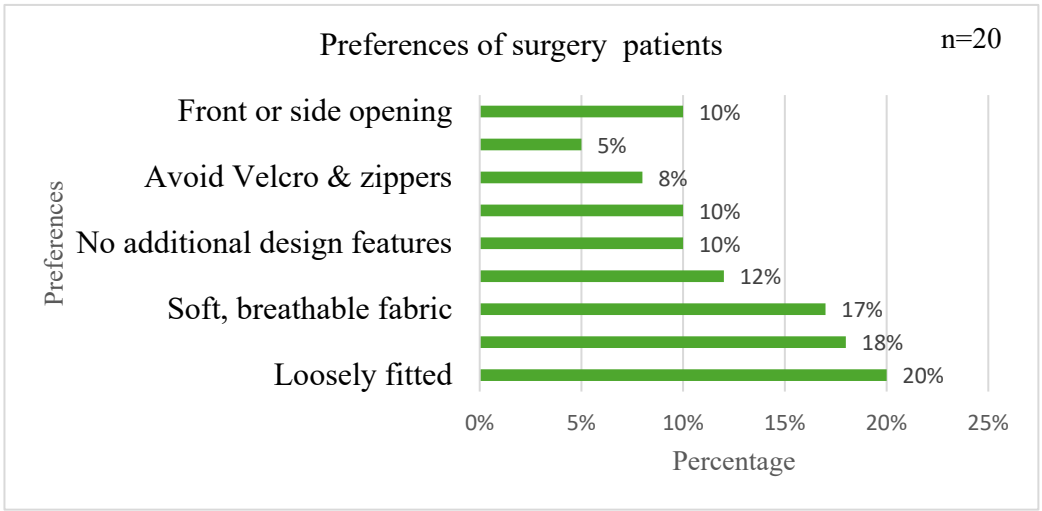
4.1.3.4. Preferences of Orthopaedic patients



Graph 4.11: Preferences of Orthopaedic Patients for Adaptive Garment

The bar graph showed orthopaedic patients' key clothing preferences for adaptive garments, with loosely fitted designs (20 per cent), breathable fabric (18 per cent), and one-piece garments (15 per cent) as top choices. Lightweight fabric (12 per cent), easy closures (10 per cent), and adaptive features for hands and legs (7 per cent) were also important, while Velcro and zippers (8 per cent) were avoided. These findings help in developing user-centred adaptive clothing that improves comfort, mobility, and ease of use.

4.1.3.5. Preferences of surgery patients



Graph 4.12: Preferences of Surgery Patients for Adaptive Garment

The bar graph shows surgery patients preferred loosely fitted garments (20 per cent), breathable fabric (17 per cent), and lightweight materials (18 per cent) for comfort. Front/side openings (10 per cent) and simple closures (10 per cent) were favoured,

These findings aided in designing adaptive garments for better comfort and accessibility.

4.1.2. Existing environment and clothing of the users

In S.S.G. Hospital Each department had four to five wards, each accommodating around 50 patients, including a female-designated ward. Staffing included nurses, sub-head nurses, and resident doctors, with departments spanning 2000–3000 sq. ft. The wards had ceiling fans but lacked air conditioning, relying on window ventilation.

A key issue was the absence of professional caregivers, leaving relatives responsible for patient care, including dressing and undressing. The hospital provided no standard patient garments, except OT gowns for surgery. Many patients wore the same clothes for over 10 days, causing poor hygiene, and relatives sleeping on patient beds further worsened sanitation conditions.

In G.M.E.R.S. Hospital, the study was conducted in the Surgery Department, which included general wards along with 3 male and 3 female wards each with 20 beds capacity

Plate 4.1: Floor Layout of the S.S.G. Hospitals ward

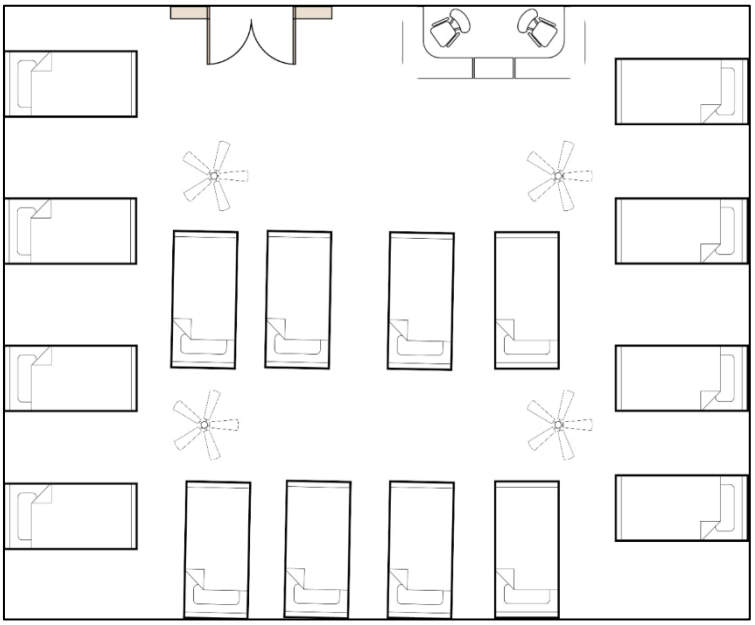


Plate 4. 2: Floor Layout of the G.M.E.R.S. Hospitals ward

It was observed that during their admitted period in the hospital, the patients were not provided with hospital gowns, and a lack of hygiene too was observed by the researcher during data collection and field surveys. It was noted that some patients went without changing their clothing for several days, often continuing to wear the same garments they had on during their accident or injury. The relatives, who acted as caregivers, assisted with basic needs but, due to lack of awareness and proper resources, were reluctant to help dress the patients, as suitable garments were unavailable. This situation highlighted a significant gap in patient care, where both patients and caregivers faced challenges due to the unavailability of adaptive garments and the lack of proper clothing hygiene.

4.1.2.1. Current clothing worn in hospitals

Table 4.2: Current clothing in hospitals n=40

Clothing Type	Frequency	Percentage (per cent)
One piece-gown	11	27
Two piece-Shirt and Track pant	7	17
Two piece-Salwar kameez	4	10
Two piece-Shirt, pant	3	7
Saree	3	7
Two piece-Shirt, jeans	3	7
Two piece-t-Shirt, Track pant	2	5
Only shirt	2	5
Two piece-T-shirt, plazo	1	3
Shirt only	1	3
Two piece-T-shirt, Shorts	1	3

The data revealed that bedridden hospital patients primarily wore their own clothing brought from home, with 27 per cent having worn one-piece gowns and 73 per cent having opted for various two-piece outfits, such as shirt & track pants (17 per cent) and salwar kameez (10 per cent). The variety in clothing choices highlighted the lack of standardized, patient-friendly attire, as traditional garments like sarees (7 per cent) and standalone shirts (5 per cent) were less practical for prolonged bedridden periods. This indicated a strong need for user-centred adaptive garments that prioritized comfort, accessibility, and ease of use for both patients and caregivers, ensuring effortless dressing, movement, and medical care.

4.1.4. Findings of market survey for existing adaptive garment

A market analysis of Amazon and Flipkart revealed that adaptive hospital gowns are predominantly made from polyester or polyester blends, with limited availability of high-quality cotton options. The pricing on these platforms varies significantly:

- Amazon: ₹350 to ₹12,000
- Flipkart: ₹360 to ₹8,000

This price range suggests that affordable and comfortable adaptive clothing is scarce, especially for budget-constrained government hospitals, where the allocated budget per gown is around ₹350.

Also, online sites were visited for which National as well as international brands were visited to identify the gap in current adaptive clothing for bedridden patients.

A local market survey in Vadodara further confirmed this gap, showing that no specific garments are designed for bedridden patients. The lack of accessible, breathable, and affordable options highlights an urgent need for cost-effective adaptive hospital clothing, particularly for government healthcare facilities that require functional and comfortable solutions.

Table 4.3: Table showing the details of adaptive garments

Platform	Price Range (₹)	Fabric Type	Features
Amazon	350 - 12,000	Polyester, Cotton blend, antibacterial fabric	Back-opening, varying comfort levels, high price and not specific for bedridden patients
Flipkart	350 - 8,000	Polyester, Cotton Blends	Basic designs, limited high-quality cotton options

Bedridden Patient Clothing
Platform-Flipkart
Fabric-Polyester
Price- ₹367

Hospital Gowns for woman
Platform-Flipkart
Fabric-Polycotton
Price- ₹563

Gowns for men
Platform-Amazon
Fabric-Polycotton
Price-₹556

Unisex Gown for Hospitals
Platform-Amazon
Fabric-Polyester
Price-₹607

Plate 4.3: Images of Adaptive garment during market survey

Website 1:

International brands

Silvert's Adaptive Clothing & Footwear, founded in 1930, designs and distributes adaptive clothing and footwear for people with disabilities, seniors, and others with unique clothing needs, focusing on ease of dressing and caregiver assistance

Men Open Back Long Sleeve Henley Shirt
₹ 3399

Unisex Tear-Away Post Surgery Top
₹ 3922

Men's Open Back Flannel Nightgown Bundle - 3 Pack
₹ 9412

Plate 4.4: Images of Adaptive garment in sliverts

Website 2:

National brands

Haxor is an Indian adaptive clothing brand specializing in functional and stylish apparel for people with diverse mobility needs, focusing on inclusivity and ease of dressing for seniors and individuals with disabilities.

Post surgery recovery Velcro open tearaway full sleeve sky premium cotton t-shirt
₹1499

Haxor bedridden patient clothing, hook and loop tear away cotton patient gowns
₹1999.

Haxor post-surgery recovery Velcro open tearaway full sleeve pink premium cotton t-shirt and trouser
₹2499

Plate 4.5: Images of Adaptive garment in haxor

4.2 Design and Development of User-Centred Adaptive Garments

The Design and Development of User-Centred Adaptive Garments involved creating detailed user profiles to understand patient needs and preferences. Based on these profiles, 30(15 each) garments were designs selected according to preferred criteria such as, fit, design and closure. Wear trials were conducted to assess comfort, functionality, and ease of use ensuring the fulfilment of objective 2 which is to create garment with features like comfort and accessibility simplifying caregiver's task.

4.2.1. Design brief and user profile

Based on the data collected a user profile was created for both the departments which is the Orthopaedic department and surgery department including their general Demographic details, details regarding the condition of patient's challenges faced, preferences of the patients in each department and common concerns.

User Profile: Acute Bedridden Patients in Orthopaedic and Surgery Departments in government hospitals of Vadodara – S.S.G and G.M.E.R.S

1. **General Demographics:**

- Age Group: 18-80 years
- Socioeconomic Background: Lower-income families, financially dependent on daily wages, pensions, or family support.
- Hospital Stay Duration: 3 days to 1 month, depending on recovery.
- Support System: Relies on caregivers (family members) for dressing, movement, and daily activities.
- Hygiene and Clothing Challenges: Limited access to clean clothing and hygiene facilities, making easy-to-change clothing essential.

Table 4.4: User profile of patients n=40

Category	Orthopaedic Patients	Surgery Patients
Reason for Being Bedridden	- Leg fractures (single/both), requiring immobilization. - Hand fractures (both hands), leading to full dependency on caregivers.	- Hernia, appendix, post-surgery recovery, pus formation, ulcers. - Post-surgery weakness, fatigue, and reduced mobility.
Mobility Challenges	- Slight movement possible with caregiver help. - Needs support to sit up, shift positions, and dress.	- Mostly confined to bed, less mobile than orthopaedic patients. - Can sit up with assistance but struggles to move independently.
Dressing Challenges	- Cannot wear tight or restrictive clothing due to plaster, braces, or support structures. - Prefers one-piece, front-opening garments with easy closures. - Avoids elastic closures to prevent discomfort.	- Cannot bend or exert effort to dress due to surgical incisions. - Needs one-piece, loose-fitting garments with front or side openings. - Avoids elastic closures to prevent pressure on wounds.
Emotional and Psychological Factors	- Feels frustrated due to dependency on caregivers. - Experiences pain, discomfort, and irritation from immobilization. - Concerns about loss of dignity and privacy.	- Feels weak, exhausted, and anxious about health. - Fear of wound infections and delayed recovery. - Concerns about loss of dignity and privacy.
Recommended Clothing Solution	- One-piece, loose-fitting garment to minimize pressure on injured areas. - Front or side openings with snap buttons, tie closures, or zippers (no elastic). - Wide armholes and leg openings for easy dressing. - Soft, breathable, lightweight fabric. - Minimal seams and tags to avoid irritation. - Dark-coloured material for hygiene and stain concealment.	- One-piece, loose-fitting garment for comfort and ease of movement. - Front or side openings with snap buttons, tie closures, or zippers (no elastic). - Soft, breathable, lightweight fabric. - Minimal seams and tags to avoid irritation. - Dark-coloured material for hygiene and stain concealment. - Affordable options for low-income patients.

4.2.2. Conceptualization and selected design features based on user Feedback:

The design development for bedridden patients focused on ease of dressing, comfort, and caregiver accessibility, guided by user personas and expert insights. A hospital survey identified key needs such as adaptive closures, breathable fabrics, and simplified wearability. The co-guide then finalized three designs (per department), which were **digitally illustrated using Canva by the researcher.**

These designs prioritized accessibility, mobility, and improved patient-caregiver interaction, creating the way for prototype construction and evaluation.

4.2.3. Final design selection

The final designs were selected based on the needs and preferences of both patients and caregivers.

From each of the two chosen departments, 3 designs were finalized, ensuring they addressed the specific challenges faced in those medical settings. The selection process focused on ease of dressing, patient comfort, and caregiver convenience by incorporating adaptive features improve mobility, comfort, and overall patient challenges while reducing the physical strain on caregivers such as front/side openings and accessible closures. These designs aim to

Table 4.5: Final design selected for Orthopaedic Patients

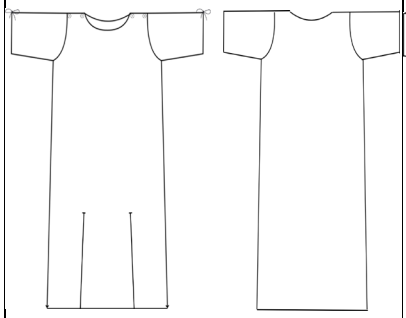
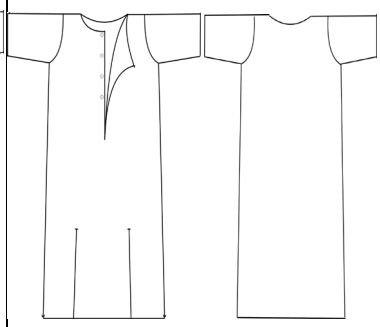
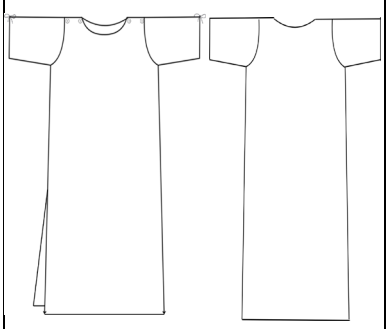
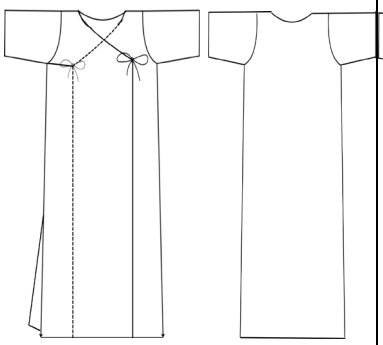
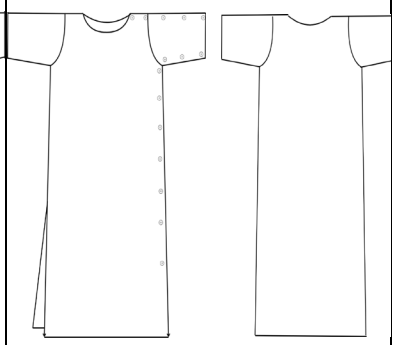
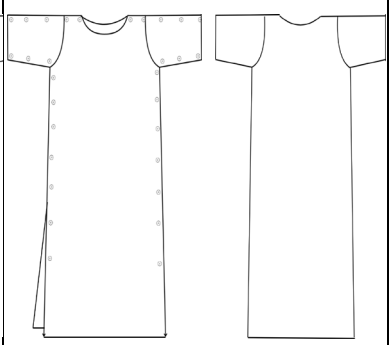
Design 1	**Design 2**	**Design 3**
		
Front Back	Front Back	Front Back
Code: O1	**Code: O2**	**Code: O3**

Table 4.6: Final design selected for Surgery Patients

Design 1	**Design 2**	**Design 3**
		
Front Back	Front Back	Front Back
Code: S1	**Code: S2**	**Code: S3**

4.2.3.1 Fabric selection

During the fabric selection phase, the researcher conducted a market survey to identify materials that met the needs and preferences of patients, caregivers, and hospital management.

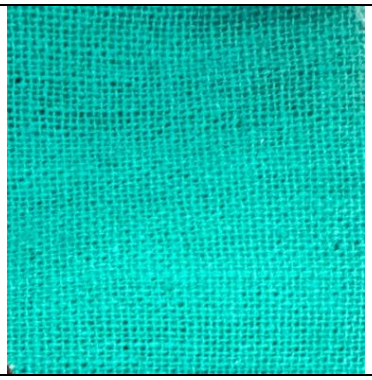
For which local shops from Vadodara were visited by the researcher and the best suited fabric along with cost consideration were chosen and selected on the basis of needs and preferences of the hospital management as well the caregivers and patients.

The focus was on fabrics that were soft, durable, breathable, and affordable. Various options were considered, including:

Table 4.7: Fabric Description of Various Fabrics

Fabric Type	**Price (₹/meter)**	**Width (inches)**	**Description**
Polycotton	36	35	Soft and durable blend of polyester and cotton, budget-friendly but narrower width.
Cotton Casement	60	40	Medium-weight cotton with good durability and breathability, suitable for hospital use.
Cotton fabric	65	45	Pure cotton, soft and breathable, slightly wider for better coverage.
Cotton Printed (Polka Dots)	80	46	Lightweight cotton with polka dot print adds aesthetic appeal while maintaining comfort.
White Cotton Cambric	65	36	Fine, tightly woven cotton, smooth texture, and good breathability.
Floral printed fabric	80	42	Printed cotton with a floral pattern, visually appealing with a soft texture.
Cotton blend (White and Green Stripes)	90	60	Cotton blend with a wider width, durable and breathable, suitable for hospital wear.

Table 4.8: Swatches of the fabrics sorted during survey

Swatches of fabric	
1.Polycotton	2.Cotton casement
	
3. Cotton fabric	4. Poly cotton
	
5. White Cotton Cambric	6. Floral Printed fabric
	
7. Cotton Blend (White and Green Stripes)	
	

4.2.3.2 Final fabric selection

After conducting a thorough market survey, the researcher selected the most suitable fabric for the final garment construction.

The **white and green striped cotton blend fabric** emerged as the best choice due to its **softness, breathability, durability, and affordability**.

width - 60 inches

price - ₹90 per meter,

It provided maximum coverage while maintaining comfort for bedridden patients. This fabric not only met the preferences of patients and caregivers but also aligned with hospital management's requirements for practicality and ease of maintenance. Its selection ensured that the final adaptive garment would be both **Accessible and comfortable**, addressing the key challenges faced in hospital clothing.

Plate 4.6: Swatch of Final Fabric

4.2.5. Preparation of the specification sheet

The Specification Sheet provided detailed instructions for making the garments, including fabric type, measurements, stitching methods, and special features like easy closures and openings. It ensured accuracy and consistency in construction

Table 4.9: Specifications of all the garment

Features	Description	Purpose
Fabric Type	Cotton-viscose Blend	Lightweight, breathable, and durable
Fabric content	Cotton-75%, Viscose-25%	Breathability, softness, and flexibility
Fabric Weave	Twill Weave	Increases strength and durability
Fabric Pattern	White and Light Green Stripes	Standard hospital colour combination
Fasteners	Buttons, Tie Strings	Adjustable closures for easy wearability
Opening Style	Side/front Opening	Designed for easy dressing and undressing
Stitching Type	single Stitch & overlock hemming	Provides strength and prevents fraying
Size	Standard Unisex	Suitable for different body types
Tailoring Method	Local Tailor	Ensures quality and durability
Usage	Hospital/Patient Care	Designed for bedridden patients

Table 4.10: Measurement sheet (common for all)

Feature	Measurement (Inches)	Description
Garment Type	Unisex Gown	Standard size hospital gown for bedridden patients
Length	44 inches	Full gown length from shoulder to hem
Sleeve Length	10.5 inches	Above elbow length
Shoulder Width	19.5 inches	Shoulder seam to seam measurement
Sleeve Round	16 inches	Circumference of the sleeve opening
Chest Width	48 inches	Full chest circumference
Lower Width	50 inches	Gown width at the lower hem

Table 4.11: Specification sheet of Design 1 in Orthopaedic Department

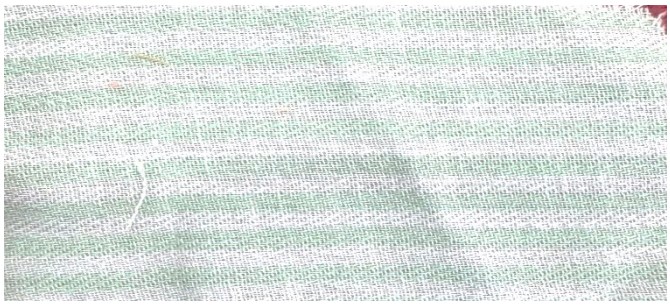
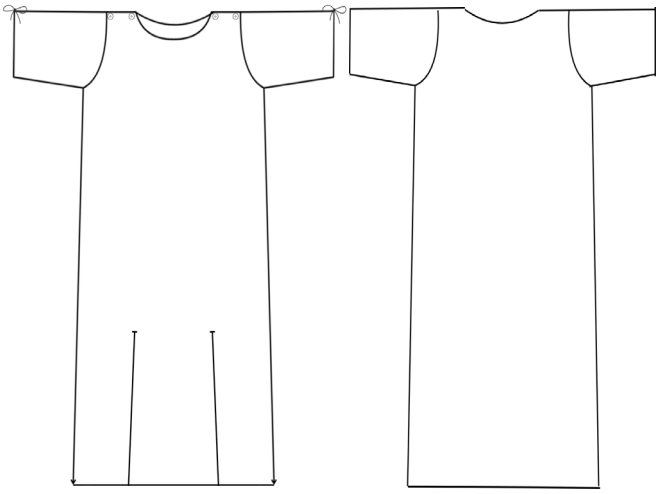
<table>
<tr><td colspan="2">Styles: One piece gown</td><td colspan="2">Date:26-02-2025</td></tr>
<tr><td colspan="4">Description and user need</td></tr>
<tr><td colspan="2">Use</td><td colspan="2">Healthcare</td></tr>
<tr><td colspan="2">User</td><td colspan="2">Hospitalised acute bedridden patients</td></tr>
<tr><td colspan="4">Material and fabric description</td></tr>
<tr><td>Fabric</td><td>Width</td><td>Content</td><td>Properties</td></tr>
<tr><td>Cotton Viscose Blend</td><td>60 inches</td><td>Cotton-75%, Viscose-25%</td><td>Lightweight, breathable, and durable</td></tr>
<tr><td colspan="4">Design feature</td></tr>
<tr><td colspan="2">Closure Type</td><td colspan="2">Buttons and Tie strings</td></tr>
<tr><td colspan="2">Sleeve Length</td><td colspan="2">Above elbow</td></tr>
<tr><td colspan="2">Opening</td><td colspan="2">Front shoulder</td></tr>
<tr><td colspan="2">Trims and fasteners</td><td colspan="2">Buttons and Tie strings</td></tr>
<tr><td colspan="2">Garment code</td><td colspan="2">O1</td></tr>
<tr><td colspan="2">Fabric swatch</td><td colspan="2">  </td></tr>
<tr><td colspan="2">Feature</td><td colspan="2">Technical sketch</td></tr>
<tr><td colspan="2">1.Calf-length design with coverage for patient comfort.
2.Buttons and tie strings closures on shoulders for easy dressing and undressing.
3.Front opening with leg separation for better accessibility and ease of use.
4.Loose fit to allow unrestricted movement and breathability.
5.Soft fabric to prevent skin irritation and enhance comfort</td><td colspan="2">  </td></tr>
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Table 4.12: Specification sheet of design 2 in Orthopaedic Department

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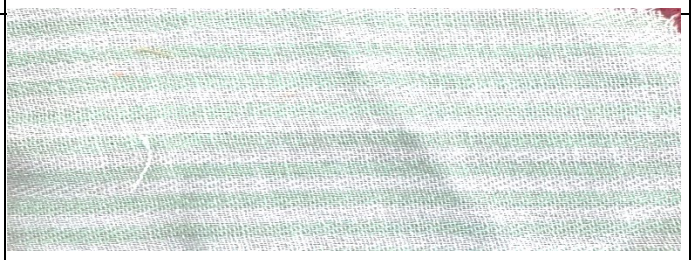
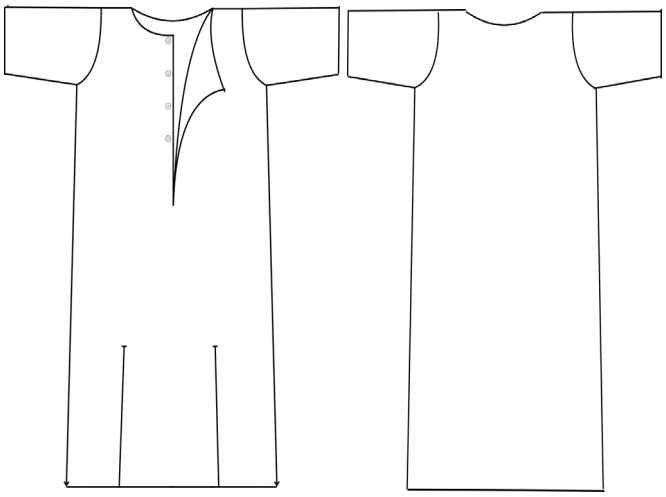
<tr><td colspan="2">Use</td><td colspan="2">Healthcare</td></tr>
<tr><td colspan="2">User</td><td colspan="2">Hospitalised acute bedridden patients</td></tr>
<tr><td colspan="4">Material and fabric description</td></tr>
<tr><td>Fabric</td><td>Width</td><td>Content</td><td>Properties</td></tr>
<tr><td>Cotton Viscose Blend</td><td>60 inches</td><td>Cotton-75%, Viscose-25%</td><td>Lightweight, breathable, and durable</td></tr>
<tr><td colspan="4">Design feature</td></tr>
<tr><td colspan="2">Closure Type</td><td colspan="2">Buttons and Tie strings</td></tr>
<tr><td colspan="2">Sleeve Length</td><td colspan="2">Above elbow</td></tr>
<tr><td colspan="2">Opening</td><td colspan="2">Front shoulder</td></tr>
<tr><td colspan="2">Trims and fasteners</td><td colspan="2">Buttons and Tie strings</td></tr>
<tr><td colspan="2">Garment code</td><td colspan="2">O2</td></tr>
<tr><td colspan="2">Fabric swatch</td><td colspan="2">  </td></tr>
<tr><td colspan="2">Features</td><td colspan="2">Technical sketch</td></tr>
<tr><td colspan="2">1. Calf-length design for complete coverage and comfort.
2. Front button closures for easy dressing and access.
3. Front opening with leg separation for better mobility and medical access.
4. Loose fit to ensure comfort and breathability.
5. Soft fabric to prevent irritation and enhance wearability</td><td colspan="2">  </td></tr>
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Table 4.13: Specification sheet of design 3 in Orthopaedic Department

<table>
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<tr><td colspan="4">Description and user need</td></tr>
<tr><td colspan="2">Use</td><td colspan="2">Healthcare</td></tr>
<tr><td colspan="2">User</td><td colspan="2">Hospitalised acute bedridden patients</td></tr>
<tr><td colspan="4">Material and fabric description</td></tr>
<tr><td>Fabric</td><td>Width</td><td>Content</td><td>Properties</td></tr>
<tr><td>Cotton Viscose Blend</td><td>60 inches</td><td>Cotton-75%, Viscose-25%</td><td>Lightweight, breathable, and durable</td></tr>
<tr><td colspan="4">Design feature</td></tr>
<tr><td colspan="2">Closure Type</td><td colspan="2">Buttons and Tie strings</td></tr>
<tr><td colspan="2">Sleeve Length</td><td colspan="2">Above elbow</td></tr>
<tr><td colspan="2">Opening</td><td colspan="2">Front</td></tr>
<tr><td colspan="2">Trims and fasteners</td><td colspan="2">Buttons and Tie strings</td></tr>
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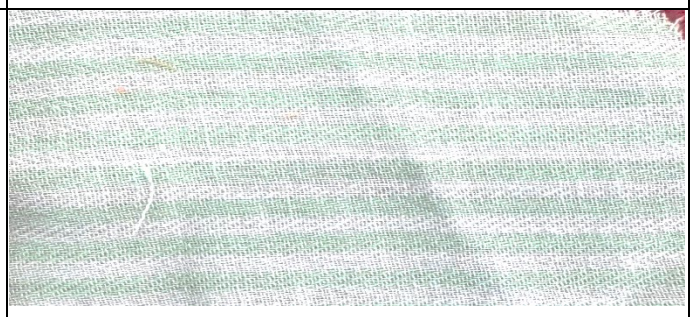
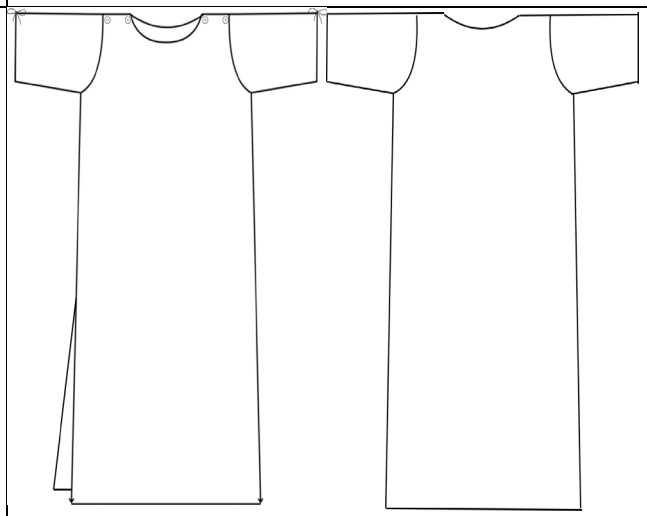
<tr><td colspan="2">Fabric swatch</td><td colspan="2">  </td></tr>
<tr><td colspan="2">Features</td><td colspan="2">Technical sketch</td></tr>
<tr><td colspan="2">1.Calf-length design for coverage and comfort.
2.Buttonsand tie string closures on the shoulders for easy dressing and undressing.
3.Side slits and shoulder opening for accessibility and caregiver convenience.
4.Loose fit for breathability and ease of movement.
5.Soft fabric to minimize skin irritation.</td><td colspan="2">  </td></tr>
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Table 4.14: Specification sheet of design 1 in surgery department

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<tr><td colspan="2">User</td><td colspan="2">Hospitalised acute bedridden patients</td></tr>
<tr><td colspan="4">Material and fabric description</td></tr>
<tr><td>Fabric</td><td>Width</td><td>Content</td><td>Properties</td></tr>
<tr><td>Cotton Viscose Blend</td><td>60 inches</td><td>Cotton-75%, Viscose-25%</td><td>Lightweight, breathable, and durable</td></tr>
<tr><td colspan="4">Design feature</td></tr>
<tr><td colspan="2">Closure Type</td><td colspan="2">Tie strings</td></tr>
<tr><td colspan="2">Sleeve Length</td><td colspan="2">Above elbow</td></tr>
<tr><td colspan="2">Opening</td><td colspan="2">Front</td></tr>
<tr><td colspan="2">Trims and fasteners</td><td colspan="2">Tie strings</td></tr>
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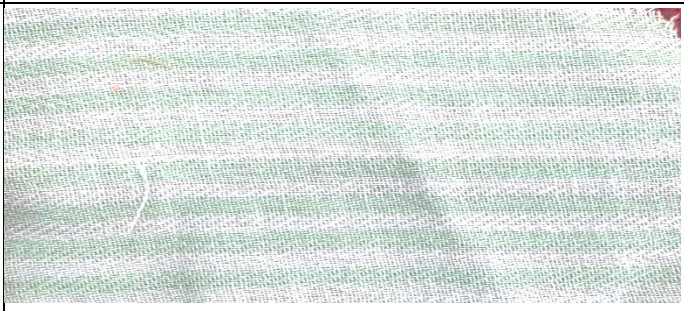
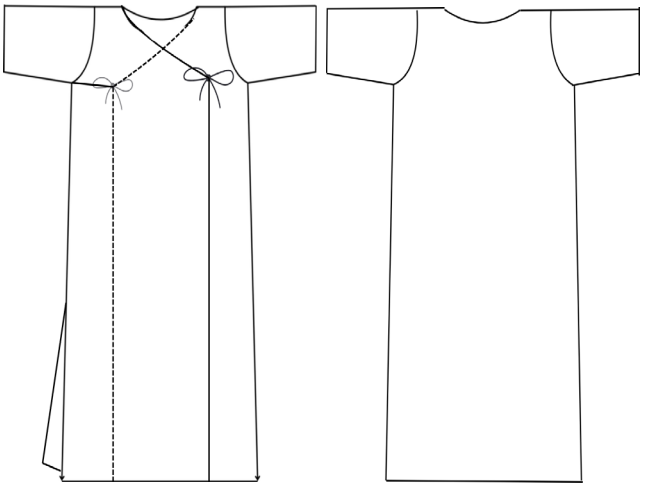
<tr><td colspan="2">Fabric swatch</td><td colspan="2">  </td></tr>
<tr><td colspan="2">Features</td><td colspan="2">Technical sketch</td></tr>
<tr><td colspan="2">1. Calf-length design for maximum coverage and comfort.
2. Wrap-style front with tie closures for easy dressing and adjustment.
3. Side slits for accessibility, aiding caregivers in dressing the patient.
4. Loose fit to promote comfort and airflow.
5. Soft, skin-friendly fabric to minimize irritation.</td><td colspan="2">  </td></tr>
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Table 4.15: Specification sheet of design 2 in surgery department

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<tr><td colspan="4">Material and fabric description</td></tr>
<tr><td>Fabric</td><td>Width</td><td>Content</td><td>Properties</td></tr>
<tr><td>Cotton Viscose Blend</td><td>60 inches</td><td>Cotton-75%, Viscose-25%</td><td>Lightweight, breathable, and durable</td></tr>
<tr><td colspan="4">Design feature</td></tr>
<tr><td colspan="2">Closure Type</td><td colspan="2">Tie strings</td></tr>
<tr><td colspan="2">Sleeve Length</td><td colspan="2">Above elbow</td></tr>
<tr><td colspan="2">Opening</td><td colspan="2">Front</td></tr>
<tr><td colspan="2">Trims and fasteners</td><td colspan="2">Tie strings</td></tr>
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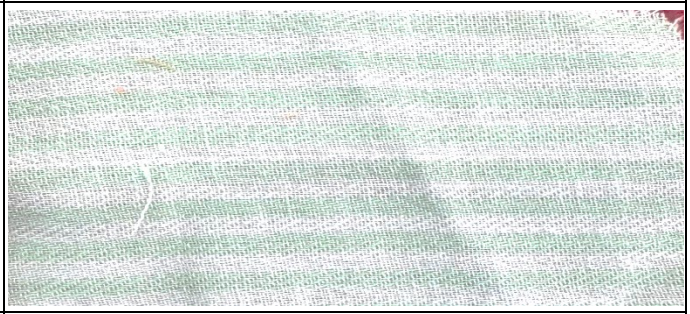
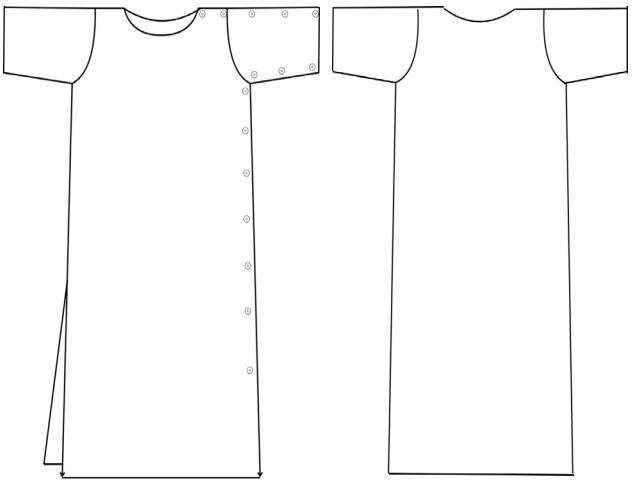
<tr><td colspan="2">Fabric swatch</td><td colspan="2">  </td></tr>
<tr><td colspan="2">Features</td><td colspan="2">Technical sketch</td></tr>
<tr><td colspan="2">1. Calf-length design for maximum coverage and comfort.
2. Button closures along the shoulder and side for easy dressing and medical access.
3. Side opening for accessibility, aiding caregivers in dressing the patient.
4. Loose fit to promote comfort and airflow.
5. Soft, skin-friendly fabric to minimize irritation.</td><td colspan="2">  </td></tr>
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Table 4.16: Specification sheet of design 3 in surgery department

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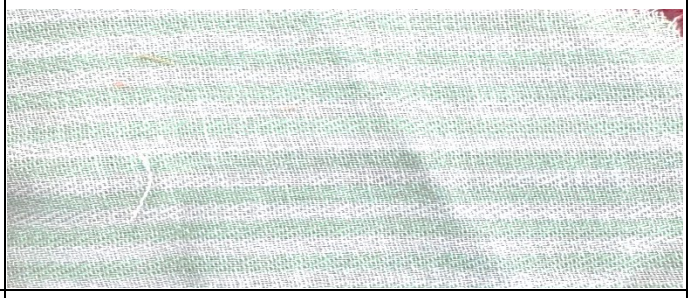
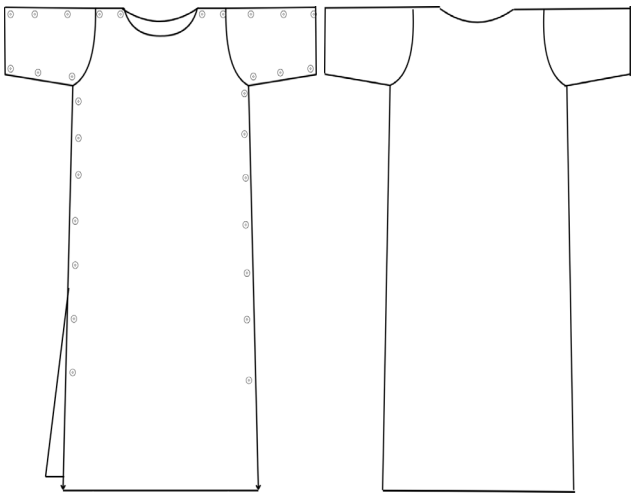
<tr><td colspan="2">User</td><td colspan="2">Hospitalised acute bedridden patients</td></tr>
<tr><td colspan="4">Material and fabric description</td></tr>
<tr><td>Fabric</td><td>Width</td><td>Content</td><td>Properties</td></tr>
<tr><td>Cotton Viscose Blend</td><td>60 inches</td><td>Cotton-75%, Viscose-25%</td><td>Lightweight, breathable, and durable</td></tr>
<tr><td colspan="4">Design feature</td></tr>
<tr><td colspan="2">Closure Type</td><td colspan="2">Tie strings</td></tr>
<tr><td colspan="2">Sleeve Length</td><td colspan="2">Above elbow</td></tr>
<tr><td colspan="2">Opening</td><td colspan="2">Side</td></tr>
<tr><td colspan="2">Trims and fasteners</td><td colspan="2">Tie strings</td></tr>
<tr><td colspan="2">Garment code</td><td colspan="2">S3</td></tr>
<tr><td colspan="2">Fabric swatch</td><td colspan="2">  </td></tr>
<tr><td colspan="2">Features</td><td colspan="2">Technical sketch</td></tr>
<tr><td colspan="2">1.Calf-length design for maximum coverage and comfort.
2.Button closures along the shoulder and side for easy dressing and medical access.
3.Side opening for accessibility, aiding caregivers in dressing the patient.
4.Loose fit to promote comfort and airflow.
5.Soft, skin-friendly fabric to minimize irritation.</td><td colspan="2">  </td></tr>
<tr><td colspan="2"></td><td>Front</td><td>Back</td></tr>
</table>

4.2.5.1. Cost sheet of the Prototypes

Table 4.17: Key Details prototypes

Details	Garment 1	Garment 2	Garment 3	Garment 4	Garment 5	Garment 6
Garment name	Gown with front slits with shoulder opening	Gown with Front slits with middle opening	Gown with side slits with shoulder opening	Gown with Front Tie String	Gown with one side opening	Detachable gown
Garment code	O1	O2	O3	S1	S2	S3
Fabric Type	Cotton blend	Cotton blend	Cotton blend	Cotton blend	Cotton blend	Cotton blend
Closure Type	Tie string and buttons	Buttons	Tie string and buttons	Tie string	Buttons	Buttons
Size Range	Free size	Free size	Free size	Free size	Free size	Free size

Table 4.18: Material Costs (For 6 Garments)

Item Description	Total Quantity (6 units)	Unit Cost (₹)	Total Cost (₹)	Cost per Garment (₹)
Fabric (m)	10 meters	90 ₹ /meter	900₹	148.5
Trims -Buttons	55 pieces	15₹ /20 pieces	45₹	7.5₹
Total Material Cost			**945₹**	**156₹**

Table 4.19: Labor Costs (For 6 Garments)

Process	Time Taken (days/hours)	Cost per Garment (₹)
Labour cost per garment	1 day 4 hours	400₹
Total Labour cost	7 days	2400₹

Table 4.20: Final Cost Calculation

Cost Component	Total Cost ($)	Cost per Garment ($)
Total Material Cost	945₹	156₹
Total Labor Cost	2400₹	400₹
Total Production Cost (6 garments)	**3300₹**	**556₹**

4.2.6. Prototype construction

After the design and fabric selection, the next stage involved prototype construction to bring the finalized designs to life.

Prototype construction involves Pattern making and construction, for the pattern making researcher drafted patterns for the final construction of the prototypes.

To ensure cost-effectiveness and timely completion, various local tailors in Vadodara were visited to assess their labour charges and the time required for garment construction.

After evaluating multiple options, one tailor was selected based on affordability and their ability to meet the required time frame without compromising quality. The researcher provided detailed instructions on garment designs, stitching techniques, and adaptive features to be incorporated, ensuring that the final prototypes aligned with the intended functionality and design specifications. The best designs were then constructed, making them ready for wear trials and evaluation to assess their effectiveness in real-world patient care settings.

4.2.6.2. Final Constructed Prototypes

The final prototypes were completed with key adaptive features based on caregiver feedback. They included buttons and Tie strings closures for easy dressing, soft, breathable fabric, and strategically placed openings for minimal patient movement. These designs aimed to improve comfort and simplify care for bedridden patients

Prototypes of Orthopaedic patients

Garment O1-Gown with front slits with shoulder opening

Plate 4.7: prototype O1 Front and Back

Garment O2-Gown with Front slits with middle opening

Plate 4.8 : prototype O2 Front and Back

Garment O3-Gown with side slits with shoulder opening

Plate 4.9: prototype O3 Front and Back

Prototypes of Surgery patients

Garment S1-Gown with Front Tie String

Plate 4.10: prototype S1 Front and Back

Garment S2-Gown with one side opening

Plate 4.11: Prototype S2 Front and Back

Garment S3-Detachable gown

Plate 4.12: prototype S3 Front and Back

4.2.7. Bill of Material

. The **Bill of Material (BOM)** listed all the necessary materials, such as fabric, trims, and fasteners, making it easier to gather everything needed for production. Both the specification sheet and BOM helped in maintaining quality, simplifying the tailoring process, and ensuring the final garments met the required design and functionality.

Table 4.21: Bill of Material

Sr. No.	Material Description	colour and pattern	Dimensions	Fiber content	Purpose	cost / unit	Total Quantity	Total Cost
1	The Fabric	white and Celadon green (light green) striped with twill weave	60 inches	Cotton-85 Per cent and viscose-15 Per cent	Base material for gown, soft breathable light weight colour, best quality	90 ₹/meter	10 meters	900₹
2	Thread	white	0.6mm	polyester - 100 Per cent	Stitching and seam durability	10 ₹/1000 meter	3 reels	30₹
3	Buttons	white transparent	1 cm	plastic	Fastening for secured closure	15 ₹/20 pieces	55 pieces	45₹

4.3 Evaluation of Designed Adaptive Garments

The prototype evaluation was conducted through wear trials in the selected government hospitals, involving:

Three patients from the orthopaedic department

Three patients from the Surgery department

These trials aimed to assess the garments' accessibility, comfort, and ease of use for both patients and caregivers. Patients were dressed in the adaptive clothing, and feedback was gathered on factors such as mobility, fabric comfort, and accessibility for medical procedures. Caregivers also evaluated the garments based on ease of dressing, time efficiency, and patient handling.

Observations from the orthopaedic department focused on flexibility and support for patients with mobility restrictions, while trials in the surgery department assessed accessibility to surgical sites and overall comfort during recovery.

The feedback was documented, and necessary adjustments were noted to further refine the designs for improved usability and effectiveness in real-world medical settings. and it fulfilled objective 3 which is to evaluate the accessibility and comfort of the constructed garment.

The details about the procedure to be followed for the wear trials with the patients is as follows:

Table 4.22: Details for wear trials

Parameter	Details
Total Garments	6 garments
Departments Involved	Orthopaedic & Surgery
Garments per Department	3 garments each
Wear Trial Duration	10 hours (10 AM – 8 PM)
Patient Participation	3 patients per department (Total: 6 patients)
Garment Evaluation Process	Worn for 10 hours, then washed and reassigned to another patient
Objective	Assess comfort, durability, and ease of use in real hospital settings
Feeback Gathered	Through evaluation form

Table 4.23: Procedure for wear trials for both department in S.S. G and G.M.E.R.S.Hospital

Day 1	Day 2	Day 3
Patient 1-Garment 1	Patient 1-Garment 2	Patient 1-Garment 3
Patient 2-Garment 2	Patient 2-garment 3	Patient 2-Garment 1
Patient 3-Garment 3	Patient 3-garment 1	Patient3 -Garment 2

4.3.3. Wear trial outcomes: usability, comfort, and accessibility

Wear trials done with the patients were as follows

The wear trials were conducted over three days in the Orthopaedic and Surgery departments, involving six garments and six patients (three per department). Each patient tested a different garment each day, ensuring a thorough evaluation of comfort, durability, and ease of use in a real hospital setting.

The trial duration was 10 hours per day (10 AM – 8 PM), after which the garments were washed and reassigned to another patient for further assessment. Feedback was gathered through evaluation forms, focusing on fabric comfort, movement ease, long-term wearability, and closure convenience.

This structured approach ensured comprehensive feedback on each garment's performance across multiple users and conditions, aiding in the refinement of the final designs.

Orthopaedic Department- (S.S.G. Hospital)

Table 4.24: Detail of Patient 1 for wear trials in Orthopaedic Department

Details	Patient 1	Caregiver
Age	25	20
Reason for being Bedridden	Hand Fracture	-
Duration	10 days	-

Plate 4.13: wear trials by P1 for three different styles in Orthopaedic Department*

*Garment O1-Gown with front slits with shoulder opening

Garment O2-Gown with front slits with middle opening

Garment O3-Gown with side slits with shoulder opening

Table 4.25: Detail of Patient 2 for wear trials in Orthopaedic Department

Details	Patient 3	Caregiver
Age	35	38
Reason for being Bedridden	Knee Fracture	
Duration	13 days	

Plate 4.14: wear trials by P2 for three different styles in Orthopaedic Department*

*Garment O1-Gown with front slits with shoulder opening

Garment O2-Gown with front slits with middle opening

Garment O3-Gown with side slits with shoulder opening

Table 4.26: Detail of Patient 3 for wear trials in Orthopaedic Department

Details	Patient 2	Caregiver
Age	61	60
Reason for being Bedridden	Knee Fracture	
Duration	15 days	

Plate 4.15: wear trials by P3 for three different styles in Orthopaedic Departmen

*Garment O1-Gown with front slits with shoulder opening

Garment O2-Gown with front slits with middle opening

Garment O3-Gown with side slits with shoulder opening

Surgery Department- (G.M.E.R.S. Hospital)

Table 4.27: Detail of Patient 1 for wear trials in Surgery Department

Details	Patient 1	Caregiver
Age	55	50
Reason for being Bedridden	Puss formation in leg due to diabetes	
Duration	10 days	

Plate 4.16: wear trials by P1for three different styles in Surgery Department*

*Garment S1-Gown with Front Tie String

Garment S2-Gown with one side opening

Garment S3-Detachable gown

Table 4.28: Detail of Patient 2 for wear trials in Surgery Department

Details	Patient 2	Caregiver
Age	25	18
Reason for being Bedridden	Appendix surgery	
Duration	9 days	

Plate 4.17: wear trials by P2 for three different styles in Surgery Department*

*Garment S1-Gown with Front Tie String

Garment S2-Gown with one side opening

Garment S3-Detachable gown

Table 4.29. Detail of Patient 2 for wear trials in Surgery Department

Details	Patient 3	Caregiver
Age	55	52
Reason for being Bedridden	Surgery for Stone in kidney	
Duration	10 days	

Plate 4.18: wear trials by P2 for three different styles in Surgery Department*

*Garment S1-Gown with Front Tie String

Garment S2-Gown with one side opening

Garment S3-Detachable Gown

4.3.2. Data Analysis Results

The assessment of adaptive clothing prototypes utilized both quantitative and qualitative analysis to ensure a thorough and holistic evaluation of the garments' effectiveness, comfort, and usability for bedridden patients. The combination of these two research methodologies provided objective numerical data and subjective experiential insights, ensuring that both measurable performance metrics and real-world user experiences were taken into account.

4.3.2.1. Quantitative Analysis: Objective Measurement of Garment Performance

Quantitative analysis involved structured data collection through a 5-point Likert scale, evaluating key factors such as fabric softness, comfort, ease of use, adaptability, and medical accessibility. The primary findings included:

Fabric Comfort & Sensory Experience:

-All garments received high ratings (5.00/5.00) for fabric softness, breathability, and long-term comfort (up to 10 hours).

-The garments did not cause irritation or discomfort, ensuring they were well-suited for prolonged use in hospital or home care settings.

Ease of Use & Functional Design:

-The gown with front slits and shoulder openings (Garment O1) emerged as the most preferred design, with 100 per cent positive feedback for ease of dressing, movement, and medical accessibility.

-Adaptive closures such as tie strings, side openings, and detachable components simplified the dressing process for caregivers while maintaining patient dignity.

Medical Accessibility & Practicality:

Openings allowed easy access to medical devices (IV lines, catheters, monitors) without disturbing patient comfort.

The garments prevented excessive sweating, reducing the risk of skin complications and discomfort.

Statistical Insights & Performance Trends:

The likelihood of recommendation by users and caregivers was notably high, with an average of 93-100 per cent positive responses across garment designs. Designs that provided greater ease of repositioning were rated higher, particularly in cases where patients required frequent turning to prevent pressure ulcers.

Table 4.30: Key findings from Orthopaedic Department

Metrics	**O1 - Gown with Front Slits & Shoulder Opening**		**O2 - Gown with Side Slits & Middle Opening**		**O3 - Gown with Side Slits & Shoulder Opening**	
	Average Avg	Percentage per cent	Average Avg	Percentage per cent	Average Avg	Percentage per cent
Fabric softness & comfort	5.00	100	5.00	100	5.00	100
No irritation or discomfort	5.00	100	5.00	100	5.00	100
Ease of movement	5.00	100	5.00	100	5.00	100
Long-term comfort (10 hours)	5.00	100	4.67	93.3	5.00	100
Sensory comfort (not rough, stiff, or irritating)	5.00	100	5.00	100	5.00	100
Supports repositioning without restriction	5.00	100	4.33	86.7	5.00	100
Easy to put on & take off	5.00	100	4.00	80	4.33	86.7
Medical needs accommodation	5.00	100	4.67	93.3	5.00	100
Closures are easy to use	5.00	100	4.33	86.7	4.33	86.7
Breathability & sweat prevention	5.00	100	5.00	100	5.00	100
Overall design satisfaction	5.00	100	4.67	93.3	4.67	93.3
Would recommend to other patients	5.00	100	4.00	80	4.67	93.3

The evaluation of three adaptive gown designs—O1 (Front Slits & Shoulder Opening), O2 (Side Slits & Middle Opening), and O3 (Side Slits & Shoulder Opening)—showed high satisfaction across multiple comfort and usability metrics. O1 and O3 consistently scored 100 per cent in most categories, ensuring fabric softness, sensory comfort, breathability, ease of movement, and medical accommodations. O2 had slightly lower scores, particularly in repositioning support (86.7 per cent), ease of use (80 per cent), and overall design satisfaction (93.3 per cent). However, all gowns were well-received, with O1 and O3 being the most preferred due to their superior comfort and functionality.

Table 4.31: Key findings from Surgery Department

Metrics	**S1 Gown with Front Tie String**		**S2 Gown with One Side Opening**		**S3 Detachable Gown**	
	Average Avg	Percentage per cent	Average Avg	Percentage per cent	Average Avg	Percentage per cent
Fabric Softness Comfort	5.00	100	5.00	100	5.00	100
No Irritation or Discomfort	5.00	100	5.00	100	5.00	100
Ease of Movement	5.00	100	4.33	86.7	5.00	100
Long-term comfort.10 Hours	4.67	93.3	5.00	100	5.00	100
Sensory comfort (not rough, stiff, or irritating)	5.00	100	5.00	100	5.00	100
Supports repositioning without restriction	5.00	100	4.67	93.3	5.00	100
Easy to put on & take off	5.00	100	4.33	86.7	4.67	93.3
Medical needs accommodation	5.00	100	5.00	100	5.00	100
Closures are easy to use	5.00	100	4.33	86.7	4.00	80
Breathability & sweat prevention	5.00	100	5.00	100	5.00	100
Overall design satisfaction	5.00	100	4.67	93.3	5.00	100
Would recommend to other patients	5.00	100	4.33	86.7	5.00	100

The evaluation of three adaptive gown designs—S1 (Front Tie String), S2 (One Side Opening), and S3 (Detachable Gown)—revealed high overall satisfaction across key comfort and usability metrics. S1 and S3 consistently scored 100 per cent in most areas, including fabric softness, sensory comfort, breathability, and medical accommodations. S2 had slightly lower ratings, particularly in ease of movement (86.7 per cent), ease of use (86.7 per cent), and closure functionality (80 per cent). Despite these minor variations, all gowns were rated positively, with S1 and S3 emerging as the most preferred options for their superior comfort, ease of use, and adaptability to patient needs.

Table 4.32: Evaluation of all the garment of orthopaedic patients

Garment	Average Score (out of 5)	Percentage (per cent)
O1 - Gown with Front Slits & Shoulder Opening	5	100
O2 - Gown with Side Slits & Middle Opening	4.56	91.20
O3 - Gown with Side Slits & Shoulder Opening	4.83	96.70

The evaluation showed that O1 (Front Slits & Shoulder Opening) was the top choice, scoring a perfect 5.00 (100 per cent) for comfort, ease of dressing, and medical adaptability. O3 (Side Slits & Shoulder Opening) followed with 4.83 (96.7 per cent), performing well with minor improvement areas. O2 (Side Slits & Middle Opening) scored lowest at 4.56 (91.2 per cent), mainly due to slightly lower ease of use. Overall, O1 was the most preferred, with O2 and O3 needing small refinements.

Table 4.33: Evaluation of all the garment of surgery patients

Garment	Average Score (out of 5)	Percentage (per cent)
S1-Gown with Front Tie String	4.97	99.30
S2-Gown with One Side Opening	4.56	91.20
S3-Detachable Gown	4.92	98.40

The evaluation showed that S1 (Gown with Front Tie String) was the most preferred, scoring 4.97 (99.3 per cent) for its comfort, ease of use, and adaptability. S3 (Detachable Gown) followed closely with 4.92 (98.4 per cent), performing well with minor closure improvements suggested. S2 (Gown with One Side Opening) had the lowest rating at 4.56 (91.2 per cent), mainly due to slightly lower ease of movement and dressing. Overall, S1 was the top choice, with S2 and S3 requiring small refinements.

4.3.2.2. Qualitative Analysis: User Experience & Practical Feedback

The qualitative analysis highlighted key user experiences, focusing on fabric comfort, ease of dressing, and medical accessibility. Caregivers and patients emphasized the soft, breathable fabric, which prevented discomfort and irritation. Adaptive closures, especially in detachable gowns (Garment S3), were beneficial for patients with mobility issues, though minor improvements in fastening mechanisms were suggested. Additionally, medical accessibility was enhanced by designs like Garment O3, which allowed for easy access to medical equipment without full garment removal.

Table 4.34: Summary of Evaluation Findings

Evaluation Aspect	Key Findings from Qualitative Analysis
Fabric & Sensory Comfort	Soft, breathable, and non-irritating fabric enhanced comfort.
Ease of Dressing & Closures	Detachable gown (S3) reduced patient movement; minor refinements needed in fastening.
Medical Accessibility	Garment O3 allowed medical access without full removal, ensuring dignity.
Overall Performance	Balanced usability, comfort, and practicality for caregivers and patients.

4.4. Reporting and Recommendation

Optimizing Garment Design

Based on the study findings, S1 and O1 emerge as the most effective designs due to their comfort, ease of use, and medical adaptability. These garments serve as the foundation for future iterations, ensuring that patient and caregiver needs remain central to the design process. Further refinements focus on enhancing mobility, durability, and functionality while maintaining a user-friendly structure.

Improving Closure Systems

To enhance ease of wear and removal, alternative closure mechanisms such as magnetic fasteners, Velcro straps, and advanced snap buttons are explored. These modifications provide quick and hassle-free dressing, especially for patients with limited mobility or medical attachments such as IV lines and catheters. The most effective and user-friendly closures are integrated based on ongoing trials and feedback.

Enhancing Fabric Performance for Long-Term Wear

Given the importance of hygiene and comfort, future garment prototypes incorporate antimicrobial finishes and moisture-wicking properties. These enhancements reduce bacterial growth, minimize odor, and improve breathability, making them suitable for prolonged wear. Although the current study indicates that most patients remain hospitalized for fewer than 10 days, these fabric treatments prepare the garments for broader applications in long-term care and home-based recovery.

Expanding User Trials for Inclusive Feedback

To ensure that the garments cater to diverse user needs, research expands to a larger and more varied sample of patients and caregivers. Expanding trials provides a comprehensive understanding of real-world challenges and allows for refinements that enhance

adaptability across different body types, medical conditions, and caregiving scenarios. Continuous user feedback remains central to improving functionality and ensuring widespread acceptance.

Ensuring Cost-Effective and Scalable Production

For successful mass adoption, scalable and cost-effective manufacturing techniques are implemented. Collaboration with textile manufacturers, healthcare institutions, and rehabilitation centres facilitates efficient production while maintaining affordability and quality. Sustainable and economical material sourcing ensures that adaptive clothing is accessible in hospitals, nursing homes, and home-care settings.

By implementing these improvements, adaptive garments enhance user comfort, improve caregiver efficiency, and support better healthcare outcomes, ensuring that bedridden patients receive garments that meet both functional and medical needs effectively.

Chapter V

SUMMARY AND CONCLUSION

5.1. Introduction

Clothing served as a fundamental aspect of human life, providing not only protection and comfort but also a means of self-expression. However, for bedridden patients, clothing needed to go beyond aesthetics and conventional functionality to ensure ease of movement, accessibility, and hygiene. Traditional hospital gowns and everyday garments often failed to meet these essential requirements, creating significant challenges for both patients and caregivers. Ill-fitting clothing, difficult fastenings, and lack of accessibility contributed to patient discomfort and hindered caregivers in performing routine tasks such as dressing, undressing, and medical care. Given the vulnerability of bedridden patients, clothing needed to be designed to accommodate their medical needs while also enhancing their dignity, comfort, and overall well-being.

This study emphasized the importance of User-Centred Design (UCD) in developing adaptive garments tailored to the specific needs of bedridden patients and their caregivers. A user-centered approach ensured that the designs were functional, comfortable, and easy to use, addressing real-life challenges faced in caregiving. The research focused on government hospitals in Vadodara, where a lack of suitable adaptive clothing forced caregivers to struggle with inappropriate garments that complicated patient care. To bridge this gap, the study involved 40 participants, including both patients and caregivers, to gather first-hand insights into the challenges posed by conventional clothing.

Based on the findings, six adaptive garment prototypes were developed—three for orthopaedic patients and three for surgical patients. These garments incorporated strategic fastenings, breathable fabrics, and minimal seams to enhance patient comfort and usability. The designs prioritized ease of dressing and undressing, allowing for quick and convenient medical access while reducing strain on both patients and caregivers. Additionally, the selected cotton-viscose blend fabric ensured breathability, softness, and affordability, making it suitable for hospital use.

By integrating UCD principles, practical fabric choices, and adaptive design features, this study contributed to the development of functional, cost-effective, and scalable adaptive clothing solutions for bedridden patients.

5.2. Purpose of the Study

This study focused on the challenges faced by bedridden patients due to ill-fitting and inaccessible garments, which cause discomfort and hinder medical procedures. Caregivers also struggle with dressing patients due to the lack of strategic openings and easy closures. To address these issues, adaptive garments were designed using breathable fabrics, minimal seams, and adjustable closures like buttons and tie strings. These user-centered designs enhance patient comfort, improve accessibility, and reduce caregiver effort, offering a practical, cost-effective solution for better patient care

5.3. Objectives

1. Identify the specific issues faced by patients and caregivers.
2. Develop garments that enhance comfort and accessibility.
3. Evaluate the effectiveness of the constructed garments.

Delimitation

The study was conducted in two government hospitals in Vadodara (SSG Hospital and GMERS Medical College) between September 2024 and February 2025, focusing on bedridden or hospitalized patients within this period.

5.4. Methodology

This study, "User-Centered Design of Adaptive Garments for Bedridden Patients," was conducted to address the challenges faced by bedridden patients and their caregivers in dressing. The research followed a structured approach, starting with a preliminary survey that combined secondary research (literature review) and primary research (hospital visits, questionnaires, caregiver interviews, and observations) to assess the limitations of existing adaptive garments. A mixed-method research design was employed, incorporating qualitative and quantitative methods, with data collected from SSG Hospital and GMERS Hospital in Vadodara. The study identified key challenges such as discomfort, difficulty in dressing, and fabric limitations through patient and caregiver surveys. Ethical approvals and permissions were obtained from the hospitals, and a purposive random sampling method was used to select 40 participants from the Departments of Medicine, Surgery, and Orthopaedics. Data was collected through semi-structured questionnaires and interviews,

focusing on clothing-related challenges, fabric preferences, and care needs. Findings were analysed using descriptive statistical methods (frequency and percentage).

Based on these insights, adaptive garments were designed using a user-centered approach, ensuring comfort and ease of use. A concept-building phase led to the creation of 30 initial sketches, 12 shortlisted designs, and 6 finalized prototypes (3 for orthopaedic and 3 for surgical patients). Locally sourced soft, breathable fabrics were chosen, and detailed garment specifications, measurements, and cost sheets (BOM) were prepared. The prototypes were developed by tailors specializing in hospital garments and evaluated through wear trials with 6 patients over three days. Feedback was collected via interviews, observation, and questionnaires, and garment effectiveness was assessed using qualitative and descriptive statistical analysis. The results highlighted improvements in patient comfort, medical accessibility, and ease of dressing. The study concluded with recommendations for optimizing durability, integrating antimicrobial fabrics, and expanding user trials for broader applicability. By focusing on cost-effective, functional designs, this research contributes to the development of adaptive clothing solutions that enhance patient well-being and caregiving efficiency in healthcare settings.

5.5. Results and Discussion

This study aimed to design adaptive garments for bedridden patients using a user-centred approach, ensuring enhanced patient comfort and caregiver efficiency. The research was conducted at S.S.G. and G.M.E.R.S. hospitals in Vadodara, involving 40 participants, including patients and caregivers. The study identified several challenges related to dressing, mobility, and accessibility, emphasizing the need for specialized clothing solutions. Traditional hospital garments often failed to provide adequate comfort, accessibility, and hygiene, leading to increased stress for both patients and caregivers. Based on these insights, six adaptive garment prototypes were developed to address the specific needs of orthopaedic and surgical patients. These garments incorporated user-friendly features such as side and front openings, breathable fabrics, and adaptive fastenings to facilitate ease of use.

5.5.1. Need Gap Identification and Research Significance

The study identified significant challenges faced by bedridden patients and their caregivers due to the lack of suitable adaptive garments. Existing hospital clothing often compromised hygiene, patient dignity, and ease of dressing, making caregiving tasks more difficult.

Patients, particularly those recovering from surgeries and orthopaedic conditions, experienced discomfort, restricted mobility, and stress due to ill-fitting and non-functional garments. Additionally, caregivers struggled with dressing and undressing patients, leading to increased physical strain and inefficiency in hospital care. The market analysis revealed a gap in affordable and accessible adaptive clothing, with most available options being expensive and made from unsuitable synthetic fabrics. These findings highlighted the pressing need for patient-friendly garments that cater to both comfort and practical usability in healthcare settings.

5.5.2. Development of Adaptive Garments

To address the identified need gaps, this study developed six adaptive garment prototypes based on patient and caregiver feedback. The garments were designed with accessibility, comfort, and functionality in mind. Strategic design features such as front and side openings, breathable cotton-viscose fabric, and minimal seams were incorporated to enhance ease of wear and overall usability. Special attention was given to closure mechanisms, including buttons and tie strings, to facilitate dressing and undressing without excessive movement or discomfort. The selection of a hospital-friendly cotton-viscose blend ensured durability, affordability, and compliance with hygiene requirements.

5.5.3. Evaluation and Feedback

Wear trials conducted on selected patients provided valuable insights into the practical effectiveness of the adaptive garments. Patients reported improved comfort, reduced irritation, and greater ease in movement. Caregivers found the garments convenient to use, reducing the physical effort required to dress and undress patients. Specific designs, such as the wrap-style surgery gown (S1) and shoulder-opening orthopaedic gown (O1), were particularly effective in enhancing medical accessibility and caregiver assistance. Some areas of improvement, such as alternative fastening options like Velcro and magnetic closures, were noted for future iterations.

5.5.4. Cost Analysis and Practical Implementation

The study ensured cost-effective production by selecting affordable materials and optimizing labour costs. The final cost per garment was approximately ₹556, making these adaptive garments feasible for large-scale production in public hospitals. The research findings suggest that scalable and sustainable manufacturing methods can make these

garments widely accessible to patients in need. Additionally, incorporating antimicrobial and moisture-wicking fabric treatments can further enhance their functionality in hospital settings.

Conclusion

The findings from this study reinforce the importance of designing clothing that meets the specific needs of bedridden patients. The integration of user feedback, practical design considerations, and affordability makes this approach feasible for large-scale implementation in hospitals. Future research can build on these insights by exploring advanced textile technologies and inclusive design practices, ensuring that adaptive garments continue to evolve to meet patient needs effectively. By addressing a critical gap in hospital clothing, this study lays the foundation for more accessible, functional, and dignified healthcare attire for patients in need

Scope of the study

This study focused on designing and evaluating adaptive garments for bedridden patients, prioritizing comfort, accessibility, and caregiver convenience. Conducted at S.S.G. and G.M.E.R.S. hospitals in Vadodara, the research identified significant challenges in existing hospital clothing, including discomfort, mobility restrictions, and hygiene concerns. A total of 40 participants, including both patients and caregivers, were involved to gather first-hand insights into these difficulties. The study utilized a User-Centred Design (UCD) approach to develop six adaptive garment prototypes specifically designed for orthopaedic and surgical patients. These garments incorporated essential features such as front and side openings, breathable fabrics, and easy-to-use fasteners to facilitate dressing, medical accessibility, and improved patient dignity.

Beyond garment design, the study also assessed the market gap in adaptive clothing, revealing that existing products were often expensive, polyester-based, and unsuitable for hospital use. To address this, cost-effective materials and production methods were explored, ensuring affordability and scalability for widespread implementation in public hospitals. The research findings provide a strong foundation for future innovations in hospital garment design, including antimicrobial fabric treatments, enhanced fastening mechanisms, and large-scale production strategies. These advancements could significantly improve patient care, making hospital stays more dignified and reducing the physical burden on caregivers.

Future Recommendations

Based on the study findings, the following recommendations are proposed for future improvements and implementation:

I. Enhanced Fastening Mechanisms: Exploring Velcro, magnetic closures, and advanced snap buttons for improving accessibility.

II. Fabric Innovations: Integrating antimicrobial and moisture-wicking treatments for better hygiene and long-term usability.

III. Wider Wear Trials: Conducting large-scale trials with diverse patient demographics for broader validation.

IV. Scalability and Affordability: Partnering with healthcare institutions and manufacturers to produce garments at an economical scale.

V. Design Refinements: Adjusting garment lengths, closure positions, and fabric blends to enhance functionality and durability.

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Appendix 1

Department of Clothing and Textiles

Faculty of Family and Community Sciences

The Maharaja Sayajirao University of Baroda

Fatehgunj Road, Vadodra-390002

Ph: (+91-0265)2795522

Permission Letter for Hospital visit

To

_____

_____

Subject: Request for Approval to Conduct Research Interviews with Caregivers, Management, and Bedridden Patients, and Wear Trials with Caregivers and Patients

Dear Sir/ Madam,

Greetings from the Department of Clothing and Textiles!

The student Ms. Kashish Panchal is pursuing Masters' in Clothing and Textiles; and in partial fulfilment of the degree requirements, she has undertaken research titled: "User-centered design of adaptive garments for bedridden patients"

The purpose of this study is to explore the challenges that caregivers face when dressing and undressing bedridden patients, as well as understanding how management is conducted in terms of clothing of Bedridden patients, Additionally, it seeks to identify the difficulties faced by bedridden patients themselves, with a focus on identifying difficulties and potential areas for improvement in adaptive clothing design.

Furthermore, the study will include a wear trial phase, where prototypes of adaptive garments will be tested by bedridden patients and caregivers to gather practical feedback. This phase is essential for evaluating the effectiveness of the clothing designs in enhancing caregiver efficiency and patient comfort.

May I request your kind permission to conduct research interviews and wear trials with respondents as above at your facility for the study. All interviews and wear trials will be voluntary, confidential, and carried out with minimal disruption to daily routines, in an ethical and respectful manner.

Your support in advancing knowledge in this field is highly solicited.

Thank you and Sincere Regards,

Dr. Reena Bhatia
I/C Head and Guide,
Department of Clothing and Textiles,
Faculty of Family and Community Sciences,
The Maharaja Sayajirao University of Baroda, Vadodara-390002

Appendix 2

Institutional Human Ethics Committee
CDSCO Registration No. EC.R/28/Inst/GJ/2013/RR-24 Approved upto 15 / April / 2029
NECRBHR Provisional Registration No. ECINEWIINST/2021/GJ/0016 Approved upto 15/November/ 2026
GMERS Medical College & Hospital, Gotri, Vadodara – 390021, Gujarat, India
Phone: (0265) 2398008, Fax: (0265) 2398009, Email: ihecmcgv@gmail.com

Annexure I (A)- IHEC Application form for Academic Project of faculty/PG/UG students.

For Office Use

Received Date:
IHEC No:
Returned after IHEC evaluation:
Received after revision:
IHEC Approval Date:

FOR

Investigators' details:

	Name, Qualifications & Designation	Address, Mobile & Email ID	Signature
Faculty/Student	Ms. Kashish Panchal Sr. Masters Student	13/Ajitnath society opp. nirvana residency, near water tank, karelibaugh, vadodara 390018 MO:8200324350 Email ID: kashishpanchal10@gmail.com	
Co- Guide	Dr. Amul Bhedi		

Minimal Risk Yes ☐ / No ☐

Checklist for attached documents:

1. IHEC Application form Yes ☐
2. Curriculum Vitae Principal Investigator Yes ☐
3. GCP Certificate Yes ☐ / No ☐ / NA ☐
4. Approval of departmental scientific committee/Institutional scientific board Yes ☐
5. Proposal (Introduction, Review & Justification, Objectives, Methodology, Outcome measures, Plan for data analysis) Yes ☐
6. Case Record Form and / or questionnaires Yes ☐
7. Patient information sheet (Dardi Mahiti Patrak) in English Yes ☐ / No ☐ / NA ☐
8. Patient information sheet (Dardi Mahiti Patrak) in vernacular language Yes ☐ / No ☐ / NA ☐
9. Informed Consent form (Dardi Sahmati Pratrak) in English Yes ☐ / No ☐ / NA ☐
10. Informed Consent form (Dardi Sahmati Pratrak) in vernacular languages Yes ☐ / No ☐ / NA ☐

Date:

MS. KASHISH PANCHAL
Principle Investigator

DR. AMUL BHEDI
Co-Guide

Appendix 2a.

Institutional Human Ethics Committee
CDSCO Registration No. ECR/28/Inst./GJ/2013/RR-19 Approved upto 15 / April / 2024
NECRBHR Provisional Registration No. ECINEWIINST/2019/261 Approved upto 12 / November / 2021
GMERS Medical College & Hospital, Gotri, Vadodara – 390021, Gujarat, India Phone: (0265) 2398008, Fax: (0265) 2398009, Email: ihecmcgv@gmail.com

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Annexure –
Investigator's Undertaking
Study Title: USER-CENTERED DESIGN OF ADAPTIVE GARMENTS FOR BEDRIDDEN PATIENTS

1. We certify that, we have determined that the proposal herein is not unnecessarily duplicative of previously reported research.
2. We certify that, we are qualified by education, training and have enough experience to do such a study.
3. For procedures listed under proposal, we certify that we have reviewed the pertinent scientific literature and have found no valid alternative to any procedure described herein which may cause less pain or distress to the patient.
4. We certified that, study will be initiated only upon review and approval of scientific intent by IHEC GMERS Medical College and Hospital Gotri, Vadodara and getting a certificate from IHEC.
5. We will do necessary changes in our study protocol as per the suggestions given by respected IHEC members during meeting before getting approval letter and bound to submit the changes to IHEC. We will obtain approval from the IHEC GMERS Medical College and Hospital Gotri, Vadodara, before making any significant changes in this study. Institutional Biosafety Committee's (IBC) certification of review and concurrence will be taken (Required for studies utilizing DNA agents of human pathogens).
6. We will do our study according to ICH-GCP guidelines and maintain all the study related records. Whenever asked, we are bound to produce to IHEC GMERS Medical College and Hospital Gotri, Vadodara.
7. We will report adverse drug reaction to Pharmacovigilance Cell & IHEC whenever, we come across the adverse drug reaction while doing research work. (If Applicable)
8. We certify that, we will follow the recommendations of IHEC and Govt. of Gujarat rules and regulation issued from time to time.
9. We certify that, record of all premature termination of a study with a summary of the reasons/final report after completion of the study including microfilms, CDs and Video recordings, will submit to the IHEC GMERS Medical College and Hospital Gotri, Vadodara.

Name signature and date of all investigators

Ms. Kashish Panchal
Principle investigator

Dr. Reena Bhatia
Guide

Appendix 3

Informed Consent for Need assessment for Bedridden patients

DEPARTMENT OF CLOTHING AND TEXTILE
FACULTY OF FAMILY & COMMUNITY SCIENCES
THE MAHARAJ SAYAJIRAO UNIVERSITY OF BARODA
VADODARA

STUDY TITLE: **USER-CENTERED DESIGN OF ADAPTIVE GARMENTS FOR BEDRIDDEN PATIENTS**

INVESTIGATORS

Guide – Dr. Reena Bhatia
Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
(M): +919376235666
Email Id: reenabhatia-ct@msubaroda.ac.in

Researcher-Ms. Kashish panchal
Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
(M): +918200324350
Email Id: kashishpanchal10@gmail.com

Researcher: Ms. Kashish Panchal

Research Guide: Dr. Reena Bhatia

The purpose of this study is to explore the challenges caregivers face when dressing and undressing bedridden patients, with a focus on identifying difficulties and potential areas for improvement in adaptive clothing design. The findings aim to inform the development of more practical and user-friendly clothing solutions to enhance both caregiver efficiency and patient comfort. The study is conducted in partial fulfillment of Master's dissertation in Clothing and Textiles.

Procedures: If you agree to participate in this study, you will be expected / asked to provide some needful insights into the questions asked in the questionnaire

Risks and Benefits: There are no known risks associated with participating in this study. However, we hope that the information we gather from this study will help us gain insights into the difficulties faced by bedridden patients as well as their caregivers in terms of dressing and undressing their garments.

Confidentiality: All information collected during this study will be kept strictly confidential. Your name will not be used in any reports or publications resulting from this study. Your responses will be assigned a unique identification number that will be used to identify your data.

Voluntary Participation: Participation in this study is entirely voluntary. You may refuse to participate or withdraw from the study at any time without penalty or loss of benefits to which you are otherwise entitled.

Cost: Participating in this study will entail no associated costs or charges.

Contact Information: If you have any questions or concerns about this study, please contact (kashish panchal. 82003-24350, kashishpanchal10@gmail.com)

Consent: By signing this consent form, you agree to participate in this study. You understand that you are free to withdraw from study at any time without penalty. You also understand that your participation in this study is confidential.

Signature of participant

_____

Investigator's Statement
I have explained the purpose of the study. The participant was given an opportunity to discuss these procedures and ask any additional questions.

_____
Kashish Panchal

Date:

Thank you for your willingness to contribute to this research.

Appendix 3a

દર્દીઓ માટેની જરૂરિયાતનું મૂલ્યાંકન માટે સંમતિપત્ર
DEPARTMENT OF CLOTHING AND TEXTILE
FACULTY OF FAMILY & COMMUNITY SCIENCES
THE MAHARAJ SAYAJIRAO UNIVERSITY OF BARODA
VADODARA

STUDY TITLE: **USER-CENTERED DESIGN OF ADAPTIVE GARMENTS FOR BEDRIDDEN PATIENTS**

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Faculty of Family and Community Sciences
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સંશોધક: મિસ કશિશ પંચાલ
સંશોધન માર્ગદર્શક: ડૉ. રીણા ભાટિયા

અભ્યાસનો હેતુ:
આ અભ્યાસનો હેતુ એ છે કે કાળજીદારોને બેડ પર પડેલા દર્દીઓને કપડાં પહેરવામાં અને ઉતારવામાં આવતી મુશ્કેલીઓ જાણવા, અને આ પ્રક્રિયામાં કયા વિસ્તાર પર સુધારો થઇ શકે તે ઓળખવા. આ અભ્યાસમાંથી મળેલી માહિતી કાળજીદારોના કાર્યને સરળ અને દર્દીઓ માટે આરામદાયક કપડાં ડિઝાઇન કરવામાં મદદરૂપ થશે. આ અભ્યાસ કાપડ અને વસ્ત્ર વિષયમાં માસ્ટર નિબંધ પુર્ણ કરવા માટે કરવામાં આવી રહ્યો છે.

પ્રક્રિયાઓ:
જો તમે આ અભ્યાસમાં ભાગ લેવા તૈયાર છો, તો તમને પ્રશ્નાવલીમાં પૂછાયેલી કેટલીક માહિતી આપવી રહેશે, જે સંશોધનમાં જરૂરી છે.

જોખમ અને લાભ:
આ અભ્યાસમાં ભાગ લેવાનો કોઇ જોકમ નથી. આશા છે કે આ અભ્યાસથી બેડ પર પડેલા દર્દીઓ અને તેમના કાળજીદારોને કપડાં પહેરવામાં અને ઉતારવામાં જે મુશ્કેલીઓ આવે છે, તે સમજવામાં મદદ મળશે.

ગોપનીયતા:
આ અભ્યાસ દરમિયાન મળી આવેલી તમામ માહિતી ગોપનીય રહેશે. તમારું નામ કોઇ રિપોર્ટ અથવા પ્રકાશનમાં દાખલ નહીં થાય. તમારે પ્રતિસાદને ઓળખવા માટે એક યુનિક આઇડેન્ટિફિકેશન નંબર અપાશે.

સ્વૈચ્છિક ભાગીદારી:
આ અભ્યાસમાં ભાગ લેવું સંપૂર્ણ રીતે સ્વૈચ્છિક છે. તમે કોઇ પણ સમયે અભ્યાસમાંથી બહાર નીકળી શકો છો અને તમારે માટે કોઇ દંડ નહીં થાય અથવા લાભ ગુમાવશો નહીં.

ખર્ચ:
આ અભ્યાસમાં ભાગ લેવું મફત છે અને તેની કોઇ પણ કિંમત નથી.

સંપર્ક માહિતી:
જો તમને આ અભ્યાસ વિશે કોઈ પ્રશ્નો અથવા ચિંતાઓ હોય, તો કૃપા કરીને (કશિશ પંચાલ, 82003-24350, kashishpanchal10@gmail.com) પર સંપર્ક કરો.
સંમતિ:
આ સંમતિપત્ર પર સહી કરીને, તમે આ અભ્યાસમાં ભાગ લેવા સંમત છો. તમે સમજો છો કે તમે કોઈ પણ સમયે અભ્યાસમાંથી બહાર નીકળી શકો છો અને તમારે માટે કોઈ દંડ નહીં થાય. તમે સમજશો કે આ અભ્યાસમાં તમારો ભાગ ગોપનીય રહેશે.
ભાગીદારની સહી:

તારીખ:

અન્વેષકનો નિવેદન:
મેં અભ્યાસનો હેતુ સમજાવ્યો છે. ભાગીદારને આ પ્રક્રિયાઓ વિશે ચર્ચા કરવાનો અને કોઈ પણ વધારાના પ્રશ્નો પૂછવાનો અવસર આપવામાં આવ્યો હતો.
કશિશ પંચાલ

તારીખ:

આ સંશોધનમાં સહકાર આપવા બદલ તમારો આભાર!

Appendix 4

Informed Consent for Need assessment for Caregiver
DEPARTMENT OF CLOTHING AND TEXTILES
FACULTY OF FAMILY & COMMUNITY SCIENCES
THE MAHARAJ SAYAJIRAO UNIVERSITY OF BARODA, VADODARA

STUDY TITLE: **USER-CENTERED DESIGN OF ADAPTIVE GARMENTS FOR BEDRIDDEN PATIENTS**

INVESTIGATORS

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Email Id: kashishpanchal10@gmail.com

Researcher: Ms. Kashish Panchal

Research Guide: Dr. Reena Bhatia

The purpose of this study is to explore the challenges caregivers face when dressing and undressing bedridden patients, with a focus on identifying difficulties and potential areas for improvement in adaptive clothing design. The findings aim to inform people about the development of more practical and user-friendly clothing solutions to enhance both caregiver efficiency and patient comfort. The study is conducted in partial fulfillment of Master's dissertation in Clothing and Textiles.

Procedures: If you agree to participate in this study, you will be expected / asked to provide some needful insights into the questions asked in the questionnaire

Risks and Benefits: There are no known risks associated with participating in this study. However, we hope that the information we gather from this study will help us gain insights into the difficulties faced by bedridden patients as well as their caregivers in terms of dressing and undressing their garments.

Confidentiality: All information collected during this study will be kept strictly confidential. Your name will not be used in any reports or publications resulting from this study. Your responses will be assigned a unique identification number that will be used to identify your data.

Voluntary Participation: Participation in this study is entirely voluntary. You may refuse to participate or withdraw from study at any time without penalty or loss of benefits to which you are otherwise entitled.

Cost: Participating in this study will entail no associated costs or charges.

Contact Information: If you have any questions or concerns about this study, please contact (kashish panchal. 8200324350, kashishpanchal10@gmail.com)

Consent: By signing this consent form, you agree to participate in this study. You understand that you are free to withdraw from the study at any time without penalty. You also understand that your participation in this study is confidential.

Signature of participant

_____

Investigator's Statement
I have explained the purpose of the study. The participant was given an opportunity to discuss these procedures and ask any additional questions.

_____
Kashish Panchal

Date:

Thank you for your willingness to contribute to this research.

Appendix 4a

કાળજીદારો માટેની જરૂરિયાતનું મૂલ્યાંકન માટે સંમતિપત્ર

DEPARTMENT OF CLOTHING AND TEXTILE
FACULTY OF FAMILY & COMMUNITY SCIENCES
THE MAHARAJ SAYAJIRAO UNIVERSITY OF BARODA
VADODARA

STUDY TITLE: **USER-CENTERED DESIGN OF ADAPTIVE GARMENTS FOR BEDRIDDEN PATIENTS**

INVESTIGATORS

Guide – Dr. Reena Bhatia
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Researcher-Ms. Kashish panchal
Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
(M): +918200324350
Email Id: kashishpanchal10@gmail.com

સંશોધક: મિસ કશિશ પંચાલ
સંશોધન માર્ગદર્શક: ડૉ. રીણા ભાટિયા

અભ્યાસનો હેતુ: આ અભ્યાસનો હેતુ એ છે કે કાળજીદારોને બેડ પર પડેલા દર્દીઓના કપડાં પહેરવામાં અને ઉતારવામાં શું કઠિનાઈઓ આવતી હોય છે, તે જાણવી. આ અભ્યાસથી મળેલી માહિતી અનુકૂલિત કપડાંની ડિઝાઇનમાં સુધારાઓ લાવવા માટે ઉપયોગી રહેશે, જેથી કાળજીદારોના કાર્યમાં સરળતા અને દર્દીઓ માટે આરામ વધુ થાય. આ અભ્યાસ કાપડ અને વસ્ત્ર વિષયમાં માસ્ટરનું નિબંધ પુર્ણ કરવા માટે કરવામાં આવી રહ્યો છે.

પ્રક્રિયાઓ: જો તમે આ અભ્યાસમાં ભાગ લેવા તૈયાર છો, તો તમને પ્રશ્નાવલીમાં આપેલી કેટલીક માહિતી આપવાનું જણાવાશે, જે મદદરૂપ બનશે.

જોખમ અને લાભ: આ અભ્યાસમાં ભાગ લેવાનો કોઇ જોકમ નથી. આશા છે કે આ અભ્યાસથી મળેલી માહિતી બેડ પર પડેલા દર્દીઓ અને તેમના કાળજીદારોની કપડાંની સાથે જોડાયેલી મુશ્કેલીઓ સમજવામાં મદદરૂપ થશે.

ગોપનીયતા: આ અભ્યાસ દરમિયાન મળી આવેલી તમામ માહિતી ગોપનીય રાખવામાં આવશે. તમારી ઓળખ કોઇ પણ રિપોર્ટ અથવા પ્રકાશનમાં દાખલ નહીં થાય. તમારે પ્રતિસાદને ઓળખવા માટે એક યુનિક આઇડેન્ટિફિકેશન નંબર અપાશે.

સ્વૈચ્છિક ભાગીદારી: આ અભ્યાસમાં ભાગ લેવું સંપૂર્ણ રીતે સ્વૈચ્છિક છે. તમે ભલે અભ્યાસમાં ભાગ ન લો અથવા જ્યારે ઇચ્છો ત્યારે બહાર નીકળી શકો, તમારે માટે કોઇ દંડ અથવા લાભની કાપણી નહીં થાય.

ખર્ચ: આ અભ્યાસમાં ભાગ લેવું મફત છે અને તેની કોઇ કિંમત નથી.

સંપર્ક માહિતી: જો તમને આ અભ્યાસ વિશે કોઈ પ્રશ્નો અથવા ચિંતાઓ હોય, તો કૃપા કરીને (કશિશ પંચાલ, 8200324350, kashishpanchal10@gmail.com) પર સંપર્ક કરો.

સંમતિ: આ સંમતિપત્ર પર સહી કરીને, તમે આ અભ્યાસમાં ભાગ લેવા સંમત છો. તમે સમજો છો કે કોઈ પણ સમયે આ અભ્યાસમાંથી બહાર નીકળી શકો છો અને તમારા માટે કોઈ દંડ નહીં થાય. તેમજ આ અભ્યાસમાં તમારો ભાગ ગોપનીય રહેશે.

ભાગીદારની સહી:

તારીખ:

અન્વેષકનો નિવેદન:
મેં અભ્યાસનો હેતુ સમજાવ્યો છે. ભાગીદારને આ પ્રક્રિયાઓ વિશે ચર્ચા કરવાનો અને કોઈ પણ વધારાના પ્રશ્નો પૂછવાનો અવસર આપવામાં આવ્યો હતો.

કશિશ પંચાલ

તારીખ:

આ સંશોધનમાં સહકાર આપવા બદલ તમારો આભાર!

Appendix 5

Questionnaire for data collection

Objective 1. To identify the caregiver's responsibility and address specific issues faced by the caregivers of bedridden patients.

For this objective, the goal is to explore and understand the challenges caregivers face while attending to bedridden patients. This requires a deep dive into their day-to-day tasks, emotional and physical burdens, and specific pain points related to caregiving.

Semi structured interview to identify the key Challenges in Dressing and Undressing Bedridden Patients for caregiver

Demographic Information		
1	Caregiver's Name	
2	Patient reason for being bedridden	
3	years of experience	
4	Please provide details of the bedridden patients you cared for	a. Acute Bedridden patients b. Chronic Bedridden patients c. Terminally ill bedridden patients
5	Clothing used presently for bedridden patients	a. Two piece b.one piece c.no garment d. any other

6.How stressful do you find the process of dressing or undressing bedridden patients?
a) Very stressful
b) Somewhat stressful
c) Neutral
d) Not stressful at all

7.How often do you feel anxious about injuring the patient during dressing or undressing?
a) Always
b) Often
c) Sometimes
d) Rarely
e) Never

8.How do patients typically respond emotionally to the dressing process?
a) Calm and cooperative
b) Mildly resistant

c) Frequently distressed or uncomfortable
d) Other (please specify)

9.Which type of clothing do you find the most difficult to manage during the dressing process?
a) Upper garment

b) lower garment
c) one piece
d) Other (please specify)

10.What part of the body is most challenging to dress or undress?
a) Upper body (shirts, gowns)
b) Lower body (pants, underwear)
c) limbs (hands or legs)
d) Other (please specify)

11.list the fasteners which increase the difficulty of dressing/undressing?

_____

12.What is the biggest challenge you face with clothing when dressing bedridden patients?

13.What improvements would you suggest making clothing easier to manage for bedridden patients?

14.How does the patient's emotional response during the dressing process affect your approach?

15.What other feedback do you have regarding clothing design for bedridden patients?

Appendix 6

Tool 2

Semi structured Questionnaire to identify the key Challenges faced by bedridden patients while Dressing and Undressing

Demographic Information		
1.	Name of the patient	
2.	Age of the patient	
3.	Reason for being bedridden	
4.	Duration of Bedridden period:	
5.	Gender	

6.How comfortable do you feel during the process of being dressed or undressed?
a) Very comfortable
b) Somewhat comfortable
c) Neutral
d) Uncomfortable
e) Very uncomfortable

7.How often do you experience pain or discomfort when being dressed or undressed?
a) Always
b) Often
c) Sometimes
d) Rarely
e) Never

8.How do you feel emotionally during the dressing/undressing process?
a) Calm and relaxed
b) Anxious or tense
c) Frustrated
d) Embarrassed
e) Other (please specify)

9.Do you feel that your dignity is maintained during the dressing/undressing process?
a) Always
b) Often
c) Sometimes
d) Rarely
e) Never

10. Any issues you've experienced with feeling too hot or cold because of the type of clothing you wear,
a) Always

b) Often
c) Sometimes
d) Rarely
e) Never

11.**What type of clothing do you find most comfortable to wear while bedridden?**
a) Loose-fitting garments (e.g., nightgowns, pyjamas)
b) Regular clothing (e.g., shirts, pants)
c) Hospital gowns
d) Other (please specify)

12.Which part of the body do you feel the most discomfort when being dressed or undressed?
a) Upper body (shirts, gowns)
b) Lower body (pants,peticoats)
c) limbs (hands or legs)
d) Other (please specify)

13.How often do you feel that the clothing you wear is too tight or restrictive?
a) Always
b) Often
c) Sometimes
d) Rarely
e) Never

14.How often does the fabric of your clothing cause irritation or discomfort?
a) Always
b) Often
c) Sometimes
d) Rarely
e) Never

15.Do you feel that the clothing you wear affects your ability to move or be repositioned comfortably?
a) Yes, it restricts movement
b) No, it does not affect movement
c) Unsure

16.Do you prefer clothing with certain features (e.g., elastic waistbands, no buttons or zippers)?
a) Yes
b) No
(If yes, please specify which features): _____

17.How satisfied are you with the current clothing options available to you as a bedridden patient?

a) Very satisfied
b) Satisfied
c) Neutral
d) Dissatisfied
e) Very dissatisfied

18.**What are the biggest challenges you face with the clothing you wear while bedridden?**

19.What types of clothing do you think would make dressing and undressing more comfortable for you?

20.What improvements would you suggest for the clothing design to make dressing/undressing easier for both you and your caregivers

Appendix 7

Evaluation form for Garment feedback (Same series follows for all the garments.)

Researcher: Ms. Kashish Panchal, Sr. M.Sc. (F.C. Sc)
Department/Faculty: Clothing and Textiles, Family and Family and Community Sciences
University: The Maharaja Sayajirao University of Baroda, Vadodara
Guide: Dr. Reena Bhatia

This evaluation form is a part of my research study entitled *"***User centered design of adaptive garment for bedridden patients"**guided by Dr. Reena Bhatia. Your valuable feedback will contribute to fulfilling one of my research objectives.

Objective: To evaluate the comfort and accessibility of the constructed garment.

Thank you for your time and valuable input. Your responses will help improve maternity wear designs in public healthcare settings

Demographic Details

1.Hospital

- G.M.E.R.S.Hospital
- S.S.G.Hospital

2.Department

- Surgery
- Prthopadeic

3.Patients Name-

4.Caregivers Name-

5.Reason for Being Bedridden

6.Duration of Bedridden period

Garment 1 Feedback

Instructions: Please evaluate the adaptive garment based on your experience during the wear trial. Indicate your level of agreement with each statement by marking the appropriate box.

Scale:
1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

Garment Code -If Orthopaedic Department

O1-Gown with front slits with shoulder opening

O2-Gown with side slits with middle opening

O3-Gown with side slits with shoulder opening

Garment code- If Surgery Department

S1-Gown with Front Tie String

S2-Gown with one side opening

S3-Detachable gown

1.The fabric of the garment feels soft and comfortable against the skin.

1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

2. garment does not cause any irritation or discomfort.

1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

3.The garment allows for ease of movement while lying down.

1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

4.The garment maintains comfort over an extended period of wear.(10 hours)

1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

5.The garment provides adequate sensory comfort (e.g., does not feel too rough, stiff, or irritating).

1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

6. The garment supports movement comfort, allowing for natural repositioning without restriction.

1 - Strongly Disagree
2 - Disagree
3 - Neutral

4 - Agree
5 - Strongly Agree

7. The garment is easy to put on and take off with minimal effort.

1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

8. The garment design accommodates medical needs (e.g., IV lines, catheters, knee braces etc.).

1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

9. The closures (Buttons, Tie strings) are easy to use and do not cause inconvenience.

1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

10. The fabric feels breathable and prevents excessive sweating.

1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

11. The overall design of the garment is satisfactory.

1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

12. The garment would be recommended for other bedridden patients.

1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

13. **Additional Comments:**

सत्यं शिवं सुन्दरम्
Estd: 1949,
Accredited Grade "A+" by NAAC

Department of Clothing and Textiles
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
Fatehgunj Road, Vadodra-390002
Ph: (+91-0265)2795523

Date: 27-09-2024

Permission Letter for Hospital visit

To,
Dr, Ranjan G. Aiyer
Medical Superintendent
S.S.G Hospital, Jail road
Anandpura Vadodara
Gujarat - 390001

Subject: Request for Approval to Conduct Research Interviews with Caregivers, Management, and Bedridden Patients, and Wear Trials with Caregivers and Patients

Dear Sir/ Madam,

Greetings from the Department of Clothing and Textiles!

The student Ms. Kashish Panchal is pursuing Masters' in Clothing and Textiles; and in partial fulfilment of the degree requirements, she has undertaken research titled: "User-centered design of adaptive garments for bedridden patients"

The purpose of this study is to explore the challenges that caregivers face when dressing and undressing bedridden patients, as well as understanding how management is conducted in terms of clothing of Bedridden patients, Additionally, it seeks to identify the difficulties faced by bedridden patients themselves, with a focus on identifying difficulties and potential areas for improvement in adaptive clothing design.

Furthermore, the study will include a wear trial phase, where prototypes of adaptive garments will be tested by bedridden patients and caregivers to gather practical feedback. This phase is essential for evaluating the effectiveness of the clothing designs in enhancing caregiver efficiency and patient comfort.

May I request your kind permission to conduct research interviews and wear trials with respondents as above at your facility for the study. All interviews and wear trials will be voluntary, confidential, and carried out with minimal disruption to daily routines, in an ethical and respectful manner.

Your support in advancing knowledge in this field is highly solicited.

Thank you and Sincere Regards,

Reena Bhatia

Dr. Reena Bhatia
I/C Head and Guide,
Department of Clothing and Textiles,
Faculty of Family and Community Sciences,
The Maharaja Sayajirao University of Baroda, Vadodara-2

Heads.
Surgery
Medicine
Ortho.

Medical Superintendent
S.S.G. Hospital, Vadodara.

Permitted
28/12/2024.

After proper consent from the parents,

Institutional Human Ethics Committee
CDSCO Registration No. ECR/28/Inst/GJ/2013/RR-24 Approved upto 15 / April / 2029
NECRBHR Registration No. ECINEWIINST/2021/GJ/0016 Approved upto 15 / November / 2026
GMERS Medical College & Hospital, Gotri, Vadodara – 390021, Gujarat, India
Phone: (0265) 2398008, Fax: (0265) 2398009, Email: iheemcgv@gmail.com

Annexure 2

OUTWARD NO : IHEC/24/044/SRMSU02
IHEC, GMERS MEDICAL COLLEGE & HOSPITAL, GOTRI, VADODARA.

RECEIVED DATE: 20/11/2024
OUTWARD NO: IHEC/24/OUT/SRMSU02
APPROVAL DATE: 29/11/2024

To,
Student: Ms. Kashish Panchal, Sr. Masters Student, Maharaja Sayajirao University
Guide: Dr. Amul Bhedi, Professor & Head - Surgery, GMERS MCGV
Co-I/Guide: Reena Bhatia, Assistant Professor, Family and Community Sci. MSU

Sub: Approval of your research proposal

Dear Ms.Kashish Panchal,

The Institutional Human Ethics Committee reviewed and discussed your application to conduct the research proposal entitled: **"User Centered Design of Adaptive Garment for Bedridden."** on 29th Nov. 2024.

The following documents were reviewed
1. IHEC filled up a research proposal form.
2. Investigation's Undertaking
3. Departmental Scientific Meeting report.
4. Curriculum Vitae Principal Investigator
5. Proposal of departmental scientific committee/institutional s
6. scientific board Outcome measures, Plan for data analysis
7. Questionnaire/CRF.
8. Patient Information Sheet and Informed consent form.(English, Gujarati)
9. Informed Consent form (Dardi Sahmati Patrak) in Vernacular languages
10. Informed Consent form (Dardi Sahmati Patrak) in English

As the research study classifies in the minimal risk category, the IHEC GMERS approves your study to be conducted in the presented form.

The approval remains valid for a period of 1 year. In case the study is not initiated within one year. The Ethics Committee expects to be informed about the reason for the same and a fresh approval will have to be obtained subsequently.

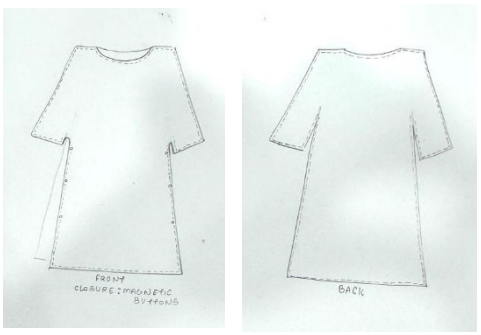
The IHEC expects to be informed about the progress of the study (every 6 months), any Serious Adverse Event (SAE) occurring in the course of the study, and if any changes are made in the protocol or patient information/informed consent The IHEC needs to be informed about this in advance and an additional permission is required to be taken. The IHEC also requires you to submit a copy of the final study report.

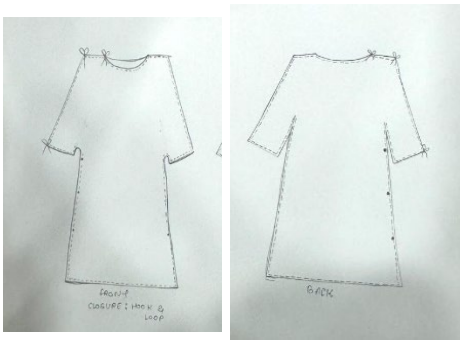
MEMBER SECRETARY
IHEC
GMERS Medical College
& Hospital
Gotri, Vadodara

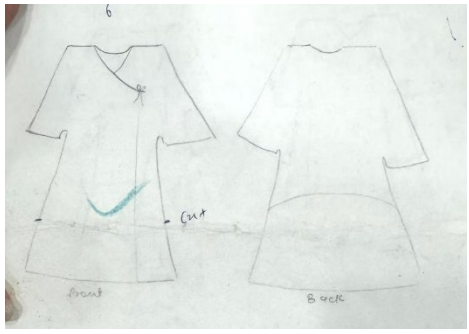
Signature
Member Secretary,
IHEC

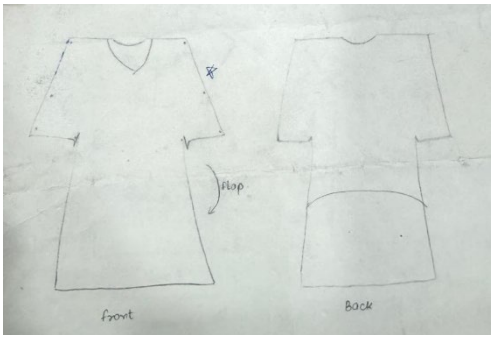
Annexure 3

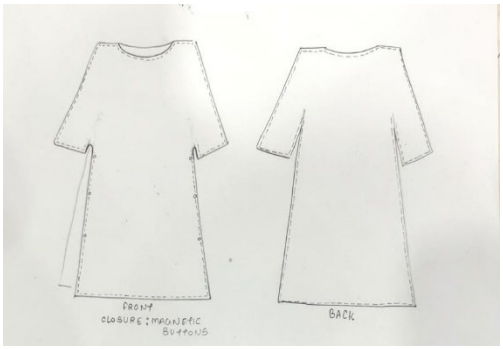
Initial sketches made by the researcher

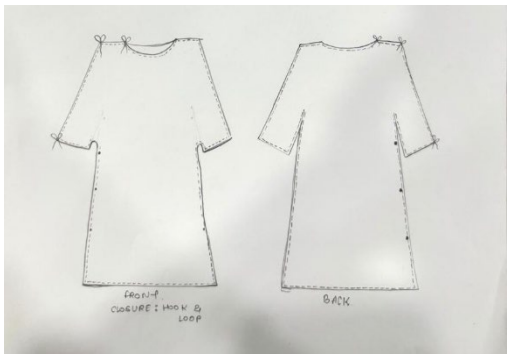


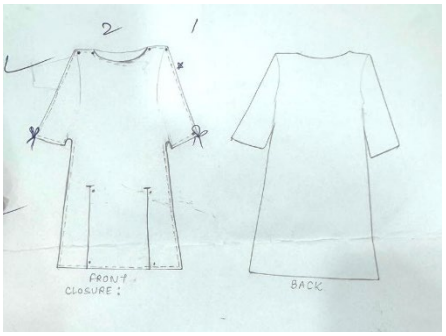


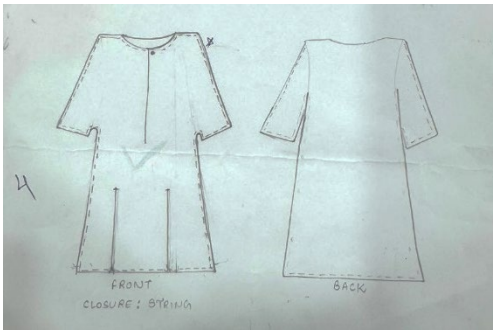


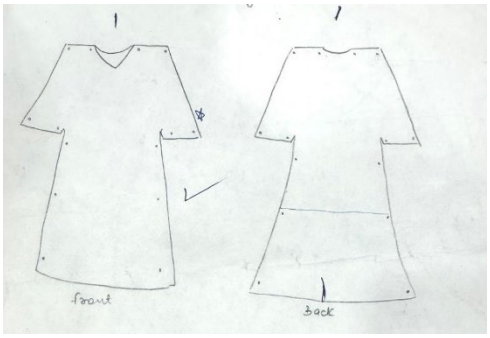








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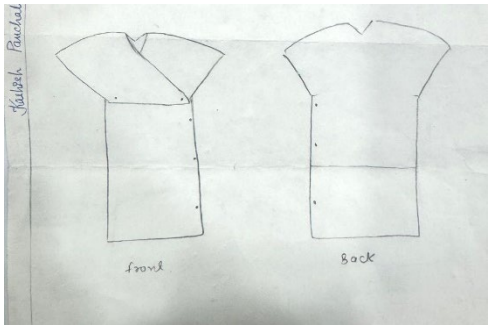
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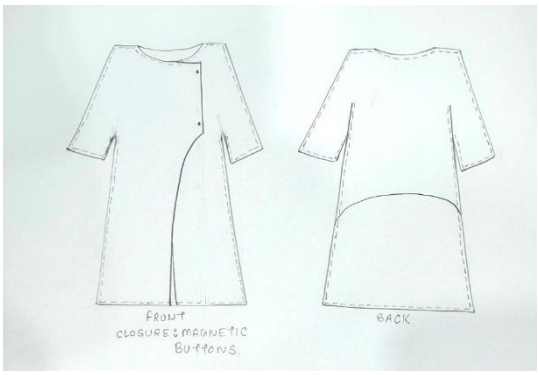
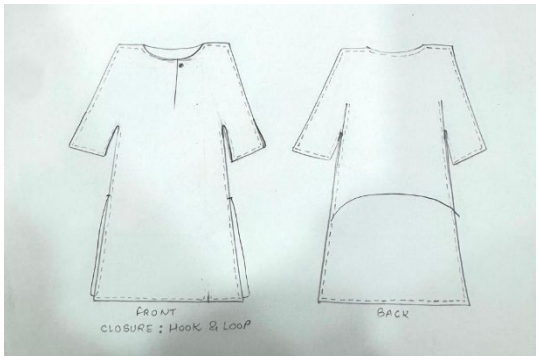

FRONT
CLOSURE : MAGNETIC BUTTONS.
BACK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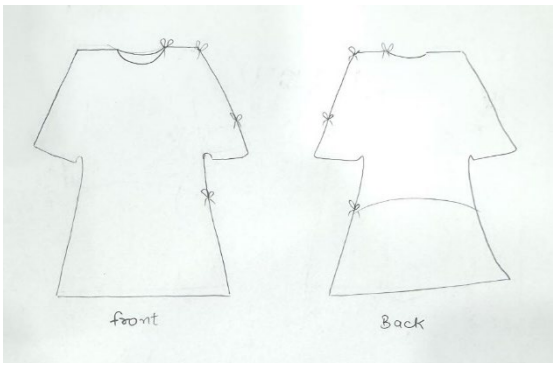
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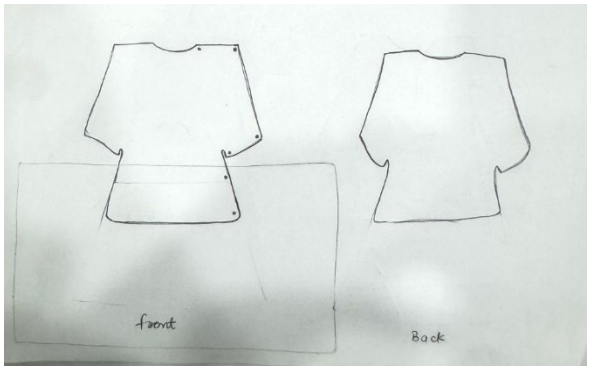
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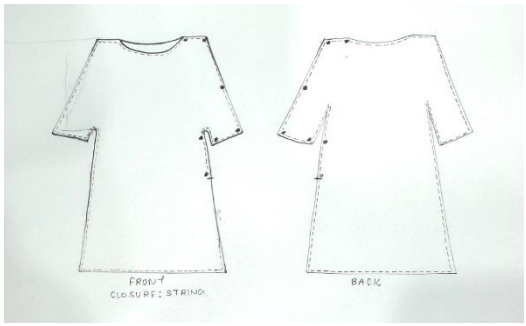
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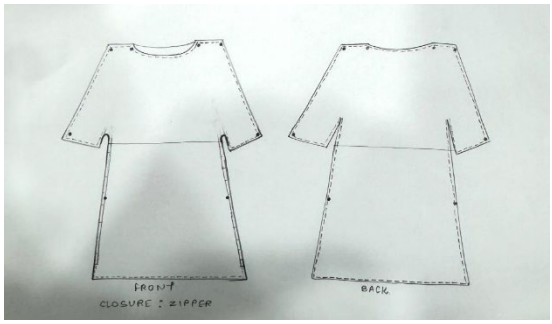
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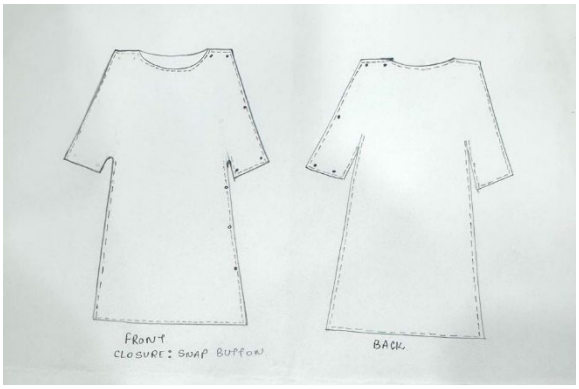
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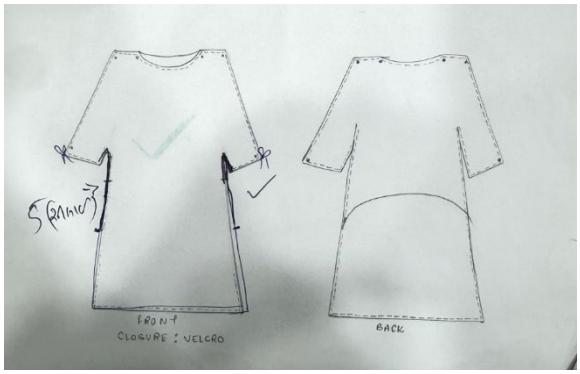
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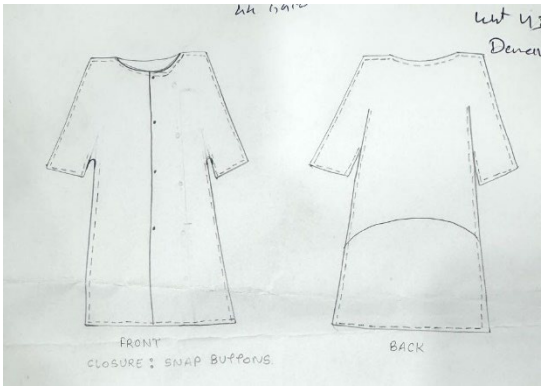
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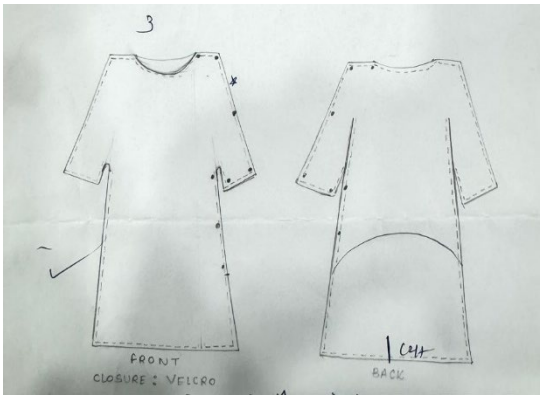
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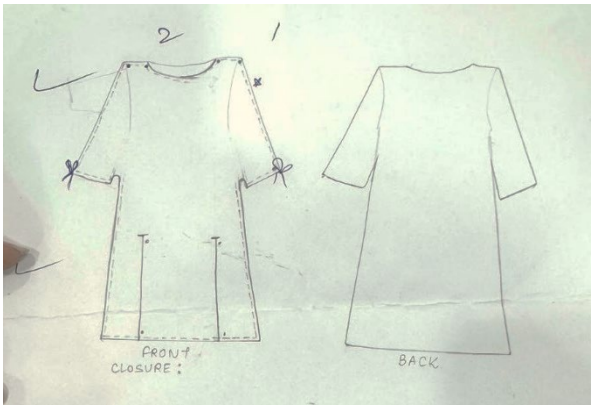
2
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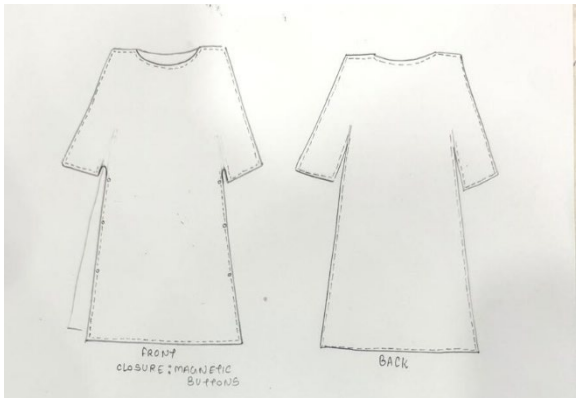
FRONT
CLOSURE :
BACK


FRONT
CLOSURE : MAGNETIC BUTTONS
BACK