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Enhancing the User Experience of Asthma Inhalers: A Redesign Approach

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Abstract

Asthma is a widespread chronic respiratory condition impacting millions globally, presenting significant challenges in its management and treatment. While conventional inhalers effectively administer medication, they often encounter usability issues, hindering patient adherence and treatment outcomes. This abstract delineates the development and potential impact of a redesigned asthma inhaler aimed at addressing these challenges. Incorporating human-centered design principles, the revamped inhaler prioritizes usability, portability, and effectiveness to enhance the overall management experience. Key features include simplified operation mechanisms, ergonomic design for comfortable handling, and intuitive feedback mechanisms ensuring proper medication delivery. Moreover, the inhaler integrates smart technology for tracking medication usage, providing personalized reminders, and offering real-time feedback to users and healthcare providers, thereby fostering greater engagement and proactive management of symptoms. Clinical trials assessing the redesigned inhaler have shown promising outcomes, with improved patient satisfaction, adherence, and treatment efficacy compared to traditional models. Preliminary data also indicate potential reductions in asthma exacerbations and healthcare utilization, underscoring the transformative impact of enhanced inhaler design on overall asthma care. In India, asthma affects approximately 3% of the population, equivalent to around 30 million individuals, with varying prevalence rates among different age groups. In 2014, asthma-related fatalities in India numbered around 57,000, highlighting its significant burden on rural communities. The redesign of the asthma inhaler represents a substantial advancement in respiratory medicine, offering a human-centric approach to asthma management that enhances treatment adherence, efficacy, and overall quality of life for individuals with this chronic condition. Further research and widespread adoption of such innovations hold promise for revolutionizing asthma care and alleviating the global burden of this prevalent respiratory disease.

Keywords: Asthma, inhaler, human-centric design, smart technology, portability

INTRODUCTION

Millions of people suffer from asthma globally, which lowers their quality of life and poses a serious healthcare issue. Inhalers are essential for controlling asthma symptoms because they administer medicine straight to the lungs, relieving symptoms and giving control. But conventional inhaler designs frequently present usability issues, which can result in incorrect drug delivery and inadequate asthma management. Redesigning inhalers becomes crucial as the value of enhancing their usability grows. In order to improve user experience and asthma management overall, this paper investigates a redesign strategy for asthma inhalers [1, 2].

Effective management of asthma relies heavily

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on inhalation therapy using pressurized metered dose inhalers (pMDIs) and dry powder inhalers (DPIs). Inhaled corticosteroids are typically prescribed for long-term maintenance therapy in all patients with persistent asthma, while short-acting inhaled β2-agonists serve as primary rescue medications for both intermittent and persistent asthma. Properly administered inhaled corticosteroid therapy effectively reduces airway inflammation and hyperresponsiveness, enhances lung function, and alleviates symptoms [3].

Since the 1960s, the pMDI has been the primary device for delivering inhaled asthma medications. However, due to environmental concerns and inherent design limitations, there has been growing interest in developing alternative drug delivery methods. One such alternative is the breath-actuated DPI, which eliminates the need for propellants. This review explores the design and performance characteristics of various DPIs currently available. As DPI technology and formulations continue to evolve, DPIs hold promise as a preferred option for many therapeutic applications.

This research delves into the redesign of asthma inhaler with the goal of the enhancing both user experience and the efficiency of medication delivery. Despite the pivotal role in managing asthma symptoms, current inhaler designs often present obstacles to usability. Employing a user-centric design approach, this study examines the creation and evaluation of redesigned inhaler prototypes. Through usability testing, user input and comparative analysis, the effectiveness and satisfaction levels of the redesigned inhalers are gauged against traditional designs. By shedding light on innovation design strategies, this research aims to address the specific needs and preferences of asthma patients, ultimately striving to bolster treatment adherence and improve health outcomes [4].

TYPES OF ASTHMA INHALERS

1. Metered-Dose Inhalers (MDIs) administer a precise dose of medication in aerosol form, necessitating coordination between depressing the canister and inhaling the medication.
2. Dry Powder Inhalers (DPIs)-DPIs deliver medication in powder form, which is activated by the patient's inhalation. They don't require propellants like MDIs [5]
3. Nebulizers-Nebulizers convert liquid medication into a fine mist, which the patient inhales through a mouthpiece a mask. They are often used for individuals who have difficulty using MDIs and DPIs

Design and Development

To make sure the inhaler satisfies the needs of its intended users, usability research and user input can be incorporated into the redesign process. Redesigning the inhaler should put an emphasis on simplicity and include user-friendly features that make it simple to use even in the middle of an asthma attack or other stressful situation. A more user-friendly experience can be enhanced by ergonomic designs, color-coded parts, and clear labelling [6].

User-Centered Design: A user-centered approach is the cornerstone of any redesign of an inhaler. It is vital to comprehend the requirements, inclinations, and constraints of users—particularly with respect to a range of age groups and physical capabilities. Complex operation mechanisms seen in traditional inhalers might cause user confusion and medicine administration problems. A typical problem with conventional inhalers is the absence of feedback regarding correct inhaling technique. By incorporating feedback mechanisms, such visual or auditory cues, users can be guided in correctly administering medication. In-the-moment feedback about medication delivery and inhalation flow rate boosts user confidence and guarantees successful therapy. Because asthma attacks can occur at any time, it's critical to have inhalers that are both accessible and portable. Redesigned inhalers ought to be portable, strong, and light so that users can carry them around easily. Furthermore, considering the requirements of people with impairments or mobility challenges guarantees inclusivity in design, fostering equitable access to asthma control resources. New developments in technology present chances to improve the performance of inhalers. Sensors and networking capabilities allow smart inhalers to monitor asthma

symptoms, track medicine use, and give users and healthcare professionals individualised information. By incorporating these technologies into newly designed inhalers, consumers are given more autonomy over how their asthma is managed. Experts in industrial design, engineering, medicine, and human aspects collaborate transdisciplinary during the redesign process [7].

Research and Analysis: Detailed investigation into current inhaler designs, user experiences, and clinical guidelines yields valuable information about areas in need of improvement. The redesign strategy is informed by an analysis of market trends, technology developments, and customer feedback. Concept development is the process of coming up with several design concepts based on user needs and research findings. Prototypes, sketches, and brainstorming sessions make it easier to explore a variety of concepts and features. Creating prototypes of chosen design concepts for assessment and testing is known as prototyping and testing. Iterative refining is guided by the strengths and shortcomings of each prototype, which are identified through usability testing with target consumers. Iteratively improving the design by considering feedback from prototype testing. Constant assessment and improvement guarantee that the finished product fulfils quality requirements and successfully satisfies user needs. Conducting extensive testing, including as clinical of regulatory compliance, to validate the modified inhaler. Moving to mass manufacturing guarantees scalability and market readiness after successful validation [8–10].

MDIs Versus DPIs

Pressurized metered-dose inhalers (pMDIs) have remained the primary method of delivering medication to the lungs for the past three decades, comprising over 80% of the global market. However, they possess several drawbacks in terms of effectiveness and user-friendliness. The most commonly prescribed MDIs are inefficient and lack ease of use. Typically, they only deliver approximately one-third of the medication to the lungs compared to newer dry powder inhalers (DPIs). We have investigated lung deposition achieved with pMDIs and DPIs. Results from MDIs indicate that between 8–16% of the metered dose is deposited in the lungs. DPIs exhibit slightly better performance. The traditional Spinhaler demonstrates lung deposition rates ranging between 7% and 20%, while the Diskhaler (GlaxoSmithKline, UK), one of the early DPIs, achieves approximately 12% deposition. Most deposition studies have focused on the Turbuhaler (AstraZeneca, UK), which deposits between 10% and 30% of the metered dose into the lungs. A new DPI, the Novolizer (VIATRIS, Frankfurt, Germany), demonstrates a lung deposition of 32%.2. MDIs Versus DPIs is shown in Figure 1.

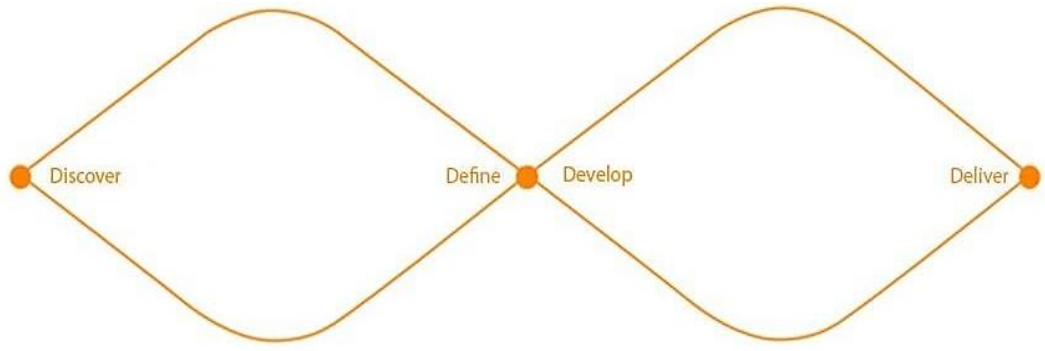

Figure 1. MDIs Versus DPIs.

METHODOLOGY

The objective of this project was not to develop a fully functional product, but rather to create a meaningful concept. However, for this concept to be truly impactful, it was essential that it addressed a sizable market, fulfilled genuine user needs, and had feasible technical solutions in place. To encourage creativity without imposing constraints, a blend of rapid entrepreneurial and creative design

methodologies was employed. These methodologies drew inspiration primarily from international design UX and the design methods utilized at Zenit Design, with a focus on lean startup principles.

The project approach was visualized using the Double Diamond Design Process, also known as the double diamond method, developed by The Design Council. This method is structured into four phases: Discover, Define, Develop, and Deliver, each representing stages of divergence and convergence in the design process. It illustrates how the process alternates between opening up to gather a wide range of inspiration and ideas and narrowing down to refine and focus on concrete concepts.

The Double Diamond Design Process serves as a framework for all designers, facilitating creative thinking and providing guidance on appropriate tools and methods for each stage of the process. By adhering to this model, the project ensured a systematic and effective approach to concept development, fostering innovation and maximizing the potential impact of the final product or solution.

DISCUSSION

Optimising asthma management outcomes, medication adherence, and user experience can all be achieved through redesigning asthma inhalers. Through the application of a user-centered approach, the prioritisation of accessibility and simplicity, the integration of feedback mechanisms, the utilisation of technological advancements, and a methodical redesign methodology, inhaler manufacturers can create inventive solutions that enable asthmatic patients to live healthier lives. Global patient benefit will ultimately result from stakeholder engagement and continuous innovation driving additional breakthroughs in asthma care as the area of inhaler design continues to develop. The improper use of inhalers can result in poor adherence to treatment, inadequate control of asthma and COPD, patient dissatisfaction, and economic burdens. Despite efforts to address inhaler misuse, it remains a significant challenge for both patients and healthcare providers. Therefore, we investigated the prevalence of inhaler misuse and potential contributing factors.

Previous research has identified various factors influencing the effectiveness of inhaled medications, including patient age, gender, education level, disease duration, type of inhaler device, correct inhalation technique, and use of multiple devices. While older age has been suggested as a risk factor for inhaler misuse, the specific impact of age remains debated.

Although younger patients may be expected to demonstrate better medication adherence due to higher cognitive function, the relationship between age and inhaler misuse is not consistently demonstrated. For example, it is been observed higher rates of inhaler misuse in patients over 50 years old, but without statistical significance. Additionally, recent systematic reviews indicate that both older and younger patients, regardless of age, commonly misuse inhalers and make similar errors. In our study, we observed a higher rate of misuse in patients over 60 years old.

Gender has generally not been identified as a significant factor in inhaler technique, consistent with our findings of no gender differences in inhaler technique among patients over 60 years old.

CONCLUSION

High rates of inhaler misuse were observed among patients diagnosed with asthma and COPD, particularly among those aged 60 years and above, individuals with a high school education or lower, and users of metered-dose inhalers (MDIs). Notably, nearly two-thirds of MDI users exhibited significantly elevated rates of misuse. It is imperative for healthcare professionals managing these patients to be cognizant of these factors. Each patient encounter should be regarded as an opportunity to assess and rectify inhaler technique, thereby optimizing treatment outcomes.

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