Journal of Human Centered Technology

https://www.humentech.utm.my E-ISSN: 2821-3467

Online Platform for Home-Based Medical Device Lifecycle Management: A User-Centric Approach

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Cite: https://doi.org/10.11113/humentech.v4n2.101 Research Article

Abstract:
The growing access to medical devices in home settings that is driven by the advancements in telemedicine and home monitoring technologies, has significantly increased their usage, especially in post-pandemic era. However, home-based medical device users often face challenges in accessing reliable information and support for device operation, maintenance and training. This study addressed these issues by developing a user-friendly online platform using Wix to support individuals managing medical devices in home settings. The platform integrates multiple functionalities, including access to product specification, warranty management, rental request, maintenance request submission, regulatory compliance information and user training resources. The usability testing with 40 diverse participants revealed high satisfaction rates with 92% agreeing that the platform effectively supports medical device management and 96% acknowledge the clarity and value of the educational resources. This study highlights the platform's potential to empower home users by improving their competency in medical device utilization and improve health outcomes in home-care environments.

Keywords: Home-based support; Lifecycle management; Medical device.

1. INTRODUCTION

The growing use of medical devices in home settings, which is fueled by the advancements in telemedicine and home monitoring technologies has played a key role in enhancing patient autonomy and improving health management. This shift is largely driven by the rising prevalence of chronic conditions and the increasing demand for more personalized care solutions (1, 2). The COVID-19 pandemic has further accelerated this trend, highlighting the urgent need for remote healthcare systems that can ensure continuity of care while reducing the risk of infection (3, 4). Furthermore, the increasing availability of hospital-grade medical devices for home use has enabled patients to receive high-quality care without the need for prolonged hospital stays. These medical devices range from diagnostic tools such as blood pressure monitors and glucometers to therapeutic and monitoring devices like nebulizers, insulin pumps, oxygen concentrators, vital sign monitors and many more (5, 6). This shift has been beneficial for individuals with chronic illnesses, post-surgical recovery needs or those requiring ongoing therapeutic interventions. Many patients now prefer the comfort and convenience of receiving treatment at home, facilitated by hiring nurses or personal physicians to administer the care (7–9). Despite their growing adoption, home users still face significant challenges in managing these devices across their lifecycle.

However, the integration of medical devices into home settings requires reliable support systems to ensure their safe and effective use. Unfortunately, such systems are often lacking and leaving home users to face significant challenges throughout the device lifecycle from acquisition and setup to training and maintenance. One major obstacle is the difficulty in accessing accurate and comprehensive product information before making a purchase. Unlike healthcare professionals, home users typically lack the resources to evaluate device specifications, compare models or verify regulatory compliance, which often results in suboptimal or inappropriate device choices for their specific needs (10–12).

In addition to limited pre-purchase support, post-market services such as installation, routine maintenance, warranty tracking, and repair management are frequently fragmented and poorly coordinated. This can lead to prolonged device downtimes and decreased usability which ultimately compromise home-based health management (8, 9, 13–14). Furthermore, the absence of accessible educational resources means that many users are not adequately trained to

Received 14 January 2025; Accepted 10 April 2025
Available online 06 August 2025

operate or maintain their devices. Without proper training materials, the risk of device misuse, safety issues and non-compliance with essential protocols increases significantly (15–16).

To address the challenges faced by home-based medical device users, this study proposes the development of an integrated online platform designed to support users throughout the entire device lifecycle—including acquisition, training, setup, and maintenance. Built using the Wix web development tool, the platform is intended for adoption by medical device suppliers as an extension to their existing websites, enabling them to offer centralized and user-friendly access to essential services.

The platform combines multiple functionalities in a single interface: users can browse detailed product specifications, compare devices, manage rentals and purchases, schedule maintenance and access warranty tracking tools. To further support safe and effective device usage, it also offers educational resources such as interactive training modules and instructional videos aimed at enhancing users' confidence and proficiency (17). By streamlining these critical processes into one cohesive system, the platform empowers home users to make informed decisions and manage their medical devices more efficiently.

The usability and effectiveness of the platform are evaluated through comprehensive testing with a diverse group of home-based medical device users. Findings from this evaluation are expected to demonstrate the platform's potential in minimizing device downtimes, improving user satisfaction, and ultimately contributing to safer and more effective healthcare in home settings (18). This research underscores the increasing need for accessible and robust digital solutions to support the shift toward home-based healthcare.

2. METHODOLOGY

The methodology adopted in this study on the development of the online platform for medical device lifecycle management began with the planning and design phase. Stakeholder requirements, particularly from medical device home users, were collected through interviews and benchmarking with existing platforms available online (19). A workflow diagram was then constructed to map the system's functionalities and key modules necessary for effective device lifecycle management.

2.1 System Architecture

The system architecture was designed based on Wix's capabilities which combined both front-end and back-end functionalities for improved performance as shown in Figure 1. The front-end development utilized the Wix Editor to create a visually appealing and intuitive interface for the end user. The interface included key product pages designed with detailed descriptions, high-quality images and interactive elements to enhance user engagement. The layout was structured using Wix's drag-and-drop builder which enables rapid customization of the layout elements. This design facilitated easy navigation with strategically placed Call-to-Action (CTA) buttons, such as "Learn More," "Download Brochure," and "Contact Us." Content management was also improved by embedding hyperlinks for essential documents such as user guides, installation manuals and regulatory compliance documentation, enhancing accessibility for users (20).

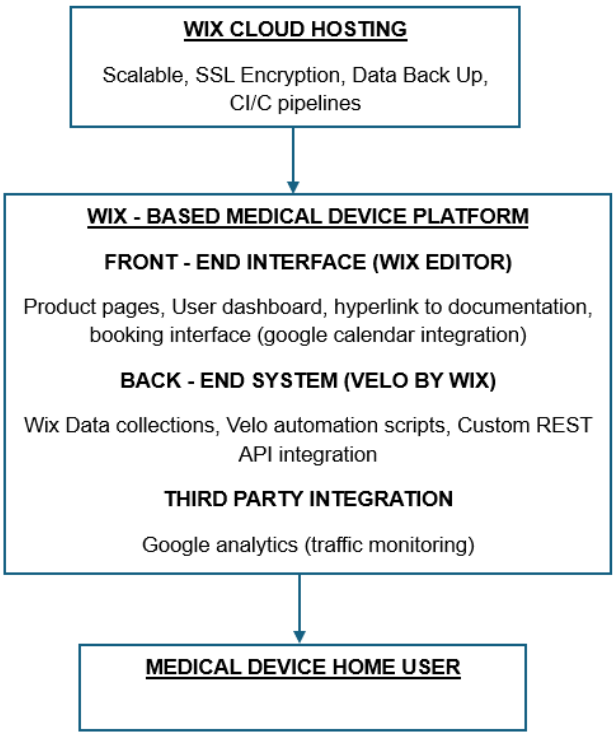

Figure 1. Overall system architecture for medical device online platform.

For the back-end development, Wix Data collections were employed to manage structured data efficiently. Product entries were organized with attributes such as product names, descriptions, pricing, specifications and inventory levels. Velo by Wix, a JavaScript-based development tool, was used in this study to create custom interactions for dynamic content. Custom Velo scripts were also used to automate tasks such as handling user queries, processing orders and securely managing user authentication. Additionally, an inventory management system is included to ensure real-time updates by dynamically adjusting stock levels whenever orders are placed to improve operational efficiency (21). Furthermore, custom REST APIs are integrated to ensure real-time synchronization of data related to maintenance schedules, rental tracking and warranty management directly with vendor systems.

To demonstrate the system's functional flow, a workflow diagram was developed to illustrate the steps carried out for significant features like the real-time device monitoring feature, vendor communication and rental process. These diagrams provided clarity on how user interactions trigger backend processes. For instance, when a user clicks the "real-time device monitoring" feature from the dashboard, the system triggers a background Velo script that initiates a request to the vendor's API. The API fetches data regarding device status, maintenance schedules and warranty details, which are then displayed on the user dashboard. Furthermore, for purchasing and rental features, custom Velo scripts were created to send requests directly to vendor systems via secure REST APIs. This enabled real-time synchronization of stock availability, order confirmation and rental tracking data and ensuring accurate updates for the users.

To improve platform functionality, third-party tools like Google Analytics for traffic monitoring and Wix Bookings for automated scheduling were integrated. A support system was established using LiveChat integration for real-time assistance, coupled with automated follow-up emails managed through Velo scripts. Additionally, QR codes were implemented for payment solutions via Touch 'n Go and other local banks, ensuring cost-effective transactions with clear instructions for users (22). For hosting and security, Wix Cloud Hosting was selected for its scalability, ensuring optimal performance during traffic spikes. Built-in security features such as SSL encryption and data backup ensured data integrity and protection against unauthorized access. Continuous Integration and Continuous Deployment (CI/CD) pipelines were implemented to streamline updates and ensure ongoing improvements to platform performance and security (23).

As this website serves as a proof-of-concept prototype, certain assumptions were made. It was assumed that medical device vendors provide real-time API access for warranty and maintenance data and that vendor systems would adopt standardized API structures for seamless integration with the platform. These assumptions were made to simplify the design process while demonstrating the feasibility of the proposed system within the project's scope and timeline.

2.2 Usability Testing

To evaluate the system's usability, a testing phase was conducted with 40 participants from diverse backgrounds, including healthcare professionals, device vendors, and general home users. The survey included 10 structured questions designed to assess key aspects such as system usability, content clarity, and functionality. Each question was rated on a scale of 1 to 5, allowing both qualitative and quantitative data collection. Interviews were conducted both online and physically, accommodating participants' availability and preferences. The demographic breakdown of participants included 40 general home users, 10 device vendors, and 2 healthcare professionals. Age and gender distributions were balanced to ensure a diverse representation of users' perspectives. Feedback was collected via surveys and interviews, focusing on system navigation, task completion, and overall satisfaction (24). Quantitative metrics such as system response times were measured using GTmetrix, while qualitative feedback was used to refine the platform iteratively. The integration of Google Analytics provided further insights into user behavior, enabling data-driven improvements.

3. RESULTS AND DISCUSSION

3.1 Website Features

This study has successfully implemented an online platform for managing the lifecycle of medical devices for home users. This platform is designed for medical device suppliers to adopt within their existing websites to provide essential support to home-based users throughout the device lifecycle which integrate essential functionalities that enhance medical device management at home. The platform incorporates multiple features including medical device purchasing and renting, maintenance scheduling and warranty management as well as training features to help home users in optimizing the management of medical devices in the home setting. One of the key features of the platform is the user dashboard which centralizes all necessary information for the user. This dashboard includes a detailed list of available medical devices for purchase and rent including the device specifications for comparison and warranty status. Additionally, the dashboard integrates regulatory compliance tracking, ensuring that users remain informed about the relevant legal and safety requirements for each device (Figure 2).

The product page on the platform is designed to provide comprehensive support for home users in making well-informed purchasing decisions as shown in Figure 3. It features detailed product descriptions that highlight the key functionalities and benefits of each device. High-quality images and videos are available to demonstrate the device in use, which aids in the assessment of its practicality for home usage. A key features section outlines critical specifications of the device to allow users to quickly grasp the core advantages of each device. In addition, the page also includes comprehensive documentation such as user manuals, maintenance guides and regulatory compliance information which are essential for the safe and effective use of the equipment as well as to ensure adherence to medical standards and legal requirements. The reviews and ratings section are another valuable feature to enable users to leave feedback based on their experiences. Ratings offer a quick summary of user satisfaction, while reviews provide insights into the device's reliability, ease of use and overall performance.

Another feature is the medical device comparison table as shown in Figure 4. The function users to compare medical devices effectively in terms of its purpose, price, operating specifications, electric shock protection, language settings and other relevant specifications easily before making any decision. By organizing this information side-by-side, the table facilitates quick identification of devices that best meet the user's needs. This comparison tool is particularly beneficial as it saves time by consolidating essential product details in one place and enhances decision-making by presenting clear, objective data on each device's capabilities and performance.

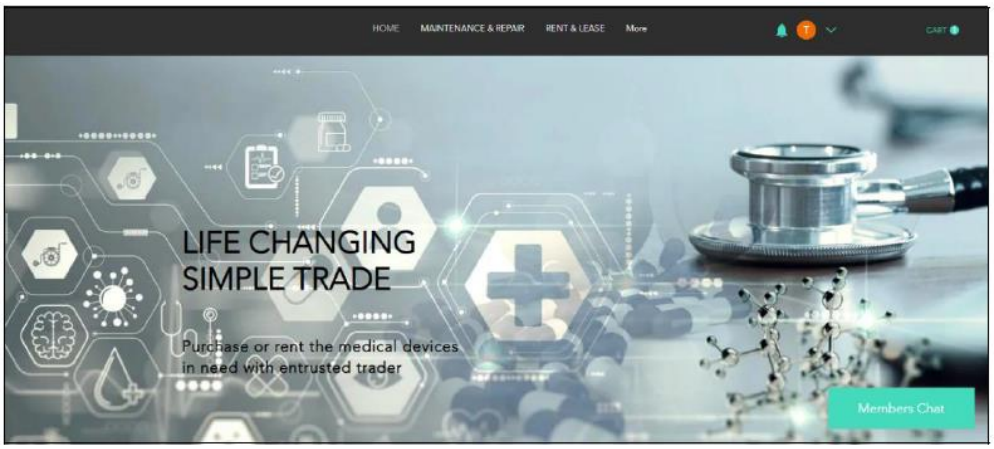

Figure 2. Homepage of medical device website: Overview of site's key functionalities.

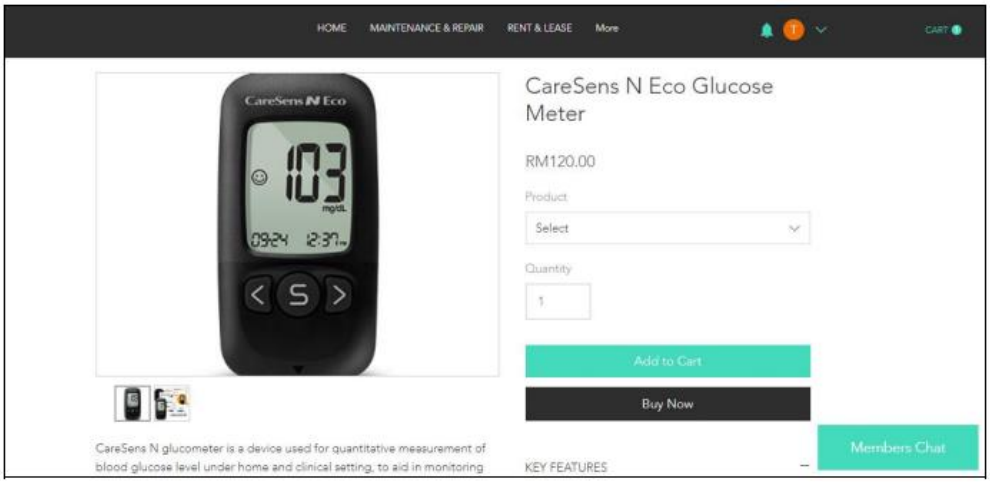

Figure 3. Specific product page is available for purchase.

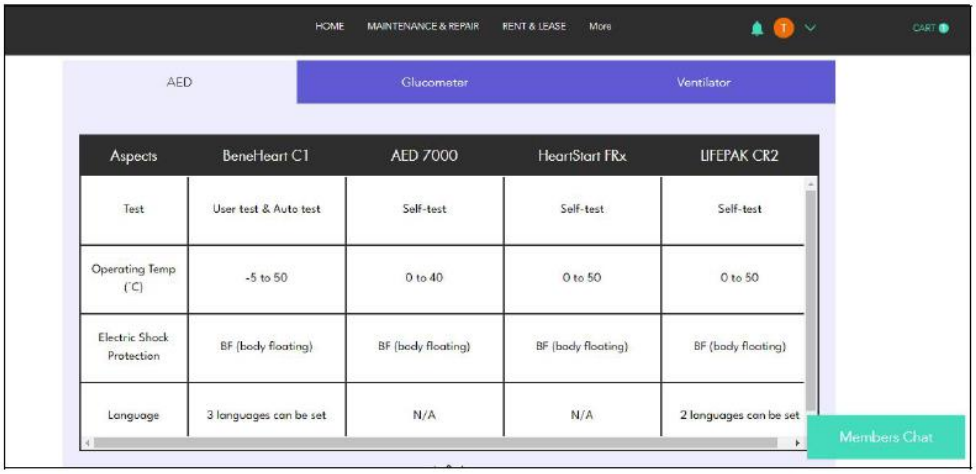

Figure 4. Product comparison tables which allow users to compare product specifications before purchasing and renting.

The next feature is the warranty claim and repair submission page which is to support any warranty claims and repair request from the users as shown in Figure 5(a). This page is a crucial component as it enables users to efficiently request repair services and submit warranty claims for their medical devices quickly whenever it is needed. Through the interface, users can input necessary details, such as device information, issue description and proof of purchase which facilitates faster processing of requests. This not only improves the timeliness of repair requests to support corrective maintenance but also helps in minimizing downtime and maintaining the reliability of medical care especially during plan preventive maintenance scheduling. Additionally, by consolidating warranty and repair requests in one place, users are empowered to track their submissions and receive timely updates easily.

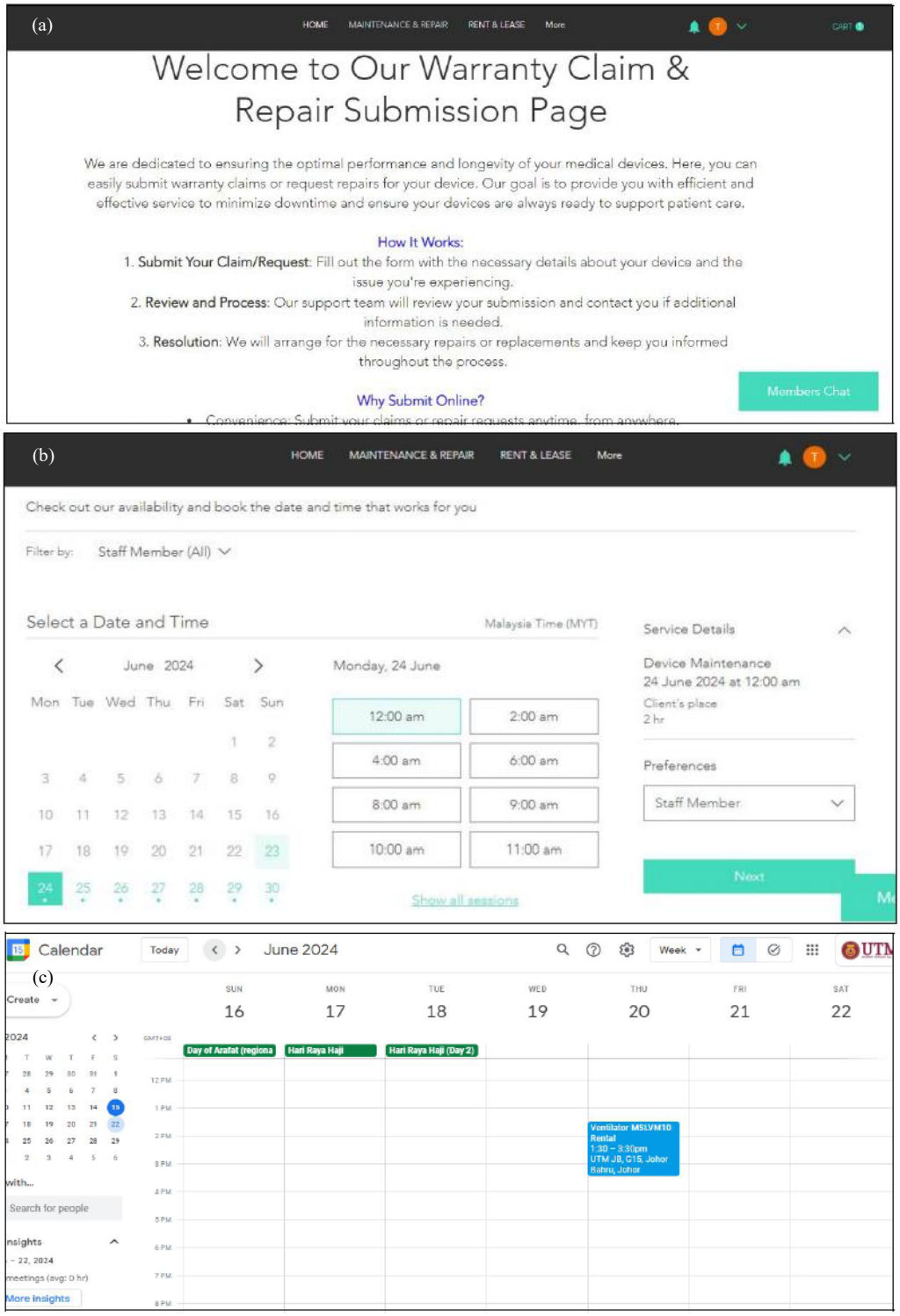

Figure 5. (a) Features for warranty claim and repair page, (b) appointment booking page for user to select date and time based on their preference and (c) appointment is integrated with user's google calendar.

The integration of Google Calendar on the website significantly improves the booking experience for users as shown in Figures 5(b) and 5(c) respectively. When a booking is confirmed, an invitation is automatically linked to the user's Google Calendar. This feature allows users to add the booking to their personal calendars with a simple click to have a visual reminder of their upcoming maintenance sessions. Furthermore, users will also receive session reminders 24 hours before the session starts to reduce the chances of missed appointments. The calendar invitation includes session details such as date, time and location to not only improve convenience but also allows them to re-track the booking.

On top of maintenance management, the platform also includes a content management system that houses various educational resources to assist home users in optimizing the use of their medical devices. These resources include step-by-step guides, instructional videos, product tutorials, and FAQs. All those materials are designed for user training purposely to enhance the user's ability to operate their devices safely at home. Users can access these resources directly from their dashboards to find solutions to common issues, review product specifications, and gain insights into troubleshooting and repair.

3.2 Quantitative Surveys and Interviews Results

The usability survey conducted at the end of the project has shown positive feedback with regards to the online platform for medical device lifecycle management for home users as shown in Figure 6. Most participants who contributed their feedback (92%) found that the platform is highly useful for managing the lifecycle of medical devices from home. Additionally, educational resources, such as training modules and instructional videos have received even higher satisfaction rates and positive feedback with 96% of home users expressing that it is helpful in improving home user competence. Lastly, 92% of participants have reported the tendency of improved decision-making due to features like detailed product specifications and comparison tables which facilitated clearer and more informed procurement choices.

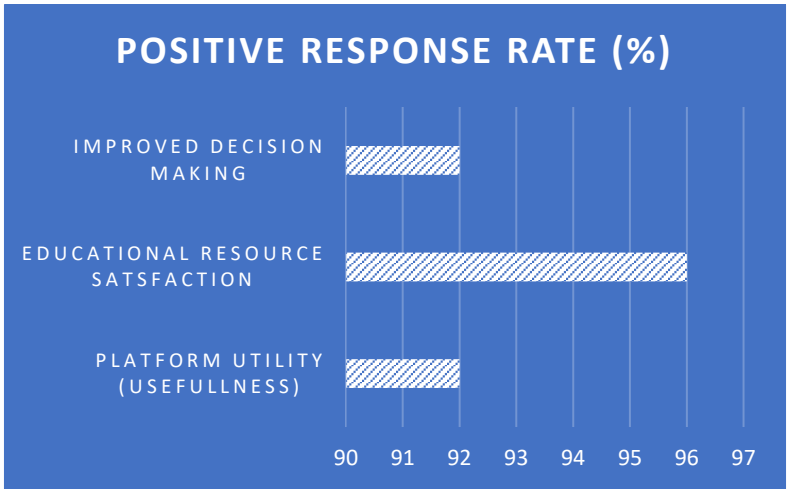

Figure 6. Positive response rate from usability survey.

The feedback also highlights the overall positive user experience with the medical device platform. Users appreciated the platform's ease of navigation and design which is helpful in accessing information related to medical devices and services. The visually structured layout and integrated educational resources were particularly well-received as it helped users to better understand medical device features and functionalities. Despite these positive aspects, the respondents have also identified areas for improvement. Some respondents suggested expansion on the existing range of medical devices listed on the platform to cater to a broader audience while others recommended to enhance the platform's compatibility with mobile devices to improve accessibility for users on smartphones. There was also a suggestion for more advanced reporting features such as detailed analytics to track device performance and maintenance history comprehensively. Overall, the feedback has highlighted the platform's effectiveness in addressing key challenges in medical device lifecycle management while pointing out opportunities for further enhancements to its functionality and user experience.

4. CONCLUSION

The development of the medical device website on the Wix platform has successfully addressed the unique needs of home-based medical device users by providing a centralized and user-friendly platform. This platform empowers users with detailed information on medical devices including specifications and side-by-side comparisons to support informed purchasing decisions for home use. By simplifying the often-complex process of selecting and integrating hospital-grade devices into home settings, the website offers greater accessibility and usability for non-professional users.

Inclusive maintenance scheduling for warranty services and repairs, the platform helps in minimizing device downtime and ensures optimal performance of medical equipment at home. Other than that, educational resources, such as training modules, user guides and video tutorials, are tailored to the needs of home users not only to equip them with knowledge and competency of handling medical devices at home but also to empower users to manage their medical devices safely

and effectively. The platform's adherence to industry standards and regulations further strengthens trust and confidence among home users by ensuring the safety and reliability of the devices offered. Clear documentation and transparency provide users with the assurance needed to integrate medical devices into their daily lives without concern.

AUTHORSHIP CONTRIBUTION STATEMENT

Tan Yee Hui: formal analysis, investigation, methodology, writing – original draft; Maheza Irna Mohamad Salim: funding acquisition, project administration, supervision, writing – review & editing; Rania Hussein Ahmed Al-ashwal, Tan Tian Swee and Ahmad Zahran Md. Khudzari: validation, writing – review & editing.

DATA AVAILABILITY

Data is not available.

DECLARATION OF COMPETING INTEREST

All authors declared no competing interest in the publication.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to Department of Biomedical Engineering and Health Sciences, Universiti Teknologi Malaysia and Diagnostics Research Group for the continuous support throughout the preparation of this manuscript. Special thanks are extended to the copyediting and review panel for their constructive feedback and recommendations. The authors also acknowledge any individuals who contributed indirectly to this work.

REFERENCES

(1) Flavián C, Orús C, Gurrea R. Effect of product presentation videos on consumers' purchase intention. Front Psychol. 2022; 13:812579. https://doi.org/10.3389/fpsyg.2022.812579.
(2) Grewal D, Roggeveen AL, Nordfält J. The future of retailing. J Retail. 2017; 93(1):1–6. https://doi.org/10.1016/j.jretai.2016.12.008.
(3) Nguyen SV, Nguyen HDV, Nguyen HB, Doan MAT, Nguyen DT, Tran AT, Hoang KK, Ly OH, Dang TX, Tran THT, Tran HQ, Nguyen NB, Nguyen TTT, Rai R, Pham AL. Telemedicine in home-based care for COVID-19 patients. BMC Prim Care. 2023; 24:250. https://doi.org/10.1186/s12875-023-02199-y.
(4) Saini G, Budhwar V, Choudhary M. Review on people's trust on home use medical devices during COVID-19 pandemic in India. Health Technol. 2022; 12(2):527–546. https://doi.org/10.1007/s12553-022-00645-y.
(5) Coffey JD, Christopherson LA, Williams RD, Gathje SR, Bell SJ, Pahl DF, Manka L, Blegen RN, Maniaci MJ, Ommen SR, Haddad TC. Development and implementation of a nurse-based remote patient monitoring program for ambulatory disease management. Front Digit Health. 2022; 4:1052408. https://doi.org/10.3389/fdgth.2022.1052408.
(6) Li J, Mao Y, Zhang J. Maintenance and quality control of medical equipment based on information fusion technology. Comput Intell Neurosci. 2022; 2022:9333328. https://doi.org/10.1155/2022/9333328.
(7) Jerjes W, Harding D. Telemedicine in the post-COVID era: Balancing accessibility, equity, and sustainability in primary healthcare. Front Digit Health. 2024; 6:1432871. https://doi.org/10.3389/fdgth.2024.1432871.
(8) Tase A, Buckle P, Ni MZ, Hanna GB. Usability of home use medical technology: The patient perspective. J Patient Saf Risk Manag. 2024; 29(2):83–91. https://doi.org/10.1177/25160435241230143.
(9) Tase A, Vadhwana B, Buckle P, Hanna GB. Usability challenges in the use of medical devices in the home environment: A systematic review of literature. Appl Ergon. 2022; 103:103769. https://doi.org/10.1016/j.apergo.2022.103769.
(10) Bitterman N. Design of medical devices—A home perspective. Eur J Intern Med. 2011; 22(1):39–42. https://doi.org/10.1016/j.ejim.2010.09.017.
(11) Hilbers ES, de Vries CG, Geertsma RE. Medical technology at home: Safety-related items in technical documentation. Int J Technol Assess Health Care. 2013; 29(1):20–26. https://doi.org/10.1017/S0266462312000694.
(12) Harkin KR, Sørensen J, Thomas S. Lifecycle evaluation of medical devices: Supporting or jeopardizing patient outcomes? A comparative analysis of evaluation models. Int J Technol Assess Health Care. 2024; 40(1):e2. https://doi.org/10.1017/S026646232300274X.
(13) National Research Council (US) Committee on the Role of Human Factors in Home Health Care. The role of human factors in home health care: Workshop summary. Washington (DC): National Academies Press; 2010. https://doi.org/10.17226/12927.
(14) Sabah S, Moussa M, Shamayleh A. Predictive maintenance application in healthcare. Annu Reliab Maintainab Symp. 2022; 2022:1–9. https://doi.org/10.1109/RAMS51457.2022.9893973.
(15) Bhattad PB, Pacifico L. Empowering patients: Promoting patient education and health literacy. Cureus. 2022; 14(7): e27336. https://doi.org/10.7759/cureus.27336.
(16) ECRI. Safe home healthcare: Addressing risks in home medical device use [Internet]. ECRI Blog. 2025 [cited 2025 Jan 21]. Available from: https://home.ecri.org/blogs/ecri-blog/safe-home-healthcare-addressing-risks-in-home-medical-device-use
(17) Schwamm LH, Erskine A, Licurse A. A digital embrace to blunt the curve of COVID-19 pandemic. NPJ Digit Med. 2020; 3(1):1–3. https://doi.org/10.1038/s41746-020-0279-6.

(18) Corrao NJ, Robinson AG, Swiernik MA, Naeim A. Importance of testing for usability when selecting and implementing an electronic health or medical record system. J Oncol Pract. 2010; 6(3):120–124. https://doi.org/10.1200/JOP.200017.
(19) Tsai IC, Wang CD, Chen PT. Strategies for medical device development: User and stakeholder perceptions. J Healthc Eng. 2023; 6724656. https://doi.org/10.1155/2023/6724656.
(20) Martinez-Caro JM, Aledo-Hernandez AJ, Guillen-Perez A, Sanchez-Iborra R, Cano MD. A comparative study of web content management systems. Information. 2018; 9(2):27. https://doi.org/10.3390/info9020027.
(21) Mashayekhy Y, Babaei A, Yuan X.-M, Xue A. Impact of internet of things (IoT) on inventory management: A literature survey. Logistics. 2022; 6(2):33. https://doi.org/10.3390/logistics6020033.
(22) Chellappan K, Elanchselvan T, Abu-Samah A. E-wallet delivery technology architecture adoption: A review. J Kejuruteraan. 2025; 37(1):219–232. https://doi.org/10.17576/jkukm-2025-37(1)-14.
(23) Singh N, Buyya R, Kim H. Securing cloud-based internet of things: Challenges and mitigations. Sensors. 2025; 25(1):79. https://doi.org/10.3390/s25010079.
(24) Al-Abri R, Al-Balushi A. Patient satisfaction survey as a tool towards quality improvement. Oman Med J. 2014; 29(1):3–7. https://doi.org/10.5001/omj.2014.02.