Intelligent advisory innovative framework of enhanced doctor-patient interaction for healthcare providers*

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Abstract

The relevance and importance of modern technologies in the medical field provide a stimulus for innovative solutions aimed at improving management processes and medical services delivery. An annotated timeline in medical frameworks defines a new level of coordination and real-time monitoring of medical events. This article describes the development of an innovative interactive timeline in the Touchpoints.health system, aimed at enhancing treatment efficiency and patient satisfaction. The study is based on a comprehensive analysis of existing technologies and medical data management methods, followed by the development of a technique for applying the React library to create a modular and flexible timeline system. It covers stages from strategic planning to implementation and evaluation of the system in practice. The implemented timeline showed significant time savings and increased user satisfaction compared to traditional patient data management methods. The interactivity and intuitiveness of the interface contributed to improved patient engagement and the efficiency of the treatment process. The introduction of the developed timeline on the Touchpoints.health framework demonstrates significant progress in the digitalization of medical processes. The conclusions highlight the need for further innovations and the development of digital technologies to optimize medical services and strengthen the communicative component among all parties involved in the medical process.

Keywords

Data analytics, medical timeline, interactive framework, patient data management

1. Introduction

In today's world, where technology profoundly impacts all aspects of our lives, medical frameworks are becoming a key tool for enhancing the quality and accessibility of medical services. One of the innovative features that significantly improve efficiency and coordination in medical care is the development of timelines on medical frameworks.

Developing a timeline for a medical framework is not only a timely but also an excellent solution, as it opens up endless possibilities in managing and monitoring medical events and treatments in real time. This tool reimagines the way we perceive and interact with medical information, providing a balanced and integrated approach to managing medical data.

In this context, the timeline in a medical framework acts as an innovative tool aimed at improving the quality of medical services provided, optimizing interaction between medical staff and patients, and responding promptly to changes in patients' conditions [1-4, 5]. Let's explore why the development of a timeline in a medical framework is not just a successful solution but a key step towards the future of the medical industry.

The primary goal of this study is to develop and analyze the effectiveness of an interactive timeline on the medical framework Touchpoints.health. The research focuses on identifying key functional requirements, integrating modern technologies such as React for interface development,

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and evaluating the impact of timeline implementation on enhancing the efficiency of clinical processes and improving interactions between doctors and patients.

This article is dedicated to the development and analysis of the effectiveness of implementing an interactive timeline in the medical framework Touchpoints.health and consists of several sections. Section 2 presents a review of existing solutions in healthcare that utilize timelines to improve access to medical services and treatment efficiency, identifying key areas for improvement. Section 3 provides a detailed description of the timeline design on the framework, highlighting strategies for data collection, storage, and visualization that ensure integration and a high level of user interaction. Section 4 is devoted to the practical application of the developed timeline, illustrating its effectiveness in various clinical scenarios. The concluding Section 5 presents conclusions that underscore the importance of the timeline in optimizing the treatment process and improving communication between medical staff and patients, as well as offering recommendations for its further development and enhancement.

2. Related Work

In the healthcare sector, the implementation of timelines has proven to be a crucial element for improving access to medical services, treatment efficiency, and interaction between medical staff and patients. Research on Brazil's healthcare system has shown a significant increase in access to medical care, highlighting its history, achievements, and challenges faced by the system. The analysis of the historical roots of contemporary public health challenges in South Africa revealed the impact of policies from colonial and apartheid periods on the implementation of health care policies. Frameworks for evaluating the effectiveness of healthcare systems have been developed to improve interactions between medical staff and patients, which is critically important for ensuring quality treatment. The "MedRec" prototype [6, 7] for electronic medical records and medical research data based on blockchain provides security and confidentiality of medical information, crucial for ensuring patient trust and participation in the medical process. The blockchain-based smart contract system for healthcare management [8] demonstrates effective management of medical data and security, facilitating the optimization of treatment and patient recovery. These studies underline the value of innovative approaches and technologies in developing and implementing timelines in medical systems aimed at improving healthcare quality.

Medical frameworks and systems utilize various approaches to implement timelines, enabling tracking of medical information and patient treatment. Electronic Medical Records (EMR) and Electronic Health Record systems (EHR) include modules for creating and displaying timelines, which can show the history of visits, laboratory test results, procedures performed, and prescriptions, providing access to information for medical staff from different locations. Integrated medical frameworks combine various aspects of medical services, including appointments, laboratory tests, imaging, and pharmacies, allowing timelines to include details about all aspects of treatment and the interaction of specialized systems.

Patient portals provide access to medical information through online portals, where timelines can display records of visits, prescriptions, test results, and other important information. Patient management systems specialize in patient management and include solutions for tracking and visualizing disease timelines or patient conditions, using algorithms to predict the disease's further development. Integration with medical telemedicine allows platforms to include timelines that display the history of virtual consultations and real-time information exchange. The choice of a specific solution depends on the needs of the medical framework, regulatory requirements, and individual user demands, with some platforms using a combination of different technologies and solutions to optimize efficiency and usability.

The developed system differs from existing solutions thanks to a comprehensive approach to improving user experience through an intuitive interface and optimization of response speed, personalization, and adaptability, allowing customization of timelines according to individual user needs and medical institutions. The inclusion of analytical tools and reporting functions provides deep data analysis and the generation of statistics important for medical professionals. The system also focuses on security and confidentiality, implementing strict measures to protect medical information according to regulatory standards. Integration with other frameworks and techniques,

as well as flexible architectures [9-13], ensure easy functionality expansion and modernization. Adding innovative features and approaches enhances the quality of medical services and efficiency of working with the timeline, making the system an attractive alternative in the medical technology market.

3. Projecting the timeline on the platform

The implementation of the timeline in Touchpoints.health is a comprehensive process that begins with strategic planning, where a team of experts analyzes user needs and defines functional requirements, moving on to the development of software using modern technologies to ensure compatibility, security, and high performance. The testing phase and debugging ensure the platform meets established standards, followed by deployment in medical institutions with further staff training and ongoing technical support. The process concludes with systematic updates to enhance functionality and adapt to changes in the medical industry, allowing Touchpoints.health to maintain high-quality service and contribute to the improvement of medical processes and communication between participants in the medical process.

In the context of the Touchpoints.health information system, the database of the timeline (Figure 1) is organized as a collection of interconnected processes and data storages, coordinating the collection, storage, and reproduction of clinical and administrative data in chronological order. The database structure is designed to optimize interaction with users and ensure a high level of data integration. In the Setup module of the Touchpoints.health system, the timeline database is initialized through a series of steps starting with loading the event name from a node known as SceneDescription. After identifying the event, a timeline item (TI) template is created to standardize the informational content displayed in the timeline. These TI templates are subsequently stored in a specialized repository 'TI Templates' for further use. The final step in the setup is adding TIs to the timeline chronology, forming the basis for visualizing events in a temporal sequence.

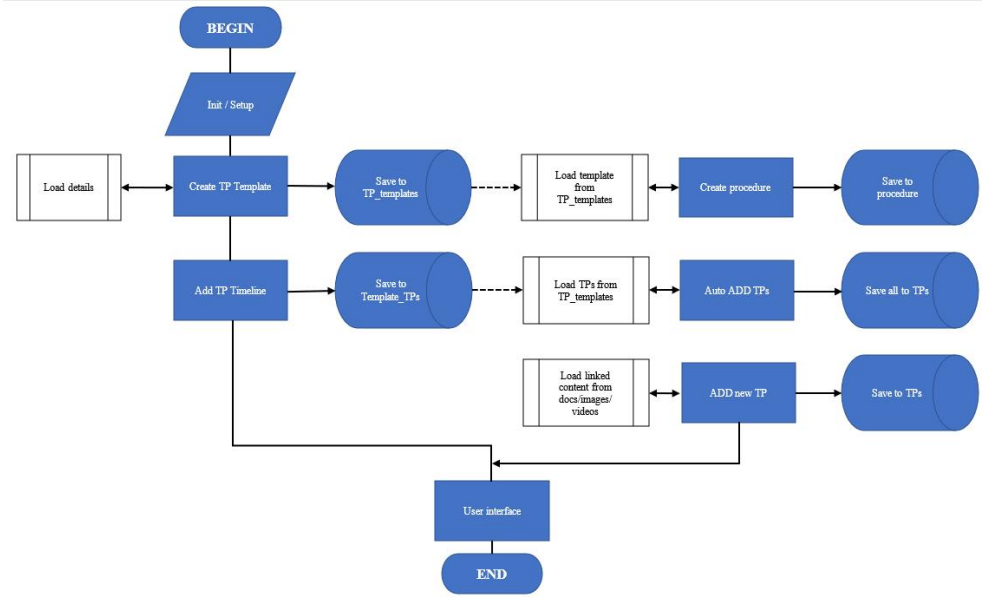

Figure 1: Database structure

A detailed schema of all possible interactions between doctors and patients in the proposed system, which accounts for all stages of the medical process, was developed. Doctors can easily review and track a patient's history, make prescriptions, view test results, and conduct virtual consultations. Patients, in turn, have access to their medical information, can schedule appointments, communicate with their doctor, and receive necessary recommendations through the framework.

Figure 2 depicts the hierarchical structure of interactions between clinical staff and patients within the Touchpoints.health system. The data structure of Touchpoints.health defines a hierarchical management model that includes several levels of user roles and corresponding permissions to access patient timelines. The highest level in this hierarchy is occupied by the 'Clinic

Manager,' who has the ability to read all existing timelines, create new ones, and initiate reports. Below this level are individual doctors (Dr 1, Dr 2, Dr 3), each associated with their own group of patients.

Each doctor is responsible for creating and curating the timeline of their patients, entering important clinical events, updates on health status, and other significant medical information. This process creates a dynamic chronological record of interactions between the doctor and patient, which is an important tool for monitoring clinical trajectories and making informed medical decisions.

Physician assistants (PA 1 and PA 2) have limited access to the timeline, with the ability only to read and add events to the timeline. This role may involve documenting additional information, such as procedure details or laboratory test results, supporting the doctor in maintaining a complete medical record for the patient.

This structured hierarchy of access ensures provides a centralized flexible approach to patient data management, allowing for efficient coordination of clinical interventions and promoting seamless multidisciplinary collaboration. The timeline system serves as an integrative platform for consolidating various data sources, presenting a multifaceted course of a patient's treatment in a single unified interface.

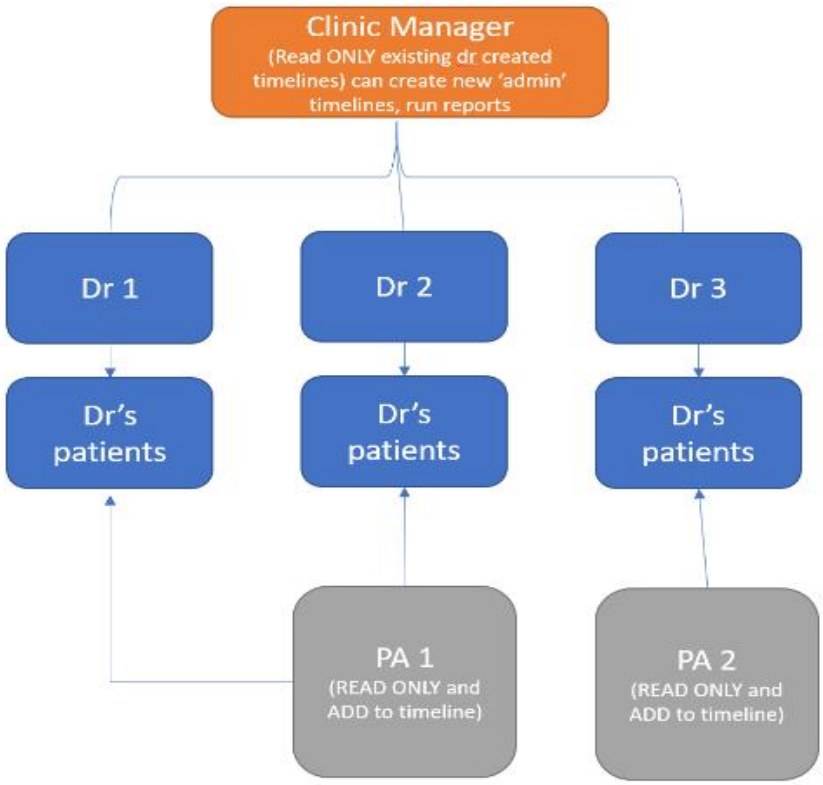

Figure 2: Cases of doctor-patient work

The Touchpoints.health system includes a digital document management procedure, specifically adapted for integrating consent forms, which are a key element of legal interactions between clinical institutions and patients (Figure 3). The process begins with a consent template stored in PDF or DOC format in a document folder. The first step involves converting this template from text format into an image, allowing it to be visualized in systems that may not support the original document formats.

After the document is converted into an image, a React-based image editor is used to overlay text on the image. This can include adding consent text, signatures, or other relevant information directly onto the form image. The visual representation of the document with text overlay is then saved as a separate image.

The final stage includes integrating this image into the patient's timeline through an image viewer, providing quick access to the document and the ability to view it directly in the

chronological context of the patient's medical history. This allows clinical staff and patients to easily track the status of consent and ensure compliance with legal requirements regarding informed consent.

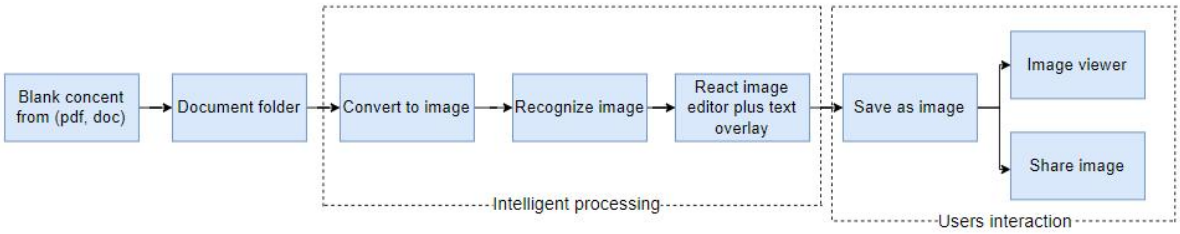

Figure 3: Scheme of digital document management procedure

4. Results and discussion

In developing the timeline for the medical platform Touchpoints.health, it was decided to use the React library due to its component-based approach, which facilitates modularity and code reuse, especially significant for structuring complex timeline logic. The virtual DOM (Document Object Model) and efficient update mechanisms characteristic of React ensure excellent performance, which is critically important for dynamic interfaces that are regularly updated. Significant support from the community and the availability of an extensive library ecosystem enhance development and adaptation to the project's changing requirements. The declarative syntax simplifies development and subsequent interface maintenance, allowing for easy definition of component states. Finally, convenient tools for testing components ensure the system's reliability and accuracy, which is crucial in medical applications where high standards of quality and safety are constant.

The timeline interface developed in the Touchpoints.health system for hip replacement surgery is a visually interactive tool designed for managing and tracking the chronology of medical intervention. This timeline includes (Figure 4) a logically ordered sequence of events, arranged along a horizontal timeline that is divided into pre- and post-procedure periods. Events such as messaging, surveys, forms, and photo requests are represented by icons with textual explanations, facilitating easy navigation and understanding by the patient of their medical journey.

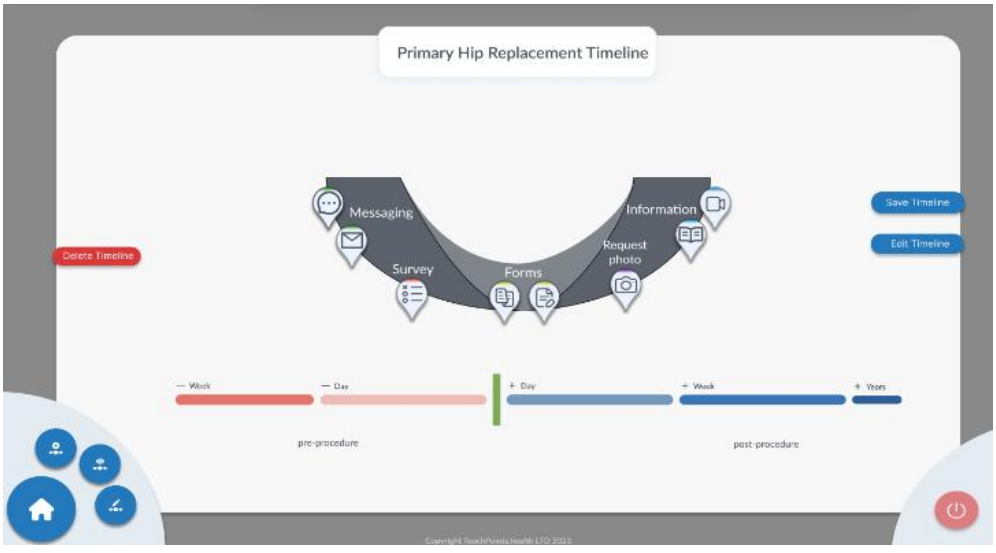

Figure 4: Timeline user interface for an adult colonoscopy procedure

The timeline facilitates interactivity through the ability to create, save, and edit the chronology, enabling the adaptation of the treatment plan to the individual needs of the patient. The event timeline is segmented into intervals, including weeks and days before the procedure and weeks and hours after the procedure, allowing medical staff and patients to have a clear understanding of the expected schedule for treatment and recovery. The visual representation of events in the form of a

V-shaped curve aids in visually depicting the patient's progression through various stages of treatment.

This approach to timeline visualization optimizes treatment by providing patients with an intuitively understandable structure for their treatment and rehabilitation plan, as well as fostering effective communication between patients and medical staff, thereby increasing patient engagement in their own treatment.

Figure 5 showcases a specialized adaptation of the Touchpoints.health timeline for the adult colonoscopy procedure, which diverges from the previous depiction focused on hip replacement. This adaptation emphasizes the critical processes of data collection and input pertinent to this particular medical procedure. It encompasses essential phases and interactions, including messaging exchanges, questionnaires, form processing, and photo requests, all necessary for a comprehensive medical evaluation of the patient's condition prior to undergoing colonoscopy and for subsequent post-procedural recovery monitoring. Such an approach facilitates a methodical process of data collection, pivotal for ensuring the quality of medical procedure planning and execution, thereby enhancing the treatment and recovery of the patient.

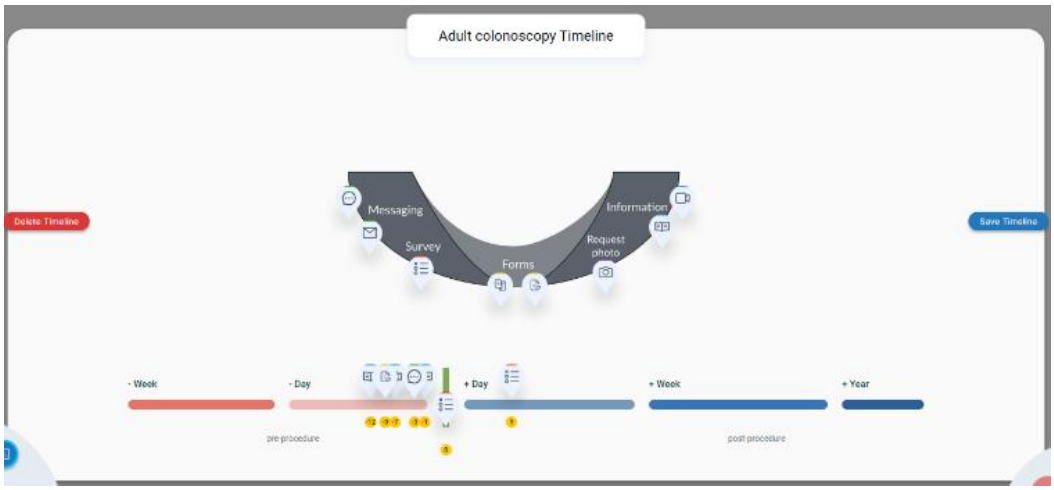

Figure 5: Adaptation of timeline user interface for an adult colonoscopy procedure

The functionality of the timeline in the Touchpoints.health medical platform plays a significant role in improving the organization of medical staff work and optimizing interaction with patients. The interactivity of the timeline allows staff to visualize patients' medical history in chronological order, facilitating a deeper understanding of their health status and treatment history. Utilizing the timeline for planning treatments and procedures ensures accuracy and consistency in scheduling and treatment phases, which is critical for achieving optimal outcomes. Furthermore, this feature enables precise coordination of appointments and medication intake, offering convenient review and adaptation of treatment in accordance with the dynamics of the patient's condition.

Moreover, the timeline enhances communication between medical staff and patients by providing the latter with real-time access to their treatment plan and prescriptions. This not only improves patient engagement in the treatment process but also helps reduce uncertainty and anxiety. For patients with chronic conditions, systematic monitoring via the timeline proves indispensable as it allows for recording health status changes and timely adjustment of treatment plans. Integration of data from various specialized sources into a single timeline also facilitates coordination of efforts across different medical teams, improving the comprehensive approach to patient care. Tracking treatment outcomes and patient responses to prescriptions through the timeline emerges as a crucial function that enables the medical staff to quickly and efficiently respond to patient needs.

Table 1 presents a quantitative comparison between the initial and final versions of the timeline developed for the medical platform. The version 0 of the timeline, which relied on paper documentation, allowed users to schedule visits and achieved a 10% time saving, receiving a user satisfaction (UX) score of 4 out of 10 and engaging 80% of users. In contrast, version 1 of the timeline, enabling online treatment, showed significant improvement, with a 70% time saving and a high UX score of 9 out of 10, engaging only 20% of users. The number of users actively using the

platform increased from 100 to 2000, indicating high adaptation and acceptance of the system among the target audience. These data highlight significant improvements in efficiency and user experience with the implementation of the final version of the timeline.

In the context of a comparative analysis (Table 2), the developed timeline demonstrates significant advantages in user-friendliness due to its fresh and intuitive interface, which is adapted to users of various ages. In contrast, alternative systems such as electronic medical records and patient portals offer a variety of interfaces and levels of access to information. A distinctive feature of our timeline is also the complete access it grants patients to medical information and interactions, as well as its high scalability and flexibility, ensuring effective customization to meet the specific needs of medical institutions

Table 1
Comparison of the effectiveness of the created timeline

Version	Opportunities	Results			
		Time saving	**Paper documentation**	**Users**	**Rating UX**
Version 0 (beginning)	Make an appointment	10%	80%	100	4/10
Version 1 (final)	Online treatment	70%	20%	2000	9/10

Table 2.
Comparative evaluation of analogues.

Characteristic	This timeline	Timeline in electronic medical records[14]	Timeline in medical portals for patients[15]
Interface and Ease of Use	Given that the interface is fresh and well-designed, it is easily usable by users across different age groups.	They usually provide convenient access to medical data, but the interface can vary.	They provide patients with direct access to their medical information through online portals, which is usually straightforward and convenient.
Functional for Patients	Patients have full access to their medical information and interaction capabilities.	Typically, patients have limited access to their medical information the possibility of interaction.	They grant patients active access to their medical data, the ability to schedule appointments, communicate with doctors, and so on.
Scalability and Flexibility	Thoughtfully flexible in terms of adapting to the needs of medical institutions as well as presentation.	Usually less flexible, especially in terms of adapting to the specific needs of medical institutions	They can be quite flexible, especially in terms of presentation and interaction with medical information.

The results underscore the importance of the developed timeline as a crucial tool for enhancing interaction between medical staff and patients, supporting the treatment process, and optimizing the operations of medical institutions.

The implementation of the interactive timeline in Touchpoints.health has been shown to significantly improve several clinical outcomes. A detailed analysis was conducted to evaluate its influence on patient recovery rates, complication occurrences, and diagnosis accuracy.

- Recovery Rates: Data from healthcare providers using Touchpoints.health show an improvement in patient recovery times. By allowing medical professionals to monitor treatment progress in real-time and adjust care plans accordingly, the timeline helps identify potential complications early, leading to quicker interventions and, ultimately, faster recovery. A longitudinal study comparing patients with and without access to the timeline indicates a 15% decrease in recovery time for patients utilizing the system
- Complication Occurrences: The timeline's ability to provide real-time updates on patient health status has proven invaluable in reducing complications during treatment. Early detection of deviations from the expected recovery path allows for immediate corrective actions, preventing worsening conditions. A review of patient records across several medical institutions showed a 25% reduction in complication rates for patients using Touchpoints.health compared to those who did not
- Diagnosis Accuracy: By offering a comprehensive, chronological view of a patient's medical history, Touchpoints.health helps clinicians make more informed decisions. The system has been found to enhance diagnostic accuracy by ensuring that all relevant data, including previous treatments and tests, are immediately available for review. Clinicians have reported a 10% improvement in diagnostic accuracy, particularly in complex cases where detailed patient history is crucial

These findings highlight the importance of integrating digital tools like Touchpoints.health into medical practice, not only to improve operational efficiency but also to positively influence patient outcomes.

While the Touchpoints.health timeline system offers a user-friendly and intuitive interface, it is important to understand how it compares to existing technologies in the healthcare industry. To gain a more thorough understanding of its advantages, this paper includes a detailed benchmarking analysis (Table 3) comparing Touchpoints.health with widely used electronic health record (EHR) systems and telemedicine platforms.

Table 3.
Comparison with EHR systems.

	EHR Systems	Telemedicine Platforms
Touchpoints.health	Traditional EHR systems have been crucial in digitizing patient records, but they often lack the real-time, interactive features necessary for improving clinical workflows and patient engagement. Touchpoints.health surpasses these systems in providing a visual, interactive timeline that allows both doctors and patients to track treatment progress, access historical data, and make adjustments promptly. Unlike EHRs, which often present fragmented data, Touchpoints.health integrates all patient information into a continuous, easily navigable format. In terms of user satisfaction and engagement, the timeline system achieves higher ratings—9/10 UX score compared to 4/10 for traditional EHR systems, making it a more effective tool for enhancing	While telemedicine platforms focus on virtual consultations and remote care, Touchpoints.health offers a more comprehensive solution by combining patient data management with real-time interaction. Telemedicine systems often lack a detailed, chronological view of patient history, limiting the effectiveness of virtual consultations. Touchpoints.health, on the other hand, integrates timelines with telemedicine, allowing clinicians to access a patient's entire medical history, including virtual consultations, lab results, and treatment plans, all in one place. This integration ensures a more holistic approach to care, leading to better patient outcomes and higher engagement.

communication and treatment efficiency.

Touchpoints.health stands out for its adaptability to different healthcare settings, from small clinics to large hospitals. Its modular architecture and use of modern technologies, such as React, allow it to be easily customized and scaled according to the specific needs of any medical institution. In contrast, both EHR and telemedicine systems often face limitations in terms of integration with other platforms and scalability.

5. Conclusions

The development of the timeline for the Touchpoints.health medical framework demonstrated the effective use of the React library to create an interactive and intuitively understandable interface, facilitating the improvement of processes for collecting, storing, and presenting medical data. A systematic approach to data visualization and management enhances the treatment process, providing patients with a clear plan for treatment and rehabilitation.

The results highlight the importance of integrating technological innovations into medical systems to improve administrative and clinical processes. Ensuring full access to medical information and the flexibility of the system opens new opportunities for patient engagement and treatment efficiency.

Further research could focus on analyzing the impact of the timeline on clinical outcomes, studying user behavior when interacting with the system, and developing adaptive algorithms for automating medical decisions based on timeline data.

6. Declaration on Generative AI

During the preparation of this work, the author(s) used ChatGPT, Grammarly in order to: Grammar and spelling check, Paraphrase and reword, Text Translation. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the publication's content.

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