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CHATBOTS IN CLINICAL TRIALS: IMPROVING PATIENT ENGAGEMENT

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ABSTRACT

Clinical trials serve as vital tools in enhancing our understanding of the effectiveness of new treatments across various diseases, including cancers. Despite their importance, studies reveal that less than 5% of cancer patients engage in any form of research study or clinical trial. This low participation rate can be attributed to diverse factors. To address this issue, we propose an innovative solution: the implementation of a Chatbot. This Chatbot is designed to foster interactive, two-way communication with users, aiding them in assessing their eligibility for clinical trials. By providing a user-friendly interface for individuals to explore their potential participation in research studies, the Chatbot aims to overcome barriers and promote greater engagement in clinical trials.

KEYWORDS: Clinical trials, cancer research, patient participation, eligibility assessment, Chatbot, interactive communication, research study engagement.

INTRODUCTION

The healthcare industry is undergoing a transformative shift towards leveraging chatbots to enhance patient engagement and automate aspects of patient care. This technological evolution addresses the need for efficient communication in scenarios where the involvement of a human doctor may not be imperative. Notably, chatbots are proving particularly effective in handling sensitive topics, such as mental health and other medical information, as patients often find it easier to be transparent with a bot than with their healthcare providers.

In the realm of clinical trials, the integration of chatbots introduces a plethora of advantages for both participants and investigators. This technology streamlines various aspects of the clinical trial process, providing a virtual assistant that can facilitate scheduling site visits, reporting adverse events in real-time, sending medication reminders, monitoring health status, and handling other time-consuming tasks through online interactions.

Benefits and Use Cases of Chatbots in Clinical Trials

Efficient Scheduling and Reminders

One of the primary challenges in clinical trials is coordinating and scheduling site visits for participants. This process often involves complex logistics and the coordination of multiple stakeholders. Chatbots address this challenge by providing an intuitive interface for participants to schedule their site visits efficiently. Through automated scheduling functionalities, chatbots eliminate the need for extensive back-and-forth communication, enabling participants to choose convenient time slots that align with their schedules.

Moreover, automated reminders play a pivotal role in reducing the likelihood of missed appointments. Participants receive timely notifications through the chatbot, reminding them of upcoming site visits or other crucial trial-related activities. This not only enhances overall trial adherence but also contributes to the reliability and consistency of participant involvement.

Real-Time Adverse Event Reporting

The prompt and accurate reporting of adverse events is a critical aspect of clinical trials. Traditional methods of collecting this information often rely on periodic assessments or manual reporting, which can introduce delays and potential inaccuracies. Chatbots revolutionize this process by allowing participants to report adverse events in real time.

Through interactive conversations, participants can communicate any adverse events or concerns directly to the chatbot. This real-time reporting mechanism ensures that investigators receive timely and accurate information, enabling them to assess and address potential issues promptly. The immediacy of this feedback loop enhances participant safety and contributes to a more dynamic and responsive approach to managing the trial.

Medication Adherence Support

Medication adherence is a significant factor influencing the success of clinical trials. Participants may forget to take their medications as prescribed, impacting the reliability of trial results. Chatbots play a crucial role in supporting medication adherence by sending automated reminders to participants.

These reminders are personalized based on the participant's medication schedule, creating a proactive system that helps individuals stay on track. The chatbot can send notifications at specified intervals, ensuring that participants take their medications as prescribed. This not only contributes to better adherence rates but also enhances the overall integrity and validity of the trial outcomes.[1]

Health Status Monitoring

Engaging participants in regular conversations to monitor their health status is another valuable use case for chatbots in clinical trials. Through structured interactions, chatbots can collect relevant information about participants' well-being, including symptoms, side effects, and overall health status.

By analyzing the data collected through these virtual check-ins, investigators can gain insights into trends and patterns that may indicate potential issues. Early detection of changes in health status allows for timely interventions, contributing to participant safety and well-being throughout the duration of the trial. The continuous nature of these interactions fosters a more holistic understanding of participants' experiences, beyond the confines of periodic assessments.

Virtual Q&A Sessions

Participants often have questions or concerns related to the clinical trial process, medication regimens, or potential side effects. Chatbots provide a convenient platform for hosting virtual Q&A sessions, offering participants instant access to information and clarification on various aspects of the trial.

The interactive and conversational nature of chatbots makes them an ideal medium for addressing participant queries. Participants can pose questions to the chatbot, which responds with accurate and relevant information. This virtual support system enhances participant engagement, empowering individuals with the knowledge they need to navigate the complexities of the trial. It also serves as a valuable tool for educating participants about the trial protocol and addressing any misconceptions or uncertainties they may have.

Data Collection and Insights

Chatbots contribute to streamlined data collection by interacting with participants in a structured manner. Beyond simple reminders and scheduling, chatbots can facilitate the collection of specific data points relevant to the trial.

Through guided conversations, chatbots ensure that participants provide accurate and standardized information. This not only enhances the quality of the data collected but also facilitates the extraction of valuable insights for investigators. The structured nature of interactions allows for consistent data capture, enabling researchers to analyze participant experiences and identify trends that may inform decision-making throughout the trial.

Enhanced Participant Engagement

The interactive nature of chatbots fosters continuous participant engagement throughout the duration of the clinical trial. Participants may feel more comfortable sharing information with a chatbot than with a human, especially when it comes to sensitive topics such as mental health or other medical information.

The virtual nature of these interactions creates a non-judgmental and confidential space for participants to express their concerns or share experiences. This increased transparency contributes to a more comprehensive understanding of participant experiences, allowing investigators to adapt and tailor their approach based on real-time insights.

Cost and Time Efficiency

By automating routine tasks and interactions, chatbots contribute to significant cost and time savings in the clinical trial process. The efficiency gains are particularly evident in administrative tasks, such as scheduling and data collection, which can be resource-intensive when managed manually.

Chatbots free up valuable human resources, allowing research staff to focus on more complex aspects of trial management, data analysis, and participant interactions that require a human touch. The time saved through automation translates into accelerated timelines for trial execution, enabling researchers to meet milestones more efficiently.

Patient Recruitment / Pre-Screening

Patient recruitment for clinical trials poses an enduring challenge, despite the advancements in social media and digital campaigns that enhance trial visibility and attract potential participants to clinical sites. The influx of website traffic, email inquiries, and telephone calls from interested individuals creates a substantial workload for clinical sites, particularly when it comes to screening each candidate against the specific eligibility criteria of a given study.

In addressing this challenge, chatbots emerge as a valuable tool to streamline the patient recruitment and pre-screening process. By leveraging automated logical branching questions, chatbots can efficiently assess whether an individual meets the eligibility criteria for a particular study based on their responses. This not only

saves valuable time for clinical sites but also ensures a systematic and standardized approach to screening.

How Chatbots Facilitate Patient Recruitment

1. Automated Logical Branching Questions

Chatbots are equipped with the capability to ask a series of logical branching questions. These questions are designed to navigate through the specific inclusion and exclusion criteria of a clinical trial. The branching logic allows the chatbot to tailor subsequent questions based on the participant's previous responses, creating a dynamic and personalized screening process.[2]

2. Efficient Eligibility Determination

Through the use of logical branching, chatbots can swiftly and accurately determine whether a potential participant is eligible for a specific study. The automated nature of this process eliminates the need for manual screening of each inquiry, saving time and reducing the risk of human error.

3. Data Storage and Accessibility

The responses gathered by chatbots during the pre-screening process can be systematically stored and accessed for future reference. This not only facilitates the management of the current study's recruitment but also provides valuable data for other studies with different inclusion criteria. Clinical sites can leverage this stored information to identify and reach out to potential participants for future trials.

4. Enhanced Efficiency and Scalability

Chatbots operate efficiently, handling multiple inquiries simultaneously without compromising the quality of screening. This scalability is particularly advantageous for clinical sites dealing with a high volume of potential participants. The automated nature of chatbots allows sites to manage recruitment processes seamlessly, ensuring that each candidate is assessed promptly.

5. Consistent and Standardized Screening

Human screening processes may introduce variability due to individual judgment and interpretation. Chatbots, on the other hand, apply consistent criteria in the screening process, ensuring a standardized approach. This consistency is crucial for maintaining the integrity of the recruitment process and adhering to the study's specific eligibility criteria.

6. Immediate Interaction and Engagement

Potential participants often seek immediate responses when expressing interest in a clinical trial. Chatbots provide instant interaction, engaging with individuals at their convenience. This immediate engagement not only enhances the participant experience but also expedites the screening process, allowing clinical sites to capture the interest of motivated individuals promptly.

Implementation in Practice

To implement chatbots effectively in patient recruitment, clinical sites can integrate these automated tools into their websites, social media platforms, and communication channels. A well-designed chatbot interface can guide potential participants through a series of questions, presenting information in a conversational and user-friendly manner.

The chatbot can initiate the pre-screening process by asking fundamental questions related to the study's eligibility criteria. As participants provide responses, the chatbot dynamically adjusts its questions based on the logic programmed into its system. This adaptive approach ensures that participants receive a personalized screening experience tailored to their specific circumstances.

Moreover, the chatbot can provide additional information about the clinical trial, address frequently asked questions, and guide participants on the next steps in the recruitment process. This comprehensive engagement contributes to a positive participant experience, fostering trust and transparency.

Future Considerations and Challenges

While chatbots offer significant advantages in patient recruitment, there are considerations and challenges that warrant attention:

1. Ethical Considerations

Ensuring that participants fully understand the automated nature of the pre-screening process and the potential use of their data is essential. Transparent communication about data privacy and the role of chatbots in the recruitment process is crucial for maintaining ethical standards.

2. Human Oversight

Despite the efficiency of chatbots, incorporating a mechanism for human oversight is advisable. Certain nuanced situations may require human judgment, and having a process for manual review can address these complexities.

3. Technological Integration

Clinical sites need to seamlessly integrate chatbot technology into their existing systems to ensure smooth data flow and accessibility. Collaboration with technology experts may be necessary to achieve optimal integration.

4. Customization for Study Specifics

Chatbots must be customized for each clinical trial, considering the unique eligibility criteria and study requirements. A one-size-fits-all approach may not effectively address the intricacies of diverse research studies.

5. Participant Education
Ensuring that potential participants are well-informed about the role of chatbots in the pre-screening process is crucial. Educating participants about the benefits and limitations of chatbots contributes to a positive recruitment experience.

Site Selection
Site selection is a critical component of the clinical trial process, significantly influencing the overall success of a study. Identifying, engaging, and collaborating with experienced and qualified sites are paramount considerations in ensuring the smooth progression and favorable outcomes of a clinical trial. In this context, the integration of chatbots into the site selection process emerges as a innovative and efficient solution.

The Significance of Optimal Site Selection
Trial Success Dependency
The success of a clinical trial is often contingent on the capability of the selected study sites. Optimal sites contribute to streamlined operations, effective participant recruitment, and the generation of high-quality, reliable data.

Resource Utilization
Efficient site selection ensures the judicious use of resources, minimizing the risk of delays and budget overruns. Identifying sites with a proven track record and appropriate resources enhances the overall efficiency of the trial.

Data Quality and Integrity
Well-chosen sites with experienced staff and suitable facilities contribute to the generation of reliable and high-quality data. Data integrity is a critical factor in establishing the credibility and validity of trial outcomes.

Participant Recruitment and Retention
Sites with a history of successful participant recruitment and retention are pivotal for meeting enrollment targets. Effective engagement with qualified sites can positively impact the participant experience and trial adherence.

Leveraging Chatbots in Site Selection
The integration of chatbots into the site selection process introduces a dynamic and interactive approach to gathering essential information from potential study sites. This innovative use of technology streamlines the traditionally time-consuming and resource-intensive aspects of site selection.[3]

1. Information Gathering
Chatbots can be deployed on the websites of Contract Research Organizations (CROs) or sponsors to collect crucial information from potential study sites. This may include details about staff qualifications, available facilities and equipment, past performance in clinical trials, and the overall site profile.

2. Immediate Feasibility Reports
The data collected through chatbot interactions can be instantly processed to generate feasibility reports for each site. These reports provide valuable insights into the suitability of a particular site for a specific study, enabling sponsors and CROs to make informed decisions swiftly.

3. Enhanced Efficiency and Accuracy
By automating the information-gathering process, chatbots enhance efficiency and reduce the potential for human error. The dynamic nature of chatbot interactions allows for tailored inquiries based on the specific requirements of the study and the site.

4. Real-time Communication
Chatbots facilitate real-time communication between sponsors or CROs and potential study sites. This immediate interaction expedites the exchange of information, clarifications, and any additional details required for the site selection process.

5. Customized Queries for Site Evaluation
Chatbots can be programmed to pose customized queries to sites, ensuring that the information gathered aligns with the unique needs and criteria of the clinical trial in question. This tailored approach enhances the relevance and specificity of the data collected.

6. Integration with Decision-making Processes
The feasibility reports generated by chatbots can seamlessly integrate into the decision-making processes of sponsors and CROs. This integration ensures that site selection decisions are data-driven, informed, and aligned with the goals of the clinical trial.

Future Considerations and Challenges
While the use of chatbots in site selection presents numerous advantages, certain considerations and challenges merit attention:

Data Security and Privacy
As chatbots collect sensitive information, ensuring robust data security and privacy measures is paramount. Compliance with data protection regulations is essential to maintain trust and ethical standards.

Integration with Existing Systems
Effective integration of chatbots with existing systems and databases is crucial for the seamless flow of information. Collaborating with IT experts and system administrators is necessary to achieve optimal integration.

Human Oversight
While chatbots enhance efficiency, incorporating a mechanism for human oversight is advisable. Certain nuances and complexities in site information may require human judgment.

Standardization of Queries
Ensuring that chatbot queries are standardized yet flexible enough to accommodate diverse study requirements is essential. Customization should not compromise the consistency and comparability of gathered data.

eCRF
The Electronic Case Report Form (eCRF) serves as a pivotal tool in the documentation and management of patient data within the context of clinical trials. Traditionally, data collection has been primarily conducted during site visits, where clinical sites gather information directly from trial participants. The eCRF streamlines this process, offering a digital platform for data entry and compilation.

Role of eCRF in Clinical Trials
Data Centralization
The eCRF acts as a centralized repository for patient data, consolidating information collected during various site visits. This ensures that all relevant data points are documented in a standardized format.

Study Protocol Adherence
By structuring data entry based on the study protocol, the eCRF assists clinical sites in adhering to specific guidelines and requirements. This standardization is crucial for maintaining the integrity and validity of the trial data.

Review and Analysis
Regulatory bodies, such as the FDA, rely on comprehensive and well-organized data for review and analysis. The eCRF facilitates this process by presenting data in a format that aligns with regulatory standards, streamlining the review and approval process.

Integration of Chatbots for Remote Data Collection
The integration of chatbots into the clinical trial ecosystem introduces a transformative approach to data collection, allowing for remote interactions with trial participants. This innovation extends beyond the limitations of traditional site visits and enhances the overall efficiency and flexibility of the data collection process.

1. Remote Participant Engagement
Chatbots enable remote engagement with trial participants, allowing for the collection of relevant data without the need for physical site visits. Participants can respond to queries, provide updates, and engage in real-time conversations, enhancing the overall patient experience.

2. Real-time Adverse Event Reporting
Participants can use chatbots to report adverse events or health issues in real-time. This immediate communication ensures that healthcare professionals are promptly informed, allowing for timely interventions and assessments.

3. Access to Study Information
Clinical sites and Contract Research Organizations (CROs) can leverage chatbots to access information about ongoing studies or specific participants. This access is facilitated through conversational interactions, providing a dynamic and user-friendly interface for information retrieval.

4. Data Security and Compliance
While collecting data remotely, ensuring data security and compliance with regulatory standards remains a priority. Chatbot interactions can be designed to adhere to data protection regulations, safeguarding the confidentiality and privacy of patient information.

5. Enhanced Participant Convenience
The use of chatbots for data collection enhances participant convenience by eliminating the need for frequent site visits. Participants can contribute to the trial from the comfort of their homes, potentially increasing overall engagement and retention rates.

Challenges and Considerations
Data Accuracy
Ensuring the accuracy of remotely collected data is paramount. Implementing mechanisms to validate and cross-check information is essential to maintain data integrity.

User Training
Both trial participants and healthcare professionals interacting with chatbots may require training to optimize the use of the technology. User-friendly interfaces and clear instructions are crucial.

Integration with eCRF Systems
The seamless integration of chatbot-collected data with existing eCRF systems is essential for data continuity. Collaboration between technology experts and clinical research professionals is necessary for effective integration.

ePRO/eCOA
Patient-Reported Outcome (PRO) systems play a pivotal role in clinical trials, enabling the direct collection of data from participants regarding their health status, treatment experiences, and overall well-being. Traditionally, this information is gathered through patient diaries and surveys, contributing valuable insights into the benefits and risks associated with the treatment under investigation. The integration of chatbots into the PRO framework represents a transformative shift, introducing automation and real-time data collection capabilities.

Traditional PRO Systems

Data Collection through Diaries and Surveys

Patient diaries and surveys are employed to systematically capture participant-reported data at regular intervals throughout the trial. This information provides a comprehensive understanding of the treatment's impact on participants' health.

Measurement of Treatment Benefits and Risks

PRO systems contribute to the evaluation of treatment efficacy and safety by quantifying patient-reported outcomes. This patient-centric approach ensures that the trial's success is not solely determined by clinical metrics but also incorporates participants' perspectives.

Innovation with Chatbots in PRO Systems

The integration of chatbots into PRO systems brings forth several advantages and innovations:

1. Automated Data Collection

Chatbots automate the process of data collection, allowing for multiple interactions with participants throughout the day. This real-time data capture provides a dynamic and continuous overview of participants' health status.

2. Enhanced Participant Engagement

Chatbots facilitate interactive and user-friendly conversations, making it easier for participants to record their health improvements or report any difficulties. The conversational nature of chatbots enhances participant engagement and encourages regular data input.

3. IVR Integration for Voice Response

Interactive Voice Response (IVR) systems can be seamlessly integrated into chatbots, enabling participants to provide data through voice responses. This feature accommodates participants who may prefer or find it more convenient to report information verbally.[4]

4. Real-time Monitoring of Health Metrics

Through chatbots, participants can report health metrics in real-time, offering a more immediate and accurate reflection of their well-being. This real-time monitoring can be particularly crucial in assessing the evolving nature of certain health conditions.

5. Timely Intervention for Adverse Events

The instant data collection capability of chatbots facilitates prompt identification of adverse events or difficulties reported by participants. This timely information enables healthcare professionals to intervene and address issues promptly.

6. Reduced Participant Burden

Chatbots streamline the data collection process, reducing the burden on participants associated with traditional diaries and surveys. The conversational approach of chatbots creates a more user-friendly experience.

Challenges and Considerations

Data Security and Privacy

Ensuring the confidentiality and privacy of participant-reported data collected through chatbots is paramount. Robust security measures must be implemented to adhere to data protection regulations.

User Accessibility and Training

Participants and healthcare professionals interacting with chatbots may require training to optimize the use of this technology. Ensuring accessibility for diverse user groups is essential.

Integration with PRO Platforms

Effective integration of chatbot-collected data with existing PRO platforms is crucial for data continuity. Collaboration between technology experts and clinical research professionals is necessary for seamless integration.

Chatbots in Healthcare: Revolutionizing Patient Engagement

Chatbots, powered by artificial intelligence, have emerged as transformative tools in healthcare, reshaping the dynamics of patient interaction and information dissemination. This article explores the role of chatbots in the orthopedic perioperative period, shedding light on their applications, benefits, and potential to enhance patient care.

Understanding Chatbots in Healthcare

Definition and Examples

A chatbot, short for chat robot, is an artificially intelligent software application designed to simulate human conversation. Operating within messaging platforms like SMS, Facebook Messenger, WhatsApp, and more, chatbots streamline communication and provide quick, automated responses. Notable examples in the healthcare domain include STREAMD (StreaMD Corp.) in Chicago, Conversa (Conversa Health) in Portland, and Memora Health in San Francisco.

Versatility in Healthcare Tasks

In healthcare, chatbots have proven versatile, tackling tasks ranging from symptom checking and medication adherence to nutritional counseling and mental health coaching. Their ability to deliver instant, automated answers makes them particularly attractive in addressing routine queries during the orthopedic perioperative period.

Benefits of Chatbots in Orthopedic Perioperative Care

Timely Information and Accessibility

Chatbots excel in delivering timely, educational information to orthopedic patients. Immediate access to care instructions and relevant details is crucial during the perioperative phase. Patients can receive instant answers to questions, eliminating the waiting time associated with traditional communication methods.

Efficiency and Resource Allocation
By automating responses to common questions (e.g., "When can I shower?"), chatbots free up clinical staff to focus on more complex issues or urgent patient concerns. This efficiency in handling routine inquiries optimizes resource allocation and enhances the overall patient experience.

Customization and Procedure Specifics
Chatbot content can be tailored to individual physicians and specific procedures. This customization ensures that the information provided aligns with the preferences and protocols of the treating physician, enhancing the relevance and accuracy of the guidance given.

SMS-Based Chatbots: Accessibility and User-Friendly Interaction
Widespread Accessibility
SMS-based chatbots offer a distinct advantage in terms of accessibility. Unlike portals or apps that may require specific devices, text messaging can be delivered to any mobile phone. This inclusivity is especially crucial, reaching individuals across various socioeconomic classes and age groups, including those above 65 years.

User-Friendly Interface
Patients appreciate the simplicity and ease of use associated with SMS-based chatbots. The ubiquity of text messaging ensures that a broader demographic can engage with these chatbots without the need for specialized devices or technological expertise.

Challenges and Future Considerations
While chatbots offer substantial benefits, challenges related to data security, integration with existing systems, and user education need careful attention. Ensuring a seamless and secure integration of chatbots into healthcare workflows is essential for maximizing their potential.

Drawbacks
The drawbacks of chatbots include their limited features and potential for inaccuracy. Because chatbots exist within messaging platforms, they may offer fewer features and capabilities compared with portals or applications. Depending on the specific Chatbot, patient conversations that take place within the Chatbot may not be integrated with the HER. Above all, the effectiveness of a Chatbot relies on its accuracy and ability to provide helpful information. This is largely dependent on its ability to categorize topics of discussion and provide appropriate responses to patient-generated questions. This requires thoughtful design and an extensive database of relevant clinical conversations. The utility of chatbots is particularly enhanced for procedures and protocols that are consistent for all enrolled patients (i.e., large joint replacements, medication reminders, etc.

DISCUSSION
In an era where orthopedic patients are spending more time outside of the traditional hospital setting, there is a special interest in initiatives and activities that help effectively engage patients to optimize their outcomes and reduce the cost of each care episode. PEPs are playing a growing role in this effort by providing a digital platform that assists in the coordination of care during the perioperative period.

Today, a multitude of PEPs exist and take the form of web-based portals, mobile applications, and chatbots. In general, these platforms can improve patient outcomes, decrease costs, and assist with the collection of patient-reported outcomes. These platforms share many similarities, and choosing a specific one to incorporate into your practice should be based on your particular practice's needs and clinical initiatives. For example, if you are looking to create secure messaging channels with your patients, a HIPAA compliant mobile app may be the best-suited solution. If you are looking to limit resource utilization and create automated patient-facing pathways, an SMS Chatbot may be a great option.[5]

In regard to cost, pricing is highly variable among different platforms. Some are billed on a per-patient or per-message basis, while others are billed as a monthly or annual subscription that supports unlimited patient enrollments and messages. Consider the length of the contract as well. If you are not satisfied, how easily can you end the service? Further, in an era of cost containment and overhead reduction, it is important to determine if such patient communication or "remote touches" can be reimbursed, included in the episode cost or potentially shared amongst all parties (as there are potential benefits to providers, insurance companies and patients).

Future directions
The future will continue to bring many new digital opportunities and refine the ones we are currently using. Automated communication will be the next phase of efficiency in regard to patient communication, engagement, and clinical resource utilization. We will see integration of the stand-alone PEPs into the HER and further integration of wearable devices (e.g. pedometers, pulse oximeter, blood pressure monitors) and have better data as to the value that monitoring these metrics brings to our clinical treatment algorithms. We will continue to identify what objective and subjective patient-generated data is associated with improved patient outcomes, and we will refine our data collection efforts based on these findings. Ultimately, it will be the simplest and most efficient solution that is supported by high-quality clinical data that will stand the test of time and be the best fit for our patients and treatment teams.[2-4]

CONCLUSION
In conclusion, the integration of chatbots in clinical trials represents a significant advancement in optimizing

participant engagement and trial management. The diverse use cases, ranging from scheduling and reminders to real-time adverse event reporting, showcase the versatility and potential impact of chatbots in streamlining various aspects of the clinical trial ecosystem. As technology continues to evolve, the role of chatbots is likely to expand, offering even more sophisticated solutions for enhancing the efficiency and effectiveness of clinical trials. The healthcare industry stands at the forefront of this technological revolution, leveraging chatbots to create a more patient-centric and streamlined approach to clinical research.

REFERENCE

1. Miller AN, Lake AF, Emory CL. Establishing a fracture liaison service: an orthopaedic approach. JBJS., 2015; 97(8): 675–681. Doi: 10.2106/JBJS.N.00957. [PubMed] [CrossRef] [Google Scholar]
2. Salmond SW, Echevarria M. Healthcare transformation and changing roles for nursing. Orthop Nurs., 2017; 36(1): 12–25. Doi: 10.1097/NOR.0000000000000308. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
3. Moulton LS, Evans PA, Starks I, Smith T. Pre-operative education prior to elective hip arthroplasty surgery improves postoperative outcome. Int Orthop, 2015; 39(8): 1483–1486. Doi: 10.1007/s00264-015-2754-2. [PubMed] [CrossRef] [Google Scholar]
4. Sinsky C, Colligan L, Li L, Prgomet M, Reynolds S, Goader's L, Westbrook J, Tutty M, Blike G. Allocation of physician time in ambulatory practice: a time and motion study in 4 specialties. Ann Intern Med., 2016; 165(11): 753–760. Doi: 10.7326/M16-0961. [PubMed] [CrossRef] [Google Scholar]
5. Tarity TD, Swall MM. Current trends in discharge disposition and post-discharge care after total joint arthroplasty. Curr Rev Musculoskelet Med., 2017; 10(3): 397–403. Doi: 10.1007/s12178-017-9422-7. [PMC free article] [PubMed] [CrossRef] [Google Scholar]