Arthroplasty Today 27 (2024) 101349

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Special Issue: Highlights from the Young Arthroplasty Group (YAG) of AAHKS. Edited by Anna A.R.Cohen-Rosenblum

Patient Engagement Platforms: How Technology Is Impacting Perioperative Communication and Engagement in Total Hip and Knee Arthroplasty

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ARTICLE INFO

Article history:
Received 23 August 2023
Received in revised form
28 January 2024
Accepted 5 February 2024
Available online 28 June 2024

Keywords:
Patient engagement platforms
Patient portals
Chatbots
Communication
Mobile health applications

ABSTRACT

Orthopedic clinics are becoming strained with clinical volume outpacing resources and personnel. Patient engagement platforms can help bridge the communication and engagement gaps between patients and their healthcare teams as total hip and knee arthroplasty transitions to the outpatient setting. These platforms provide a digital infrastructure that allows patients to participate in their healthcare journey while alleviating the burdens on clinic staff. Multiple forms of patient engagement platforms exist but typically fall into one of 3 groups: patient portals, mobile health applications, and chatbots. They all play an important role in enhancing postoperative rehabilitation, patient engagement, and patient care overall. This article explores the spectrum of available patient engagement platforms and examines their advantages, limitations, and documented benefits on clinical outcomes.

Introduction

The volume of total hip arthroplasty (THA) and total knee arthroplasty (TKA) continues to rise in the United States, and several studies project a significant rise in the coming years. Current estimations predict the annual volume of primary THAs and TKAs in 2030 to be 850,000 and 1,921,000, respectively [1,2]. Several studies have examined the growing mismatch of the rates of growth between the volume of THA and TKA to available arthroplasty surgeons [3]. This increasing clinical volume poses a challenge to surgeons and clinics to adequately engage patients perioperatively.

Patient engagement platforms (PEPs) leverage varying forms of technology to foster perioperative communication between patients and their healthcare teams and encourage patient engagement. The goals of these platforms are to improve patient satisfaction and outcomes by serving as a conduit for improved communication in addition to disseminating educational videos and rehabilitation protocols. In addition, these platforms allow for tracking pain levels, collecting patient-reported outcomes (PROs), and enabling patients to communicate concerns to their healthcare teams [4]. For research purposes, several PEPs allow data collection on biometrics and PROs, which can then be used for research and quality-improvement purposes [5,6]. Given the growing emphasis on obtaining these postoperative metrics, PEPs continue to increase in relevance within orthopedic research.

To date, there are multiple forms of PEPs that exist (Fig. 1). Common examples include smart phone applications, chatbots, and patient portals [4]. These PEPs have varying technological prerequisites and range from cellphones capable of basic text messaging to tablets, wearable technology, and personal computers. Each of these platforms has their associated benefits and limitations and should be chosen based on a particular practice's needs (Table 1).

Office tip

In this article, we describe PEPs and analyze their benefits, limitations, and documented impacts on patient outcomes for

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https://doi.org/10.1016/j.artd.2024.101349

patients undergoing THA or TKA. Clinicians should weigh the unique benefits and limitations of each platform to best address the needs of their practices, and the following is a review of commonly available platforms.

Patient portals

Patient portals are online platforms that allow patients to securely access portions of their electronic health record (EHR) and communicate with their healthcare teams. These portals have become increasingly prevalent in healthcare systems and enable patients to review summaries from recent appointments, access test results, review discharge instructions, among other features. Many portals enable patients to securely message their surgeons and care teams, seek clarification regarding postoperative instructions, request medication refills, discuss any concerns, and receive timely responses by clinic staff. Portals can essentially function as a secure and augmented alternative to traditional email communication. In our practice, this is particularly helpful in reducing travel for postoperative patients that live at long distances from our clinic. It allows the patient to obtain radiographs at their local healthcare facilities and have their surgical wounds evaluated virtually. This strategy is also used to initially evaluate some patients from afar. Patients' histories, symptoms, imaging, and labs can be reviewed virtually, allowing us to create an early treatment plan. Often these patients then visit our clinic the day before their surgical procedure and have additional travel reduced. However, some patients still prefer to speak with their healthcare team in person, have concerns about privacy, and do not have a reliable way to access the portal via a personal computer or laptop [7]. In addition, there is concern that the technology requirement to access patient portals may be a barrier to our more vulnerable patient populations, such as those with limited internet access, lower health literacy, or those who are unable to afford personal computers. Specifically, patient portal users are significantly more likely to be young, healthy (American Society of Anesthesiologists 1 or 2), Caucasians, married, employed, and to have private insurance [8]. Given these limitations, alternative PEP may be necessary to adequately engage our underserved patient populations. Finally, the number of inbound messages to patient portals has become increasingly difficult to manage. Some health systems are charging patients for these types of communications, and others are deploying artificial intelligence to automatically respond to common queries given the increased communication burden on clinics [9,10].

Mobile health applications

Mobile health applications, also referred to as mHealth apps, utilize smartphones and mobile devices to encourage patient engagement, measure clinical improvements, and improve overall clinical care. Rather than requiring a tablet or personal computer, patients download these applications onto their android/iOS smartphones and access them at their convenience [11]. Mobile health apps provide an array of features ranging from secure 2-way messaging, collecting PROs, and monitoring patient concerns (such as pain, swelling, wound concerns). Many of these applications allow for patients to review perioperative surgical instructions and set recovery goals. Several of these applications can be linked to a patient's EHR, but given these apps are created by independent companies, this is not a universal feature. These apps can also be paired to wearable technologies, such as smartwatches, to track patients' activity levels (step count, gain symmetry, and so on) and overall postoperative progress. Several studies have demonstrated that patients utilizing wearable technology have increased activity levels following TKA and THA and that these devices can help identify proper exercise posture nearly 90% of the time [12,13]. The literature also supports that the function and activity data obtained from wearable technology, such a step count and exercise tracking, correlate with both clinical outcomes and PROs [14-16]. The utilization of mHealth apps in conjunction with wearable technology may provide further opportunity for investigation in patients undergoing total joint arthroplasty. In our practice, we have partnered to obtain wearable technology for patients in the form of smartwatches. There is a significant number of patients who already possess this technology, but we realize the associated cost barriers associated with these smartwatches and have made efforts to provide these to patients at no cost to them. For example, different versions of the Apple Watch (Apple Inc., Cupertino, CA) range from several hundred to over a thousand dollars, and we believe it is crucial to not exclude patients who are unable to afford these. However, this PEP is not without its associated drawbacks. Specifically, the average age of patients undergoing primary THA and TKA is 65.7 years and 67.2 years, respectively [17]. Navigating a new smartphone app may be difficult for our aging population. In addition, patients must have a smartphone to use these applications, and Pew Research suggests that up to 15% of Americans do not possess smartphone technology [18]. Finally, many mHealth apps allow for 24/7 2-way messaging between patients and healthcare teams, but this can ultimately strain already limited clinic resources and contribute to staff fatigue.

Chatbots

In recent years, chatbots have emerged as a tool for engaging patients undergoing THA or TKA. Chatbots that are developed using natural language processing involve several key steps. First, chatbots are trained on large datasets of texts derived from a variety of sources. The accuracy of these data is paramount as biases in these data can then be adopted by the chatbot. Model training is then used to teach a machine learning model to understand and generate human language. Data are processed in the form of splitting text into words or phrases, which then makes it appropriate for machine learning algorithms. A deep learning model is then chosen with specific training objectives, such as chatbot responses to patient questions. This process then undergoes repetitive processing before moving to the validation stage. Once this is complete, a final product is then able to be tested with new data/patient queries to assess overall performance. Chatbots are able simulate conversation and deliver immediate information. This real-time ability to interact and respond is beneficial to patients seeking quick and straightforward information, such as postoperative instructions and general questions about their recovery process. As a benefit, clinics and healthcare teams can redirect their focus toward more complicated patient concerns, thereby optimizing their time and expertise. An additional advantage of using chatbots, and SMS-based chatbots in particular, is their widespread accessibility. As discussed previously, nearly 15% of Americans do not possess smartphone technology, but in this same survey, it was revealed that 97% of patients possess cellphones capable of basic texting (SMS capable cell phones) [18]. In evaluating the ability to at least briefly capture patients' attentions, research shows that nearly 99% of marking SMS marketing messages are opened within 20 minutes, as opposed to an overall read rate of 20% for emails [19,20]. This streamlined technology requirement may allow patients from diverse socioeconomic backgrounds and age groups to interact with this technology by eliminating the need for smartphones, personal computers, or data plans. However, the ability of patients to pay for their phone bill, outside of their data plan, must also be considered. Within the limited-English proficiency (LEP)

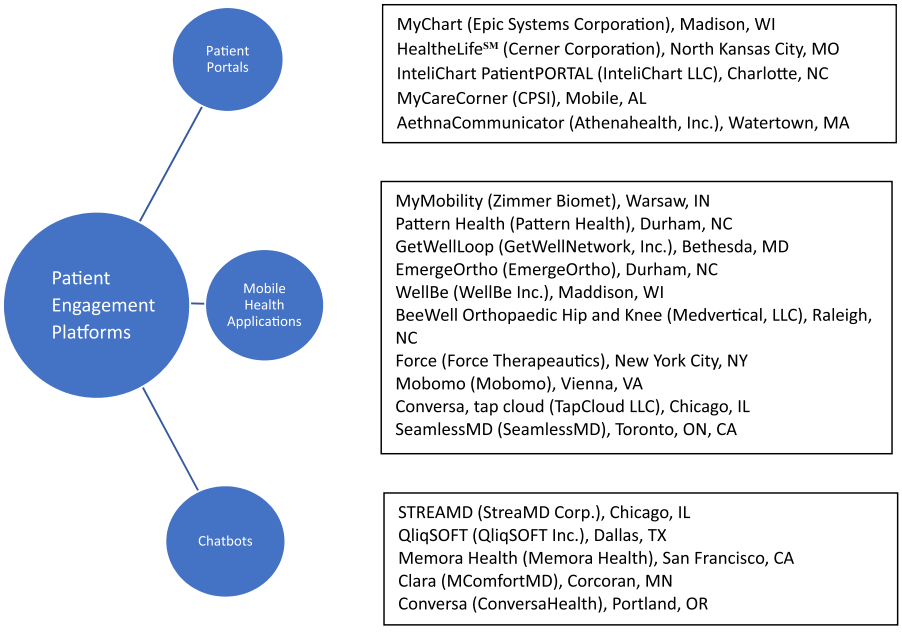

Figure 1. Commercial examples of patient engagement platforms.

population, a multilingual SMS-based chatbot has been demonstrated to equally engage LEP patients in comparison to patients with English as their primary language [21]. In addition, multilingual SMS-based chatbot enrollment was associated with fever readmissions than a historical cohort of LEP patients not enrolled [21]. Although chatbots have notable strengths, like other PEPs, they are not without limitations. Chatbot accuracy is contingent on the ability to accurately categorize patient queries and generate appropriate responses. This requires extensive clinical conversational databases and natural language processing. In addition, several chatbots are integrated within non–health insurance portability accountability act (HIPAA)-compliant messaging platforms, and this limits integration within patient' EHRs. Although these chatbots can be helpful in answering patients' questions postoperatively, any form of collecting non–HIPAA-compliant communication should be explicitly prohibited. Healthcare members should understand the limitations of the particular chatbot used and ensure that protected health information of patients is safeguarded. This stands in contrast to many patient portals and several mHealth apps that are integrated into HIPAA-compliant communication. This lack of integration of certain chatbots to patients' EHRs may present fragmented data and make research difficult.

Discussion

As clinical volume outpaces resources and clinic personnel, the use of PEP provides an opportunity to improve patient care and communication. Several PEPs exist and have distinct advantages and limitations which must be considered before implementation. For example, if a practice has a high clinic burden of patient phone calls for routine postoperative questions, an arthroplasty-specific chatbot may be well-suited to relieve clinic staff from these calls. On the other hand, if a clinic needs an HIPAA-compliant form of communication to answer patient concerns or view incisions, then an mHealth app or patient portal may be a better choice. There is a growing body of literature examining the clinical impact of PEPs. In patients undergoing TKA, web-based patient portals have been associated with increased physical function and joint-specific PROs [22]. In this same study, increased portal logins were associated

Table 1
Advantages and disadvantages of patient engagement platforms.

Patient engagement platform	Advantages	Disadvantages
Patient portals	• Functions as a "secure email" • Provides information about perioperative care • Medication refills can be requested • Allows for wound inspection with patient-submitted photos	• Must have personal computer or tablet for use • Privacy concerns still exist • May exclude more vulnerable patient populations
Mobile health applications	• Accessible anywhere with smartphone • Several apps offer secure, 2-way messaging • Collection of patient-reported outcomes • Monitor patients' clinical improvements	• Must possess smartphone for use • Mobile applications may be difficult to navigate for the elderly • 24/7 Two-way messaging may overwhelm clinics
Chatbots	• Minimal technology investment by patients • 24/7 immediate responses to questions • Simulates clinical conversation • Collection of patient-reported outcomes • Available in multiple languages	• Accuracy relies on clinical conversational databases • Integration within EHRs is not universal • Several chatbots integrated with non–HIPAA-compliant messaging platforms

with more rapid clinical improvement and higher functional scores [22]. However, it should be noted that there were inherent differences in patients who decided to opt-in vs opt-out of this web-based patient portal and may not be able to be reproducible to all patient populations. Regarding mHealth applications, a multicenter observational cohort study at 10 practice sites found their PEP was associated with a 45.4% relative reduction in 90-day hospital readmissions and a 54.4% relative reduction in 90-day complications compared with those not enrolled. There was also a mean saving of over $650 per patient compared to those not enrolled in this PEP [23]. Similar PEPs have been investigated for patients undergoing traditional vs virtual physical therapy and have shown no difference between the 2 when evaluating postoperative TKA or THA patients [24]. As it relates to chatbots, there is randomized, prospective literature supporting perioperative chatbot use. Patients undergoing THA or TKA who were randomized to the chatbot cohort exercised more per day, had improved visual analog scales, discontinued narcotic medications earlier, and placed fewer telephone calls to clinics [25]. Finally, the ability of these PEPs to collect PROs will become increasingly important given the upcoming mandate for hospitals under the Hospital Inpatient Quality Reporting program to report PROs for their arthroplasty patients [26]. Further investigation remains on how to best utilize and apply these PEPs given the rapidly increasing clinical volume of THAs and TKAs in the United States.

Currently our arthroplasty clinic utilizes multiple forms of PEPs and have found the implantation of these technologies to be fairly streamlined. When patients present to our institution, they are prompted to create a patient portal to help navigate their care. Unique to our arthroplasty clinic is enrollment in a SMS-based chatbot for perioperative updates unique to a patient's particular arthroplasty surgeon. Patients choose to elect this service however, and time is taken to explain to the patients what these text updates mean and how they are generated. Given the current success with patient engagement in our arthroplasty clinic, several other orthopedic subspecialties have now adopted this technology, and we are collaborating to better improve patient engagement across multiple subspecialties.

Technology continues to provide opportunities to improve communication and engagement in our patient population. However, the importance of personal interaction cannot be understated, and we are not advocating that the use of PEPs or technology replace the relationship with patients and their healthcare teams. Rather, we advocate for using existing technology to augment interactions with patients when possible. By alleviating the communication burden of clinic staff, the hope is that these PEPs may allow the healthcare team to focus on more pressing clinical concerns impacting their patients. However, continued assessment of PEPs is crucial given their potential to worsen healthcare disparities due to cost barriers and their varying prerequisite of technologic literacy. The growing use of these technologies may inadvertently exclude communities with limited access to digital resources and may negate their intended benefits on patients. Therefore, ongoing investigation into PEPs is paramount to ensure equitable care for all patients.

Summary

PEPs present an opportunity to engage patients outside of the clinical setting as THA and TKA volume continues to outpace resources. Patient portals, mHealth apps, and chatbots all have their unique advantages and limitations. Incorporation of these technologies requires thoughtful planning to ensure that they best serve specific patient populations in addition to addressing the specific needs of a particular clinic. A well-rounded approach utilizing PEPs may help optimize patient outcomes and resource utilization amid the escalating volume of THA and TKA in the United States.

Conflicts of interest

L.A.A. is in the speakers' bureau of or gave paid presentations for Medacta; is a paid consultant for Medacta; has stock or stock options in OrthoGrid; and has research support from Stryker and Zimmer. B.E.B. is a member of AAHKS. K.J.C. has stock or stock options in STREAMD and is an unpaid consultant for BoneFoam. J.M.G. receives royalties from OrthoGrid; is a paid consultant for Stryker, OrthoGrid, and Enovis; has stock or stock options in OrthoGrid, CoNextions, and MiCare Path; receives research support from Zimmer Biomet, Stryker, and Medacta; is in the editorial/governing board of Journal of Arthroplasty; and is a member of AAHKS. J.P.R. has nothing to disclose.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2024.101349.

CRediT authorship contribution statement

Joshua P. Rainey: Writing – review & editing, Writing – original draft, Visualization, Conceptualization. **Brenna E. Blackburn:** Writing – review & editing, Writing – original draft. **Kevin J. Campbell:** Writing – review & editing, Writing – original draft. **Lucas A. Anderson:** Writing – review & editing, Writing – original draft. **Jeremy M. Gililland:** Writing – review & editing, Writing – original draft.

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