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Original Article

Creation of an Online Wiki Improves Post-Operative Surgical Protocol Adherence in Arthroplasty Patients

Eric F. Swart, MD [a, *], Daniel J. Miller, MD [b], Thomas R. Hickernell, MD [b], Kevin J. Bozic, MD, MBA [c, d], Jeffrey A. Geller, MD [b], William B. Macaulay, MD [b, e]

[a] Department of Orthopaedics and Rehabilitation, University of Massachusetts - Worcester, Worcester, Massachusetts
[b] Department of Orthopaedics, Columbia University Medical Center, New York, New York
[c] Department of Orthopaedic Surgery, University of Texas at Austin Dell Medical School, Austin, Texas
[d] Department of Surgery and Perioperative Care, Dell Medical School at UT Austin, Austin, Texas
[e] Department of Orthopaedics, New York University, Langone Medical Center, New York, New York

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ABSTRACT

Background: Perioperative care pathways are tools used in high-volume clinical settings to standardize care, reduce variability, and improve outcomes. However, the mechanism by which the information is transmitted to other caregivers is often inconsistent and error-prone. At our institution, we developed an online, user-editable ("wiki") database to communicate post-operative protocols. The purpose of this study is to evaluate the hypothesis that implementation of the wiki would improve protocol adherence and reduce unintentional deviations inpatient care.
Methods: We conducted a retrospective review of patients who underwent primary lower extremity arthroplasty at our institution during three 6-month time periods including immediately before, 6 months after, and 2 years following introduction of the wiki. Adherence to defined perioperative care pathways (laboratory studies, post-operative imaging, perioperative antibiotics, and inpatient pain medications) was compared between the groups.
Results: After wiki implementation, adherence to protocols improved significantly for laboratory orders ($P < .0001$), imaging ($P < .001$), pain control regimen ($P = .03$), and overall protocol adherence ($P < .001$). Improvements were seen in some areas almost immediately, while others did not show improvements until 2 years after implementation. Costs associated with unnecessary testing were reduced by 82%.
Conclusion: Development of an online wiki for tracking post-operative protocols improves care pathway adherence and reduces variability in care while lowering costs associated with unnecessary testing, although some benefits may not be immediately realized. Several practical barriers to implementing the wiki are also discussed, along with proposed solutions.

Perioperative care pathways (PCPs) are tools used to improve quality of care and reduce variability associated with high-volume procedures, such as total joint arthroplasty [1,2]. PCPs, sometimes called clinical care pathways or critical pathways, involve care standardization, goals, or milestones (usually set for each day), along with variance tracking and ongoing performance feedback. PCPs have been shown to improve organization of care [3], productivity [4], patient and provider satisfaction [5], and health outcomes [6–10], all while lowering costs and optimizing resource efficiency [4–8,11–14].

Despite benefits of PCPs, they remain challenging to implement, and variability in care delivery is often high between multiple providers in the same group [15] or even for the same surgeon, despite the existence of established pathways [16]. Multiple

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Ethical review statement: This study was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki and HIPAA regulations, and was IRB approved (letter attached).

Work location: The work was performed at Columbia University Medical Center.

* Reprint requests: Eric F. Swart, MD, Department of Orthopaedics and Rehabilitation, University of Massachusetts, Worcester, NY 01655.

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barriers to successful use of PCPs exist, and include caregiver buy-in, agreement on the pathways themselves, and the resources required to initiate a systems-based change in care [17].

One major logistical barrier that is not frequently discussed is the sharing of information between providers. Often, the pathways themselves are generated by consensus agreement between senior physicians and hospital administrators, while the actual implementation of the protocols falls to the "front line" providers (eg, residents, physician extenders, and nurses). As a result, clear communication of the actual details of the protocols can become problematic, and "sign out" on a surgeon's protocol usually comes in many disparate forms; e-mails, printed (and photocopied) hardcopy documents, and verbal handoffs are all frequently exchanged between different members of the care team. As a result, multiple parallel copies of "the protocol" can be generated, inevitably leading to inadvertent alterations and discrepancies between different versions [18].

An ideal system for tracking this information would involve (1) a clear single location where the protocol can be found, (2) ease of access for all the members of the care team, and (3) ability to quickly adjust protocols as they evolve and alterations are made. This would hopefully eliminate redundant copies of information, improve fidelity of sign out, reduce inadvertent variability of care, and ultimately improve the quality of care delivered.

With that in mind, our orthopedic surgery department created an online, user-editable orthopedic surgery "wiki" (a wiki is defined as "a website that allows collaborative editing of its content and structure by its users" [19]) for use in creating, editing, and implementing our post-operative protocols. Similar web-based tools have been shown to reduce error rates on patient-specific tasks such as handoffs [20], although never tested for development of general care pathways. The wiki is easily accessible via the Internet, and modifications can easily be made by any member of the wiki via a simple text editing interface. We initially piloted the use of the wiki on our arthroplasty service, as that was a service which already had clear protocols in place, and had a high volume of relatively uniform surgical procedures.

The purpose of this study is to evaluate whether the implementation of the wiki led to improvement in care delivery by increasing adherence to pre-determined protocols, as well as describe some of the challenges and encountered obstacles to successful use of a wiki-based PCP management system. Our hypothesis was that care pathway adherence, as measured by orders entered at the time of hospital admission for primary joint arthroplasty, would improve following implementation of the wiki.

Materials and Methods

Study Design

This study is a retrospective cohort study, examining the adherence of post-operative orders to pre-defined surgeon-specific protocol order sets for hip and knee arthroplasty, both before and after implementation of the wiki. Adherence to clinical pathway protocols was assessed in the following domains: laboratory studies, post-operative imaging, perioperative antibiotics, and inpatient pain control. This study was conducted with approval of our hospital's institutional review board.

Pre-Wiki Protocol Tracking

Prior to creation of the wiki, there was no formal protocol for developing, storing, and distributing information on clinical care pathways in our department. There was a departmental shared network drive, which was accessible by residents and attending surgeons that was commonly (although not universally) used to store information about protocols. However, the location within the drive, format of the documents, and content of the protocols were not standardized.

Wiki Design

The wiki was created using a software package from Wikispaces (Tangient LLC, San Francisco, CA) and run on a dedicated server supported by our institution's information technology department. The wiki itself contains no protected health information, so can be open to the public or restricted to select users (we chose to make it viewable by the public, but only modifiable by registered/invited users).

Sample screenshots of the wiki are shown in Appendix A. The home page is a simple interface with links to different surgeons and their protocols. Under each procedure is a surgeon-specific perioperative protocol following a defined format with categories including the following: perioperative antibiotics, laboratory studies, post-operative imaging studies, deep vein thrombosis prophylaxis, inpatient pain control regimen, and discharge instructions and medications. The overall hierarchical structure of the wiki itself is static and only modifiable by an administrator (one of the chief residents.) The content of each individual protocol is dynamic and is freely modifiable by registered users. Any changes made to an individual page are immediately visible to all users. Old versions of protocols remain stored on the wiki which allows all changes to be easily tracked.

The attending surgeon was ultimately responsible for determining the protocol. In our institution, just before a rotation change, the outgoing resident will update the wiki with any changes or corrections to the protocols, then sign out the protocol to the incoming resident. The incoming resident will then meet with the attending surgeon at the beginning of the next rotation and review the protocol to confirm accuracy. This system ensures that the content is continuously updated and reviewed, and represents the current protocol and practice preferences of the surgeon.

Patient Selection and Study Period

Subjects who underwent primary unilateral total hip or total knee arthroplasty with one of the 2 attending surgeons during 3 different 6-month time periods were identified via retrospective review using the relevant current procedural terminology codes (27130 and 27447). The 6-month time periods were chosen based on relation to the introduction of the wiki, which was first implemented in July 2012. Group 1 was "pre-wiki," and consisted of subjects who underwent surgery during the 6-month period immediately preceding the publishing of the wiki (January 2012-June 2012). Group 2 was "initial post-wiki", and consisted of patients who underwent surgery during a period beginning 6 months after implementation of the wiki (January 2013-June 2013). Group 3 was "long-term post-wiki," and consisted of patients who underwent surgery 2 years after implementation of the wiki (July 2015-December 2015), when the use of the wiki was more definitively established in the department.

All procedures took place at 2 hospitals affiliated with a single academic healthcare institution. Both hospitals use the same electronic medical record for all documentation, orders, and imaging. Residents were responsible for all perioperative order entry and documentation under the oversight of the attending surgeon. Exclusion criteria included patients who underwent bilateral procedures, revision arthroplasty, hip resurfacing, unicompartmental knee arthroplasty, or arthroplasty for treatment of an acute fracture.

For each subject, adherence within each domain was reviewed based on orders entered in the electronic medical record at the