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Effectiveness of an Automated Digital Remote Guidance and Telemonitoring Platform on Costs, Readmissions, and Complications After Hip and Knee Arthroplasties

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ABSTRACT

Background: The impact of a new class of automated digital patient engagement (DPE) platforms on potentially avoidable costs, hospital admissions, and complications after discharge following hip and knee arthroplasties has not been established.

Methods: We conducted a multicenter observational cohort study comparing claims data for potentially avoidable costs, hospital admissions, and complications for 90 days after discharge following hip and knee arthroplasties at 10 practice sites in CA and NV. One hundred eighty-six patients, enrolled between 2014 and 2016 on an automated DPE platform receiving guidance and remote monitoring perioperatively, were compared with 372 patients who underwent the same procedures from the same physicians within 3 years immediately preceding platform implementation. The primary end point was the proportion of patients with $0.00 in 90-day target costs because of potentially avoidable utilization within the platform's influence. Secondary end points included rates of potentially avoidable 90-day hospital admissions and composite complications.

Results: Ninety-three percent and 84.7% of the study and baseline cohorts, respectively, had $0.00 in target costs ($P = .004$), with a mean savings of $656.52/patient ($P = .006$). The baseline and study cohorts had 3.0% and 1.6% 90-day hospital admission rates (relative risk 0.545; 0.154, 1.931, $P = .40$), and 15.3% and 7.0% composite complication rates, respectively (relative risk 0.456; 0.256, 0.812, $P = .004$).

Conclusion: Patients enrolled on an automated DPE platform after hip and knee arthroplasties demonstrated a significant reduction in potentially avoidable 90-day costs, a 45.4% nonsignificant relative reduction in 90-day hospital admissions, and a 54.4% significant relative reduction in 90-day complications.

Over 1.2 million total joint arthroplasties (TJAs) were performed in the United States in 2014 alone [1], a procedural volume that has been projected to increase to more than 3.5 million by 2030 [2]. In an effort to link reimbursement to quality of care, and to transition from fee-for-service to value-based models, initiatives from the Centers for Medicare and Medicaid Services such as the Hospital Readmissions Reduction Program [3] and the Comprehensive Care for Joint Replacement (CJR) program [4] have imposed financial penalties on hospitals for readmissions. CJR was particularly notable in that it placed the index hospital at financial risk not just for readmissions, but for excess costs associated with the episode of care, and extended the window to 90-day postdischarge.

The scale of potentially avoidable costs and utilization postdischarge has been described by Jencks, who demonstrated that Medicare fee-for-service beneficiaries alone had a 34% 90-day readmission rate, with over $17.4 billion in potentially avoidable expenditure [5]. Major hip and knee surgeries constituted the

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second leading surgical category for the proportion of all readmissions. One study described that in the first 30 days after discharge following TJA, the average per patient costs for emergency room visits and readmissions were $429 and $6484, respectively [6]. As the number of patients <65 years of age receiving TJAs grows at a rate disproportionately larger than that for patients aged 65 years and older [7], and as private payers model their own bundles after CJR, the problem is not one isolated to Centers for Medicare and Medicaid Services beneficiaries alone.

Timeliness of postdischarge follow-up has often been cited as critical for reducing potentially avoidable healthcare costs, mortality, and readmissions [8–11]. However, patient access to follow-up care varies widely [11]. Although Jencks advocated for scheduling follow-up appointments for every patient before discharge rather than only for those at high risk, challenges with doing so exist, and risk-stratification, notably among patients with medical discharges, remains widely used. With the promise of scalability, however, remote monitoring has long been explored as a means of mitigating potentially avoidable morbidity. However, the effects of various remote monitoring approaches, particularly those that are reliant on patient participation such as interactive voice response systems and voluntary device use for transmitting physiologic parameters, have been equivocal, with little cost-benefit, mixed benefits on clinical outcomes and healthcare utilization [12–19], and limited potential, if applied outside of a clinical trial setting, to maintain patient engagement [14].

However, driven in part by the emergence of mandated bundles such as CJR, a new class of automated digital patient engagement (DPE) platforms that combine remote guidance and telemonitoring has witnessed increasingly widespread adoption in community and academic medical centers over the last 5 years. These platforms may help bridge the postdischarge gap, but their evaluation for clinical efficacy has only just begun [20], and their impact on costs and clinical outcomes has yet to be determined.

This study is the first of its kind to use payer claims data to assess the impact of an automated DPE platform on cost, healthcare utilization, and outcomes in real-world clinical orthopedic settings.

Materials and Methods

Study Design

We conducted a multicenter observational cohort study across 10 community orthopedic practice sites in CA and NV, examining the impact of a DPE platform (HealthLoop, Inc., Mountain View, CA) on potentially avoidable 90-day postdischarge costs, hospital admissions, and a composite of complications for patients undergoing hip or knee arthroplasty. The intent was to report on those methods and findings that could be generalized more broadly to DPE platform technologies. The involved practices had implemented the platform for their routine provision of care across all TJA patients, and therefore, no concurrent control groups were available within each of these practices for comparison. Therefore, the study involved a proximate historical control consisting of patients undergoing TJA from the same physicians at the same practices before platform implementation at each practice site. The claims data of Anthem Blue Cross (Anthem) members at these sites (study cohort) were compared with the baseline Anthem cohort who had undergone the same procedures by the same providers in the 3 years immediately preceding platform implementation. This approach enabled (1) comparison of costs, readmissions, and complications before and after platform deployment using each physician as his or her own control, and (2) mitigation of confounding by variations in practice patterns, risks, and patient demographics that could have occurred had we compared practices and physicians using the platform concurrently with those at practice sites not using it.

The study cohort was defined as patients receiving platform-based remote guidance and telemonitoring postdischarge. Conservatively, this included patients who activated their platform accounts and were receiving check-in notifications after discharge, irrespective of their levels of platform participation.

We followed the REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) statement checklist (an extension of the EQUATOR Network STROBE Guidelines) [21,22] and the Standards for Quality Improvement and Reporting Excellence (SQUIRE) guidelines [23]. This study received a determination of exemption from human subjects research by E&I Review Services, an independent institutional review board.

Claims Data

To reflect real-world data and evidence which have become increasingly important in demonstrating outcomes using digital health technologies [24], community orthopedic practices were included that were already using the platform for their routine provision of care. Inclusion of claims data in the study was limited to those of enrolled patients who were Anthem members undergoing eligible procedures. Claims data availability for the baseline and study cohorts spanned 2011-2014 and 2014-2016, respectively.

Digital Care Plans

Digital care plans consisted of scheduled guidance materials and telemonitoring questions spanning preoperative (typically 30 days) and postdischarge periods (typically 90 days). Automated check-in notifications generated by the platform and designed to come from the physicians were sent to patients longitudinally over time according to the predetermined schedule. An e-mail link took the patient into the platform where materials pertinent to that day were queued up, taking on average 6.9 minutes per check-in to complete. These included reminders, checklists, educational materials, structured symptom assessments, and patient-reported outcome surveys (see Appendix for examples). Check-in frequency varied, with the highest occurring 1-week preoperatively and 1-week postdischarge. Symptoms exceeding certain thresholds (eg, 7 of 10 on a pain scale) or abrupt changes over time (eg, 1 of 10 on a pain scale with sudden change to 6 of 10) generated notifications to healthcare providers. The platform was accessible on desktop, laptop, tablet, and iOS or Android-enabled mobile devices.

Study Outcomes

The primary outcome was the proportion of patients with $0.00 in target costs associated with potentially avoidable target causes (ie, complications) within the platform's influence. These target causes included deep vein thrombosis (DVT), pulmonary embolism, surgical site infection (including sepsis), hemorrhage (including gastrointestinal bleeding), wound dehiscence, severe constipation, and fracture/dislocation/hardware malposition. A care plan's influence over potentially avoidable target causes consisted of reminders, education, and assessments of adherence to preventive activities related to those causes (see Appendix for examples). Furthermore, because of telemonitoring, the platform could influence the timeliness with which complications would come to the attention of clinical staff, thereby potentially impacting target costs by enabling early intervention and treatment.