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Adoption of new medical technologies: The effects of insurance coverage vs continuing medical education

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ABSTRACT

Medical technologies innovate rapidly and responsively to patient needs, but the adoption of the latest technologies in practice can be delayed by lack of knowledge and ability to pay. Customized individually made (CIM) knee implants potentially provide an option for individuals to maintain moderate to high activity levels with fewer surgical revisions following a total knee replacement, however they are costlier upfront. Not only is the technology more expensive, but insurance typically covers around 50% (versus 90% for older off-the-shelf knee implants). We used a recent simulation model and analyzed the effects on overall adoption of CIM through 2026 and found that continuing medical education (CME)—a common intervention to increase the adoption of new medical technologies through increasing practitioner knowledge and comfort with the new technologies—can increase the adoption of CIM to 48% in the short term, but increasing insurance coverage to be equal to OTS knee replacement coverage increases the adoption to 87% in the sustained long term. Efforts to implement CME are well-placed and will increase the rate of adoption, however the combination of CME and increased insurance coverage provides the most benefit, with the technology reaching 80% of the population undergoing total knee replacement by 2021.

Introduction

Total knee replacement utilization more than doubled between 2000 and 2011, and there is a disproportionate increase in total knee replacements among younger age groups [1]. Given the aging population and high prevalence of obesity, this number is projected to grow by 3.5 million people per year by 2030 [2]. Currently, many efforts are directed toward controlling the cost of total hip and knee replacement, but it is crucial to preserve the quality and outcomes of the procedure in the long term [3].

A de novo effort that deems to simultaneously increase the efficiency and decrease the cost of knee procedures is additively manufactured customized individually made (CIM) implants [4]. However, limiting the diffusion of emerging products, CIM implants have yet to be widely adopted by orthopedic surgeons and patients. Since CIM knee transplants could potentially improve patient outcomes in comparison to off-the-shelf (OTS) implants [5–7], we previously developed a simulation model to investigate the impact of insurance coverage on the future adoptions of CIM [8]. While insurance coverage has shown intrinsic influence in accelerating the adoption of CIM implants, it is also imperative to investigate the impact of continuing medical education (CME) as the singular factor that self-evidently increases the adoption of new treatment as advocated by literature [9].

Previous studies on physicians' adaptivity and CME describe the impact of CME on the adoption of new technologies; however, the comparative effects of CME versus increased insurance coverage on the adoption dynamics of medical devices have not been investigated. To address this gap, we expanded our simulation model on the adoption of CIM knee transplants in consideration of CME.

Methods

We developed a simulation model for the adoption of CIM implants and its association with insurance coverage to quantify the outcomes such as 90-day readmission rate and long-term cost of care [8]. This study expands the previous model to consider the impacts of CME in addition to the out-of-pocket surgery costs and

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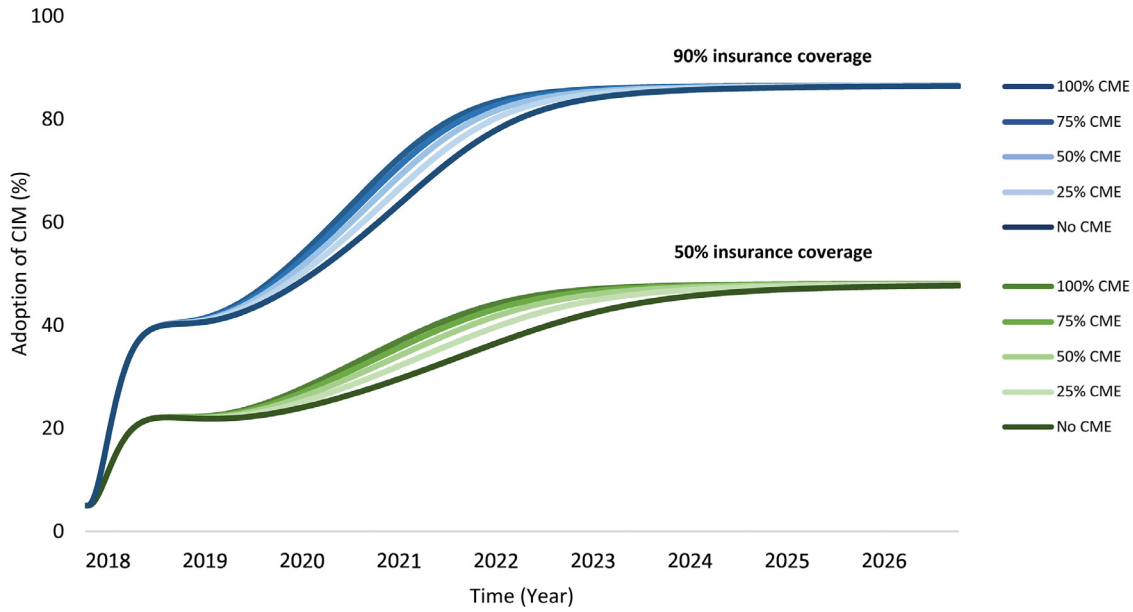

Fig. 1. CIM implant adoption under different CME and insurance coverage levels. While the CME can increase the CIM implants adoption rate to 48% by 2026, the major shift in the CIM diffusion occurs when the insurance coverage for CIM and OTS are equal, bringing CIM adoption to nearly 87% by 2026.

surgeons' pro-CIM recommendations on the adoption of CIM implants.

In the model, patients are divided into two categories according to their choice of implant (OTS or CIM). The early patient performance post-surgery is a function of the average range of motion, axial rotation of knee, and implant lift-off in early and late flexion. The simulated patients may have different severity of the postoperative complications according to patients' functionality and outcome. The factors for the adoption of CIM technology include: insurance coverage, out-of-pocket costs, CME impacts, surgeon preferences, salesforce influence, and manufacturers' willingness to switch to the new technology, among others—see [8] for the details of the original model.

In this analysis, we added CME as a new factor that may influence surgeons' preference to adopt CIM implants. Effective CME may include outreach visits, advice from opinion leaders, patient-mediated interventions, physician reminders, or the combination of any of these strategies [9]. CME impacts are distinguished by simulating a variety of possible CIM adoption scenarios. This modified model considers higher CME to be favorable for pro-CIM physicians' recommendations because it familiarizes the physician with the emerging technology in question and facilitates the adoption of the new products by physicians. Therefore, a higher rate of CME improves physicians' perceptions of CIM technology, which in the long-run could improve their levels of comfort and flexibility with the new technology. This eventually leads to further recommendation of the new products to the new patients. In this analysis, CME is explored in a variety of scenarios from no- to high-impact on the physicians' and, consequently, patients' CIM adoption.

Results

To analyze the impact of CME on the adoption of CIM implants, five scenarios are investigated. These scenarios represent different levels of CME and the corresponding influence on the physicians to facilitate the adoption of the new technology. The first scenario is the "status quo" without CME intervention, followed by low, moderate, high, and very high CME interventions. A higher CME rate reflects greater exposure of the physicians to CIM technology through educational sessions, increasing willingness to adopt. The status quo CIM adoption is considered to be 5%, according to the current market share of these products, thus all scenarios begin with 5% adoption [10].

CIM implants are generally 20% to 30% more expensive than OTS implants. Accordingly, the status quo CIM insurance coverage scenario replicates the existing fixed-rate bundled payment programs which cover approximately 50% of the total costs of CIM procedure. Compared with 90% insurance coverage for OTS implants (the rate that we analyzed in [8]), it is possible to show the influence of 90% on CIM adoption. In addition, the effectiveness of CME interventions with two insurance coverage rates is presented.

Fig. 1 presents the dynamics of CIM adoption under the five CME intervention levels for the status quo coverage level at 50% (in green) and equal coverage level at 90% (in blue) for both OTS and CIM procedures. The results primarily illustrate that an increase in the CME level for both scenarios could facilitate the adoption of the new technology. The adoption increase rate by patients is not significant when compared to the adoption escalation caused by equal coverage of insurance bundled payment as illustrated in Fig. 1, where the CIM insurance coverage raises to the same level coverage as OTS procedures from the status quo.

Discussion

Our analysis shows that CME interventions can increase the adoption of CIM implants by up to about 10% in two to three years post-CME introduction. This delay is a result of the lag between the immediate effects of CME on physicians and when they implement their new knowledge into practice. As CME increases, the proportion of physicians that are exposed and willing to adopt the new technology will eventually increase.

However, the influence of CME fades into insignificance after a long-time interval (5+ years). This indicates that CME can initially increase the speed of CIM adoption after a short delay, but there is a point of saturation at which CME's influence on physicians' decision-making no longer impacts adoption. Thus, CME's positive effect is mostly achieved in the middle of our simulated period. In the unequal insurance coverage scenario, CME's impact is more sustained, indicating that coverage's effect supersedes CME before its full impact is realized.

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We show that insurance coverage of CIM implants overall has a higher impact on the adoption and these increased adoptions are sustained in the long term. The magnitude of CME's impact is limited to its direct relationship with increased CIM implant recommendation by surgeons, but insurance coverage directly activates three mechanisms; first, it also directly affects surgeons' recommendations. This could be due to the nature of the physician-patient relationship; for example, if a physician knows that a patient's insurance is unlikely to provide full coverage for a medical technology, they may be less likely to recommend it, especially if the benefits seem marginal. Second, insurance coverage is inversely related to out-of-pocket surgery costs for patients. Third, increased coverage increases the upfront costs to insurance providers and hospitals; increasing coverage activates a balancing loop here which can ultimately limit the maximum adoption rate.

Our results also show that the dynamics of new medical technology adoption are not one-dimensional. While CME impacts the adoption rate by physicians and health practitioners, it does not translate into immediate higher use of CIM technology. The out-of-pocket costs and the insurance coverage of CIM are important dynamics that can escalate the use of the new technology. Interestingly, providing equal insurance coverage for the OTS and CIM activates the adoption cycle through patient-driven mechanisms.

Finally, we observed that with both performance and outcome improvements, adoption continues to increase through the reinforcement of improved patient and practitioner perceptions (via clinical information and word of mouth, respectively). CIM technology's potential to both improve patient outcomes and decrease long-term costs drives the effort to increase adoption, however at current relative low coverage levels for CIM, OTS implants remain an attractive option. This imbalance will have a major effect on adoption and by extension, population-level patient outcomes. CME cannot prevent these gaps in adoption, but it can attenuate them in the short- and medium-term.

Our findings were limited by the assumption that no exogenous interference with the adoption of a new medical technology will occur; some examples of this are still-newer products in the market, clinical trials indicating that the new technology is not as safe or effective as originally thought, or changes in indication for knee replacements.

Conclusion

Our modeling analysis indicates that CME leads to the faster adoption of the new technology by physicians; however, the insurance coverage relative to alternative options still can be a dominant factor in the adoption of new and more expensive technologies by both physicians and patients.

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Ethical approval

Not required

Declaration of Competing Interest

None.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.hlpt.2020.01.003.

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