Optimising detection and prevention of prosthetic joint infections

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Translation of best practices to clinical practice can be a considerably lengthy process. Reducing surgical site infections (SSIs) following primary hip and knee arthroplasties is a crucial endeavour in light of the continued rise in the number of these operations being performed and the morbidity associated with prosthetic joint infections (PJIs).[1] A number of interventions have been successful in lowering SSI rates following orthopaedic procedures, with those targeting *Staphylococcus aureus* particularly effective given that it is the most common pathogen.[2] Measures to reduce SSIs are evidence-based, relatively straightforward and cheap, yet widespread implementation remains elusive. Perioperative staphylococcal decolonisation represents a substantial cost savings opportunity given the economic burden associated with PJIs, including revision operations, rehospitalisation and prolonged antibiotic courses .[3]

Calderwood *et al*[4] report on the impact of disseminating a SSI prevention bundle for hip and knee PJIs using a pre-existing platform designed for quality improvement initiatives. States with hospitals participating in the quality improvement initiative were compared with those who were interested in participating, revealing a reduction in SSI incidence following primary hip and knee arthroplasty. The size and scope of the intervention (193 hospitals in 5 states) were equally as impressive as the reduction in SSI rates observed (PJI reductions in intervention states exceeded the declines in comparator states by 12%–15%). The bundle included a number of simple measures: *S. aureus* screening with carrier decolonisation, preoperative chlorhexidine washes, alcohol-based antiseptic for operative skin preparation, avoidance of shaving the operative site and appropriate timing of perioperative SSI prophylaxis. Beyond these direct interventions, the bundle also included a multitude of ready-for-use education materials delivered in a variety of forums, from patient-level information through to a business case outline to achieve an organisational thrust towards improving SSIs . This multipronged approach targets diverse stakeholders and provides both practical and educational information that can be adapted to the organisational structure of each hospital.

Employing state-level detection of SSIs was accomplished through the use of administrative databases. The wide population coverage afforded by administrative databases, in addition to the cost savings of using pre-existing information, makes them an attractive option to perform SSI surveillance, particularly when robust arthroplasty registries are unavailable. As PJIs are relatively uncommon, complicating only 1%–2% of primary arthroplasties, administrative databases provide a large sample size from which differences in infection rates over time can be detected.[5 6] Moreover, it is not infrequent that individuals who suffer from a SSI following a hip or knee arthroplasty present to a hospital other than the facility where their primary procedure was performed.[7] Relying on active surveillance by individual hospital infection prevention programmes would miss 20%–30% of infections. Even more problematic with using individual hospital-based surveillance is the technological challenge of linking information across hospitals using different electronic medical record platforms as well as the lack of uniformity in PJI detection strategies. The high cost of active surveillance can preclude some hospitals from performing postorthopaedic SSI monitoring altogether. Expanding the detection zone to the state-wide jurisdiction not only ensures adequate capture of the incidence of SSIs, it provides an opportunity to understand what drives this potentially fragmented care. Future studies of postsurgical initiatives should follow the approach of Calderwood *et al*[4] and study outcomes of hospital-level initiatives across large

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populations, either through leveraging the information stored in administrative databases or using nationwide arthroplasty registers.

The International Classification of Diseases, Ninth Revision, hip or knee PJI diagnosis codes were used to capture individuals with a PJI. Using administrative databases for PJI detection has a sensitivity of between 60% and 90%, a specificity that approaches 100%, a positive predictive value of 50%–90% and a negative predictive value above 90%.[8–11] The same limitations presumably exist, and impact PJI detection similarly, in both the intervention and control states. Nevertheless, the low sensitivity underestimates the burden of SSIs following arthroplasties. Other studies using administrative data have used additional approaches to more accurately identify orthopaedic SSIs by combining the diagnostic codes with specific orthopaedic procedure codes.[5 8 12] A potential approach to improve PJI detection could involve machine-learning techniques to create novel diagnosis algorithms to be applied within administrative databases.[13] If available, mature arthroplasty registries represent an accurate and, depending on the scope, comprehensive means of PJI surveillance.[14–16] Some potential approaches to further enhance PJI detection in arthroplasty registries or administrative databases might include linking in data on antimicrobial prescription claims and intraoperative bacterial culture results.[14]

Using a 90-day time period to identify PJIs, while concordant with the Centers for Disease Control and Prevention guidelines, is brief and encompasses only a small fraction of total PJIs. A recent large observational study of revision operations for PJIs following hip arthroplasties found that only 14% of PJIs occurred during the 90-day postoperative period.[17] Other large retrospective cohorts created using administrative databases in Europe, North America and Australia have similarly demonstrated that a low proportion of PJIs occur in the weeks following arthroplasty.[5 12 18] In addition, when follow-up is extended for more than 10 years, the risk of a PJI wanes but never plateaus, suggesting that the potential benefit of SSI prevention strategies may accrue over long time horizons.[5] Although *S. aureus* infections, the primary target of decolonisation regimens, usually manifest within 90 days of surgery, these treatments should also reduce infections caused by less virulent organisms, such as coagulase-negative *Staphylococci*, which tend to present much further from the operation. Moreover, while the effectiveness of staphylococcal decolonisation decreases with time, those treated with mupirocin still remain less likely to be colonised by staphylococci up to a year later, which further suggests that the Project JOINTS (Joining Organizations IN Tackling SSIs) prevention bundle has the potential to reduce late staphylococcal PJIs seeded haematogenously.[19] Assessing the impact of this initiative over a longer postoperative interval would be informative.

Optimal reductions in SSI rates will require multipronged approaches, such as the bundle implemented in this study, which can be adapted at a hospital level. Future assessments of SSI prevention strategies following hip and knee arthroplasties should have longer follow-up periods, ideally of 2 years' duration. As administrative databases are increasingly being used to capture PJIs, there is a need to optimise detection strategies to improve sensitivity while preserving specificity. This article demonstrates that a multipronged approach to dissemination of best practices for reducing SSIs following orthopaedic procedures can be widely implemented and achieve meaningful population benefits. The study could have benefited from a longer follow-up time period and improved detection algorithms to more robustly understand the impact of the intervention.

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