

Is Routine Antibiotic Prophylaxis Cost Effective for Total Joint Replacement Patients?



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ABSTRACT

The routine use of amoxicillin antibiotic prophylaxis prior to dental procedures for patients with total joint prostheses in place remains controversial. This analysis shows that the practice may not be cost-effective for patients in whom the risk of infection with dental work is low. However, specific data quantifying the risk and the impact prophylactic antibiotics can have is needed. Patients and physicians will need to continue to consider their use on an individual basis and should consider the risk of infection as well as the risk of adverse drug reaction when making treatment decisions.

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The need for antibiotic prophylaxis prior to dental procedures for patients with existing total joint replacements remains controversial. Currently, over a million hip and knee replacement procedures are done each year in the United States, resulting in a substantial number of patients who have joint replacements in place today [1–3]. Late hematogenous infection of a total joint replacement is postulated, but not definitively proven, to occur when bacteremia, caused by dental procedures, results in bacterial seeding of the prosthesis [4]. It is estimated that 6–13% of prosthetic joint infections involve organisms that could be from the oral cavity [5], and some hematogenous infections may occur through this transmission mechanism.

Antibiotic prophylaxis can reduce the incidence of bacteremia with dental procedures, thus theoretically, decreasing the likelihood of late hematogenous infections of a total joint prosthesis [4]. However, the true risk associated with dental procedures is unknown, the ability of prophylaxis to decrease the risk of these infections is not clearly established, and significant adverse drug reactions associated with antibiotic use can occur. These include allergic reactions as well as the development of *Clostridium difficile* infection (CDI), both of which also can have significant costs and clinical consequences for patients. As a result, it is difficult for clinicians and patients to weight the risks, benefits and relative costs of performing routine antibiotic prophylaxis for dental procedures.

The purpose of this study is to use a decision analysis model and the currently available data to quantify the cost-effectiveness of antibiotic prophylaxis prior to dental procedures in patients with total joint replacements and to determine the associated conditions for which it

would be cost-effective in order to help clinicians consider their treatment choice in the absence of this definitive data and to help guide future research efforts intended to determine the scenarios where antibiotic prophylaxis is indicated.

Methods

Model Design

We used a decision model [6] to evaluate the cost-effectiveness of routine antibiotic prophylaxis prior to dental work in patients with total joint replacement. The decision model depicting the pathway followed by patients in the screening program is shown in Fig. 1. Patients transition along the appropriate arm of the decision tree according to the likelihood of each event determined by the probability of each event as detailed below. In addition, we assigned a utility value, measured in quality-adjusted life-years, and a cost to every health state, which results from the sequence of events depicted in each terminal branch of the tree. The specific probabilities, utility values and costs used are discussed in detail below. The model is designed to analyze the cost-effectiveness from the payer perspective.

Model Probabilities

Health State Values

The methodology for determining the utility and disutility values was described in a previous publication and is shown again here given their importance for the reader [7]. Utilities used in the model were based on scores for joint arthroplasty reported in the literature [8,9]. The utility value after total joint arthroplasty, was set at 0.75, which is

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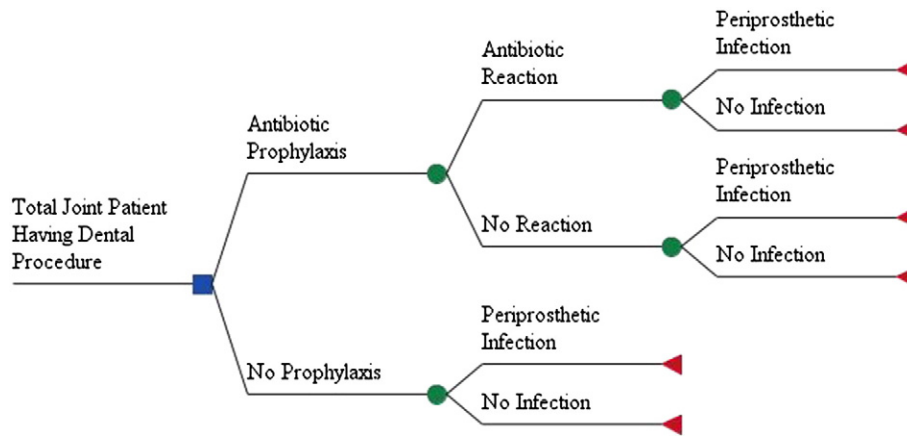


Fig. 1. The figure represents the decision model used to model patients with total joint replacement undergoing a dental procedure. Each patient either receives prophylactic antibiotics or does not. Those that receive antibiotics either have an antibiotic reaction or do not. Both groups then either have a prosthetic infection or do not.

consistent with the average utility values found in the Swedish Registry after hip arthroplasty (0.73) [10]. The utility value for an infected total joint replacement was assigned an initial value of 0.4 to be consistent with the utility value associated with this state in the literature [11].

Disutilities represent the negative preference patients have for a particular health state or outcome, such as primary or revision knee arthroplasty. These negative utility values, or disutilities, account for the decreased mobility, increased pain, and potential complications, which are incurred during the post-operative and post-acute care recovery period. The disutility of having an adverse drug reaction was set at -0.05 , or roughly loss of 3 weeks of perfect health [7].

Costs

We set the average cost of a septic joint revision at \$90,000 for the base case to be consistent with previous studies of resource utilization

for revisions of infected joint replacements [12,13]. The β -lactam class of antibiotics (such as amoxicillin) are most frequently used for dental prophylaxis and are the most frequent cause of severe drug related anaphylaxis [14], occurring in 0.015–0.004% [15] of treatments at a cost of \$7600 [16] per episode. *Clostridium difficile* infection is another severe consequence of β -lactam use, occurring in 6.7 of 100,000, or 0.0000067% [17], of outpatient treatments at a cost of \$13,000–16,400 [18] per episode. Amoxicillin, the most frequently used antibiotic for prophylaxis is associated with rash in 5.1% of patients [19] treated at a cost of \$200 per episode requiring an outpatient evaluation. Amoxicillin causes an adverse event severe enough to require emergency department evaluation (ED) in 0.15% [20] of outpatient treatments, at a cost of \$1200 [21] per ED visit. Using these data, the average cost of an antibiotic complication per prophylactic prescription is \$14.30 ($0.0015 \times \$7600 + 0.0000067 \times \$15000 + 0.05 \times \$200 + 0.0015 \times \1200).

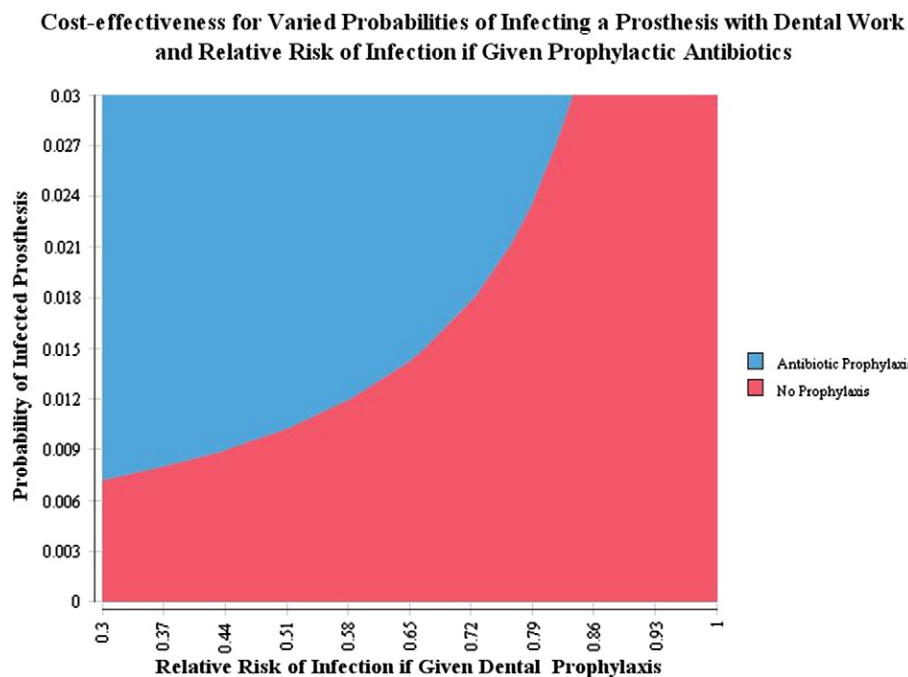


Fig. 2. Results of sensitivity analysis demonstrating the relationship between the probability of sustaining an infected prosthesis after dental work and the reduction in this risk provided by the use of prophylactic antibiotics. For example, if the risk of peri-prosthetic infection for a given patient with dental work is 0.012, or 1.2%, then the relative risk with prophylactic antibiotics would have to be 0.58, or 42% less, for the use of antibiotic prophylaxis to be cost-effective (blue areas).

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