

## Can We Predict Which Species of Bacteria Will Cause an Infection After Fracture Surgery?

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**Purpose:** The ability to reliably predict the risk of particular types of bacteria involved in fracture-related infections could alter patient management by providing opportunities for more effective pathogen-specific antibiotic prophylaxis. We hypothesized that factors predictive of specific bacterial types in fracture-related infections could be determined and used to create a clinically useful model.

**Methods:** A retrospective secondary analysis at a single Level-I trauma center between 2006 and 2015 yielded 435 patients with deep surgical site infections within 1 year of definitive fracture fixation. A control group of 576 fracture fixation surgeries was created by random sampling and application of exclusion/inclusion criteria to 53,760 orthopaedic trauma surgeries. We collected data on 16 factors theorized to be associated with postoperative infection by methicillin sensitive *Staphylococcus aureus* (MSSA), methicillin-resistant *S. aureus* (MRSA), and gram-negative rods (GNRs) versus no infection. Multiple logistic regression with bootstrap repetitions and backward elimination was used to identify candidate predictor variables for each outcome of interest. A multinomial Bayesian hierarchical model was then generated to predict the 4 outcomes of interest and the estimated odds ratio of infection for each predictor.

**Results:** The final bacterial pathogen specific prediction model consisted of 7 independent predictors of pathogen type: (1) fracture of pelvis, acetabulum, or proximal femur; (2) Gustilo type 3 open fracture; (3) fracture of lower extremity; (4) ASA class; (5) alcohol abuse; (6) diabetes; and (7) minority race. The model was well calibrated and had good discriminative ability with an area under the curve (AUC) of 0.82, 0.77, 0.72, and 0.75 for the MSSA, MRSA, GNR, and no infection groups, respectively. A fracture located at the pelvis, acetabulum, or proximal femur was the strongest predictor of MRSA with an odds ratio of 5.37 (95% confidence interval [CI] 2.29-13.60) compared to upper extremity fractures. A Gustilo type-3 open fracture was the strongest predictor of MSSA and GNR with odds ratios of 4.57 (95% CI 2.72-7.69) and 5.26 (95% CI 3.42-7.85), respectively, compared to closed and Gustilo type 1 or 2 open injuries.

**Conclusion:** The proposed fracture-related infection prediction model is able to determine which patients have fractures at high risk of infection with MRSA, MSSA, and GNRs. Currently, all patients tend to receive the same prophylactic antibiotics at each institution, but this information may allow for optimization of antibiotic choices based on risk of infection with particular pathogens.