Severity Weighting of Adverse Events in Orthopaedic Trauma Surgery

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Background/Purpose: There has been a recent increase in the use of national databases to study the occurrence of adverse events following orthopaedic trauma surgery. Most of this research uses composite adverse event outcomes such as occurrence of "any adverse events," which treat adverse events with different clinical significances (for example, death and urinary tract infection) similarly. The failure to differentiate between these adverse events in terms of their clinical significance detracts from the clinical applicability of these studies' conclusions. The purpose of the present study is to address this shortcoming in research methodology through the creation of a single, severity-weighted outcome that can be used to determine the overall "severity" of any given patient's postoperative course.

Methods: Orthopaedic faculty at two academic institutions were invited to complete a severity-weighting exercise in which they were asked to consider how many of specific adverse events they would equate to the death of one patient. Their responses were used to generate a severity-weighting scheme called the "severity-weighted outcome relative to death," or SWORD. In the SWORD, patients with no adverse event are assigned 0%, patients with postoperative death are assigned 100%, and patients with other adverse events are assigned percentages in between (determined from the participants' responses). The SWORD was then applied. Patients undergoing eight common orthopaedic surgeries were identified in the 2012 American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database. First, mean SWORD was compared by procedure with adjustment for demographic and comorbidity characteristics. Second, patients undergoing the procedure with the highest mean SWORD (hip fracture surgery) were examined in depth. Among only these patients, mean SWORD was tested for association with age, sex, and six commonly studied comorbidities.

Results: At institution A, 23/23 faculty members (100%) completed the exercise, while at institution B, 24/27 faculty members (89%) completed the exercise, leading to an overall number of participants of 47 and an overall response rate of 94%. Mean severity weights generated from participant responses are provided in Figure 1. The weights ranged from 0.23% for urinary tract infection (least severe) to 15.14% for coma (most severe). A total of 85,031 patients from the 2012 NSQIP met inclusion criteria for the demonstration portion of the study. Mean SWORD ranged from 0.2% among patients undergoing elective anterior cervical decompression and fusion (procedure with the lowest mean SWORD) to 6.0% among patients undergoing hip fracture surgery (procedure with the highest mean SWORD; $P < 0.001$). Among patients undergoing hip fracture surgery, mean SWORD was independently associated with age, sex, and 4 of 6 tested comorbidities ($P < 0.05$ for each).

Conclusion: We present here the "severity-weighted outcome relative to death," or SWORD, a single, severity-weighted outcome that can be used to characterize the severity of any

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given orthopaedic trauma patient's postoperative course. The SWORD is designed to be used in future orthopaedic trauma database studies as a primary outcome that is more clinically meaningful than the composite outcomes that currently dominate the literature. The SWORD was highly associated with procedure type, demographics, and comorbidities. Taken together, these results demonstrate the manner in which the SWORD is intended to be used in future studies: to compare the severity-weighted outcome by demographic, comorbidity, and procedural characteristics to understand what are and are not risk factors for a problematic postoperative course. Future studies in orthopaedic trauma may benefit from use of the severity-weighted outcome score presented here. Other fields with growth in database research may consider using similar methods to create severity-weighting systems of their own.

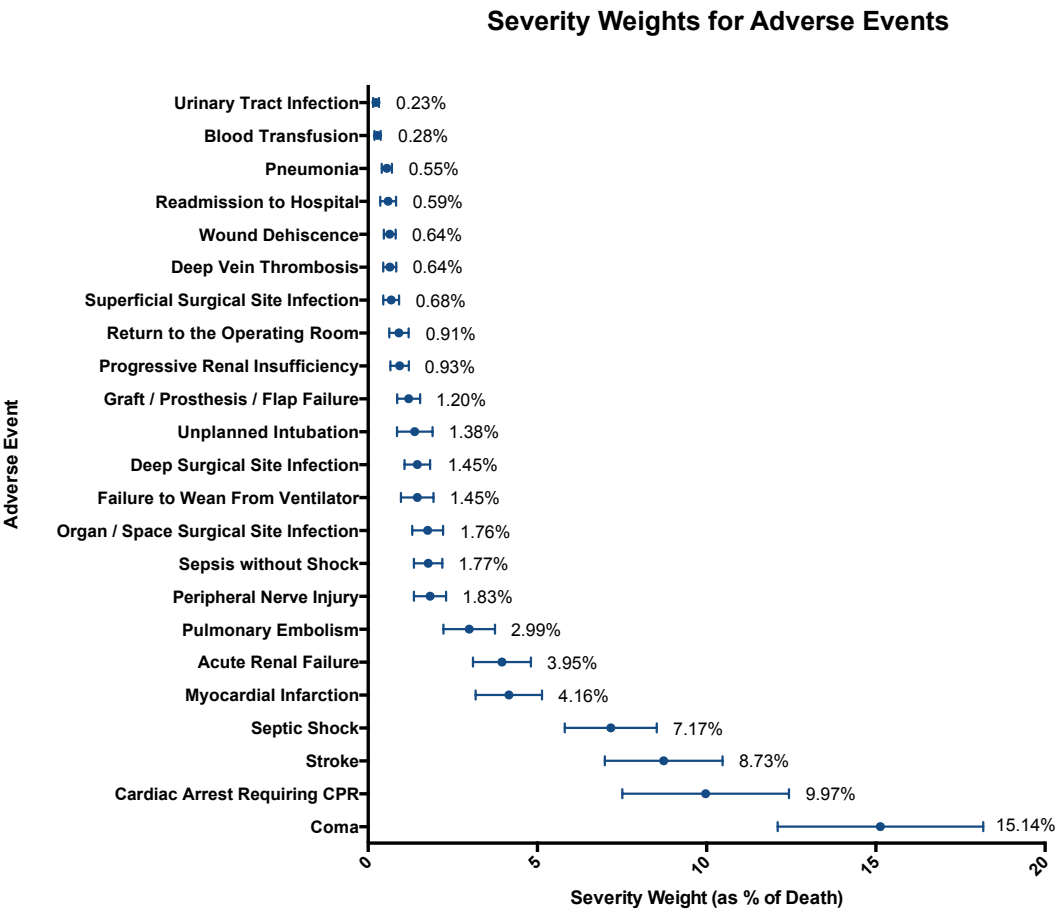

Figure 1

Figure 1. Severity weights for adverse events. Error bars indicate standard errors.