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# Comparison of Two Comorbidity Scoring Systems for Older Adults with Traumatic Injuries



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- BACKGROUND:** The purpose of this study was to determine the mortality predictive value of two different comorbidity scores, Comorbidity–Polypharmacy Score (CPS) and Charlson scoring system, in a large sample of older trauma patients.
- STUDY DESIGN:** At an urban tertiary care Level I trauma center, trauma patients aged 55 years and older who were initially admitted to critical care were included. This retrospective chart review was conducted at Harborview Medical Center in Seattle, WA. Older trauma patients admitted from January 1, 2010 through December 31, 2010 were screened for inclusion. One-year mortality data were obtained from the Washington State Department of Health. Covariates included age, presence of hypotension, traumatic brain injury, and Injury Severity Score.
- RESULTS:** Records for 667 older trauma patients were reviewed. In multivariate analyses, CPS was an independent predictor of fatal outcomes. Higher CPS was associated with greater mortality, however, it was not superior to Charlson methodology in predicting 1-year mortality in this patient cohort.
- CONCLUSIONS:** The addition of a comorbidity score improves multivariate models predicting long-term mortality in older trauma patients. There was no advantage to using CPS instead of Charlson score, and each was an independent predictor of fatal outcomes. (*J Am Coll Surg* 2014;219:631–637. © 2014 by the American College of Surgeons)
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The burden of injury in older adults is increasing as our society ages. Although younger patients constituted the majority of trauma victims in the past, trauma centers have witnessed a shift toward older patients.<sup>1</sup> The appropriate age cutoff for geriatric trauma is still debated, but there is strong evidence that injury in older age groups leads to high mortality and decreased quality of life in survivors.<sup>2,3</sup> Comorbidities are more prevalent in aging patients and have a measurable impact on hospitalization outcomes. Although pre-injury comorbidities are strongly linked to worse post-injury outcomes, the best approach to capture comorbid conditions in older trauma patients remains unclear.

The Charlson<sup>4</sup> methodology has been widely used in the trauma and geriatric literature, but presents several

limitations. Developed in 1987, it assigns weights between 1 and 6 on 22 different medical conditions to help predict 1-year mortality. Conditions associated with increased mortality are given a higher score (eg, AIDS is assigned a score of 6, as is metastatic cancer). Medical care has improved vastly since that time and, as a result, the weights given to certain diseases might not accurately reflect their current impact. For example, AIDS no longer carries an 82% 1-year mortality with appropriate medical management.

The Charlson score also ignores the burden of medications on outcomes. Recent research implicates several classes of medications in the risk for falls, fractures, intracranial hemorrhage, and death after trauma. Many studies have focused on individual classes of medications (ie, anticoagulants,  $\beta$ -blockers, or statins) before injury, but have not assessed the total number of medications pre injury. The Comorbidity–Polypharmacy Score (CPS) is a new methodology developed recently in an attempt to broaden this focus by summing all comorbidities and medications. This new scoring system assigns 1 point per medication intake and 1 point per comorbidity present on admission.<sup>5-7</sup> Unlike Charlson, no differential weight is assigned to various conditions.

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**Abbreviations and Acronyms**

CPS = Comorbidity–Polypharmacy Score  
HMC = Harborview Medical Center  
ISS = Injury Severity Score  
OR = odds ratio  
ROC = receiver operating characteristic

We hypothesized that the inclusion of Charlson comorbidity into a multivariate model that factors age, injury severity, traumatic brain injury, and early hypotension will improve mortality prediction for older trauma patients. We also hypothesized that the addition of medications to comorbidities would result in a superior model for mortality risk assessment, rather than relying on comorbidities alone. As such, a model that includes CPS methodology might better predict 1-year mortality in injured older patients than a similar model using Charlson score. The purpose of this study was to compare multivariate models that include either Charlson or CPS to predict 1-year mortality.

**METHODS****Study design**

We conducted a retrospective review of all trauma patients aged 55 years and older admitted to Harborview Medical Center (HMC) from January 1, 2010 to December 31, 2010. One-year mortality was the primary end point of interest. Main covariates were age, injury severity, presence of traumatic brain injury, hypotension in the emergency department, comorbidities, and pre-injury medications.

**Hospital setting**

Harborview Medical Center is a county teaching hospital with 413 beds, including 89 ICU beds. An affiliate of the University of Washington, HMC is the only Level I trauma center for the states of Washington and Alaska, as well as Northern Montana and Idaho. It is also a safety-net hospital with the mission to provide health care for underserved patients in King County, WA.

**Subjects**

Older patients for this study were identified using the HMC Trauma Registry Database. Patients were included if they were 55 years or older at the time of injury, admitted to the ICU, and a resident of Washington State. Patients were excluded if they had burn as first-listed diagnosis, or were transferred >48 hours after sustaining trauma. We also excluded those who died within 12 hours of admission because they likely died from

devastating injuries, which often limits our ability to fully capture their comorbid conditions. Chart reviews were conducted on all included patients via the electronic medical record and trauma registry. Data collection variables included demographic information (ie, age, sex, height, and weight), Injury Severity Score (ISS),<sup>8,9</sup> home medications, medical history (comorbidities), blood pressure in the emergency department, presence of brain injury, living situation before trauma, transfer from an outside hospital, traumatic brain injury, and disposition after discharge. The confounding variables were chosen based on our previous data on the best model to predict mortality in trauma patients.<sup>10</sup>

**Assignment of comorbidity and polypharmacy burden**

We calculated a modified Charlson score for each patient according to the method published by Deyo and colleagues.<sup>11</sup> Charlson scores can range from 0 to 40. In contrast, the CPS methodology assigns a point to each chronic health condition and each medication that a patient takes for that condition.<sup>6</sup> For instance, if a patient takes 2 medications for hypertension and 3 medications for diabetes, they would have a CPS of 7. There is no maximum CPS. Previous studies have shown an association between comorbidity and polypharmacy with trauma outcomes in patients older than 45 years old. Evans and colleagues stratified the scores as minor (0 to 7), moderate (8 to 14), severe (15 to 21), and morbid ( $\geq 22$ ) classifications.<sup>6</sup>

**Outcomes**

The primary outcomes of this study included prediction of 1-year mortality. Death and survival data up to 1 year after injury were obtained from the Washington State Department of Health by tracking names and dates of birth for patients included in the analysis. Charlson score and CPS were compared with one another as predictors of 1-year mortality.

**Data analyses**

Participants were stratified into 4 groups according to CPS ranges. Discharge disposition and unadjusted mortality up to 1 year were evaluated. Survival differences among the 4 categories were analyzed by unadjusted log-rank test. We next evaluated potential associations with 1-year mortality by univariate analysis and included factors associated with mortality at the  $p \leq 0.20$  level in multivariate models. Charlson scores and CPS were kept as continuous variables in multivariate analyses for the following reasons: first, Charlson is primarily used as a continuous measure of comorbidity and, second, defining

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