*Brief Report*

# Predictors of Advance Care Planning Documentation in Patients With Underlying Chronic Illness Who Died of Traumatic Injury

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## Abstract

**Context.** Advance care planning (ACP) is difficult in the setting of a life-threatening trauma but may be equally important in this context, especially with increasing numbers of trauma victims being elderly or having multimorbidity.

**Objectives.** Identify predictors of absent ACP documentation in the electronic health records of patients with underlying chronic illness who died of traumatic injury.

**Methods.** We used death records and electronic health records to identify decedents with chronic life-limiting illness who died of traumatic injury between 2010 and 2015 and to evaluate factors associated with documentation of living wills, durable powers of attorney, or physician orders for life-sustaining treatment.

**Results.** Only 22% of decedents had ACP documentation at time of injury. Among those without preinjury ACP documentation, 4% completed ACP documentation after injury. In multipredictor analyses, patients were less likely to have ACP documentation at the time of injury if they were younger ($P < 0.001$), had fewer chronic illnesses ($P = 0.002$), and had fewer nonsurgical hospitalizations ($P = 0.042$) in the year before injury. Among patients without ACP documentation before injury, those with fewer postinjury nonsurgical hospitalizations were less likely to complete ACP documentation after injury ($P = 0.019$).

**Conclusions.** Our findings suggest that patient characteristics play an important role in the completion of ACP among patients with chronic life-limiting illness and who died from sudden severe injury. Interventions to improve ACP completion by patients with serious chronic conditions have the potential for increasing goal-concordant care in the event of traumatic injury. J Pain Symptom Manage 2019;58:857–863. *© 2019 American Academy of Hospice and Palliative Medicine. Published by Elsevier Inc. All rights reserved.*

***Key Words***

*Advance care planning, trauma, injury, chronic illness*

## Introduction

A growing body of literature emphasizes the effect of patient characteristics on trauma outcomes. In the adult trauma population, increasing age and the presence of preexisting disease are independent predictors of increased in-hospital mortality[1], increased length of hospitalization[2], and increased 1-year mortality.[3]

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Integrating advance care planning (ACP) and palliative care practices in the trauma setting has the potential to improve end-of-life care without worsening mortality.[4] However, implementation of ACP in trauma patients is challenging. Traumatic injury is typically abrupt and unanticipated, providing little time for patients and their families to become acclimated to increased disability.[5] Additional distress occurs if patients experience trauma-related cognitive impairments and family members are asked to take on the burden of decision-making surrounding end-of-life care.[4] Although preinjury completion of ACP documents could lead to reduced distress among family members[6] and facilitate care that is aligned with patient preferences,[7] such planning activities may occur less frequently for trauma patients who are likely to be younger than other end-of-life populations.[8]

Prior studies have analyzed predictors of do-not-resuscitate orders[9,10] and withdrawal of life-sustaining therapy in trauma patients,[11–13] but few have explored predictors of preadmission advance directives.[8] This study aims to identify those who were less likely to have engaged in ACP before injury among patients with chronic illness who died of injury and those whose electronic health record (EHR) did not contain ACP documents at the time of death among those without preinjury ACP.

## Methods

### *Setting and Study Population*

The study was conducted at UW Medicine, an integrated academic health system comprising a university medical center, a county safety-net hospital that is the only Level 1 trauma center serving a five-state region, a large clinic network, and a cancer care center. Annual patient volume exceeds 64,000 hospital admissions and 1.6 million outpatient and emergency department visits. The study was approved by the University of Washington Institutional Review Board (no. STUDY00002590).

The study population consisted of decedents of age ≥18 years at death with one or more chronic life-limiting illnesses documented in the EHR, who died of traumatic injury in Washington State between 2010 and 2015, whose death certificate indicated the date of traumatic injury, who received care through UW Medicine prior to injury/death, and who died within 2 years after injury. Decedents were considered to have died of traumatic injury if the death certificate indicated a cause-of-death International Classification of Diseases code that was consistent with traumatic injury[14] and did not indicate that the injury was a complication of medical care. We restricted the sample to patients receiving care at UW Medicine prior to injury to ensure that there was an opportunity for ACP documents to be included in the UW Medicine EHR before the injury. Receipt of care through UW Medicine was evaluated for two index dates (injury and death), with decedents required to meet the following requirements at both time points: at least two outpatient visits at the same UW Medicine facility in the 32 months prior to the index date, with at least one visit occurring during the 24 months prior to that date; or—if the outpatient requirement was not met—to have had at least one nonsurgical inpatient visit at an affiliated hospital in the two years prior to the index date.[15] These criteria were chosen to exclude patients referred during the relevant periods solely for a second opinion or elective surgery. Based on International Classification of Diseases codes recorded in the EHR, eligible decedents had at least one of nine chronic conditions, as defined by the Dartmouth Atlas, during the 24 months prior to injury: cancers with poor prognosis (primary malignancies with poor prognoses, leukemias, and metastatic disease), chronic pulmonary disease, coronary artery disease, congestive heart failure, severe chronic liver disease, chronic renal disease, dementia, diabetes with end-organ damage, and peripheral vascular disease.[15,16]

### *Outcomes*

The primary outcome was absence of ACP documentation in the EHR prior to injury. Among those without preinjury ACP documentation, we also examined a secondary outcome: absence of ACP documentation in the EHR at time of death. ACP documentation was defined as one or more of the following three types of document: living will, durable power of attorney, or POLST form. The outcome variable for each time period was dichotomized (0/1), with "1" indicating that no ACP documents were present in the EHR prior to the date of interest (injury or death).

### *Predictors*

We examined the following predictors: gender, race/ethnicity (white non-Hispanic vs. minority), level of education, marital status, age, type of insurance, number of chronic illness conditions documented in previous 2 years, health-care utilization in previous year, and the facility providing the most recent care. For the secondary outcome, we also used the elapsed time between injury and death as a predictor. Gender, racial/ethnic minority status, level of education, and marital status were obtained from the death certificate. Age was computed from date of birth (EHR) and date of death or injury (death certificate). All other predictors were abstracted from the EHR. EHR variables that could change over time were evaluated at both injury and death.

*Table 1*
**Characteristics of Sample**[a]

| Characteristic | Valid n[b] | *n* (%)[c] |
|---|---|---|
| Female | 841 | 284 (33.8) |
| Race/ethnicity | 841 | |
| White non-Hispanic | | 671 (79.8) |
| Racial/ethnic minority | | 170 (20.2) |
| Black | | 75 (8.9) |
| Native American | | 29 (3.4) |
| Asian | | 36 (4.3) |
| Pacific Islander | | 4 (0.5) |
| White Hispanic | | 17 (2.0) |
| Mixed race/ethnicity[d] | | 9 (1.1) |
| Age at time of injury, mean (SD) | 841 | 63.2 (17.5) |
| Level of education achieved by time of death | 790 | |
| 8th grade or less | | 33 (4.2) |
| 9th-12th grade, no diploma | | 100 (12.7) |
| High school graduate or equivalent | | 285 (36.1) |
| Some college, no degree | | 135 (17.1) |
| Associate's degree | | 59 (7.5) |
| Bachelor's degree | | 104 (13.2) |
| Master's degree | | 43 (5.4) |
| Doctorate or professional degree | | 31 (3.9) |
| Marital status at death | 812 | |
| Never married | | 209 (25.7) |
| Married | | 255 (31.4) |
| Previously married | | 348 (42.9) |
| Health insurance at time of injury | 841 | |
| Private insurance | | 189 (22.5) |
| Medicare | | 237 (28.2) |
| Medicaid | | 308 (36.6) |
| Military insurance | | 23 (2.7) |
| Other insurance type | | 28 (3.3) |
| Uninsured | | 56 (6.7) |
| Number of Dartmouth Atlas diagnoses at time of injury, mean (SD) | 841 | 1.7 (1.0) |
| Specific diagnoses at time of injury | 841 | |
| Cancer | | 90 (10.7) |
| COPD | | 317 (37.7) |
| CAD | | 260 (30.9) |
| CHF | | 211 (25.1) |
| PVD | | 94 (11.2) |
| Liver disease | | 109 (13.0) |
| Diabetes | | 93 (11.1) |
| Renal disease | | 161 (19.1) |
| Dementia | | 105 (12.5) |
| Days between injury and death, mean (SD) | 841 | 11.3 (43.0) |
| Number of inpatient stays between injury and death, mean (SD) | 841 | 0.5 (0.7) |
| Number of surgeries between injury and death, mean (SD)[e] | 587 | 0.5 (1.8) |
| Place of death | 841 | |
| Hospital inpatient | | 385 (45.8) |
| Harborview or University of Washington Medical Center | | 292 (34.7) |
| Comfort care orders[f] | | 104 (35.6) |
| Code status at death[f] | | |
| Full code | | 40 (13.7) |
| DNR/DNI | | 83 (28.4) |
| DNR | | 39 (13.4) |
| No code status recorded in EHR | | 130 (44.5) |
| Other hospital | | 93 (11.1) |
| Home | | 260 (30.9) |
| Dead on arrival | | 1 (0.1) |
| Emergency department | | 26 (3.1) |
| Nursing home | | 48 (5.7) |
| Inpatient hospice | | 11 (1.3) |
| Other place | | 110 (13.1) |
| Health-care utilization in year prior to injury | 841 | |
| Number of unduplicated outpatient providers, mean (SD) | | 2.0 (3.2) |
| Number of outpatient visits, mean (SD) | | 4.8 (9.3) |
| Number of ED visits, mean (SD) | | 1.0 (3.0) |
| Number of inpatient stays, mean (SD) | | 1.2 (1.7) |
| Number of nonsurgical inpatient stays, mean (SD) | | 0.8 (1.7) |
| Number of surgical inpatient stays, mean (SD) | | 0.4 (0.6) |
| Facility providing care prior to injury | 841 | |
| Harborview (inpatient) | | 280 (33.3) |
| University of Washington Medical Center (inpatient) | | 12 (1.4) |
| Seattle Cancer Care Alliance | | 45 (5.4) |
| UW Medicine Neighborhood clinics | | 43 (5.1) |
| Harborview (outpatient) | | 289 (34.4) |
| University of Washington Medical Center (outpatient) | | 172 (20.5) |

SD = standard deviation; COPD = chronic obstructive pulmonary disease; CAD = coronary artery disease; CHF = congestive heart failure; PVD = peripheral vascular disease; DNR = do not resuscitate; DNI = do not intubate; EHR = electronic health record; ED = emergency department.
[a]The sample included 841 decedents whose deaths were attributed to traumatic injury, who had documentation of one or more chronic illnesses in the 24 months prior to injury and also in the 24 months prior to death, who were at least 18 years old at the time of death, whose death certificates specified the injury date, who died within 730 days of injury, and who, at the time of injury, were attributed to Harborview Medical Center, University of Washington Medical Center, the Seattle Cancer Care Alliance, or University of Washington Neighborhood Clinics.
[b]The number of cases with valid data on the characteristic indicated in the row.
[c]Except where otherwise noted, the numbers in the cells indicate the number of decedents in the sample or subsample with the characteristic and (in parentheses) the percentage of the "valid *n*".
[d]The mixed race/ethnicity group includes decedents with multiple races, as well as Hispanic decedents with non-white race.
[e]This variable is based on patients whose injuries occurred from 2012 onwards. Specific data on surgeries before 2012 were rarely recorded.
[f]The percentages are based on patients who died at either Harborview Medical Center or University of Washington Medical Center.

### *Variables Characterizing the Sample*

Information describing the sample included all variables used as predictors of the primary outcome. In addition, we provided descriptive information about patients' specific racial/ethnic categories and places of death (from the death certificate), specific diagnoses at the time of injury, elapsed time between injury and death, number of surgeries between injury and death, and—for patients who died in the two UW Medicine hospitals—code status and comfort care orders in place at the time of death (from the EHR).

### *Analysis*

We used identical analytic procedures for each of the two outcomes of interest. We first ran separate probit regression models for each predictor, estimated with weighted mean- and variance-adjusted least squares, with the binary absence-of-ACP outcome regressed on the predictor. To test for independent

associations between the predictors and outcome, we then ran a multipredictor probit regression model, including all predictors that had a *P*-value ≤ 0.200 in the bivariate models but excluding predictors that showed high multicollinearity (tolerance < 0.300). *P*-values for the omnibus tests for unordered categorical variables (marital status, insurance, and facility) were based on Wald's test of parameter constraints. Descriptive statistics were calculated using SPSS version 19, and regression analyses were performed using Mplus version 8.2.

## Results

### *Sample Description*

Eight hundred and forty-one decedents met inclusion criteria for the study: 66% were male, and their mean age at injury was 63 years (Table 1). Thirty-seven percent were insured by Medicaid, 28% by Medicare, and 23% by private insurance. The mean number of chronic illness diagnoses at injury was 1.7: 58% with one diagnosis, 22% with two, and 19% with three or more.

Twenty-two percent of all decedents had EHR documentation of ACP prior to injury, including 1% who had additional ACP documents uploaded to the EHR after injury (Table 2). When stratified by age, 14% of those younger than 65 years and 37% of those aged 65 years or older had ACP documents in place at time of death. Three percent of the full sample had ACP documents uploaded to the EHR only after injury. More than three-quarters had no ACP documents uploaded to the EHR during either time period.

### *Association of Predictors with Absence of ACP Documents at Injury*

In unadjusted models, 11 predictors were significantly associated with the absence of ACP documents at time of injury (Table 3). In multipredictor analyses, patients who were less likely to have ACP documents at time of injury included those who died at a younger age ($P < 0.001$), had fewer chronic illness diagnoses ($P = 0.003$), or had fewer outpatient visits ($P = 0.004$) or fewer nonsurgical hospitalizations prior to injury ($P = 0.049$) (Table 3). Results stratified by individual chronic conditions were similar and are in the electronic supplement (Appendix).

### *Association of predictors with absence of ACP documents at death among those without ACP documents before injury*

In unadjusted analyses of patients without ACP documents before injury, five predictors were associated with absence of ACP documents in the EHR at time of death (Table 4). In multipredictor analyses, only one of these variables had an independent association with the outcome: patients with fewer nonsurgical hospitalizations after injury were less likely to have completed ACP documents by the time of death ($P = 0.015$).

## Discussion

This study examined predictors of ACP documentation among decedents with chronic illness who died of traumatic injury and received care in a large academic health system between 2010 and 2015. Less than 25%

*Table 2*
**ACP Documentation Before and After Injury**[a]

| | All Decedents | | | Decedents With No ACP at Injury | | |
|---|---|---|---|---|---|---|
| | Before Injury | | | Before Injury | | |
| Age Group | No ACP | ACP | Total | No ACP | ACP | Total |
| All ages | | | | | | |
| After injury | | | | | | |
| No ACP | 632 (75.1) | 173 (20.6) | 805 (95.7) | 632 (96.2) | 0 (0.0) | 632 (96.2) |
| ACP | 25 (3.0) | 11 (1.3) | 36 (4.3) | 25 (3.8) | 0 (0.0) | 25 (3.8) |
| Total | 657 (78.1) | 184 (21.9) | 841 (100.0) | 657 (100.0) | 0 (0.0) | 657 (100.0) |
| Age <65 years[b] | | | | | | |
| After injury | | | | | | |
| No ACP | 384 (86.1) | 58 (13.0) | 442 (99.1) | 384 (99.2) | 0 (0.0) | 384 (99.2) |
| ACP | 3 (0.7) | 1 (0.2) | 4 (0.9) | 3 (0.8) | 0 (0.0) | 3 (0.8) |
| Total | 387 (86.8) | 59 (13.2) | 446 (100.0) | 387 (100.0) | 0 (0.0) | 387 (100.0) |
| Age 65+ years[b] | | | | | | |
| After injury | | | | | | |
| No ACP | 248 (62.8) | 115 (29.1) | 363 (91.9) | 248 (91.9) | 0 (0.0) | 248 (91.9) |
| ACP | 22 (5.6) | 10 (2.5) | 32 (8.1) | 22 (8.1) | 0 (0.0) | 22 (8.1) |
| Total | 270 (68.4) | 125 (31.6) | 395 (100.0) | 270 (100.0) | 0 (0.0) | 270 (100.0) |

ACP = advance care planning.
[a]Each cell shows the number of cases and percentage of the age category with ACP documentation at each time point.
[b]For all decedents, the age categories represent age at injury. For decedents with no ACP at injury, the age categories represent age at death.

*Table 3*
**Associations of Predictors With Absence of Advance Care Planning Documents at the Time of Injury[a]**

| | Single-Predictor Models | | | MultiPredictor Model | | |
|---|---|---|---|---|---|---|
| Predictor | Valid n[b] | b | *P* | Valid n[b] | b | *P* |
| Female | 841 | 0.002 | 0.983 | | | |
| Racial/ethnic minority | 841 | 0.244 | 0.054 | 788 | 0.206 | 0.209 |
| Age at injury | 841 | −0.021 | **<0.001** | | −0.020 | **<0.001** |
| Level of education at death | 790 | −0.080 | **0.005** | | −0.045 | 0.177 |
| Marital status at death[c] | 812 | | **0.016** | | | 0.501 |
| Never married | | 0.000 | | | 0.000 | |
| Married | | −0.376 | | | 0.219 | |
| Previously married | | −0.303 | | | 0.138 | |
| Health insurance at time of injury[c] | 841 | | **0.001** | | | 0.858 |
| Private insurance | | 0.000 | | | 0.000 | |
| Medicare | | 0.006 | | | 0.105 | |
| Medicaid | | 0.458 | | | 0.143 | |
| Military insurance | | 0.199 | | | 0.267 | |
| Other insurance type | | 0.657 | | | 0.273 | |
| Uninsured | | 0.273 | | | 0.266 | |
| Number of Dartmouth Atlas diagnoses at injury | 841 | −0.246 | **<0.001** | | −0.159 | **0.003** |
| Health-care utilization in year before injury | 841 | | | | | |
| Number of unduplicated outpatient providers[d,e] | | −0.048 | **0.001** | | | |
| Number of outpatient visits | | −0.016 | **<0.001** | | −0.018 | **0.004** |
| Number of ED visits | | 0.011 | 0.428 | | | |
| Number of inpatient stays[e,f] | | −0.100 | **<0.001** | | | |
| Number of nonsurgical inpatient stays | | −0.062 | **0.020** | | −0.077 | **0.049** |
| Number of surgical inpatient stays | | −0.410 | **<0.001** | | −0.227 | 0.058 |
| Facility providing care prior to injury[c] | | | **0.025** | | | |
| Harborview (inpatient) | | 0.000 | | | 0.000 | 0.424 |
| University of Washington Medical Center (inpatient) | | 0.341 | | | 0.072 | |
| Seattle Cancer Care Alliance | | 0.146 | | | 0.285 | |
| UW Medicine Neighborhood clinics | | 0.703 | | | 0.566 | |
| Harborview (outpatient) | | 0.323 | | | 0.172 | |
| University of Washington Medical Center (outpatient) | | 0.055 | | | −0.019 | |

ACP = advance care planning; ED = emergency department.
*P*-values ≤ 0.05 are indicated in bold.
[a]Results were based on probit regression models estimated with weighted least squares with mean and variance adjustment (WLSMV).
[b]The number of cases with data for the predictor.
[c]The *P*-value shown is for the omnibus test, based on Wald's test of parameter constraints.
[d]The number of outpatient providers was not used as a predictor in the multipredictor model because of high collinearity with the number of outpatient visits (tolerance = 0.188 with all potential predictors included).
[e]With the final set of predictors in the multipredictor model all tolerances were 0.429 or higher.
[f]The total number of inpatient stays was not used as a predictor in the multipredictor model because of high collinearity with the number of nonsurgical inpatient stays (tolerance = 0.075 with all potential predictors except nonsurgical inpatient stays in model).

of decedents had ACP documentation by the time of death, despite all having at least one underlying chronic, life-limiting illness. Prior studies of patients who died of traumatic injury have demonstrated similar rates of ACP documentation, ranging from 15% to 23%.[12,13,17] However, the rate among our patients with traumatic injury contrasts sharply with the 63% to 67% ACP completion rates reported by other researchers for patients with chronic diseases but without traumatic injury[7,18] and is also substantially lower than 36% completion rates we identified in the EHR for patients with chronic, life-limiting illness but without trauma (unpublished data). Given the increasing age of the U.S. population and resulting rising incidence of geriatric trauma and trauma in patients with multimorbidity,[19,20] our findings suggest an important opportunity for promoting ACP.

Our results are consistent with prior studies that report associations of age and comorbidity with the presence of preadmission advance directives in trauma patients.[8] Additionally, we found that patients with more nonsurgical hospitalizations, both before and after injury, were more likely to have ACP documentation; this may reflect increased severity of illness, increased opportunities to address ACP in the context of an illness requiring hospitalization, or increased engagement with the health system. Although completing ACP documentation with patients after injury may not be possible as a result of patients' inability to participate in ACP, the extremely low prevalence of postinjury ACP documentation highlights important opportunities for improvement in implementing ACP and palliative care services for patients experiencing trauma. Previous studies have found that inpatient palliative care is associated with less intense end-of-life care among older trauma patients.[21] The provision of ACP and palliative care services at the time of injury to facilitate

*Table 4*
**Association of Predictors With Absence of Advance Care Planning Documents at Death Among Those Without Advance Care Planning Before Injury**[a]

| | Single-Predictor Models | | | Multipredictor Model | | |
|---|---|---|---|---|---|---|
| Predictor | Valid n[b] | b | *P* | Valid n[b] | b | *P* |
| Female | 657 | 0.122 | 0.535 | | | |
| Racial/ethnic minority | 657 | 0.043 | 0.847 | | | |
| Age at death | 657 | −0.026 | **0.002** | 632 | −0.016 | 0.171 |
| Level of education at death | 616 | −0.055 | 0.208 | | | |
| Marital status at death[c] | 632 | | 0.066 | | | 0.849 |
| Never married | | 0.000 | | | 0.000 | |
| Married | | −0.709 | | | −0.251 | |
| Previously married | | −0.586 | | | −0.294 | |
| Health insurance at death[c] | 657 | | 0.596 | | | |
| Private insurance | | 0.000 | | | | |
| Medicare | | −0.112 | | | | |
| Medicaid | | 0.300 | | | | |
| Military insurance | | 0.001 | | | | |
| Other insurance type | | 0.001 | | | | |
| Uninsured | | 0.001 | | | | |
| Number of Dartmouth Atlas diagnoses at death | 657 | −0.130 | 0.196 | | −0.066 | 0.668 |
| Weeks between injury and death | 657 | −0.042 | <**0.001** | | −0.016 | 0.287 |
| Health-care utilization between injury and death | 657 | | | | | |
| Number of unduplicated outpatient providers[d] | | −0.635 | <**0.001** | | | |
| Number of outpatient visits | | −0.265 | <**0.001** | | −0.115 | 0.127 |
| Number of ED visits | | 0.033 | 0.941 | | | |
| Number of inpatient stays[e] | | | | | | |
| Number of nonsurgical inpatient stays | | −0.743 | <**0.001** | | −0.506 | **0.016** |
| Number of surgical inpatient stays[e] | | | | | | |
| Facility providing care at death[c] | 657 | | 0.108 | | | 0.904 |
| Harborview (inpatient) | | 0.000 | | | 0.000 | |
| University of Washington Medical Center (inpatient) | | 0.002 | | | 0.003 | |
| Seattle Cancer Care Alliance | | 0.002 | | | 0.004 | |
| UW Medicine Neighborhood clinics | | 0.497 | | | 0.222 | |
| Harborview (outpatient) | | 0.404 | | | 0.134 | |
| University of Washington Medical Center (outpatient) | | 0.984 | | | 0.569 | |

ED = emergency department.
*P*-values ≤ 0.05 are indicated in bold.
[a]Results were based on probit regression models estimated with weighted least squares with mean and variance adjustment (WLSMV).
[b]The number of cases with data for the predictor.
[c]The *P*-value shown is for the omnibus test, based on Wald's test of parameter constraints.
[d]This variable was not included in the multipredictor model because of high collinearity with number of outpatient visits (tolerance = 0.256 with all the potential predictors taken into account). With the final set of predictors, all tolerances were 0.484 or higher.
[e]There were no surgical inpatient stays between injury and death, making the number of nonsurgical inpatient stays identical to the total number of inpatient stays. Only the number of nonsurgical inpatient stays was used as a predictor in the bivariate and multipredictor models.

goal-concordant decisions may play an important role in ensuring that trauma patients receive the care they desire.

This study has several important limitations. First, the decedents were drawn from one health-care system in one geographical region that has made efforts to increase ACP completion, and our findings may not be generalized to other areas. Second, we did not evaluate the content or quality (completeness, timeliness, and accuracy) of ACP, only its presence or absence in the medical record. Third, we may have slightly undercounted the number of patients who had ACP documents, owing to exclusive reliance on electronic queries of the EHR for a substantial proportion of the sample. Detection was based exclusively on electronic queries for about 74% of the patients. For the remaining 26%, evaluation was carried out with both electronic queries and manual abstraction, with the two methods producing virtually identical results. However, an independent study evaluating a large random sample of patients (most of whom had not experienced traumatic injury) suggests that our electronic queries may miss about 4% of patients for whom manual abstraction detects ACP documents. Fourth, our focus on patients with a specific set of chronic illnesses may reduce generalizability of these results to populations with other illnesses or to those without chronic illness. Finally, the results were based on observational data, and causal relationships cannot be determined.

In conclusion, among patients with chronic life-limiting illness who died of traumatic injury, we found that patients who were less likely to have ACP documentation at time of traumatic injury included those who were younger, had fewer chronic illness diagnoses, or had fewer hospitalizations prior to injury.

Among those without ACP documents at time of injury, patients were less likely to complete ACP documents after injury if they had fewer hospitalizations between injury and death. Our findings highlight the importance of promoting ACP among patients with chronic life-limiting illness to increase the likelihood of goal-concordant care in the event of serious traumatic injury and the opportunity to incorporate ACP among trauma survivors with life-limiting illness.

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Conflicts of Interest: The authors all attest that they have no potential conflicts of interest.

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## *References*

1. Wutzler S, Maegele M, Marzi I, et al. Association of preexisting medical conditions with in-hospital mortality in multiple-trauma patients. J Am Coll Surg 2009;209:75–81.

2. Bergeron E, Lavoie A, Moore L, Clas D, Rossignol M. Comorbidity and age are both independent predictors of length of hospitalization in trauma patients. Can J Surg 2005;48:361–366.

3. Niven DJ, Kirkpatrick AW, Ball CG, Laupland KB. Effect of comorbid illness on the long-term outcome of adults suffering major traumatic injury: a population-based cohort study. Am J Surg 2012;204:151–156.

4. Mosenthal AC, Murphy PA, Barker LK, Lavery R, Retano A, Livingston DH. Changing the culture around end-of-life care in the trauma intensive care unit. J Trauma 2008;64:1587–1593.

5. Cooper Z. Palliative care and the trauma patient. J Hosp Palliat Nurs 2008;10:262–264.

6. Detering KM, Hancock AD, Reade MC, Silvester W. The impact of advance care planning on end of life care in elderly patients: randomised controlled trial. BMJ 2010; 340:c1345.

7. Silveira MJ, Kim SY, Langa KM. Advance directives and outcomes of surrogate decision making before death. New Engl J Med 2010;362:1211–1218.

8. Jawa RS, Shapiro MJ, McCormack JE, Huang EC, Rutigliano DN, Vosswinkel JA. Preadmission Do Not Resuscitate advanced directive is associated with adverse outcomes following acute traumatic injury. Am J Surg 2015;210: 814–821.

9. Salottolo K, Offner PJ, Orlando A, et al. The epidemiology of do-not-resuscitate orders in patients with trauma: a community level one trauma center observational experience. Scand J Trauma Resusc Emerg Med 2015;23:9.

10. Nathens AB, Rivara FP, Wang J, Mackenzie EJ, Jurkovich GJ. Variation in the rates of do not resuscitate orders after major trauma and the impact of intensive care unit environment. J Trauma 2008;64:81–88; discussion 8-91.

11. Cooper Z, Rivara FP, Wang J, MacKenzie EJ, Jurkovich GJ. Withdrawal of life-sustaining therapy in injured patients: variations between trauma centers and nontrauma centers. J Trauma 2009;66:1327–1335.

12. Watch LS, Saxton-Daniels S, Schermer CR. Who has life-sustaining therapy withdrawn after injury? J Trauma 2005;59: 1320–1326; discussion 6-7.

13. Sise MJ, Sise CB, Thorndike JF, Kahl JE, Calvo RY, Shackford SR. Withdrawal of care: a 10-year perspective at a Level I trauma center. J Trauma Acute Care Surg 2012; 72:1186–1193.

14. Fingerhut LA, Warner M. The ICD-10 injury mortality diagnosis matrix. Inj Prev 2006;12:24–29.

15. Dartmouth Atlas of Health Care. 2018. Available from http://www.dartmouthatlas.org/keyissues/issue.aspx?con=2944.

16. Iezzoni LI, Heeren T, Foley SM, Daley J, Hughes J, Coffman GA. Chronic conditions and risk of in-hospital death. Health Serv Res 1994;29:435–460.

17. Franklin GA, Cannon RW, Smith JW, Harbrecht BG, Miller FB, Richardson JD. Impact of withdrawal of care and futile care on trauma mortality. Surgery 2011;150: 854–860.

18. Alano GJ, Pekmezaris R, Tai JY, et al. Factors influencing older adults to complete advance directives. Palliat Support Care 2010;8:267–275.

19. Adams SD, Holcomb JB. Geriatric trauma. Curr Opin Crit Care 2015;21:520–526.

20. Davie G, Samaranayaka A, Derrett S. The role of preexisting comorbidity on the rate of recovery following injury: a longitudinal cohort study. PloS One 2018;13:e0193019.

21. Lilley EJ, Lee KC, Scott JW, et al. The impact of inpatient palliative care on end-of-life care among older trauma patients who die after hospital discharge. J Trauma Acute Care Surg 2018;85:992–998.

*Appendix*

**Predictors of Having No ACP in Place at Time of Injury—Multipredictor Models, Within Diagnosis Groups**[a]

| | Diagnosis Groups | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Age Group | Cancer ($n = 90$) | COPD ($n = 317$) | CAD ($n = 260$) | CHF ($n = 211$) | PVD ($n = 94$) | Liver Disease ($n = 109$) | Diabetes ($n = 93$) | Renal Disease ($n = 161$) | Dementia ($n = 105$) |
| Female | | | **0.037** | | | | | | |
| Racial/ethnic minority | | 0.207 | | | | 0.148 | | | |
| Age at injury | | **<0.001** | **<0.001** | **<0.001** | **0.038** | 0.074 | 0.065 | **0.029** | **0.012** |
| Health insurance | 0.803 | 0.723 | | | | 0.345 | | | |
| # Diagnoses | 0.330 | 0.307 | **0.020** | 0.138 | 0.088 | 0.332 | 0.091 | 0.231 | **0.049** |
| OP providers in past year | 0.587 | 0.074 | 0.825 | 0.765 | 0.979 | 0.317 | 0.117 | 0.478 | 0.854 |
| OP visits in past year | 0.079 | 0.314 | 0.157 | 0.528 | 0.207 | | 0.151 | 0.561 | 0.603 |
| ED visits in past year | | 0.584 | | 0.183 | | | 0.128 | | |
| Inpatient stays in past year | 0.358 | | | | | | 0.870 | | 0.091 |
| Facility providing care | | 0.490 | | | | | | 0.479 | |

ACP = advance care planning; COPD = chronic obstructive pulmonary disease; CAD = coronary artery disease; CHF = congestive heart failure; PVD = peripheral vascular disease; OP = outpatient; ED = emergency department.
*P*-values ≤ 0.05 are indicated in bold.
[a]Value in cell indicates the *P*-value for the row variable in multipredictor model of absence of ACP at time of injury. Cell is shaded if the row variable had $P > 0.20$ in the bivariate model and was not included in the multipredictor model.

## *Summary*

- There were no predictors with $P < 0.05$ in the multipredictor models for the cancer, liver disease, and diabetes groups.
- In all the other diagnosis groups, age at injury was a statistically significant predictor.
- Gender had $P < 0.05$ only among patients diagnosed with coronary artery disease.
- Number of diagnoses had $P < 0.05$ only among patients diagnosed with coronary artery disease or dementia.
- None of the other predictors had $P < 0.05$ when adjusted for other variables that had $P < 0.20$ in bivariate models.