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Hospice and palliative care utilization in 16 004 232 medicare claims: comparing trauma to surgical and medical inpatients

Samir M Fakhry ,[1] Matthew M Carrick,[2] Melissa Red Hoffman,[3] Yan Shen,[1] Jeneva M Garland ,[1] Ransom J Wyse,[1] Dorraine D Watts[1]

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[1]Center for Trauma and Acute Care Surgery Research, Clinical Services Group, HCA Healthcare Inc, Nashville, Tennessee, USA
[2]Department of Surgery, Medical City Healthcare, Plano, Texas, USA
[3]Department of Surgery, Mission Hospitals, Asheville, North Carolina, USA

Correspondence to
Dr Samir M Fakhry; samfak7@gmail.com

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ABSTRACT

Background Hospice and palliative care (PC) utilization is increasing in geriatric inpatients, but limited research exists comparing rates among trauma, surgical and medical specialties. The goal of this study was to determine whether there are differences among these three groups in rates of hospice and PC utilization.

Methods Patients from Centers for Medicare & Medicaid Services (CMS) Inpatient Standard Analytical Files for 2016–2020 aged ≥65 years were analyzed. Patients with a National Trauma Data Standard-qualifying ICD-10 injury code with abbreviated injury score ≥2 were classified as 'trauma'; the rest as 'surgical' or 'medical' using CMS MS-DRG definitions. Patients were classified as having PC if they had an ICD-10 diagnosis code for PC (Z51.5) and as hospice discharge (HD) if their hospital disposition was 'hospice' (home or inpatient). Use proportions for specialties were compared by group and by subgroups with increasing risk of poor outcome.

Results There were 16M hospitalizations from 1024 hospitals (9.3% trauma, 26.3% surgical and 64.4% medical) with 53.7% women, 84.5% white and 38.7% >80 years. Overall, 6.2% received PC and 4.1% a HD. Both rates were higher in trauma patients (HD: 3.6%, PC: 6.3%) versus surgical patients (HD: 1.5%, PC: 3.0%), but lower than in medical patients (HD: 5.2%, PC: 7.5%). PC rates increased in higher risk patient subgroups and were highest for inpatient HD.

Conclusions In this large study of Medicare patients, HD and PC rates varied significantly among specialties. Trauma patients had higher HD and PC utilization rates than surgical, but lower than medical. The presence of comorbidities, frailty and/or severe traumatic brain injury (in addition to advanced age) may be valuable criteria in selection of trauma patients for hospice and PC services. Further studies are needed to inform the most efficient use of hospice and PC resources, with particular focus on both timing and selection of subgroups most likely to benefit from these valuable yet limited resources.

Level of evidence Level III, therapeutic/care management.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The utilization of both hospice and palliative care services continues to rise and the number of palliative care teams in acute care facilities is increasing, yet a defined appropriate rate of hospice and palliative care utilization in geriatric inpatients that results in optimal care for patients has yet to be determined.

WHAT THIS STUDY ADDS

⇒ This study found that Medicare-age trauma patients had higher hospice and palliative care utilization than surgical patients, but lower than medical patients. In trauma patients, comorbidities, frailty and severe brain injuries were associated with higher utilization.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ With hospice and palliative care use on the rise, this study provides detailed knowledge of how and where these scarce resources are applied, which may support future effective utilization and promote their long-term sustainability.

BACKGROUND

Hospice and palliative care (PC) utilization has numerous documented benefits that lead to lower costs, decreased hospital length of stay (LOS), fewer in-hospital deaths and improved physical and psychological outcomes for both patients and grieving friends and family.[1] Palliative medicine is interdisciplinary care focused on improving the quality of life for patients and their families who are confronting serious illnesses. The intent is to appropriately manage symptoms, while simultaneously tending to associated physical, psychosocial and spiritual aspects of coping with the illness.[2] Hospice care is reserved specifically for patients who have 6 months or less to live and who are no longer able to, or interested in, pursuing disease-modifying treatments. Hospice focuses on the comfort and quality of life of the patient instead of a cure for the illness.[3]

The utilization of both hospice and PC services continues to rise and the number of PC teams in acute care facilities is increasing.[4] As of 2019, 72% of hospitals with 50 or more beds have a PC team.[5] Additionally, over the past two decades, Medicare reported an increase in hospice utilization from 10% to 50% in Medicare decedents.[6] In 2019, at the time of death among all Medicare decedents, 51.6% were enrolled in hospice, which is 3% higher than in 2015. Furthermore, Medicare Advantage hospice patients have also increased from 47.6% in 2015 to 50.7% in 2019.[7] With geriatric patients being the largest consumers of these services, identifying the specifics of this utilization is critical to our understanding of quality, end-of-life care in this population.

A defined appropriate rate of hospice and PC utilization in geriatric inpatients that results in optimal care for patients has yet to be determined. While the use of these services continues to increase, one study reported that "*Underutilization has been associated with primary care physicians' reluctance to make referrals, misunderstanding among physicians regarding what constitutes palliative care and hospice, lack of training, lack of knowledge of advance directives, and a fear that suggesting palliative care could cause distress and loss of hope*".[8] Aside from individual physician practice, few patients, even those with similar diagnoses, present with the same symptom burden and treatment needs, meaning that no one rate of hospice or PC utilization would reasonably apply to all patients. Consequently, it is important as an initial assessment to understand the variation across admission specialties, which may serve as general grouping categories.

The goal of this study was to determine whether there are differences among trauma, surgical and medical patients in utilization rates of hospice discharge (HD) and PC services in a large, near-population-based sample.

METHODS

Study design, data sources and study sample

This investigation was a retrospective, descriptive design employing publicly accessible records from the 2016 to 2020 Centers for Medicare & Medicaid Services (CMS) Medicare Limited Data Set Inpatient Standard Analytical Files (IPSAF).[9] The data from the IPSAF files come from Medicare fee-for-service, inpatient admission claims only; they do not encompass any information for patients in a Medicare Advantage program. Because the data from the IPSAF files are based on claims and not individual patients, it is possible for multiple claims to represent the same hospitalization. Data cleaning is, therefore, required in order to derive a set of unique hospitalizations. This was accomplished by analyzing a cross-index of the patient identifier, admission date and Medicare certification number. In this way, multiple claims for the same hospitalization were detected and either combined or removed if they were a duplicate (ie, interim claims and a final claim for the same hospitalization event). This cleaning guaranteed each record within the file represented only one distinct inpatient admission hospitalization.

The descriptive information for individual facilities was obtained by using the 2019 CMS Provider of Services (POS) files and the 2019 Medicare Open Payments List of Teaching Hospitals (OPLTH) files and then matching them to individual IPSAF hospitalizations. Information about adult trauma center designation/verification level was acquired from the American College of Surgeons Committee on Trauma (ACS-COT) database of verified trauma centers[10] and the American Trauma Society Trauma Information Exchange Program that contains information on the state designation level for trauma centers.[11] In addition, the Annual Survey of the American Hospital Association data file was employed as a guide for hospital-level institutional matching and was supplemented with fuzzy-string matching.[12] A complete description of the hospital matching process can be found in previous publications on the subject.[13]

Once the individual hospitalizations were identified and the institutional information connected to each, hospitalizations were assessed for meeting inclusion and exclusion standards for the study. An inpatient hospitalization was included if it: (1) was a patient aged ≥65 years (geriatric); (2) occurred at a US short-term, non-federal hospital; (3) had at least one diagnosis-related group (DRG) recorded; (4) came from an institution with a level I, II or III trauma center designation and (5) had an LOS ≥2 days. Per inclusion criteria, analysis was limited to institutions with designated/verified trauma centers to minimize any bias inherent in the qualitative or quantitative difference in care at a non-trauma center, and to ensure the institution had a dedicated trauma service overseeing the care of trauma patients.

Variable definitions

Patients were classified into one of three groups: trauma, surgical or medical. Since trauma is not a specific DRG category, trauma patients were identified first. A patient met inclusion criteria as 'trauma' if they had either: (1) an International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) diagnosis code for which an abbreviated injury score (AIS) could be calculated; or (2) had at least one ICD-10-CM diagnosis code for injury (trauma) as defined by the 2020 National Trauma Data Standard (NTDS) (S00-99 with a seventh digit for an initial encounter of A, B or C, or T07, T14, T20–T28, T30–T32, or T79.1A1-T79.A9 with a seventh digit of A only).[14] Patients were then removed if they met any of the following exclusion criteria: (1) they only had trauma codes for superficial injury per NTDS definition; (2) they had any burn injury; (3) they had any trauma diagnosis code or external cause code (e-code) indicating the hospitalization was a subsequent encounter for a previous injury or due to sequelae of a previous injury or (4) they only had injuries with AIS=1. Patients meeting the aforementioned inclusion/exclusion criteria comprised the 'trauma' group. The remaining non-trauma patients were classified as either 'surgical' or 'medical' using their primary DRG as the basis for group assignment.

The primary outcomes of interest for the study were *Hospice Utilization Rate* and *Palliative Care Utilization Rate* by specialty group. A patient was classified as having received PC if they had an ICD-10-CM CMS diagnosis code for a PC encounter (Z51.5). The *Palliative Care Utilization Rate* was simply the proportion of patients, overall and by specialty groups, recorded as having received PC. A patient was classified as a 'HD' by using the CMS discharge disposition, with hospice patients further classified as either 'home HD' or 'inpatient HD'. The *Hospice Utilization Rate* was the proportion of patients discharged to hospice (ie, inpatient or home hospice). The discharge status of the remaining (non-hospice) patients was classified as: expired (ie, in-hospital death), rehab facility, nursing facility, transfer-out, home, or other discharge.

Trauma center levels were assigned based on the higher of the state designation level or ACS verification level held by the center over the study period. Hospital sizes were based on Medicare-certified bed counts and were classified as small (<100 beds), medium (100–300 beds) or large (>300 beds). An institution was designated as a 'teaching hospital' if they were listed in the CMS OPLTH directory as a teaching facility. The type of institutional ownership categories were 'private, non-profit', 'private, for profit', or 'other' based on the POS files using the designations provided by CMS.[9] The institutional settings were 'urban' or 'rural' based on the core-based statistical area as used in the CMS POS files.[9]

Injury severity scores (ISS) were computed via the Association for the Advancement of Automotive Medicine (AAAM) ICD-10-CM to AIS crosswalk.[15] The AAAM ICD-AIS crosswalk has well-documented reliability and validity and uses a standardized algorithm to convert ICD-10-CM diagnosis codes to AIS codes and then calculates the ISS based on these codes.[16]

Patient-level characteristics (age, gender, race) and hospital LOS were used as defined by CMS and recorded in the IPSAF file. Comorbidity disease burden was measured based on ICD-10-CM diagnosis codes for the calculation of the van Walraven-weighted version of the Elixhauser comorbidity measure,[17] using the '*comorbidity*' package in R.[18] Frailty index was calculated using a weighted summary of the scores assigned by experts to 109 ICD-10-CM diagnosis codes.[19] A patient was considered to have ventilator use if they had an ICD-10 Procedure Coding System (ICD-10-PCS) code of 5A1935Z, 5A1945Z or 5A1955Z during the hospitalization. Intensive care unit (ICU) LOS and ICU usage were computed via CMS ICU-related revenue codes. The number of days a patient was in the ICU was noted for each revenue code, and the total number of days was added to obtain the total ICU LOS. The associated CMS reimbursement was reported using the actual recorded CMS payment for the hospitalization in US dollars (not the billed amount).

Statistical analyses

Summary statistics were computed to compare hospital characteristics, patient characteristics and outcomes by specialty group and overall using Pearson χ^2 tests of association for categorical variables and Wilcoxon Rank Sum tests for continuous variables. Since the CMS IPSAF data sample was exceptionally large, alpha was lowered to compensate and only p values less than 0.001 were considered statistically significant. Therefore, careful interpretation of the clinical importance of the absolute value of all noted differences is recommended. For trauma patients specifically, dominance analysis was performed to determine the average contribution (McFadden's R^2) for covariates adjusted in multivariable logistic regression models: age group, sex, race, Elixhauser score, frailty index, ISS, injury type, mechanism of injury, AIS head ≥3, AIS chest ≥3, AIS abdomen ≥3.[20] R software V.4.2.1 was used for all analyses.[18]

Institutional review board

Prior to the start of data analysis, this study received a formal determination of exemption from Institutional Review Board oversight in accordance with current federal regulations and institutional policy. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were utilized in the reporting of this research (online supplemental digital content 1; STROBE Statement).[21]

RESULTS

Sample

In total, the IPSAF file for 2016–2020 encompassed 53 832 677 claims. Duplicate claims were removed (n=1 129 407), as were cases not meeting initial inclusion criteria (not a US short term, non-federal hospitalization=5 956 170), <65 years=8 956 740, no DRG=70), which yielded 37 790 290 unique hospitalizations. Patients were then selected for inclusion if the institution where they received care had a level I, II or III trauma center designation (n=19 501 622) and their hospital LOS was ≥2 days (n=16 532 775). There were 2 024 273 patients with at least one trauma diagnosis code. After removing those who met the exclusion criteria (superficial injury=2 08 421, burn injury=17 743, subsequent encounter/sequelae injury codes=31 028), and those with only AIS=1 injuries (1 767 081), there were 1 495 730 hospitalizations in the trauma group. The remaining 14 508 502 patients for the final analysis who were not trauma included 10 299 259 medical and 4 209 243 surgical, which brought the total study sample to 16 004 232 patients (figure 1).

Sample characteristics

There were 1024 facilities represented in the final sample, with the ownership being mostly private, non-profit (51.2%), with private, for-profit (14.7%) and other (34.1%) making up the remainder. Most had over 300 beds (52.8%), were teaching institutions (58.6%) and were in an urban setting (83.7%). There were 236 level I (23.0%), 333 level II (32.5%) and 455 level III (44.4%) trauma centers (online supplemental digital content 2: Facility Characteristics).

Overall, the patients were evenly distributed by age group (65–69 years: 21.5%; 70–74: 20.9%; 75–79: 18.8%; 80–84: 16.1%; ≥85: 22.6%). Trauma patients had the largest proportion of those aged >85 (35.4%) compared with surgical (11.9%) and medical (25.2%), and also had the highest proportion of women (trauma: 61.7%; surgical: 49.6%; medical: 54.3%) and white race (trauma: 90.1%; surgical: 82.9%; medical: 86.5%). Despite this, the medical group had the highest comorbidity index (13.1), whereas trauma (9.3) and surgical (9.2) were similar. Although there were more level III trauma centers in the sample, they had the smallest proportion of hospitalizations (27.4%) compared with level I (34.6%) and Level II (38.1%) trauma centers (table 1).

Patient outcomes

The mean hospital LOS was 5.8 days (SD 5.9), with surgical patients having the longest mean stay of 6.7 days (SD 7.4), followed by trauma with 6.2 days (SD 6.6) and medical with 5.3 days (SD 5.0). The surgical specialty also had the largest proportions of patients with a hospital LOS ≥8 days (surgical: 26.9%; trauma: 21.4%; medical: 17.9%), an ICU stay (surgical: 30.9%; trauma: 29.3%; medical: 26.2%) and an ICU LOS ≥6 days (surgical: 31.4%; trauma: 28.0%; medical: 22.6%). Surgical patients also had the highest proportion of patients discharged to home (surgical: 65.8%; trauma: 25.1%; medical: 60.6%). The medical specialty utilized hospice the most, with 5.2% of their patients discharged to hospice (home hospice: 2.8%; inpatient hospice: 2.5%), followed by trauma (3.6%) and surgical (1.5%). Overall, 4.1% of the sample was discharged to hospice and 3.5% expired in the hospital (table 2).

Palliative care utilization

Over the 5-year study period from 2016 to 2020, utilization of PC services increased gradually until the COVID-19 pandemic, when a spike of PC utilization was observed in the second quarter of 2020. Similar trends were observed for expired disposition and hospice utilization (figure 2).

The number and proportion of patients receiving PC services by specialty group and overall appear in table 3. Overall, 6.2% of the patients received PC, and PC utilization generally increased with increasing severity of the patient's condition (any ICU: 9.4%; ICU LOS ≥5 days: 12.8%; ventilator use: 24.5%; discharge to home hospice: 55.5%, discharge to inpatient hospice: 63.8%; expired: 55.0%). When comparing the specialty groups, a smaller proportion of surgical patients received PC (3.0%) than either medical (7.5%) or trauma (6.3%) (both comparisons: p<0.001). This pattern persisted even with increasing severity of the patient's condition, with surgical patients having the lowest proportion of PC utilization regardless of the comparison group (table 3; all comparisons p<0.001). In addition, the difference between Trauma and Medical was small for most sub-groups (<1.3%), and though the differences were statistically significant due to the large sample size, their clinical meaningfulness is unclear. Similar to PC utilization, hospice utilization increased

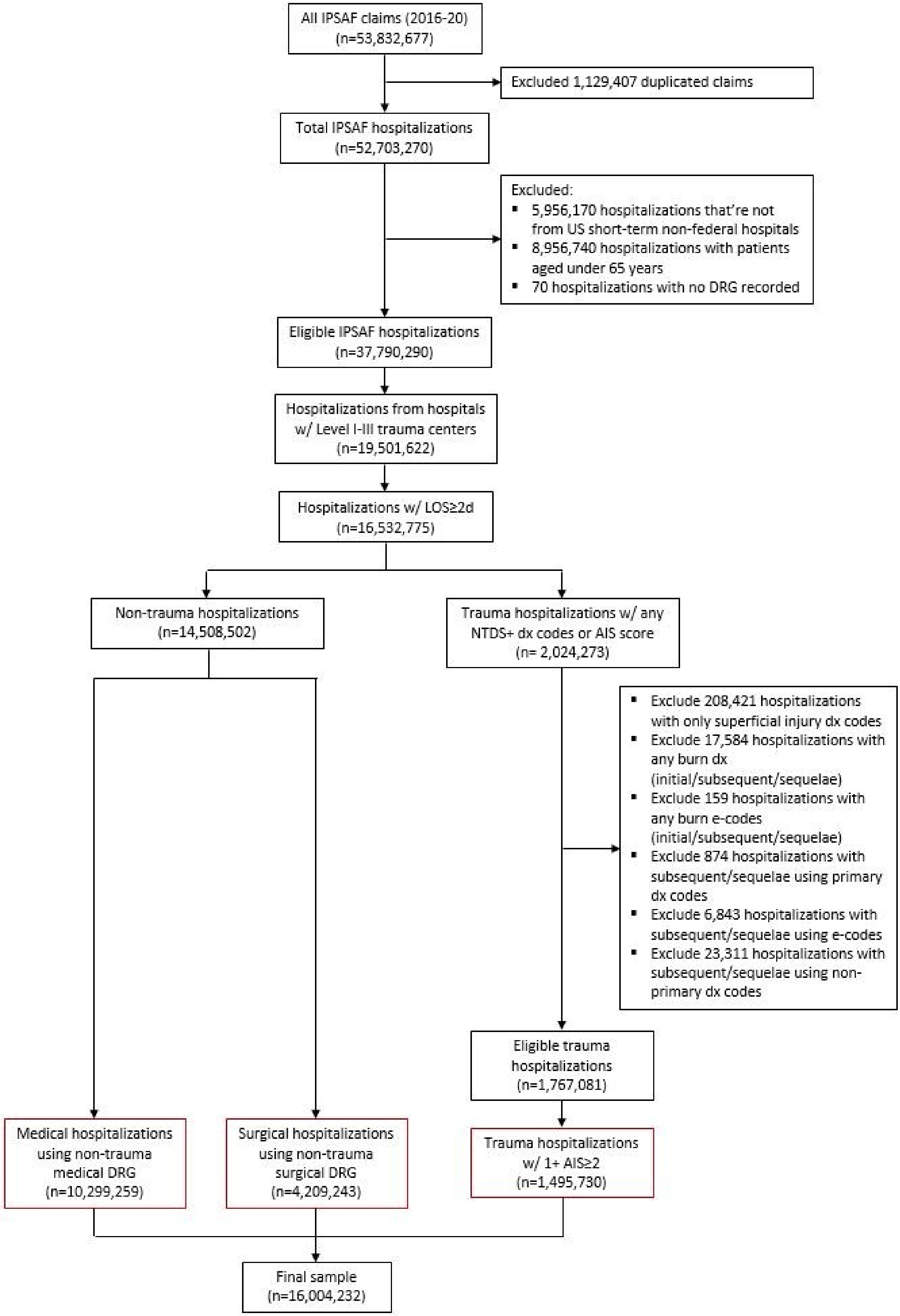

Figure 1 Consolidated Standards of Reporting Trials (CONSORT) flow diagram for selection of patients included in the study. AIS, abbreviated injury score; DRG, diagnosis-related group; IPSAF, Inpatient Standard Analytical Files; LOS, length of stay.

Table 1 Patient characteristics by specialty group and overall

Variables	Specialty group: Trauma n=1 495 730 (9.3%)	Surgical n=4 209 243 (26.3%)	Medical n=10 299 259 (64.4%)	Overall N=16 004 232 (100%)
Hospitalization counts by trauma center level, n (%)				
Level I	545 520 (36.5%)	1 684 463 (40.0%)	3 300 308 (32.0%)	4 382 110 (34.6%)
Level II	587 618 (39.3%)	1 541 300 (36.6%)	3 962 913 (38.5%)	4 382 110 (38.1%)
Level III	362 592 (24.2%)	983 480 (23.4%)	3 036 038 (29.5%)	4 382 110 (27.4%)
Age grouping, n (%)				
65–69	213 408 (14.3%)	1 186 337 (28.2%)	2 044 345 (19.8%)	3 444 090 (21.5%)
70–74	232 580 (15.5%)	1 075 553 (25.6%)	2 033 188 (19.7%)	3 341 321 (20.9%)
75–79	249 002 (16.6%)	858 202 (20.4%)	1 905 691 (18.5%)	3 012 895 (18.8%)
80–84	271 298 (18.1%)	588 559 (14.0%)	1 722 964 (16.7%)	2 582 821 (16.1%)
≥85	529 442 (35.4%)	500 592 (11.9%)	2 593 071 (25.2%)	3 623 105 (22.6%)
Elixhauser Score, mean (SD)	9.32 (8.75)	9.15 (9.33)	13.14 (9.02)	11.74 (9.28)
Female, n (%)	922 459 (61.7%)	2 085 938 (49.6%)	5 590 671 (54.3%)	8 599 068 (53.7%)
White, n (%)	1 347 635 (90.1%)	8 534 348 (82.9%)	3 639 342 (86.5%)	13 521 325 (84.5%)

All comparisons to trauma patients are statistically significant (p<0.001).

along with the worsening condition of the patient (any ICU: 5.6%; ICU LOS ≥5 days: 7.2%; ventilator use: 8.5%), with an overall hospice utilization of 4.1%. Full comparisons appear in table 3.

Among Trauma patients, 6.3% of patients received PC services. When comparing to Trauma patients who did not receive PC services, those who received PC services were significantly older (≥85 years: 47.1% vs 34.6%; p<0.001; online supplemental digital content 3: Trauma Patient Characteristics and Injury Patterns by PC Utilization), but had significantly fewer women (53.4% vs 62.2%; p<0.001). The mean Elixhauser scores for patients who used PC were almost doubled (15.77 vs 8.88; p<0.001) and they were significantly more frail (mean frailty index: 13.95 vs 9.49; p<0.001). Patients who received PC services had significantly lower proportions of blunt injuries (69.1% vs 79.6%; p<0.001) and same-level falls (37.0% vs 45.7%; p<0.001). Those who received PC suffered significantly more severe injuries (mean ISS: 8.99 vs 7.91) as well as more severe head traumas (AIS head ≥3: 40.7% vs 17.8%; p<0.001) compared with patients who did not receive PC.

For trauma patients, dominance analyses were performed to identify the most important contributors to hospice and PC utilization as well as expired disposition. For all three outcomes, Elixhauser score and frailty index were consistently the top two contributors determined by the average contribution (McFadden's R^2) (expired disposition: 7.5% and 4.2%; hospice utilization: 3.7% and 2.7%; PC utilization: 4.7% and 3.8%; figure 3). In addition, the indicator of AIS head ≥3 also had relatively higher explanatory power, which was the third highest contributor for expired disposition (2.4%) and PC utilization (1.9%), and the fourth for hospice utilization (1.1%).

DISCUSSION

This large retrospective, descriptive analysis of 2016–2020 Medicare inpatient claims data compared PC services utilization

Table 2 Outcomes by specialty group and overall

Variables	Specialty group: Trauma n=1 495 730 (9.3%)	Surgical n=4 209 243 (26.3%)	Medical n=10 299 259 (64.4%)	Overall N=16 004 232 (100%)
Hospital course				
LOS, d, mean (SD)	6.18 (6.60)	6.66 (7.42)	5.34 (5.02)	5.77 (5.92)
Any ICU stay, n (%)	437 779 (29.3%)	1 301 748 (30.9%)	2 694 154 (26.2%)	4 433 681 (27.7%)
ICU LOS, d, mean (SD)	5.09 (5.95)	5.46 (6.55)	4.20 (3.87)	4.66 (5.05)
Any ventilator use	100 835 (6.7%)	252 370 (6.0%)	408 873 (4.0%)	762 078 (4.8%)
Patient dispositions, n (%)				
Home	376 096 (25.1%)	2 768 244 (65.8%)	6 241 042 (60.6%)	9 385 382 (58.6%)
Expired	62 291 (4.2%)	112 840 (2.7%)	388 584 (3.8%)	563 715 (3.5%)
Home hospice	21 848 (1.5%)	27 878 (0.7%)	287 961 (2.8%)	337 687 (2.1%)
Inpatient hospice	31 929 (2.1%)	35 624 (0.8%)	252 375 (2.5%)	319 928 (2.0%)
Rehab facility	214 351 (14.3%)	274 782 (6.5%)	375 285 (3.6%)	864 418 (5.4%)
Nursing facility	738 466 (49.4%)	912 224 (21.7%)	2 375 611 (23.1%)	4 026 301 (25.2%)
Transfers-out	48 185 (3.2%)	72 945 (1.7%)	342 125 (3.3%)	463 255 (2.9%)
Other	2564 (0.2%)	4706 (0.1%)	36 276 (0.4%)	43 546 (0.3%)

All comparisons to trauma patients were statistically significant (p<0.001).
ICU, intensive care unit; LOS, length of stay.

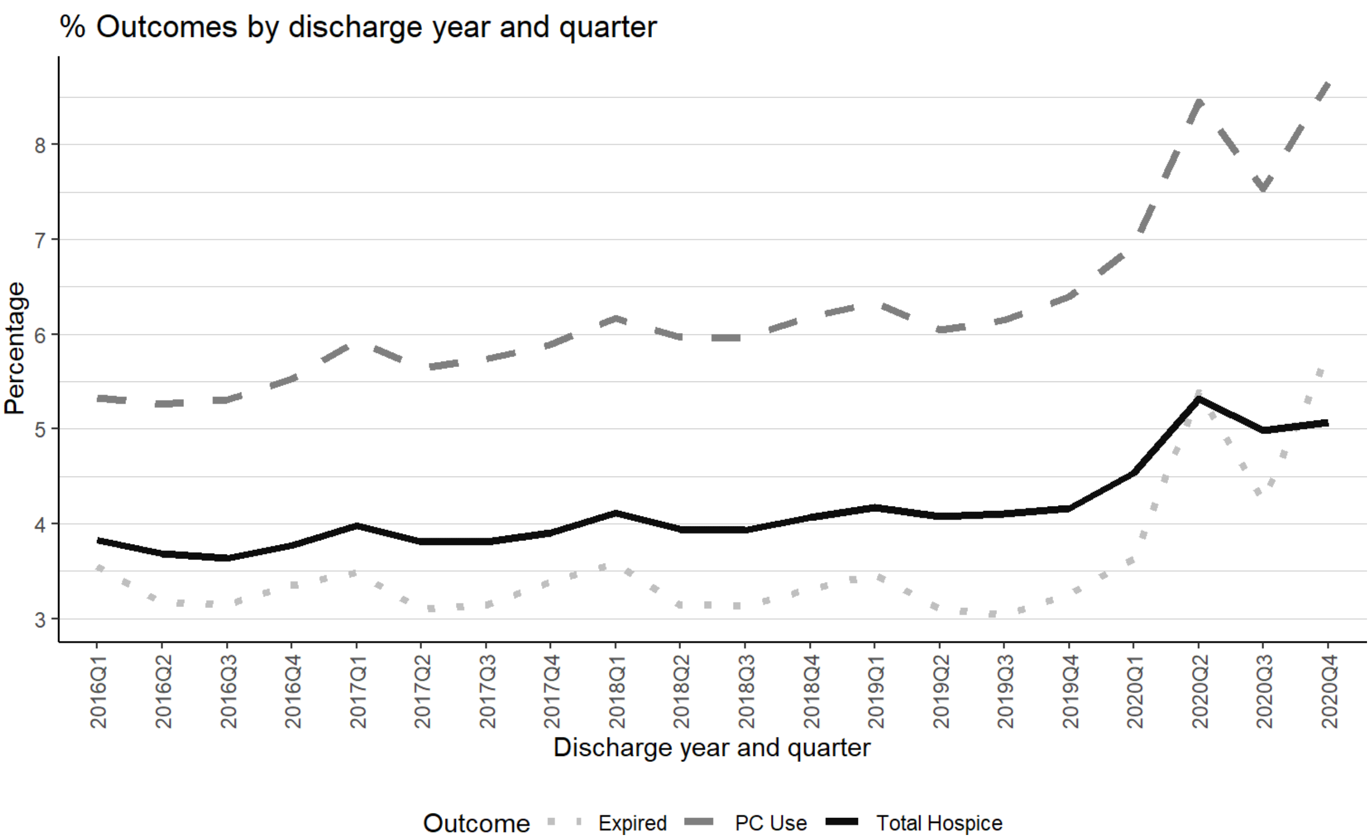

Figure 2 Trends of patient outcomes and palliative care utilization by discharge year and quarter. Description: multiple line graph illustrating proportion of CMS in-patients with PC utilization, expired hospital disposition status and total hospice, that is, the 'Hospice Utilization Rate' defined as the proportion of patients discharged to inpatient or home hospice, from the first calendar quarter of 2016 to the fourth calendar quarter of 2020. Over the 5-year study period, PC utilization, expired disposition and total hospice disposition increased gradually until the onset of the COVID-19 pandemic, when a spike of PC utilization was observed in the second quarter of 2020. CMS, Centers for Medicare & Medicaid Services; PC, palliative care.

and HD among trauma, medical and surgical patients. The study sample included 1.6 million Medicare fee-for-service inpatients at 1024 level I, II and III trauma centers and revealed that trauma patients received PC services at a rate of 6.3%, somewhat lower than medical patients (7.5%), but substantially higher than surgical patients (3.0%). Similarly, trauma patients were discharged to hospice at a rate of 3.6%, lower than medical patients (5.2%), but higher than surgical inpatients (1.5%). These findings were noted in spite of the fact that surgical patients had longer LOS and higher ICU utilization, while trauma patients had the highest in-hospital mortality rates, and medical patients had the highest rates of comorbidities. Overall, the utilization of PC services and HD increased gradually over the years of the study, spiking higher together with the significant increase in deaths during the COVID-19 pandemic in 2020 and 2021.

As would be expected, HD and PC utilization generally increased with increasing severity of the patient's condition for the sample overall as well as for each of the three subgroups (table 3). This was particularly true for patients in the ICU for over 5 days and for those on mechanical ventilation, consistent with the greater focus on these services in the critical care setting. However, it is worth noting that the majority of patients with HD and PC utilization did not have an ICU stay. This is consistent with the previously documented increase in the diffusion of PC in general to non-critical care settings and to more hospitals.[4 5] In the case of trauma patients, the American College of Surgeons Trauma Quality Improvement Program (ACS TQIP) Palliative Care Best Practices Guidelines include the recommendation that PC assessment be provided to each trauma patient within 24 hours of admission.[22] The goals of such an assessment include identifying family members, determining key decision makers, verifying pre-existing advance directives, completing a prognostic assessment and communicating prognostic information as available to the family.[22–24] This increased awareness and more widespread adoption of standardized, guideline-driven care approaches for PC in the trauma community are likely important contributors to the relatively high rates of PC utilization in trauma patients documented in this study (with medical services as the comparator). Surgical services—performing predominantly elective operations—had less utilization, which is to be expected, as their patients are inherently selected with the expectation of positive outcomes in the majority of cases. As a subspecialty of surgery, Trauma Surgery involves a higher likelihood of poor outcomes than most surgical specialties and its practitioners are more likely to have critical care training and experience with exposure to the principles that underlie a broad-based adoption of PC approaches, including the management of critically ill and injured patients, and end-of-life care, especially in the critical care setting.

Minimal previous research has compared hospice and PC utilization in trauma, surgical and medical specialties. A study by Olmsted *et al* from 2014 compared hospice and PC utilization between surgical and medical patients in their last year of life using the Veterans Health Administration data.[25] The authors

Table 3 Proportion of patients with hospice and/or PC utilization by specialty group and overall

Patient group	Specialty group: Trauma n=1 495 730 (9.3%)	Surgical n=4 209 243 (26.3%)	Medical n=10 299 259 (64.4%)	Overall N=16 004 232 (100%)
All patients, N	1 495 730	4 209 243	10 299 259	16 004 232
Proportion w/PC, n (%)	93 899 (6.3%)	124 348 (3.0%)*	774 134 (7.5%)*	992 381 (6.2%)
Proportion w/hospice disposition, n (%)	53 777 (3.6%)	63 502 (1.5%)*	540 336 (5.2%)*	657 615 (4.1%)
Proportion w/expired, n (%)	62 291 (4.2%)	112 840 (2.7%)*	388 584 (3.8%)*	563 715 (3.5%)
Any ICU stay, N	437 779	1 301 748	2 694 154	4 433 681
Proportion w/PC, n (%)	46 888 (10.7%)	71 310 (5.5%)*	299 888 (11.1%)*	418 086 (9.4%)
Proportion w/hospice, n (%)	24 474 (5.6%)	32 923 (2.5%)*	191 642 (7.1%)*	249 039 (5.6%)
Proportion w/expired, n (%)	39 196 (9.0%)	74 992 (5.8%)*	207 748 (7.7%)*	321 936 (7.3%)
ICU LOS≥5 days, N	155 926	503 956	827 895	1 487 777
Proportion w/PC, n (%)	22 532 (14.5%)	43 918 (8.7%)*	124 587 (15.0%)*	191 037 (12.8%)
Proportion w/hospice, n (%)	11 124 (7.1%)	20 047 (4.0%)*	75 879 (9.2%)*	107 050 (7.2%)
Proportion w/expired, n (%)	20 534 (13.2%)	46 260 (9.2%)*	93 355 (11.3%)*	160 149 (10.8%)
Any ventilator use, N	100 835	252 370	408 873	762 078
Proportion w/PC, n (%)	26 846 (26.6%)	49 318 (19.5%)*	110 399 (27.0%)	186 563 (24.5%)
Proportion w/hospice, n (%)	8838 (8.8%)	15 340 (6.1%)*	40 225 (9.8%)*	64 403 (8.5%)
Proportion w/expired, n (%)	34 340 (34.1%)	71 210 (28.2%)*	145 332 (35.5%)*	250 882 (32.9%)
Home hospice disposition, N	21 848	27 878	287 961	337 687
Proportion w/PC, n (%)	12 237 (56.0%)	14 884 (53.4%)*	160 358 (55.7%)	187 479 (55.5%)
Inpatient hospice disposition, N	31 929	35 624	252 375	319 928
Proportion w/PC, n (%)	20 342 (63.7%)	21 647 (60.8%)*	162 125 (64.2%)	204 114 (63.8%)
Expired disposition, N	62 291	112 840	388 584	563 715
Proportion w/PC, n (%)	34 809 (55.9%)	53 200 (47.1%)*	222 206 (57.2%)*	310 215 (55.0%)

*Indicates statistically significant comparisons to trauma patients (p<0.001).
ICU, intensive care unit; LOS, length of stay; PC, palliative care.

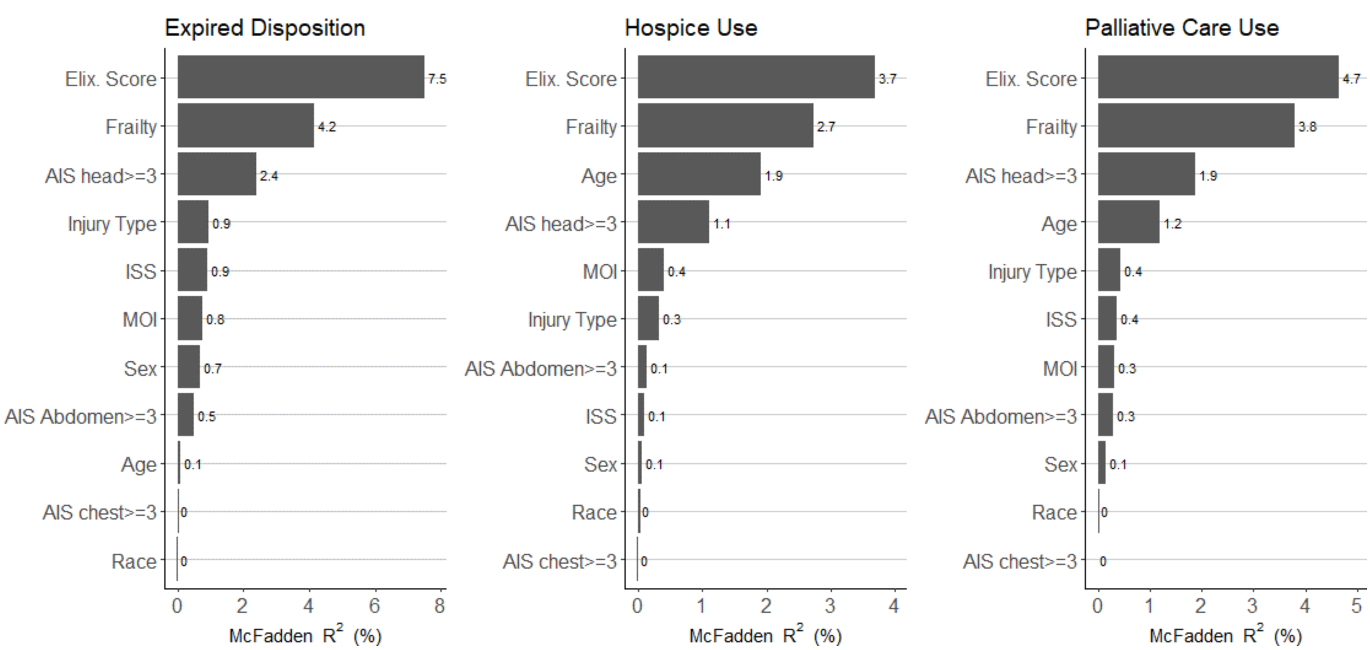

Figure 3 Mean contribution (McFadden's R^2) of covariates of models to explain variation in expired disposition and utilization of hospice and palliative care among trauma patients. Description: Dominance analysis results illustrating the relative contributions of select covariates to the logistic regression modeling expired disposition, hospice use and palliative care use as outcomes. For each outcome, Elixhauser score and frailty index were consistently the top two contributors determined by the average contribution (McFadden's R^2). In addition, the indicator of AIS head≥3 also had relatively higher explanatory power, which was the third highest contributor for expired disposition and palliative care use, and the fourth for hospice use. AIS, abbreviated injury score; ISS, injury severity scores; MOI, mechanism of injury.

reported in the last year of life, 38.6% of Veteran medical patients received PC compared with 36.5% of surgical patients, and 23.8% of medical patients utilized hospice compared with 21.2% of surgical patients. Compared with medical patients, surgical patients were statistically significantly less likely to receive hospice or PC services (OR=0.91; 95% CI 0.89 to 0.94; p<0.001). Interestingly, they also found of all those who received hospice or PC services, surgical patients lived longer than medical patients (median: 26 days vs 23 days; p<0.001).[25] Conversely, a 2022 single-center study by Haines *et al* found that 6.2% of trauma patients received orders for PC and 1.1% were discharged to hospice,[26] suggesting that at a minimum, the general trauma population experiences different utilization rates of hospice or PC than Veterans.

The subset analysis of trauma patients in this study sample revealed that those receiving PC services were significantly older, less likely to be women and had substantially higher Elixhauser and frailty scores. Patients with severe injuries were more likely to receive PC services, and those with severe traumatic brain injury (TBI) had some of the highest rates. The dominance analyses reinforced these findings, with Elixhauser score, frailty, severe TBI and age having the largest individual explanatory powers for receiving PC. This is not surprising, as these subgroups are traditionally among those well known to have poor outcomes and thus are more likely to receive these services, which have historically been associated with an expectation of poor outcome. Given the current recommendations to provide PC to all trauma patients,[22] this suggests that there are opportunities to improve adherence to these recommendations and ensure equitable access to these valuable resources.

The frequency at which PC resources and hospice referrals are utilized at the same institution and the relationship between the two is of interest in this context, as it provides insights into how often these resources are utilized and for which patients, as well as better defining the optimal strategies for utilizing these valuable but limited resources. The utilization of PC resources would, in general, be expected to exceed that of hospice utilization, as the number of patients eligible for PC interventions is usually significantly larger than those qualifying for hospice. In this study, PC utilization rates for each patient group were about 2% higher than hospice utilization rates overall, suggesting there are significant numbers of patients eligible for PC interventions who may not be receiving them. There are limited data available in the literature comparing PC utilization rates to hospice referrals at the same hospital for sufficiently large numbers of patients from varied specialties to allow for definitive conclusions.[27–30] This area remains an opportunity for additional investigation given the benefits of PC interventions for patients not needing hospice care.

There was a progressive increase in PC utilization recorded in our data set coinciding with the onset of the COVID-19 pandemic. In figure 2, the temporal trend of PC use mirrors that of the temporal pattern of in-hospital mortality, which indicates increased PC use was associated with higher risk of in-hospital mortality, as would be expected. This has been previously reported[31 32] and is consistent with the increased complexity and severity of illness encountered during the pandemic and especially with the increased mortality seen in the early years prior to introduction of vaccines and effective treatments.

It is encouraging that trauma patients appear to be receiving PC consultation at rates slightly below that of medical patients, but higher than those of surgical patients. This suggests that trauma providers are engaged in the movement to increase access to PC for all patients who need it, consistent with the recommendations in the ACS TQIP Palliative Care Best Practices Guidelines. To promote additional adherence and produce higher rates of PC utilization in trauma patients, directed monitoring of utilization for appropriate patients would need to be implemented as part of quality assessment efforts at trauma centers.

Limitations

There are several notable limitations to this research. The usual cautions regarding retrospective analysis of large administrative data sets are warranted.[33 34] The data source for the study (IPSAF files) includes only fee-for-service medicare patients, thus patients with medicare advantage plans or other health insurance coverage are not included in the analysis. Other limitations related to the file linkages needed for this analysis have been previously described.[13] Descriptive studies, such as this work, can only reveal patterns and associations and do not allow causal inferences. Finally, the very large sample size contributes to numerous associations being statistically significant, but may be clinically less important.

CONCLUSION

In this large, descriptive study of medicare patients, hospice and PC utilization rates increased over time and varied significantly among specialties. Trauma patients had higher hospice and PC utilization rates than surgical, but lower than medical. These differences tended to be less pronounced as the risk of poor outcome increased. These data suggest that trauma practitioners are employing hospice and PC resources at relatively high rates, consistent with ongoing efforts to routinely employ these services in the care of all trauma patients. The presence of comorbidities, frailty and/or severe TBI (in addition to advanced age) may be valuable criteria to consider in the selection of patients for PC utilization. Further studies are needed to inform most efficient hospice and PC utilization, especially as concerns the timing and selection of subgroups of patients in greatest need of these valuable but limited resources.

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ORCID iDs
Samir M Fakhry http://orcid.org/0000-0002-6781-0863
Jeneva M Garland http://orcid.org/0000-0003-4920-3020

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SUPPLEMENTAL DIGITAL CONTENT

Supplemental Digital Content 1. STROBE Statement—Checklist of items that should be included in reports of ***observational studies***

	Item No	Recommendation	Complete
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	4-5
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	7-9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7-11
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7-11
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9-11
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-12
Bias	9	Describe any efforts to address potential sources of bias	8-9
Study size	10	Explain how the study size was arrived at	Figure 1
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-12
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11-12
		(*b*) Describe any methods used to examine subgroups and interactions	11-12
		(*c*) Explain how missing data were addressed	Figure 1, 11-12
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	11-12
		(*e*) Describe any sensitivity analyses	11-12
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12-13 and Figure 1

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		(b) Give reasons for non-participation at each stage	Figure 1
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	13-18
		(b) Indicate number of participants with missing data for each variable of interest	Figure 1
Outcome data	15*	Report numbers of outcome events or summary measures	13-18
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13-18 and Tables 1–3
		(*b*) Report category boundaries when continuous variables were categorized	13-18 and Tables 1–3
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Figure 2
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	16-18, Tables 2 and 3, and Figure 3
Discussion			
Key results	18	Summarise key results with reference to study objectives	18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	22
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	N/A

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Supplemental Digital Content 2. Facility characteristics of the CMS patient sample, 2016 to 2020

Variables	**Facilities N=1024**
Trauma Center Level, n (%)	
I	236 (23.0%)
II	333 (32.5%)
III	455 (44.4%)
Teaching hospital, n (%)	600 (58.6%)
Bed size count, n (%)	
< 100	109 (10.6%)
100–300	374 (36.5%)
> 300	541 (52.8%)
Ownership type, n (%)	
Private, non-profit	524 (51.2%)
Private, for-profit	151 (14.7%)
Other	349 (34.1%)
Urban hospital, n (%)	857 (83.7%)

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Supplemental Digital Content 3. Trauma patient characteristics and injury patterns by palliative care utilization of the CMS patient sample, 2016 to 2020

Variables	No PC Use	PC Use	All Trauma Pts
	n=1 401 831 (93.7%)	n=93 899 (6.3%)	N=1 495 730 (100%)
Age Grouping, n (%)			
65-69	204 819 (14.6%)	8589 (9.1%)*	213 408 (14.3%)
70-74	221 828 (15.8%)	10 752 (11.5%)*	232 580 (15.5%)
75-79	235 497 (16.8%)	13 505 (14.4%)*	249 002 (16.6%)
80-84	254 479 (18.2%)	16 819 (17.9%)*	271 298 (18.1%)
≥85	485 208 (34.6%)	44 234 (47.1%)*	529 442 (35.4%)
Female, n (%)	872 307 (62.2%)	50 152 (53.4%)*	922 459 (61.7%)
White, n (%)	1 263 098 (90.1%)	84 537 (90.0%)	1 347 635 (90.1%)
Elixhauser Score, mean (SD)	8.88 (8.52)	15.77 (9.58)*	9.32 (8.75)
Frailty Index, mean (SD)	9.49 (5.77)	13.95 (5.99)*	9.77 (5.89)
Blunt, n (%)	1 115 668 (79.6%)	64 926 (69.1%)*	1 180 594 (78.9%)
MOI, n (%)			
Same level fall	640 887 (45.7%)	34 700 (37.0%)*	675 587 (45.2%)
Other fall	367 807 (26.2%)	26 216 (27.9%)*	394 023 (26.3%)
MVC	50 480 (3.6%)	2211 (2.4%)*	52 691 (3.5%)
Motorcycle	5502 (0.4%)	159 (0.2%)*	5661 (0.4%)
Pedestrian	6686 (0.5%)	349 (0.4%)*	7035 (0.5%)
Pedal cyclist	6497 (0.5%)	120 (0.1%)*	6617 (0.4%)
Assault	3567 (0.3%)	146 (0.2%)*	3713 (0.2%)
ISS, mean (SD)	7.91 (4.10)	8.99 (5.57)*	7.98 (4.21)
AIS Head ≥3, n (%)	249 087 (17.8%)	38 252 (40.7%)*	287 339 (19.2%)
AIS Chest ≥3, n (%)	9051 (0.6%)	722 (0.8%)*	9773 (0.7%)
AIS Abdomen ≥3, n (%)	506 491 (36.1%)	23 121 (24.6%)*	529 612 (35.4%)

* indicates statistically significant difference comparisons to patients without PC utilization ($P < .001$).
Abbreviations: PC=palliative care; SD=standard deviation; MOI=mechanism of injury; MVC=motor vehicle collision; ISS=injury severity score; AIS=abbreviated injury scale

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