Published in final edited form as:

J Surg Res. 2013 May 1; 181(1): 16–19. doi:10.1016/j.jss.2012.05.042.

Comorbidity-Polypharmacy Score: A Novel Adjunct In Post-Emergency Department Trauma Triage

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Abstract

OBJECTIVE—Post-emergency department (ED) triage of older trauma patients continues to be challenging as morbidity and mortality for any given level of injury severity tend to increase with age. The Comorbidity-Polypharmacy Score (CPS) combines the number of pre-injury medications with the number of comorbidities to estimate the severity of co-morbid conditions. This retrospective study examines the relationship between CPS and triage accuracy for older (≥ 45 years) patients admitted for traumatic injury.

METHODS—Patients ≥ 45 years old presenting to level 1 trauma center from 2005 to 2008 were included. Basic data included patient demographics, injury severity score (ISS), morbidity/mortality, and functional outcome measures. CPS was calculated by adding total numbers of co-morbid conditions and pre-injury medications. Patients were divided into 3 triage groups: undertriage, appropriate triage, and over-triage. Under-triage criteria included initial admission to the floor or step-down unit followed by an unplanned transfer to ICU within 24 hours of admission. Over-triage was defined as initial ICU admission for <1 day without stated need for ICU level of care (i.e., lack of evidence for tracheal intubation/mechanical ventilation, injury-related hemorrhage, or other traditional ICU indications such as intracranial bleeding). All other patients were presumed to be correctly triaged. The three triage groups were then analyzed looking for contributors to mis-triage.

RESULTS—Charts for 711 patients were evaluated (mean age 63.5, 55.7% male, mean ISS 9.02). Of those, 11 (1.55%) met criteria for “under-triage” and 14 (1.97%) were “over-triaged”. The remaining 686 patients had no evidence of mis-triage. The three groups were similar in terms

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of injury severity and age. The groups were significantly different with respect to CPS, with undertriage CPS scores (14.9 ± 6.80) being nearly three times higher than the overtriage CPS scores (5.14 ± 3.48). There were more similarities between appropriate and overtriage groups, with the undertriage group being characterized by greater number of complications, and lower functional outcomes at discharge (all, $p < 0.05$). The undertriage group had significantly higher mortality (27%) than the appropriate and over-triage groups (6% and 0%, respectively).

CONCLUSION—In the era of medication reconciliation, the CPS is easy to obtain and calculate in patients who are not critically injured. This study suggests that CPS may be a promising adjunct in identifying older trauma patients who are more likely to be under-triaged. The significance of our findings is especially important when considering that injury severity in the undertriage group was similar to injury severity in the other groups. Further evaluation of CPS as a triage tool in acute trauma is warranted.

Keywords

Trauma triage; Level of care; Undertriage; Overtriage; Older trauma patient; Comorbidity-polypharmacy score

INTRODUCTION

Post-Emergency Department (ED) triage of older trauma patients continues to be challenging, as morbidity and mortality associated with any given level of injury severity tend to increase with age. In the presence of equivalent injury severity, mortality in elderly patients is known to be two times higher than in younger patients (1). Despite this, older patients are more likely to be under-triaged compared to other adult trauma victims (2–4). Under-triage (UT) exposes patients to critical delays in diagnostic, resuscitative, and therapeutic measures (5).

Older adults are increasingly likely to be affected by multiple chronic health conditions (CHC) that require “maintenance” pharmacotherapy (6). Moreover, modern medical management of CHCs often entails escalating use of multiple medications with resultant polypharmacy – a trend that is likely to continue as the older segment of population increases in both size and proportion (6). The literature on polypharmacy shows that there are many potential hazards with the concurrent use of multiple medications in the middle age and elderly population (7–9).

In order to provide an easy-to-use method of quantification of the overall impact of comorbid conditions (including their overall severity) on clinical outcomes, our group introduced the Comorbidity-Polypharmacy Score (CPS) – a sum of all known comorbid preinjury conditions and medications present for any given patient (10, 11). Higher CPS has been associated with more severe clinical course in older trauma patients (i.e., longer hospital stays, greater mortality, and prolonged recovery) despite lower overall injury severity (10, 11). Based on these preliminary findings, we examined whether CPS might also be useful as an objective triage tool for older trauma patients. Specifically, we hypothesized that CPS could be an adjunct in identifying patients at risk for undertriage and improving the appropriateness of post-ED care placement.

METHODS

Study patients were identified from our Level 1 Trauma Center database (January 1, 2005 to December 31, 2008). Institutional Review Board approval was granted. Based on previous research, we chose to study patients aged 45 years and older because our previous work has shown that younger patients lack enough chronic health conditions and long-term

“maintenance” pharmacologic therapy to make CPS meaningful (6, 8, 11). We excluded prisoners, pregnant patients, and injured patients who died before leaving the emergency department resuscitation area.

From the medical records we obtained: patient demographics, injury severity score (ISS), Glasgow coma scale (GCS), complications per patient, functional outcome measures (FOM), discharge destination, morbidity and mortality, hospital length of stay (LOS), intensive care unit (ICU) LOS, comorbid conditions and home medications. The CPS (Comorbidity-Polypharmacy Score) was defined as the total number of pre-injury medications plus comorbidities for each patient (10, 11). Functional outcome measures were divided into the following three categories, scored (1-to-4) low-to-high: (a) expression-communication; (b) locomotion; and (c) self-feeding (11).

All patients admitted to The Ohio State University Health System undergo standardized allergy and medication history recording upon admission. In rare exceptions where such history is not immediately obtainable, the required information is gathered as quickly as possible. If a patient had been transferred from another hospital, the original home medication list was utilized and not the medication list present upon transfer.

Patients were divided into 3 groups: (a) under-triage; (b) appropriate triage; and (c) over-triage. Under-triage was defined as an unplanned level of care escalation with 24 hours of admission (i.e. not due to surgery or attributable to known clinical factors). Over-triage was defined as an initial ICU admission lasting <24 hours without an evident indication for ICU level of care, followed by transfer to regular ward or hospital discharge (see Figure 1). All other patients were considered to be appropriately triaged. Patients with active hemorrhage, hemodynamic instability, solid organ injuries, and mechanically ventilated patients were considered to be appropriately triaged if they were admitted to the surgical ICU for their initial care.

Data analysis was performed using PASW Statistics 18 (SPSS, Inc., Chicago, IL, USA) software package. Normally distributed variables were reported as mean $\pm$ SEM and tested using analysis-of-variance (ANOVA). Categorical variables were analyzed using Fisher's exact or Chi-square test, as appropriate. Statistical significance was set at $\alpha = 0.05$ was utilized.

RESULTS

Medical records of 711 patients were analyzed. The mean age of the study group was 63.5 $\pm$ 0.51. Males represented 55.7% (396/710) of the study group. Mean ISS was 9.02 $\pm$ 0.33. Pharmaceutical agent use was prevalent in the study group, with 589 of 711 (82.8%) patients receiving at least one pre-injury medication and 519 of 711 (72.9%) receiving two or more pre-injury medications. The mean polypharmacy-comorbidity score (CPS) for the entire group was 9.05 $\pm$ 0.26 (range, 0 to 33).

Overall, we identified 11 patients (1.55%) that were under-triaged and 14 (1.97%) patients that were over-triaged. The other 686 (96.48%) patients were considered to be appropriately triaged. The three triage groups were similar in terms of overall injury severity and total number of discrete injuries. Likewise, the GCS did not significantly vary across the groups (Table 1).

Increasing ISS correlated with level-of-care, with patients admitted to regular beds having lower mean ISS scores than those admitted to step-down or ICU (regular 6.95, step-down 11.3, ICU 16.2). There was also a significant difference between the triage groups with regards to mean age, which was expected considering our current patterns of practice (i.e.,

we utilize age as a triage variable). Detailed demographic information, grouped by triage category, is displayed in Table 1.

As noted in Table 1, CPS significantly correlated with triage level, with the CPS being 14.9 ± 6.80 in the undertriage group, 9.04 ± 7.03 in the AT group, and 5.14 ± 3.48 in the overtriage group ($p=0.002$). When compared to AT and OT groups, under-triaged patients had significantly worse outcomes, including higher morbidity and lower functional outcome scores at hospital discharge in all 3 categories (self-feeding score, expression-communication, locomotion). Under-triaged patients were also significantly less likely to be discharged to home (37.5%) when compared to appropriately triaged (62.2%) or overtriaged patients (85.7%, $p=0.013$). Finally, undertriaged patients had significantly higher mortality (27.2%) than appropriately triaged patients (6.3%) or overtriaged patients (0%; $p=0.012$).

DISCUSSION

Our study identified CPS as a novel adjunct for identifying older trauma patients who may be more susceptible to under-triage based on injury severity scoring or age alone. Polypharmacy is becoming more commonplace in modern healthcare, primarily due to our ability to effectively manage chronic health conditions. Although the institution of medication reconciliation makes the likelihood of “unreported” medications much smaller, the previously “unseen” effects of simultaneously using multiple pharmacologic therapies are becoming more apparent (6, 12). Our understanding of how polypharmacy influences trauma outcomes continues to be limited despite the fact that trauma patients may be more likely to experience adverse sequelae related to medications than nontrauma patients (13, 14). Increased polypharmacy augments the possibility for potential drug-drug interactions (13). Previous reports show that the risk of traumatic falls increases as the number of co-administered medications increases, with the simultaneous use of 5 or more medications being strongly associated with risk of injury from falls (7, 15). Moreover, older trauma victims may also be less likely to undergo timely trauma evaluations than younger patients (16, 17).

Despite awareness of the association between older age and undertriage in trauma patients, studies continue to show that this worrisome trend continues (2, 3, 18). This is indeed true in the current study, where the UT patients were significantly older than the appropriately triaged or overtriaged population (Table 1). Accordingly, current literature warrants better triage guidelines for older trauma victims in order to minimize inappropriate patient placement, maximize level of care, and ultimately improve outcomes (17). This study strongly suggest that CPS may be a novel adjunct for identifying older trauma patients who are susceptible to under-triage based on injury severity scoring or age alone. Specifically, we found that under-triaged patients had significantly higher CPS, with the CPS score being approximately three times higher in the undertriage group when compared to the overtriage group despite having a similar ISS.

Consistent with previous reports, we found that undertriage also correlated with significantly worse outcomes, including greater morbidity, mortality, as well as the likelihood of discharge to a facility. In fact, patients in the undertriage group were half as likely to be discharged to home when compared to the appropriate and overtriage groups (Table 1). Furthermore, undertriaged patients suffered approximately four times the mortality as appropriately triaged patients. Although age can certainly play a role in overall outcomes, the magnitude of the effect of the CPS on patient morbidity and mortality may be a better reflection of each patient’s physiologic or “true” age (i.e., a measure of frailty). It may also be a more objective decision-making tool than some of the existing criteria, especially when one considers that unconscious age bias by receiving trauma center personnel has been

previously identified as a possible cause of under-triage (19). Based on the preliminary data presented herein, it is difficult to make conclusive recommendations with regards to definitive levels of CPS scoring in the context of trauma triage. However, the CPS score of 14 or greater seems to be most closely associated with undertriage and unfavorable clinical outcomes.

Limitations of this study include its retrospective nature, small sample size for both UT and OT groups, as well as selection bias inherent to the very nature of this study. In addition, our definitions of OT/UT were very stringent due to limited data resolution, leaving the possibility that some patients in the AT group could have indeed been overor under-triaged. However, this limitation affects most similar studies, making the very nature of triage-related investigations extremely difficult (as evident by their limited number). Given the magnitude of the difference in CPS between the three groups, it is unlikely that the effect of using less stringent OT/UT criteria would make a substantial difference, but this will certainly need to be studied further in a more controlled, optimally prospective setting. Also, some delays in collecting study related data undoubtedly existed for patients unable to effectively communicate at the time of admission (i.e., intoxicated or intubated patients). Nevertheless, a major strength of this study is the high quality of medication and co-morbid condition reporting within 24–48 hours of admission.

CONCLUSION

In the era of medication reconciliation, the CPS is easy to obtain and calculate in patients who are not critically injured. This study suggests that, in patients for whom the information is readily reliable, CPS may be a promising adjunct in identifying patients who are more likely to be under-triaged. The significance of our findings is especially important when considering that injury severity in the UT group was similar to injury severity in the other groups. Further evaluation of CPS as a triage tool in acute trauma is warranted.

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Figure 1.

Schematic representation of three triage categories used in this study. Undertriage (blue arrows) was defined as a situation where a patient is admitted to the floor from the ED but is later unexpectedly transferred to the ICU. Over-triage (orange arrows) was defined as a patient admitted to the ICU without obvious indication for ICU level of care lasting <24 hours before transfer to the floor. All other patients that did not require the described transitions were considered appropriately triaged.

Table 1

Key study variables and patient characteristics listed by triage category.

Variable	Undertriage (n=11)	Appropriate triage (n=686)	Overtriage (n=14)	Significance
CPS	14.9±6.80	9.04±7.03	5.14±3.48	p=0.002
Age	74.5±15.9	63.4±13.5	59.8±15.5	p=0.016
Injury severity score	9.09±5.05	9.08±8.91	6.07±6.20	n/s
Number of injuries	2.81±1.17	3.00±2.73	4.07±2.46	n/s
Glasgow coma scale	13.5±4.48	13.3±4.19	14.9±0.267	n/s
Complications per patient	1.73±1.74	0.592±1.24	0.714±0.267	p=0.003
Self-feeding score (1–4; disch)	1.81±1.94	3.42±1.34	4.00	p<0.001
Expression-communication score (1–4; disch)	2.09±2.02	3.47±1.31	4.00	p=0.001
Locomotion score (1–4; disch)	1.91±1.87	3.03±1.24	3.71±0.468	p=0.002
Discharge to home	27.3%	58.3%	85.7%	p=0.013
Mortality	27.2%	6.3%	0%	p=0.012