MEDWIN PUBLISHERS
Committed to Create Value for researchers

Gastroenterology & Hepatology International Journal
ISSN: 2574-8009

Clinico- Pharmacologic Score Predicting Outcomes in Hospital Admitted Patients: Study from a Tertiary Centre

Sharma R[1], Nagaich N[2]* and Niranjana N[3]

[1]Department of Pathology RUHS College of medical sciences Jaipur, India
[2]Department of Gastroenterology FORTIS Escorts Hospital Jaipur, India
[3]JSS College of pharmacy, Ooty, Tamilnadu, India

***Corresponding author:** Neeraj Nagaich, Department of Gastroenterology FORTIS Escorts Hospital Jaipur, India, Email: drneerajn@gmail.com

Research Article
Volume 5 Issue 1
Received Date: February 11, 2020
Published Date: March 04, 2020
DOI: 10.23880/ghij-16000169

Abstract

Objectives: To determine the association between clinico- pharmacologic score (CPS) and clinical outcomes in patients admitted in critical care (≥45 y), focusing on outcome prognostication.

Methods: A retrospective study of patient's of ages ≥ 45 years was performed using a Hospital database. The study period was from 1st August 2017 to 31st August 2018. Data gathered included patient demographics, injury severity score (ISS), Glasgow coma scale (GCS), hospital and intensive care unit lengths of stay (HLOS and ILOS, respectively), home preinjury medications (prescription and over the counter), morbidity, comorbid conditions and in-hospital mortality. Then according to CPS ranges, patients were divided into four groups and then to two groups (for statistical purposes).

Results: The variables for the 205 patients included in the study, were analyzed. The mean patient age was 72.4 ± 13.1 years. Males represented 52 % of the study sample. Mean GCS was 13.2 ± 1.8, mean ISS was 9.4 ± 6.9 and mean number of medications per patient was 3.6±1.5 (range 0-16).

The independent predictors of mortality included age (AOR 1.21, 95 % CI 0.98-1.038, p<0.01), CPS (per-unit increase AOR 1.12, 95 % CI 1.01-1.24, p<0.02), GCS (per-unit decrease AOR 1.47, 95 % CI 1.13-1.69, p<0.01), and ISS (per-unit increase AOR 1.07, 95 % CI 1.03-1.13, p<0.01).

Independent predictors of all-cause morbidity included age (AOR 1.02, 95 % CI 1.01-1.03, p<0.01), CPS (per-unit AOR 1.04, 95 % CI 1.02-1.07, p<0.02), GCS (AOR 1.08 per-unit decrease, 95 % CI 1.03-1.11, p<0.01), and ISS (per-unit AOR 1.09, 95 % CI 1.08-1.11, p<0.01).

Independent predictors of discharge to a facility included age (AOR 1.02, 95 % CI 1.01-1.03, p<0.01), female gender (AOR 1.25, 95 % CI 1.10-1.43, p<0.01), ISS (AOR 1.09, 95 % CI 1.07-1.10, p<0.01), and GCS (AOR per-unit decline 1.18, 95 % CI 1.12-1.21, p\0.01).

Conclusion: CPS can be readily determined in the era of medication reconciliation. This study confirms that CPS is an independent predictor of all-cause morbidity and mortality in older patients. Patients with CPS of 15 or greater are at greater risk of poor clinical outcomes.

Prospective multicenter studies are needed to evaluate the use of CPS as a predictive and interventional tool, with special focus on correlations between specific pre-existing conditions, pharmacologic interactions, and morbidity/mortality patterns.

Keywords: Polypharmacy; Injury Severity; Clinico Pharmacologic Score

Abbreviations: ADRs: Adverse Drug Reactions; CPS: Clinico- Pharmacologic Score; ISS: Injury Severity Score; GCS: Glasgow Coma Scale; SD: Standard Deviation; SE: Standard Error; Aors: Adjusted Odds Ratios: IQR: Interquartile Range.

Introduction

Comorbidities are known to influence the outcomes especially in trauma patients, but their effect is difficult to quantify. As the population becomes older, more comorbidity will be commonly present at trauma centers as well as in critical care units [1].

The prevalence of co-morbid diseases in the total trauma population is estimated between 8.8% and 19.3%. [2] Trauma is the fifth leading causes of death in older trauma patients (≥65 years old), currently in the USA and older trauma patients currently account for approximately one-fourth of trauma fatalities [1,3].

Between 2030 and 2051, the proportion of adults ages 40-64 will increase to over 30% of the total population, with the segment including those ≥65 years growing to represent nearly 20% of the population, among which 80% of them in the developing countries [1,4-6].

According to Census of 2011, 5.5% of the Indian population is > 65 years of age. By 2020, 10.4% of population amounting to 142 million people 60 years or older will be living in India [7].

As the age increases, the prevalence for the chronic health conditions (CHC) also increases, which necessitate the need for a long term pharmacological therapy (maintenance therapy), resulting in an inherent risk of polypharmacy [1,8].

Polypharmacy has been defined as the concomitant use of five or more drugs, or as the number of unnecessary or inappropriate medications, the former definition is more widely used by physicians because of its clinical convenience [8].

Polypharmacy inherently carries the risk of adverse drug reactions (ADRs), drug-drug interactions, increased risk of hospitalization, reduced adherence to medication, unnecessary expenses and deleterious physiological effects on the body's response to trauma-related stress or hemorrhage. The actual occurrence of polypharmacy may be higher than documented, because of the lack of information about non-prescription medications/OTC medications. Previous studies showed a negative association between polypharmacy and trauma outcomes [8,9].

clinico- pharmacologic score (CPS) was conceived as an attempt to better quantify the magnitude of comorbid conditions. The clinico- pharmacologic score (CPS) is the absolute sum of the number of pre-injury medications with the number of comorbidities to estimate the severity of comorbid conditions. For example, a patient with a diagnosis of diabetes mellitus (1 point) taking only one medication (1 point) would have a total CPS of 2. A patient with diabetes mellitus (1 point) taking 3 medications (3 points) would have a CPS of 4 [1,4].

Patients were subsequently categorized according to CPS into four groups: 0-7 (minor), 8-14 (moderate), 15- 21 (severe), or 22 (morbid).

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 [4,10]. This retrospective study examines the relationship between CPS and clinical outcomes for older (≥45 y) patients admitted in the critical care unit of the hospital.

Methods

A retrospective study was performed using the hospital database. The study included patients admitted in critical care unit, aged 45 and older, evaluated between 1st August 2017 and 31st August 2018 regardless of admission status.

Patients under age 45 were excluded from the study based on previous research demonstrating that individuals in this younger group are much less likely to have chronic health conditions commonly treated with long-term pharmacologic therapy [1,4,10].

Additional exclusion criteria included pregnant women, and patients who died before leaving the emergency department.

Detailed review of medical charts and pharmacy records was performed, including the following variables: patient demographics, home preinjury medications (prescription and over the counter), comorbid conditions, injury severity score (ISS), Glasgow Coma Scale (GCS), morbidity, in-hospital mortality, hospital length of stay (LOS), intensive care unit (ICU) lengths of stay (HLOS, ILOS). Detailed medication reconciliation was performed for all patients.

Patients were subsequently categorized according to CPS into four groups: 0-7 (minor), 8-14 (moderate), 15-21 (severe), or ≥22 (morbid). These cutoffs were based on previously established polypharmacy range determinations [1].

For the purposes of simplifying descriptive and univariate analyses in this study, we combined minor-moderate (0-14) and severe-morbid (≥15) categories into two larger groups.

Univariate analyses consisted of χ^2 tests, Student's t-tests, Mann-Whitney rank sums tests, Kruskal-Wallis testing, and analysis of variance as appropriate to examine the primary end-points of mortality and all-cause morbidity.

Outcomes significant at p<0.20 were included in a multivariate logistic regression model. Results are presented as mean ± standard deviation (SD) or standard error (SE), medians [interquartile range], or percentages within group comparisons, as determined by types and distributions of data.

Results of multivariate analyses are reported as adjusted odds ratios (AORs) with 95 % confidence intervals, with p<0.05 denoting statistical significance.

Results

The variables for the 205 patients included in the study, were analyzed. The mean patient age was 72.4 ± 13.1 years. Males represented 52 % of the study sample. Mean GCS was 13.2 ± 1.8, and mean ISS was 9.4 ± 6.9.

In this study group, polypharmacy was definitely prevalent as the mean number of medications per patient was 3.6±1.5 (range 0-16); over 25% of patients were taking at least two daily medications and over 18% of patients taking at least five daily medications at home.

Basic descriptive information arranged according to CPS is presented in Table 1.

To examine the effect of main study parameters on mortality, the results of univariate analysis are listed in Table 2.

CPS range	0-14 (n = 197)	15+ (n=8)	p- value
Age (mean ± SD)	67.85 ± 15.29	82.67 ± 6.59	<0.001*
Any complications (n, %)	14 (6.82)	1 (12.5)	0.002*
Complications (per patient)[a]	0.10 ± 0.01	0.18 ± 0.03	0.009*
Discharge to home (n, %)	131(66.4)	4(50)	<0.001*
GSC (mean ± SD)	14.33 ± 2.25	14.65 ± 0.82	0.057
Median (IQR)	15 [12-15]	15 [13-15]	
Male gender (n, %)	104 (52.7)	3 (37.5)	<0.001*
ISS (mean ± SD)	8.92 ± 7.39	9.29 ± 6.64	0.451
Median (IQR)	8 [5-15]	9 [4-11]	
LOS, hospital (days)a	4.25 ± 0.07	5.60 ± 0.32	<0.001*
LOS, ICU (days)[a]	0.72 ± 0.03	0.96 ± 0.15	0.114
Mortality (n,%)	3 (1.52)	1 (12.68)	0.093
Blunt mechanism (n,%)	175 (88.8)	7 (87.5)	<0.001

Table 1: Patient characteristics, grouped by CPS (0-14 and 15+).
IQR interquartile range
* Denotes statistical significance (p<0.05)
A Reported as mean ± standard error, SE

Variables	Died (n=3)	Survived (n=202)	p-value
Age (mean ± SD)	75.73 ± 13.65	68.35 ± 15.31	<0.001*
Any complication (n, %)	1 (33.3)	15 (7.42)	0.003*
CPS (mean ± SE)	6.03 ± 0.62	3.55 ± 0.06	<0.001*
Male gender (n, %)	2 (66.66)	104 (51.4)	0.035*
GCS (mean ± SD)	7.34 ± 5.21	14.46 ± 1.92	<0.001*

Median [IQR]	3 [3-10]	15 [14-15]	
ISS (mean ± SD)	20.67 ± 12.68	8.76 ± 7.10	<0.001*
Median [IQR]	25 [10-30]	6 [4-10]	
Blunt mechanism (n, %)	3 (100)	180 (89.1)	0.901

Table 2: Univariate analyses of study variables versus mortality.
IQR interquartile range
*Denotes statistical significance (p<0.05)

All the variables examined had shown a statistically significant association with mortality and met criteria for further inclusion in multivariate analysis.

The independent predictors of mortality included age (AOR 1.21, 95 % CI 0.98-1.038, p<0.01), CPS (per-unit increase AOR 1.12, 95 % CI 1.01-1.24, p<0.02), GCS (per-unit decrease AOR 1.47, 95 % CI 1.13-1.69, p<0.01), and ISS (per-unit increase AOR 1.07, 95 % CI 1.03-1.13, p<0.01).

Table 3 outlines results of univariate analyses to determine the associations between key study variables and all cause morbidity.

Variables	Complication (n=15)	No complication (n=190)	Significance (p)
Age (mean ± SD)	72.95 ± 14.26	68.11 ± 15.34	<0.001*
CPS (mean ± SD)	4.96 ± 0.25	3.47 ± 0.06	<0.001*
Gender (male, n, %)	7 (46.6)	99 (52.1)	0.194
GCS (mean ± SD)	13.23 ± 3.73	14.44 ± 1.99	<0.001*
Median [IQR]	15 [14-15]	6 [4-10]	
ISS (mean ± SD)	15.83 ± 10.16	8.36 ± 6.77	<0.001*
Median [IQR]	14 [9-24]	15 [13-15]	
Mechanism (blunt, n, %)	14 (93.3)	168 (88.4)	0.010*

Table 3: Univariate analyses of study variables versus all-cause morbidity.
IQR interquartile range
*Denotes statistical significance (p< 0.05)

Independent predictors of all-cause morbidity included age (AOR 1.02, 95 % CI 1.01-1.03, p<0.01), CPS (per-unit AOR 1.04, 95 % CI 1.02-1.07, p<0.02), GCS (AOR 1.08 per-unit decrease, 95 % CI 1.03-1.11, p<0.01), and ISS (per-unit AOR 1.09, 95 % CI 1.08-1.11, p<0.01). Neither injury mechanism nor patient gender independently correlated with complications (both, p>0.05).

It is important to note that although CPS was associated with discharge to facility in univariate analysis (Table 4), it failed to reach sufficient significance as an independent predictor of the need for discharge to a facility upon multivariate analysis (AOR 1.11, 95 % CI 1.00-1.23, p = 0.116).

Variables	Facility (n=68)[a]	Home (n=137)	Significance (p)
Age (mean ± SD)	76.20 ± 14.11	64.33 ± 14.28	<0.001*
CPS (mean ± SD)	4.95 ± 0.11	2.86 ± 0.07	<0.001*
Gender (male, n, %)	29 (42.6)	77 (56.2)	<0.001*
GCS (mean ± SD)	13.70 ± 3.21	14.67 ± 1.35	<0.001*
Median [IQR]	15 [13-15]	15 [14-15]	
ISS (mean ± SD)	11.63 ± 8.81	7.51 ± 5.98	<0.001*

Median [IQR]	9 [5-17]	5 [4-10]	
Mechanism (blunt, n, %)	63 (92.6)	120 (87.5)	<0.001*

Table 4: Univariate analyses of key study variables versus discharge to facility (e.g., rehabilitation, skilled nursing, long-term acute care).
Data excludes in-hospital mortalities (n = 92) IQR interquartile range * Denotes statistical significance (p\ 0.05) a Discharge destination analyses exclude patients who died during the hospitalization.

Independent predictors of discharge to a facility included age (AOR 1.02, 95 % CI 1.01-1.03, p<0.01), female gender (AOR 1.25, 95 % CI 1.10-1.43, p<0.01), ISS (AOR 1.09, 95 % CI 1.07-1.10, p<0.01), and GCS (AOR per-unit decline 1.18, 95 % CI 1.12-1.21, p\0.01).

For these results, we can state that mechanism of injury was not an independent predictor of discharge to a facility (p>0.05). A secondary analysis of all key study variables as stratified by the ISS (Table 5) was conducted, in order to delineate the descriptive characteristics of the relationship between injury severity and the CPS in the current patient sample. As evidenced by these data, it was concluded that the mean CPS increased as the ISS increased, suggesting some degree of synergy between these two variables in relation to key study outcome parameters.

Variables	ISS <9 (n = 105)	ISS 9-15 (n = 67)	ISS ≥16 (n = 33)	Significance (p)
Age (mean ± SD)	67.0 ± 15.4	70.0 ± 15.2	70.4 ± 14.7	<0.001*
Any complication (n, %)	3 (2.85)	144 (7.49)	7 (21.2)	<0.001*
Complication (per patient)[a]	0.034 ± 0.004	0.114 ± 0.011	0.360 ± 0.028	<0.001*
Discharge to home (n, %)	79 (75.2)	1154 (60.0)	15 (45.4)	<0.001*
GCS (mean ± SD)	14.62 ± 1.52	14.57 ± 1.65	13.30 ± 3.68	<0.001*
Median [IQR]	15 [14-15]	15 [14-15]	15 [13-15]	
CPS (mean ±SE)[a]	3.24 - 0.080	3.84 - 0.108	4.35 - 0.171	<0.001*
Median [IQR]	2 [1-3]	2 [1-4]	2 [1-5]	
Male gender (n, %)	56 (53.3)	881 (45.8)	20 (60.6)	<0.001*
LOS, hospital (days)[a]	2.91 ± 0.064	4.69 ± 0.099	7.99 ± 0.281	<0.001*
LOS, ICU (days)[a]	0.17 ± 0.015	0.55 ± 0.034	2.84 ± 0.160	<0.001*
Mortality (n, %)	1 (0.95)	21 (1.09)	2 (6.06)	<0.001*
Blunt mechanism (n, %)	96 (91.4)	1685 (87.6)	27 (81.8)	<0.001*

Table 5: Univariate analysis of mortality versus CPS, using ISS ranges of <9, 9-15, and ≥16.
Mean (and median) CPS scores for each group are shown in bold IQR interquartile range * Denotes statistical significance (p\0.05) a Result listed as mean ± standard error, SE

Discussion

The burden of injury as well as trauma continues to be one of the leading causes of mortality in the rapidly increasing older population [1]. There continues to be variability of opinions with regard to the effects of age itself on trauma outcomes. Comorbid conditions may offer one way to estimate the overall health status of an older individual [4].

One of the hallmarks of modern medicine is the increasing prevalence and improving management of chronic health conditions. Intimately associated with the long-term control of chronic disease is the increasing utilization of multiple medications and resultant polypharmacy. In the current study, 40% of trauma patients aged 45 and older were using 5 or more concurrent medications. Other investigators report that over 90% of patients over 65 years were taking 1 or more medications, with an average number of 4.2 medications per patient [11].

Approximately 15% of the United States population is >65 years of age, this age group accounts for over 30% of medication consumption. In fact, studies show that an average geriatric patient takes anywhere between 2 to 6 prescription medications and 1 to 3 non-prescription medications simultaneously [12].

Polypharmacy was a frequent condition seen in the Indian population, especially among the older population. Polypharmacy has no standard definition. The term Poly pharmacy can also be defined as the use of multiple medications and/or the administration of more medications than that are clinically indicated, representing unnecessary drug use. It is difficult to treat patients with multiple co-morbidities with less number of drugs, as they require drugs for treatment of specific conditions as well as for prophylaxis, but it is also essential to keep a balance between the number of drugs and effective pharmacotherapy [5].

Several factors that have been postulated to contribute to poly pharmacy in the elderly some of them are the number of medications at baseline (i.e., at the time of initial contact with a given health care provider), patient age, presence of diabetes, coronary ischemic disease, heart failure, hypertension, atrial fibrillation, diseases of the esophagus and stomach, and drug use without an indication [12].

Another compounding factor is that "chronological age" does not necessarily correlate well with "physiological age", which may be why definitions of "older" vary from 45 to 75 [13].

The CPS is an attempt to provide an easy to use assessment, in the context of traumatic injury, of the combined impact of the patient's comorbidities and the "intensity" of medical therapy utilized to treat the respective comorbid conditions. While it did not correlate with patient mortality, CPS was independently predictive of post-hospital discharge to a facility. This finding may be important in early identification of patients who need post-discharge placement and can potentially help reduce hospital stays, especially considering the fact that increasing polypharmacy (and thus, CPS) may predispose patients with lower acuity injuries to have more severe clinical course, longer hospital stays, and prolonged recovery [11].

The most important finding of the current study is the validation of CPS as an independent predictor of trauma mortality in older patients [4,14].

Moreover, the observed increase in mortality associated with escalating CPS in this study is generally consistent with similar findings from other studies of similar trauma patient groups [14,15].

Our study findings also mirror result from research by Mubang, et al. [1], Evans, et al. [4] and Holmes, et al. [14], demonstrating that the independent contribution of CPS to patient mortality approximates the contribution of the ISS, further corroborating the hypothesis that the contribution of the pre-existing chronic disease burden to trauma outcomes in the older population is as important as the disease severity itself. Of interest, the current patient sample shows increasing CPS with increasing injury severity, suggesting a synergistic relationship between these two key outcome determinants. [1] Another important finding in the current study is the confirmation that CPS is independently associated with all cause morbidity [1].

This finding also provides a foundation for the argument that more aggressive approach to patients with high CPS scores may ultimately result in interventions designed to lower complication rates.

Given the already low mortality rates observed in this study, emphasis on preventing all-cause morbidity becomes even more relevant. Evidence from a previous study by Justiniano, et al. [16] provides further support for this line of reasoning, where it was noted that patients with higher CPS who were admitted to lower level(s) of care were more likely to require subsequent ICU admissions [8]. In addition, there is emerging evidence to suggest that CPS may help predict 30-day readmissions in older patients. It may be that prevention of complications may be tied to minimizing unanticipated readmissions and thus contribute to the development of value-based care approaches in our trauma system.

Although CPS did not independently correlate with the need to discharge to a facility following acute hospitalization, it failed to do so by a narrow margin. Based on previously published data [4,15,16], the authors expect that with larger study samples, this trend will likely become significant. It can be reasonably assumed that the need for discharge to a facility will correlate with a number of variables, including pre-hospital level of functioning, the disability associated with the trauma itself, and the ''physiologic reserve'' present at the time of injury, among other factors [1,4,15]. As outlined previously, the number of medications prescribed to a patient indirectly reflects the severity of the comorbid diagnoses that patient carries [1]. The current study investigates this association between comorbid conditions and medications on trauma outcomes. In recent years, the correlation between polypharmacy and trauma has been considered in terms of both cause and effect, with the former being more extensively studied. Current theories are mainly subjective or at best describe circumstantial evidence [1,17]. However, increasing direct evidence is becoming available in this important area of study [1,4,14-16]. Older patients are more likely to experience adverse drug reactions for a variety of reasons, some of which include increased polypharmacy use, drug-drug interactions, and age-related changes in drug distribution, metabolism, and elimination [18,19]. For example, increased risk of falls has been noted in patients who are prescribed six or more concurrent medications [1,17]. There is also emerging evidence that certain groups

of medications, including cardiac-specific, neuro-psychiatric, and coagulation modulators, may be more likely to be associated with adverse events and/or outcomes [1,4,20]. Seventy-five percent of adults aged 65 and older have multiple chronic conditions, and more than 1 in 4 are likely to have at least one potential therapeutic competition (i.e., treatment for one condition that may adversely affect a coexisting condition). Many of these patients are likely receiving at least one medication that may worsen a coexisting condition [21].

Conclusion

According to our data, CPS can be readily determined in the era of medication reconciliation. This study confirms that CPS is an independent predictor of all-cause morbidity and mortality in older patients, confirming findings from previous studies as well. Patients with CPS of 15 or greater are at greater risk of poor clinical outcomes.

Prospective, preferably multicenter studies are needed to evaluate the use of CPS as a predictive and interventional tool, with special focus on correlations between specific pre-existing conditions, pharmacologic interactions, and morbidity/mortality patterns.

References

1. Mubang RN, Stoltzfus JC, Cohen MS, Hoey BA, Stehly CD, et al. (2015) Comorbidity-Polypharmacy Score as Predictor of Outcomes in Older Trauma Patients: A Retrospective Validation Study. World J Surg 39(8): 2068-2075.

2. McMahon DJ, Schwab CW, Kauder D (1996) Comorbidity and the elderly trauma patient. World J Surg 20(8): 1113-1120.

3. Winkler EA, Yue JK, Birk H, Robinson CK, Manley GT, et al. (2015) Trauma in the Elderly 39:1-15.

4. Evans DC, Cook CH, Christy JM, Murphy CV, Gerlach AT, et al. (2012) Comorbidity-polypharmacy scoring facilitates outcome prediction in older trauma patients. J Am Geriatr Soc 60(8): 1465-1470.

5. Pandey M, Saharan V (2016) Prevalence and Risk Factors of Polypharmacy among Elderly in Mumbai. World J Pharm Pharm Sci 6(11): 902-907.

6. Stawicki SP, Kalra S, Jones C, Justiniano CF, Papadimos TJ, et al. (2015) Comorbidity polypharmacy score and its clinical utility: A pragmatic practitioner's perspective. J Emerg Truma Shock 8(4): 224-231.

7. Joshi SM and M (2012) Study of polypharmacy and associated problems among elderly patients. Internet J Med Updat 7(1): 35-39.

8. Chang YP, Huang SK, Tao P, Chien CW (2012) A population-based study on the association between acute renal failure (ARF) and the duration of polypharmacy. BMC Nephrol 13: 1471-2369.

9. Srikanth BA, Sireesha G (2012) Assesment on the Prevalence of Polypharmacy in Urban Population. Inven Impact Pharm Pract 2012(4): 215-218.

10. Justiniano CF, Evans DC, Cook CH, Eiferman DS, Gerlach AT, et al. (2013) Association for Academic Surgery Comorbidity-polypharmacy score : A novel adjunct in post e emergency department trauma triage. J Surg Res 181(1): 16-19.

11. Evans DC, Gerlach AT, Christy JM, Jarvis AM, Lindsey DE, et al. (2011) Pre-injury polypharmacy as a predictor of outcomes in trauma patients 1(2): 2-8.

12. Stawicki SP, Gerlach AT (2008) Polypharmacy and medication errors : Stop , Listen , Look , and Analyze. OPUS 12 Scientist 3(1).

13. Schwab CW, Kauder DR (1992) Trauma in the Geriatric Patient. Arch Surg 127(6): 701-706.

14. Holmes M, Garver M, Albrecht L, Arbabi S, Pham TN (2014) Comparison of two comorbidity scoring systems for older adults with traumatic injuries. J Am Coll Surg 219(4): 631-637.

15. Wazen RM, Kuroda S, Nishio C, Sellin K, Brunski JB, eta l. (2014) NIH Public Access 8(9): 1385-1395.

16. Justiniano CF, Coffey RA, Evans DC, Jones LM, Jones CD, et al. (2015) Comorbidity-polypharmacy score predicts in-hospital complications and the need for discharge to extended care facility in older burn patients. J Burn Care Res 36(1): 193-196.

17. Ziere G, Dieleman JP, Hofman A, Pols HAP, Van Der Cammen TJM, et al. (2006) Polypharmacy and falls in the middle age and elderly population. Br J Clin Pharmacol 61(2): 218-223.

18. Lazarus HM, Fox J, Evans RS, Lloyd JF, Pombo DJ, et al. (2003) Adverse drug events in trauma patients. J Trauma 54(2): 337-343.

19. Hämmerlein A, Derendorf H, Lowenthal DT (1998) Pharmacokinetic and pharmacodynamic changes in the elderly. Clinical implications. Clin Pharmacokinet 35(1): 49-64.

20. David CE, Govindarajan B, Anthony TG, Eiferman D, Cook CH, et al. (2012) Pre-injury warfarin use in older trauma patients: Risks and appropriateness of indications. J Am

Coll Surg 215(3): S57-S58.

21. Lorgunpai SJ, Grammas M, Lee DSH, McAvay G, Charpentier P, Tinetti ME, et al. (2014) Potential therapeutic competition in community-living older adults in the US: Use of medications that may adversely affect a coexisting condition. PLoS One 9(2): e89447.