American Journal of Emergency Medicine 34 (2016) 943–947

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Original Contribution

The ED as the primary source of hospital admission for older (but not younger) adults☆,☆☆

Peter W. Greenwald, MD, MS, Rosa M. Estevez *, Sunday Clark, MPH, ScD, Michael E. Stern, MD, Tony Rosen, MD, MPH, Neal Flomenbaum, MD

Emergency Department, Weill Cornell Medical College, New York, NY 10065

ARTICLE INFO

Article history:
Received 26 January 2015
Received in revised form 26 May 2015
Accepted 26 May 2015

ABSTRACT

Introduction: The elderly population in the United States is growing. This age shift has important implications for emergency departments (EDs), which currently account for more than 50% of inpatient hospitalizations. Our objective was to compare the percentage of inpatient admissions starting in the ED between elderly and younger patients.

Methods: We conducted a retrospective analysis using the National Hospital Discharge Survey. Source of admission to the hospital was evaluated for years 2003 to 2009. Total admissions from the ED and trends over time were analyzed for the following age groups: 22 to 64, 65 to 74, 75 to 84, and 85 + years old. Likelihood of having been admitted from the ED was evaluated with logistic regression.

Results: A total of 1.7 million survey visits representing 216 million adult hospitalizations were analyzed. A total of 93 million (43.2%) were among patients 65 years and older. The ED was the source of admission for 57.3% of patients 65 years and older and 44.4% of patients 64 years and younger (95% confidence interval difference, 12.97%-13.00%). By 2009, more than 75% of nonelective admissions for patients 85 years and older were through the ED. There was a linear relationship between age and the ED as the source of admission, the odds increasing by 2.9% per year (95% confidence interval, 1.029-1.029) for each year beyond age 65 years.

Conclusion: Emergency departments are increasingly used as the gateway for hospital admission for older adults. An aging US population may increase the effect of this trend, a prospect that should be planned for. From the patient perspective, barriers to care contributing to the age-based discrepancy in the use of the ED as source of admission should be investigated.

1. Introduction

The role of emergency departments (EDs) within the US health care system is changing. More than half of patients admitted to the hospital in the United States now start their hospital stay in the ED. Between 2003 and 2009, hospital admissions originating in the ED increased by 17%, whereas admissions from physicians' offices and clinics decreased by 10% [1].

Although the extent to which a patient's age is a factor in the growing use of the ED as a gateway to hospitalization has not been studied, there are several reasons to think that older patients may be disproportionately affected. The ED is a location where specialty consultation and advanced diagnostic technology are available at all hours. Given the medical complexity of older adults combined with the diagnostic and time constraints of primary care practices, older patients in need of these acute services are more likely to be referred to the ED [2-4]. In addition, patients themselves may be aware of the increased resources available in the ED or have experienced their physician's limitations, causing them to self-select the ED as their source of care. Once in the ED, older patients are more likely to be admitted than younger patients [5,6].

As is now well documented, there is a demographic change taking place in the United States; the population of older adults is growing. During the 2010 Census, more people were older than 65 years than at any previous time [7]. Between 2000 and 2010, the population 65 years and older increased at a faster rate (15.1%) than the total US population (9.7%) [8]. The total number of adults 65 and older in the United States is projected to double to 70 million between 2000 and 2030, at which point older adults will comprise 20% of the US population. Currently, the fastest growing older age group is people 85 years and older [2,9,10]. Older adults account for approximately 15% of annual US ED visits [10,11]. Based on current visit rates, this number is projected to increase to 25% by 2030 [11]. If older patients are more likely than younger patients to have their inpatient stays start in the ED, then these demographic changes will accelerate the growing use of the ED as the principal gateway to hospitalization

We used the 2003-2009 National Hospital Discharge Survey (NHDS) to investigate the relationship between increasing age and the

☆ Sources of support: None.
☆☆ Presentation: Preliminary data presented at Society of Academic Emergency Medicine Annual Meeting, May 2014.
* Corresponding author at: Emergency Medicine Residency, New York Presbyterian Hospital, 565 East 68th St, Box 301, New York, NY 10065. Tel.:+1 347 400 5844.
E-mail addresses: petergreenwald@gmail.com (P.W. Greenwald), rme2001@nyp.org (R.M. Estevez), suc2010@med.cornell.edu (S. Clark), mestern@med.cornell.edu (M.E. Stern), trosen73@gmail.com (T. Rosen), nef2002@med.cornell.edu (N. Flomenbaum).

http://dx.doi.org/10.1016/j.ajem.2015.05.041
0735-6757/

likelihood that hospitalization begins in the ED. Our analysis paralleled the methodology used by the RAND Corporation in their 2013 report "The Evolving Role of Emergency Departments in the United States," with the addition of stratification by age.

2. Methods

We conducted an analysis of data from the NHDS, an annual survey conducted by the National Center for Health Statistics at the Centers for Disease Control and Prevention. The NHDS is a complex, stratified, multistage probability design survey that draws on hospital discharge records from more than 250 000 patients at short-stay nonfederal hospitals. The data sets and probability design are available for public use (http://www.cdc.gov/nchs/about/major/hdasd/nhdsdes.htm; accessed May 9, 2013). Inclusion eligibility is restricted to hospitals having 6 or more beds and an average length of stay for all patients less than 30 days [12].

The NHDS provides detailed information on patient demographics, type of admission, source of admission, geographic region, expected source of payment, hospital size, and type of hospital ownership [12]. "Observation" status hospital stays are not included in the NHDS.

The NHDS data set includes "source of hospital admission" data starting in 2001 and ending in 2010. To allow for comparisons between our analysis and RAND's 2013 report, we evaluated data from 2003 to 2009. RAND limited their report to these years because of high rates of missing data in the source of admission field for years 2001 and 2002. Data for 2010 were not included by RAND because the coding guidelines changed, making comparison to earlier years unreliable [1].

The NHDS lists the following 10 categories for source of admission: (1) ED, (2) physician referral, (3) clinical referral, (4) HMO referral, (5) transfer from a hospital, (6) transfer from a skilled nursing facility, (7) transfer from other health facility, (8) court/law enforcement, (9) other, and (10) not available [12]. Our analysis compared the ED as the source of hospital admission to all other sources of admission. The NHDS also codes the acuity of admission as emergency, urgent, elective, and not available. We considered emergency and urgent admissions as "non-elective" admissions and compared them to elective admissions. Nonelective admissions are defined by their inability to be postponed and are dictated by the patient's medical condition and their treating physician's determination that hospitalization is required to address the problem. Elective admissions are not urgent and are chosen by the patient or their physician for reasons that are perceived to be beneficial to the patient [1].

The proportion of missing data for the category "source of admission" decreased steadily from 12% in 2003 to 4% in 2009. There were also changes in missing data for "admission type" by year. To address missing data for both source of admission and hospital admission type, we used the same methodology described by RAND: multivariable imputation using year, region, sex, and age group was used when source of admission or "hospital admission type" were coded as "not available" [1]. Multivariable imputation allows estimation missing values for source of admission and hospital admission type within strata of year, region, sex, and age group. Results of analysis of unimputed data and details regarding distribution of not available data are provided in the appendix. Our analysis included admissions for adults 22 years and older. We evaluated age both as a linear variable and by grouping patients as younger (age <65 years) vs older (age ≥65 years). In addition, we categorized age into 4 bins: age 22 to 64 years, age 65 to 74 years, age 75 to 84 years, and age ≥85 years. Percentage of admissions starting in the ED was calculated for grouped data. The relationship of age as a linear predictor for source of hospital admission was evaluated with logistic regression. Models were evaluated with and without adjustment for the effect of sex, ethnicity, insurance type, hospital size, hospital ownership, and geographic region. Additional models were constructed that were limited to patients older than 64 years based on the presence of a strong linear relationship between age and source of admission for those 65 years and older. Trends over time were evaluated by calculating percentage of patients admitted from the ED by year and age group.

All analyses were conducted using Stata version 12.0 (StataCorp, LP, College Station, TX).

The study was reviewed by the Weill Cornell Medical College Institutional Review Board and classified as exempt.

3. Results

Between 2003 and 2009, there were 1.7 million NHDS survey visits, representing 216 million adult hospitalizations. Of the 216 million hospitalizations, 93 million (43.2%) were among patients 65 years and older. Of all hospitalizations, 60.1% were for women. The mean age of patients at the time of admission was 58 years old. Nonelective admissions were 73.4% of total admissions. Slightly more than 50% of admissions were from the ED.

The ED was the source of admission for 57.3% of patients 65 years and older (95% confidence interval [CI], 57.3%-57.4%) and for 44.4% of patients younger than 65 years (95% CI, 44.4%-44.4%), with a difference of 12.99% (95% CI difference, 12.97%-13.00%). For patients age 65 to 74 years, 51.8% of admissions started in the ED (95% CI, 51.8%-51.9%); for patients age 75 to 84 years, 58.1% of admissions started in the ED (95% CI, 58.1%-58.2%); and for patients 85 years and older, 64.9% of their hospitalizations began in the ED (95% CI, 64.9%-64.9%).

There were differences in percentage of admissions starting in the ED by sex, region, hospital size, hospital type, race, and patient insurance type. These differences are summarized in Table 1.

The plot of percentage of admission from the ED by age demonstrates age-based differences in the use of the ED as the source of

Table 1
NHDS admissions and percentage of those admissions coming from the ED: by sex, race, primary payer type, hospital size, hospital ownership, and region

	No. of admissions (% total)	Percentage of admissions from ED (95% CI)
Patient sex		
Male	86 108 254 (39.9)	56.8 (56.8-56.8)
Female	129 933 308 (60.1)	45.5 (45.5-45.5)
Patient race		
White	131 917 987 (61.1)	49.3 (49.3-49.3)
Black/African American	25 902 002 (12.0)	59.0 (58.9-60.0)
American Indian/Alaskan Native	764 633 (0.4)	46.1 (46.0-46.0)
Asian	3 251 301 (1.5)	38.6 (38.6-38.7)
Native Hawaiian or other Pacific	343 530 (0.2)	45.4 (45.2-45.5)
Other	4 286 380 (2.0)	52.2 (52.2-52.3)
Multiple race	246 661 (0.1)	51.7 (51.5-51.9)
Race not stated	49 329 068 (22.8)	47.8 (47.8-47.8)
Hospital region		
Northeast	46 815 827 (21.7)	57.7 (57.6-57.7)
Midwest	49 944 954 (23.1)	48.6 (48.6-48.6)
South	80 078 411 (37.1)	49.8 (49.8-49.8)
West	39 202 370 (18.1)	42.9 (42.8-42.9)
Hospital bed size		
6-99	47 933 427 (22.2)	48.6 (48.5-48.6)
100-199	46 507 930 (21.5)	53.3 (53.3-43.4)
200-299	45 196 783 (20.9)	51.5 (51.4-41.5)
300-499	48 224 016 (22.3)	52.7 (52.7-52.7)
500 +	28 179 406 (13.0)	47.3 (47.3-47.3)
Hospital ownership		
Government hospital	26 888 809 (12.4)	51.4 (51.3-51.4)
Proprietary hospital	24 564 504 (11.4)	38.8 (38.8-38.8)
Nonprofit hospital	164 588 249 (76.2)	51.4 (51.4-51.4)
Primary payer		
Worker's compensation	1 088 400 (0.5)	39.8 (39.7-39.8)
Medicare	97 033 222 (44.9)	57.1 (57.1-57.1)
Medicaid	27 183 916 (12.6)	45.5 (45.4-45.5)
Other government	3 214 053 (1.5)	47.0 (47.0-47.1)
BlueCross/BS	19 000 761 (8.8)	39.0 (39.0-39.1)
HMO/PPO	31 092 180 (14.4)	39.9 (39.3-39.3)
Other private insurance	19 157 928 (8.9)	41.6 (41.6-41.7)
Self-pay	9 943 651 (4.6)	66.8 (66.8-66.8)
No charge	437 675 (0.2)	62.1 (61.9-62.2)
Other	3 964 798 (1.8)	43.9 (43.8-43.9)
Payer not stated	3 924 978 (1.8)	51.2 (51.2-51.3)