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Emergency Department Utilization Patterns Among Older Adults

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Abstract

Background—We identified 4-year (2 years before and 2 years after the index [baseline] interview) ED use patterns in older adults and the factors associated with them.

Methods—A secondary analysis of baseline interview data from the nationally representative Survey on Assets and Health Dynamics Among the Oldest Old linked to Medicare claims data. Participants were 4310 self-respondents 70 years old or older. Current Procedural Terminology (CPT) codes 99281 and 99282 identified low-intensity use, and CPT codes 99283–99285 identified high-intensity use. Exploratory factor analysis and multivariable multinomial logistic regression were used.

Results—The majority (56.6%) of participants had no ED visits during the 4-year period. Just 5.7% had only low-intensity ED use patterns, whereas 28.9% used the ED only for high-intensity visits, and 8.7% had a mixture of low-intensity and high-intensity use. Participants with lower immediate word recall scores and those who did not live in major metropolitan areas were more likely to be low-intensity-only ED users. Older individuals, those who did not live in rural counties, had greater morbidity and functional status burdens, and lower immediate word recall scores were more likely to be high-intensity-only ED users. Participants who were older, did not live in major cities, had lower education levels, had greater morbidity and functional status burdens, and lower immediate word recall scores were more likely to have mixed ED use patterns.

Conclusions—Nearly half of these older adults used the ED at least once over a 4-year period, with a mean annual ED use percentage of 18.4. Few, however, used the ED only for visits that may have been avoidable. This finding suggests that triaging Medicare patients would not decrease ED overcrowding, although continued surveillance is necessary to detect potential changes in ED use patterns among older adults.

Keywords

Emergency department; Utilization patterns; Medicare, Claims data

Americans rely on hospital emergency departments in growing numbers because of the skilled specialists and advanced technologies they offer. At the same time, the increasing use of the emergency care system also represents failures of the larger health care system—the growing numbers of uninsured Americans, the limited

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> alternatives available in many communities, and the inadequate preventive care and chronic care received by many. These demands can degrade the quality of emergency care and hinder its ability to provide urgent and life-saving care to seriously ill and injured patients wherever and whenever they need it. (1)

So begins the foreword to the three-volume Institute of Medicine (IOM) Report on the Future of Emergency Care (2). The lead volume in that IOM report defines the problem in a nutshell—a "national epidemic of overcrowded EDs (Emergency Departments) and trauma centers." In simple economic terms, there is a critical imbalance between demand and supply.

From 1993 to 2003 there was a net loss of 703 hospitals (11%) in the United States, a 198,000 (17%) decline in the number of inpatient beds, and a net decline of 425 EDs (9%) (3). At the same time, the U.S. population grew by 12%, hospital admissions increased by 13%, and ED visits went up by 26% (4). As a result, national studies have found that 91% of EDs report overcrowding as a problem (5), with 40% of all EDs reporting that the problem occurs daily (6), and that academic medical center EDs were overcrowded 35% of the time (7,8).

To understand the demand side of the equation, it helps to consider the payment sources. There were four major payers for the 114 million ED visits in 2003: private health insurance (36%), Medicaid (21%), Medicare (16%), and self-pay (14%) (4). Although the factors associated with the demand for ED services likely differ by payment source, little has been done to identify these factors from a population-based perspective (2,8). This is especially surprising with respect to older adults given the potential demand that the "graying of America" may place on EDs (2). Moreover, the emergency medicine community is concerned that the role of older adults was surprisingly downplayed by the IOM Report (9), especially given the monopsonistic ability to intervene via Medicare payment policy. Accordingly, this article focuses on an initial identification of ED use patterns and the factors associated with them in a large, representative sample of older adults covered by Medicare.

METHODS

Data

We conducted a secondary analysis of the baseline interview data from the Survey on Assets and Health Dynamics Among the Oldest Old (AHEAD). The design and sampling approach in the AHEAD have been well-described elsewhere (10–13). Because African Americans, Hispanics, and Floridians were oversampled, all analyses are weighted to adjust for the unequal probabilities of selection due to the multistage cluster and oversampling. The AHEAD provides a nationally representative probability sample of 4310 men and women who were 70 years old or older and self-respondents at baseline (1993) and whose survey data could be linked to their Medicare claims. Medicare claims were available from January 1991 through December 1996. For each AHEAD participant, we used all Medicare claims available within a 4-year window centered on the date of their baseline in-home interview (i.e., 2 years prior to and 2 years afterward).

Measurement

To identify ED visits in the Medicare claims, we used Current Procedural Terminology (CPT) codes (14). Following the IOM report (2), we relied on CPT codes 99281–99285, which account for >80% of all Medicare expenditures for ED services. CPT codes 99281 and 99282 correspond to payment for a low intensity of physician services, which could have been provided in alternative settings (i.e., physician offices or other outpatient

settings), suggesting that such ED visits might have been potentially avoidable or nonurgent (2). In contrast, CPT codes 99284 and 99285 correspond to payment for a high intensity of physician services for life-threatening situations, and for which ED visits are more clearly appropriate. CPT code 99283 corresponds to payment for a medium intensity of physician services which, although not life-threatening, may also be appropriate for ED visits.

Analytic Approach

We began with a two-stage exploratory factor analytic (EFA) approach (15–18). To determine empirical clusters, the first stage of our EFA approach began with 20 variables created from the harvest of the Medicare claims. These variables represented the annual total of ED visits corresponding to each of the five CPT codes. We expected a relatively simple factor structure to emerge from the EFA of these 20 variables (four annual totals for each of five CPT codes) in which the annual numbers of ED visits with CPT codes 99281 and 99282 would all load on one factor, and that the annual numbers of ED visits with CPT codes 99283–99285 would all load on another factor. In the second stage of our EFA approach, we constructed variables representing the annual counts of the numbers of ED visits in each of the two expected clusters (CPT codes 99281 and 99282 and CPT codes 99283–99285) and conducted EFA on those eight variables (the annual number of ED visits in each of the two CPT code groups).

We then examined the evidence of criterion validity (19) for our classification approach consistent with prior triaging studies (20–23). Specifically, we examined arrival by ambulance and hospitalization transition rates, mean length of stay and charges (if admitted), and mortality (by CPT code). We also applied an alternative *International Classification of Diseases*, Ninth Revision, Clinical Modification (ICD-9-CM)-based approach developed by Billings and colleagues (24,25) to our data, and cross-classified the resulting mean estimated probabilities of their ED visit classification types by CPT codes. Finally, we compared and contrasted the top ICD-9-CM codes associated with low- versus high-intensity ED visits.

Multivariable multinomial logistic regression (26) was used to compare and contrast characteristics associated with each ED use pattern, using no ED use as the overall reference group. More than 40 variables traditionally used in studying the demand for health care (27) were considered, including sociodemographics, socioeconomics, lifestyle, disease history, and functional health status. Model development and evaluation followed standard procedures (28,29), with the final model restricted to factors with significant ($p < .05$) independent associations with ED use patterns.

RESULTS

Descriptive

Table 1 contains the means (or proportions), standard deviations, and coding algorithms for each of the sociodemographic, socioeconomic, lifestyle, disease history, and functional health status variables considered as possible predictors of ED use patterns. Among the 4310 AHEAD participants in the analytic sample (weighted $N = 4337$), the mean age was 77 years, 35% were men, 9% were African American, 4% were Hispanic, and 43% were widowed. One-fourth had only been to grade school, and mean income was $25K. One-fourth had arthritis, 8% had angina, 13% had cancer, 11% had diabetes, 46% had hypertension, 4% had fractured a hip, and 7% had psychological problems. The mean number of activities of daily living (ADL) difficulties was 0.29, and the mean number of instrumental ADL (IADL) difficulties was 0.18. The mean annual percentage of participants

having any ED visits was 18.4% (range = 14.8%–20.6%). The 4-year period prevalence rate of participants having any ED visits was 44.4%.

Factor Analysis

We began with an EFA of the 20 variables representing the annual total of ED visits corresponding to each of the five CPT codes. A two-factor common model was initially extracted, and we expected these two factors to be modestly correlated. The initial results obtained (data not shown) were generally consistent with these expectations and revealed the anticipated principal factor loadings, no evidence of factorial complexity, and a modest correlation between the two factors. This indicated the appropriateness of combining CPT codes 99281 and 99282 into the low-intensity category and CPT codes 99283–99285 into the high-intensity category. We then performed EFA on the eight variables reflecting the annual numbers of low intensity (CPT codes 99281 and 99282) and high intensity (CPT codes 99283–99285) ED visits. As shown in Table 2, this EFA resulted in the expected simple two-factor structure.

Criterion Validity

We then examined the evidence of criterion validity (19) consistent with prior triaging studies (20–23). As shown in Table 3, with three exceptions there is a direct, monotonic relationship between increasing relative effort intensity levels (CPT codes) and the criteria for ED appropriateness. Table 4 contains the mean estimated probabilities of ED visit types from the ICD-9-CM based approach developed by Billings and colleagues (24) by CPT codes. With two exceptions, there is a direct, monotonic relationship between increasing relative effort intensity levels and the appropriateness of the ED visits (chi-square = 213.11; $df = 12$; $p < .0001$). Moreover, both errors involve the CPT code (99281) with the smallest ED visit share.

We also identified the five most frequent ICD-9-CM codes associated with low- versus high-intensity ED visits. For high-intensity ED visits, these were chest pain (ICD-9-CM code 786.5), congestive heart failure (428.0), respiratory distress and insufficiency (786.09), pneumonia (486.0), and other symptoms involving the abdomen or pelvis (789.0) and accounted for 18.5% of all high-intensity visits. In contrast, for low-intensity ED visits, the top five ICD-9-CM codes were open wounds of fingers (883.0), unspecified (ICD-9-CM code 401.9), other symptoms involving the abdomen or pelvis (789.0), other disorders of the urethra or urinary tract (599.0), and epistaxis (nosebleed; 784.7) and accounted for 11.1% of all low-intensity visits. These striking differences in the underlying diagnostic reasons for these ED visits provide further criterion validity for our approach.

ED Use Patterns

Based on these results, we placed each AHEAD participant into one of four ED use patterns: (i) no ED use, (ii) low-intensity-only ED use, (iii) high-intensity-only ED use, and (iv) mixed (low and high) intensity ED use. The majority of participants (56.6%) had no ED use during the 4-year period. Only 5.7% were low-intensity-only ED users (mean = 1.40 ED visits), whereas 28.9% were high-intensity-only ED users (mean = 2.02 ED visits). Mixed (low and high intensity) ED use was found for 8.7% of the AHEAD participants (mean = 4.67 ED visits).

Multivariable Model

Of the >40 variables considered as potential predictors of ED use patterns (see Table 1), only 12 had significant independent associations. Table 5 contains the adjusted odds ratios (AORs) obtained from the final model. As shown, the only variables that significantly

discriminated those who had no ED use from those who had low-intensity-only ED use were population density and cognitive ability. Participants who lived in rural counties and small cities and those who scored in the lower half on the immediate word recall test were more likely to be low-intensity-only ED users (AORs = 2.923, 2.287, and 1.553, respectively; all $p<.001$).

In contrast, all but 3 of the 12 variables included in the final model discriminated between participants with no ED use and those with high-intensity ED use only. The risk (i.e., odds) of high-intensity-only ED use increased by 5% with each year of age, by 5% with each depressive symptom, by 51% for those with angina, by 37% with each major comorbid condition, by 74% for those reporting poor self-rated health, by 24% for each IADL limitation, and by 26% for those in the lower half on the immediate word recall test. Participants with hypertension were 18% less likely, and those living in rural counties were 25% less likely, to be high-intensity-only ED users.

All but 1 of the 12 variables included in the final model also discriminated between participants with no ED use and those with mixed (low and high) intensity ED use patterns. The risk of mixed intensity ED use increased by 3% with each year of age, by 97% for those living in rural counties, by 54% for those living in small cities, by 44% for those with only a grade school education, by 10% with each depressive symptom, by 85% for those with angina, by 44% with each major comorbid condition, by 73% for those reporting poor self-rated health, and by 40% for those in the lower half on the immediate word recall test. Those with hypertension were 41% less likely to be mixed-intensity ED users.

DISCUSSION

In a nationally representative sample of 4310 older adults, we used CPT codes to identify four ED use patterns across 4 years of data. Only 5.7% of the sample participants were low-intensity-only ED users, whereas 28.9% were high-intensity-only ED users. Mixed (low and high) intensity ED use was found for 8.7% of participants. This pattern of ED usage leads to our first conclusion. Although nearly half of our nationally representative sample of older adults used the ED at least once over a 4-year period, the demand that they placed on EDs would only be modestly alleviated by focusing on triaging presumably nonurgent (low intensity) and potentially avoidable visits to alternative care sources and sites, even if effective triaging procedures were widely introduced and implemented.

We also used sociodemographic, socioeconomic, lifestyle, disease history, and functional health status measures in a multivariable, multinomial logistic regression to predict ED use patterns. Compared to older adults who did not use the ED (the reference group), the only distinguishing features of participants who used the ED only for low-intensity visits were that they more likely to have resided in rural counties or smaller cities (vs major metropolitan areas) and scored in the lower half on the immediate word recall test (a measure of cognitive performance). Given the limited modifiability of these three traits (although not the processes that led to them), we conclude that it is unlikely that an effective intervention for triaging potentially avoidable ED visits to alternative sources of health care can be developed. Moreover, increased reliance on the ED for potentially avoidable visits among those living in less metropolitan areas likely reflects restricted access to alternative sources of health care in the first place.

Compared to older adults who did not use the ED, those who used the ED for high-intensity-only visits were more likely to be older, to be men, to have greater morbidity and comorbidity, to have scored on the lower half on the immediate word recall test, and to perceive their health to be poor. Thus, the principal drivers of high intensity (and

presumably appropriate) use of the ED are generally medical need. The immutability of most of these factors further attests to the low likelihood that reducing the demand on and overcrowding of the ED can be readily achieved. Similarly, the major predictors of mixed (low and high) intensity ED use (compared to those of no ED use) were principally measures of medical need, except for the large effect of lower educational attainment. Participants who only completed grade school were 44% more likely to use the ED for mixed-intensity levels. Given the limited modifiability of educational attainment, this also does not bode well for potential interventions.

This initial investigation of ED use patterns is not without limitations. We focused on CPT codes for relative effort intensity levels rather than diagnoses, although we also showed that the correspondence between the two was considerable. Our approach did not consider attrition from Medicare claims due to a participant's movement into managed care participation, or death (although all participants were alive and not participating in managed care Medicare plans for the first 2 years of the 4-year period). We have also not addressed continuity of care, the fractional share of ambulatory care provided through ED visits, or the volume of ED visits. Furthermore, the day of the week on which the ED use occurred cannot be addressed using these AHEAD data, nor can ED use that occurs when the participants are not in the vicinity of their home residence. Finally, our data are about a decade old, and there is evidence in the IOM report (2) that the volume of ED has increased since then. There is no indication, however, that the patterns of ED use among older adults have changed. Nonetheless, continued surveillance to detect potential changes in ED use patterns among older adults is recommended before these results should be considered definitive.

Those limitations notwithstanding, our findings do shed light on the current ED crisis. Unfortunately, we do not have an easy solution to offer. Simply put, the results suggest that little alleviation of the ED overcrowding phenomenon is likely to accrue from focusing on older adults.

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Table 1

Coding Algorithms, Means (or Proportions), and Standard Deviations of the Potential Predictor Variables of ED Use Patterns Among the 4310 AHEAD Self-Respondents (Weighted *N* = 4337)

Variable	Coding Algorithm	Mean	Standard Deviation
Sociodemographics			
Age	Number of years	77.33	5.67
Gender	1 = men, 0 = women	.35	.48
Race			
White (reference group [R])	1 = yes, 0 = no	.86	.34
African American	1 = yes, 0 = no	.09	.28
Hispanic	1 = yes, 0 = no	.04	.20
Other	1 = yes, 0 = no	.01	.10
Living children	Actual number	2.68	2.15
Household size	Actual number	1.80	.90
Widowed	1 = yes, 0 = no	.43	.50
Population density			
Major city (≥250K; R)	1 = yes, 0 = no	.70	.46
Small city (20–250K)	1 = yes, 0 = no	.13	.33
Rural county (<20K)	1 = yes, 0 = no	.18	.38
Socioeconomics			
Education	1 = grade school, 0 = beyond	.25	.43
Working for pay	1 = yes, 0 = no	.09	.28
Poor neighborhood safety	1 = yes, 0 = no	.03	.17
Household income	Number of dollars	25,432.60	37,470.12
Household wealth	Number of dollars	180,067.84	292,862.02
Disease history			
Major condition count	Actual number	1.47	1.21
Angina	1 = yes, 0 = no	.08	.27
Arthritis	1 = yes, 0 = no	.25	.43
Cancer	1 = yes, 0 = no	.13	.34
Diabetes	1 = yes, 0 = no	.11	.32
Heart attack	1 = yes, 0 = no	.06	.25
Hip fracture	1 = yes, 0 = no	.04	.20
Hypertension	1 = yes, 0 = no	.46	.50
Lung disease	1 = yes, 0 = no	.09	.28
Psychological conditions	1 = yes, 0 = no	.07	.26
Stroke	1 = yes, 0 = no	.08	.27
Weight to height			
Underweight	1 = yes, 0 = no by NIH	.03	.17
Appropriate (R)	1 = yes, 0 = no by NIH	.83	.38
Obese	1 = yes, 0 = no by NIH	.14	.35
Functional health			

Variable	Coding Algorithm	Mean	Standard Deviation
Self-reported to be often bothered by pain	1 = yes, 0 = no	.32	.47
Poor self-rated memory	1 = yes, 0 = no	.04	.21
Poor self-rated hearing	1 = yes, 0 = no	.05	.22
Poor self-rated vision	1 = yes, 0 = no	.08	.27
Depressive symptoms	Actual number of 8	1.67	1.96
ADL count	Actual number of 7	.29	.74
IADL count	Actual number of 3	.18	.47
CAGE (alcoholism) cut-down question	1 = yes (need to cut-down on drinking), 0 = no	.07	.26
Driving status			
Never had a license	1 = yes, 0 = no	.11	.32
Unable to drive now (R)	1 = yes, 0 = no	.19	.38
Able to drive now	1 = yes, 0 = no	.70	.46
TICS cognitive battery	0 = worst, 15 = best	11.96	2.97
Immediate word recall	1 = below 50th percentile		
	0 = above 50th percentile	.50	.50
Delayed word recall	1 = below 50th percentile		
	0 = above 50th percentile	.56	.50
Self-rated overall health			
Excellent	1 = yes, 0 = no	.11	.32
Very good/Good/Fair (R)	1 = yes, 0 = no	.78	.41
Poor	1 = yes, 0 = no	.11	.32

Note: ED=emergency department; AHEAD=Survey on Assets and Health Dynamics Among the Oldest Old; NIH=National Institutes of Health; ADL=activities of daily living; IADL=instrumental ADL; CAGE=screening for alcohol abuse (Cut-down, Annoyed, Guilty, Eye Opener); TICS=Telephone Interview for Cognitive Screening.

Table 2

Factor Loadings for the Number of Low Intensity (CPT Codes 99281 and 99282) and High Intensity (CPT Codes 99283–99285) ED Visits, by Observation Year, Among 4310 AHEAD Self-Respondents

Annual Number of ED Visits of …	Factor 1	Factor 2
Low intensity during the 1st year	.044	.456*
Low intensity during the 2nd year	.020	.648*
Low intensity during the 3rd year	−.109	.744*
Low intensity during the 4th year	.037	.565*
High intensity during the 1st year	.801*	−.045
High intensity during the 2nd year	.791*	.033
High intensity during the 3rd year	.769*	−.073
High intensity during the 4th year	.545*	.097

Notes:

* Principal factor loading.

CPT = Current Procedural Terminology; ED = emergency department; AHEAD = Survey on Assets and Health Dynamics Among the Oldest Old.

Table 3

Criterion Validation Data for the CPT Code-Based Classification Approach

Criterion Variable	CPT Code 99281	CPT Code 99282	CPT Code 99283	CPT Code 99284	CPT Code 99285
Percentage of all ED visits, %	4.3	14.9	31.4	27.4	21.9
Arrival by ambulance, %	10.3	11.5	18.2	26.7	35.2
Admitted to hospital, %	6.0	8.2	14.3	26.2	38.2
Length of stay, mean days if admitted	5.2	6.9	8.6	7.1	7.4
Medical charges, mean $ if admitted	7909	9844	11,070	11,341	13,175
All-cause NDI mortality by 2 years after the baseline interview, % dead	9.3	3.3	6.9	12.9	22.3

Note: CPT = Current Procedural Terminology; ED = emergency department; NDI = National Death Index.

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Table 4

Mean Probabilities of the Billings and Colleagues (24,25) ED Visit Types by CPT Codes

Billings and Colleagues ED Visit Types	CPT Code 99281	CPT Code 99282	CPT Code 99283	CPT Code 99284	CPT Code 99285
Nonemergent visit	.214	.195	.159	.118	.080
Emergent visit, primary care treatable	.294	.330	.298	.247	.207
ED care needed, but the condition was preventable/avoidable	.062	.090	.103	.153	.189
ED care needed, and the condition was not preventable or avoidable	.250	.199	.253	.290	.353
Not classifiable by the Billings and Colleagues algorithm	.180	.186	.187	.192	.171
Total	1.000	1.000	1.000	1.000	1.000

Note: ED = emergency department; CPT = Current Procedural Terminology.

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Table 5

Adjusted Odds Ratios From the Final Multivariable Multinomial Logistic Regression Model of ED Utilization Patterns Among 4135 AHEAD Self-Respondents With Complete Data (Weighted $N = 4172$)

Variable	No ED Use Group (Reference)	Low-Intensity-Only ED Use Group	High-Intensity-Only ED Use Group	Mixed-Intensity ED Use Group	Overall *p* Value
Age	1.000	1.015	1.050*	1.028†	.001
Rural county	1.000	2.923*	0.750†	1.970*	.001
Small city	1.000	2.287*	0.966	1.541‡	.001
Grade school education	1.000	0.915	0.986	1.444†	.029
Major comorbid condition count	1.000	1.090	1.372*	1.500*	.001
Angina	1.000	1.269	1.507†	1.850*	.005
Hypertension	1.000	0.980	0.817‡	0.586*	.001
Psychological problem	1.000	0.929	0.747	0.492†	.016
Depressive symptom count	1.000	0.992	1.049†	1.096†	.008
IADL count	1.000	0.736	1.239†	1.1331	.010
Lower half immediate word recall scores	1.000	1.553†	1.264†	1.404†	.001
Poor self-rated health	1.000	1.144	1.740*	1.733†	.001

Notes:

*$p \leq .001$.

†$p \leq .01$.

‡$p \leq .05$.

ED = emergency department; AHEAD = Survey on Assets and Health Dynamics Among the Oldest Old; IADL = instrumental activities of daily living. Chi-square reduction from the original null model was 532.9 (36 *df*), $p \leq .001$.