ORIGINAL RESEARCH

Frequent Use of Emergency Medical Services by the Elderly: A Case-Control Study Using Paramedic Records

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Funding sources and financial interests:
Preliminary results were presented at the National Association of EMS Physicians meeting, Tucson, Arizona 2004

Keywords: elderly patient; emergency medical services; homelessness; utilization

Abbreviations:
EMS = emergency medical services
PCR = patient care report

Received: 02 February 2009
Accepted: 30 April 2009
Revised: 17 June 2009

Web publication: 03 June 2010

Abstract

Objective: The objective of this study was to identify the factors that lead to increased use of emergency medical services (EMS) by patients ≥65 years of age in an urban EMS system.

Methods: Retrospective, case-control study of frequent EMS use among elderly patients transported during one year in an urban EMS system. Three distinct groups were examined for transports that took place in 1999: (1) 1–3 transports per year (low use); (2) 4–9 times per year (high use); and (3) those transported 10+ times (very high use). This frequency-use indicator variable is the primary outcome measurement. Predictors included age, gender, pre-existing medical diseases, ethnicity, number of medications, number of medical problems, primary physician, psychiatric diagnosis, and homelessness. Analysis of predictors was done using ordinal logistic regression model, and a global test of interaction terms.

Results: Male gender, black ethnicity, homelessness, and a variety of types of medical problems were associated with increased use of EMS resources. The strongest single predictor of case status remained homelessness, which was nearly eight times as commonly associated with frequent EMS use than for the controls. The number of medical problems and medications also were significantly associated with EMS use in this patient population. There was a lack of association of alcohol, substance abuse, and psychiatric disorders with EMS use. Patients with asthma who did not have a primary care physician were more likely to use EMS services than were those who had a physician.

Conclusions: This analysis highlights homelessness as being strongly associated with frequent EMS use among the elderly and downplays other associated factors, such as psychiatric disease and substance use. Medical illness severity, particularly asthma when no primary care physician is available, also appears to drive frequent EMS use. Both findings have implications in terms of targeting of public resources; providing housing to medically ill elderly and primary care to asthmatics in particular, may provide dividends not only in terms of social welfare and medical care, but in preventing frequent EMS use by the elderly.

Tangherlini N, Pletcher MJ, Covec MA, Brown JF: Frequent use of emergency medical services by the elderly: A case-control study using paramedic records. *Prehosp Disaster Med* 2010;25(3):258–264.

Introduction

Elderly persons represent the fastest growing segment of the US population,[1] and as a group utilize emergency medical services (EMS) at higher rates than do younger persons.[2] In recent years, emergency departments in the US, which account for 10% of ambulatory healthcare expenditures in the US, have been increasingly busy and overcrowded.[3] These factors have resulted in negative impacts on EMS,[4] and emergency departments are used more frequently by the elderly than by younger patients.[5] Identifying factors that lead to use of EMS may help physicians and public health officials target medical or social services to individuals in need and simultaneously decrease costly overuse of EMS resources.

https://doi.org/10.1017/S1049023X0000813X Published online by Cambridge University Press

Frequent utilizers of the EMS System may account for 18 to 40% of system transports.[6] Having them diverted to non-emergency facilities alone has little effect on their pattern of resource utilization.[7] Rates of overcrowding in emergency departments have increased over time and produce negative spillover effects on the rest of the healthcare system.[8] The emergency healthcare system costs for those patients who frequently utilize the emergency department are higher than for infrequent users.[9] They also tend to utilize other healthcare services at higher rates than infrequent users of emergency services.[10,11] These factors taken together are likely to result in an increasing burden to an already stretched healthcare safety net resource.

Previous studies among the general population have identified a number of factors that predict frequent use of EMS, including older age, substance abuse,[12] and social isolation.[13] In Western Europe, a similar study identified unstable housing, homelessness, and recent immigration as risk factors for frequent EMS use.[14] No prior studies have examined risk factors for frequent EMS use among the elderly.

The San Francisco Fire Department EMS Division maintains electronic records of all EMS transports in the city, and can be used to identify persons according to demographic characteristics and frequency of EMS utilization. These records were used to identify very high, high, and less frequent utilizers of EMS services and to review a case-control sample of paramedic charts to identify risk factors for frequent utilization of EMS services among elderly patients in San Francisco.

Methods

Study Design, Sample, and Definition of Outcome

A retrospective, case-control study was performed to define predictors of frequent EMS use among all elderly patients (≥65 years of age) transported by an urban fire-based EMS system during 1999 (01 January–31 December). The records of elderly patients who called EMS but were not transported (i.e., left at the scene) were not examined because data on these persons were not readily available. Persons' records were sampled based on their frequency of transport during the year. Three distinct groups were examined for transport during the year 1999: (1) patients transported 1–3 times (low use); (2) those transported 4–9 times (high use); and (3) those transported 10+ times (very high use) during 1999. This frequency indicator variable is the primary outcome measurement.

Data Sources and Sampling Scheme

Initial data elements were drawn from an electronic database maintained by the EMS providers' billing company. This database includes information gathered from every patient care report (PCR), and includes identifying information used to link records and determine frequency of use. However, it did not contain sufficient clinical data to allow for a detailed analysis of predictors of high EMS use. To obtain these detailed clinical data, a case-control sample of participants was chosen for detailed manual review of PCR charts. All high and very high users and a sample of low users were included, and one transport was chosen at random from among these persons (Figure 1). Records for cases and controls were drawn randomly from the database. All the charts reviewed in the final sample were from unique users.

Measurement of Predictors

Age and sex were available through the billing database. Homeless status was obtained using listed address and pickup address recorded in the billing database. When both addresses were either blank or general delivery or a known homeless shelter, the person was considered homeless. *International Classification of Diseases*, 9th Edition (ICD9) codes were recorded in the billing database.

The remaining measurements were obtained from the PCR chart, as recorded by paramedics. Check boxes were used for most items, including apparent ethnicity, presence or absence of a primary care physician, and presence of the following medical problems: (1) angina or myocardial infarction; (2) congestive heart failure; (3) asthma; (4) chronic obstructive pulmonary disease; (5) stroke; (6) diabetes; (7) hypertension; (8) seizure disorder; (9) alcoholism; and (10) other substance abuse problems. Another check box was available for "Other" medical problems, with a blank space available for paramedics to write in free text. Any medical problems listed in this text that were not already marked in a checkbox were noted and counted. A large text blank also was provided for paramedics to write in medications (up to 16 medications may anecdotally fit in this blank), and the number of medications was counted manually. No checkbox was provided for presence of a psychiatric problem; this information was obtained through manual review of the "Other" medical problem free text as well as manual review of medications for psychotropic medications. Number of medical problems and number of medications were used as continuous predictors in our analysis.

Statistical Processing

Participant and visit characteristics among the low, high, and very high use groups were described. Chi-square tests of trend were used for bivariate comparisons of dichotomous predictors in the ordered groups. The number of medications and number of medical problems were not normally distributed, so an unordered, non-parametric Kruskal-Wallis test of the differences between groups was used.

A logistic model was constructed to identify and measure independent associations between predictors and the outcome. For the primary analysis, the high users and very high users were collapsed into one high-use category and compared with the low-use controls. Unadjusted and adjusted analyses for each predictor are presented. As a secondary analysis, an ordinal logistic regression model examining the odds of being in a "higher category" using all three ordered categories of the outcome variable also was examined, and obtained nearly identical results in all cases.

Finally, interactions between the main independent predictors were tested for using a global test of interaction terms. All analyses were performed using Stata 9.0 (College Station, Texas).

Results

During the calendar year 1999, 13,633 EMS transports of 10,918 elderly individuals occurring in San Francisco were

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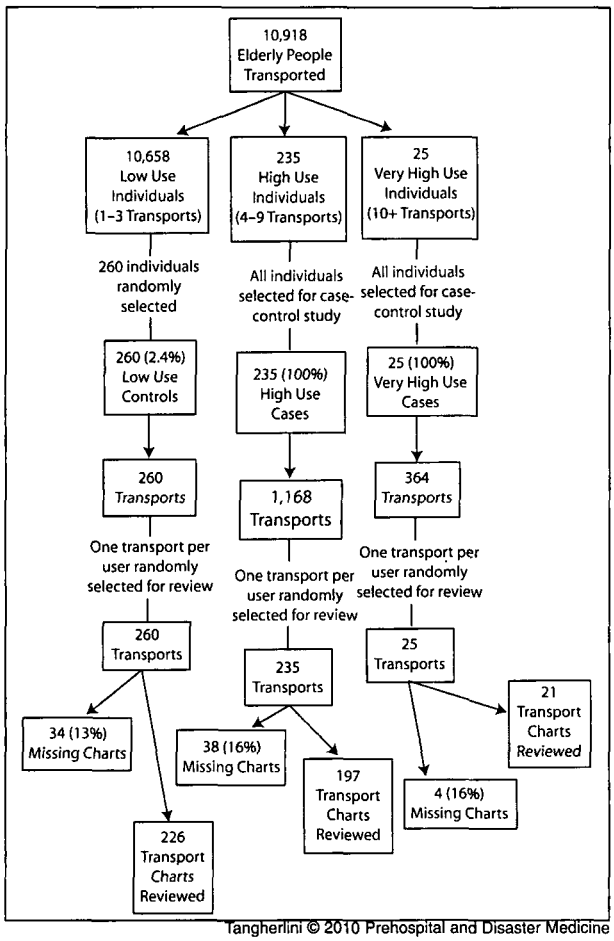


Figure 1—Elderly transports, San Francisco emergency medical services

identified. The majority of individuals (98%) were transported on fewer than four separate occasions during the year ("Low Use Controls"), and accounted for 12,099 (88.7%) of all transports; 235 individuals (2.2%) were transported between four and nine times ("High Use Cases"), accounting for 1,169 (8.6%) EMS transports; and 25 (0.23%) were transported 10 or more times ("Very High Use Cases"), accounting for 365 (2.7%) total EMS transports. High Use and Very High Use individuals were all included in the sample, and considered "cases", while an equal size number of Low Use individuals (n = 260) were chosen randomly as "controls". For each individual in the sample (n = 520), one transport was randomly selected for paramedic chart review; 76 charts were not available for review (13% of controls and 16% of cases), and these participants were excluded from the analysis leaving a total of 226 Low Use Controls, 197 High Use Cases, and 21 Very High Use Cases with both electronic and chart review data (Figure 1). Frequency of EMS use appeared to be associated with younger age within the cohort, male gender, black ethnicity, homelessness, and higher medical co-morbidity as measured by number of medical problems and medications used (Table 1).

In comparing cases (High and Very High users) to controls, male gender, and black ethnicity (compared with White/non-Latino) were more common among cases than controls, and Asian ethnicity appeared to be less common in cases. Homelessness was strongly associated with case status. A variety of types of medical problems, particularly cardiovascular and pulmonary diseases and alcoholism also were associated with cases status, as was overall higher medical illness, as measured by the number of medications used and medical conditions reported. Abuse of illicit substances overall was noted in only four subjects, but all were cases (exact p = 0.057); thereafter, these subjects were excluded so that a multivariable model could be fit. A history of seizures also was more common among cases, but this association was not statistically significant (Table 2). Psychiatric disease and presence of a primary care physician were not associated with case status.

After multivariable adjustment, including all predictors in the model, the strongest single predictor of case status remained homelessness, which was nearly eight times as common in cases as in controls. Male gender and ethnicity remained important predictors, as did coronary heart disease (angina or myocardial infarction) and asthma. The other medical conditions were no longer significant predictors after adjusting for overall medical illness. The number of medical problems was less strongly associated with case status after adjusting for number of medications. Alcoholism remained strongly associated in terms of the magnitude of the odds ratio, but uncertainty around the estimate (and the corresponding p-value) is high because it was uncommonly reported in the sample (n = 13), and was highly associated with homelessness (23% of homeless vs. 1% of non-homeless were alcoholic), an even stronger predictor of case status. Psychiatric disease and presence of a primary care physician remained unassociated with case status.

A paired-down model arrived at using backwards stepwise selection showed similar results, and included only homelessness (OR = 8.6; 95% CI = 2.6–2.8), black ethnicity (OR = 2.0; 95% CI = 1.0–3.8), and Asian ethnicity (OR = 0.46, 95% CI = 0.21–0.98) compared with white, asthma (OR = 3.6; 95% CI = 1.4–9.8), number of medical problems (OR = 1.29/problem; 95% CI = 1.05–1.58), and number of medications (OR = 1.19/medication, 95% CI = 1.09–1.30). A sensitivity analysis using ordinal logistic regression and all three categories of EMS frequency showed nearly identical results, with homelessness associated with an OR (for being in a higher category) of 8.7 (95% CI = 3.1–24) after adjustment for all other predictors, and no association with psychiatric disease or presence of a primary care physician.

No interaction was found between homelessness and other strong predictors such as medical illness indicators or asthma. However, an important interaction was found between asthma and having a primary care physician that was unlikely to have occurred by chance (p = 0.058): asthma was strongly associated with frequent EMS use among persons without a primary care physician (OR = 15, 95% CI = 1.8–12.9) but not associated with frequent EMS among persons with a primary care physician (OR = 1.4, 95% CI = 0.4–4.7) (Figure 2). Likewise, not having a primary care physician was strongly associated with frequent EMS use among persons with asthma (OR = 12, 95% CI = 1.1–142), but not among persons without asthma (OR = 1.2; 95% CI = 0.75–1.9).

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Characteristic	EMS Use Category			
	Low <4 transports n = 226	High 4–9 transports n = 197	Very High 10 transports n = 21	*p*-value
Age, median (IQR)	78 (72–84)	77 (70–84)	71 (69–75)	0.007
Gender, n (%) male	88 (39)	92 (47)	16 (76)	0.003
Ethnicity n (%)				
Asian	30 (13)	12 (6)	1 (5)	0.003
Black	20 (9)	40 (20)	4 (19)	
Latino	7 (3)	10 (5)	0 (0)	
White, non-Latino	85 (38)	71 (36)	4 (19)	
Other/Unknown	84 (37)	64 (32)	12 (57)	
Homeless n (%)	5 (2)	23 (12)	7 (33)	<0.001
Has primary physician n (%)	101 (45)	86 (44)	6 (29)	0.36
No. of medical problems, median (IQR)	1 (0–2)	2 (1–3)	2 (1–2)	<0.001
No. of medications, median (IQR)	4 (2–5)	5 (3–7)	4 (2–6)	<0.001

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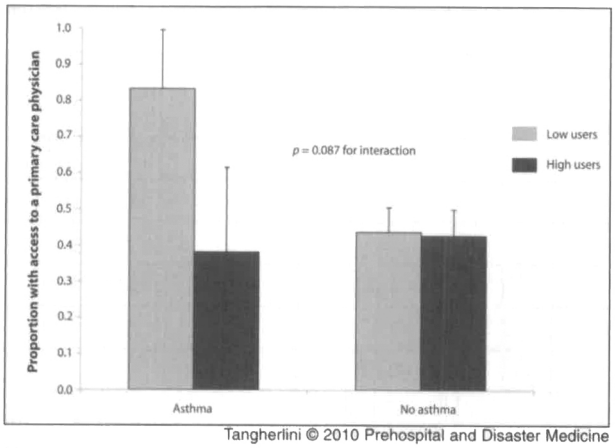
Table 1—Characteristics of low, high, and very high frequency emergency medical services users
*p-value obtained using a chi-square test for categorical variables and a Kruskal-Wallis non-parametric test of equality for continuous variables, which were all right-skewed. (IQR = interquartile range)

Predictor	n (%)	Odds ratio (95% confidence interval)	
		Unadjusted	Adjusted for all predictors†
Age, per 10 year increase	444 (all)	0.89 (0.70–1.11)	1.2 (0.9–1.6)
Male	196 (44)	1.5 (1.1–2.2)*	1.4 (0.9–2.3)
Ethnicity			
White	160 (36)	1 (reference)	1 (reference)
Asian	43 (10)	0.5 (0.2–1.0)	0.4 (0.2–1.0)
Black	64 (14)	2.5 (1.4–4.6)†	2.1 (1.0–4.5)*
Latino	17 (4)	1.6 (0.6–4.5)	1.2 (0.4–4.4)
Other/Unknown	160 (36)	1.0 (0.7–1.6)	1.1 (0.7–1.9)
Homeless	35 (8)	7.1 (2.7–19)§	7.8 (2.2–27)†
Has physician	193 (43)	0.9 (0.6–1.3)	0.8 (0.5–1.3)
History of:			
Angina or myocardial infarction	33 (7)	3.0 (1.4–6.6)†	2.6 (1.0–6.1)*
Congestive heart failure	34 (8)	3.7 (1.6–8.3)†	2.0 (0.8–5.3)
Asthma	27 (6)	3.9 (1.5–9.9)†	3.5 (1.2–10)*
Chronic obstructive pulmonary disease	30 (7)	3.1 (1.3–7.0)†	1.6 (0.6–4.5)
Stroke	39 (9)	0.8 (0.4–1.5)	0.6 (0.3–1.2)
Diabetes	63 (14)	1.6 (0.9–2.7)	1.4 (0.7–2.8)
Hypertension	125 (28)	1.2 (0.8–1.8)	1.0 (0.6–1.8)
Seizures	11 (2)	2.8 (0.7–11)	2.4 (0.5–12)
Psychiatric disorder	110 (25)	1.0 (0.6–1.5)	0.8 (0.5–1.3)
Alcoholism	13 (3)	3.6 (1.0–13)	5.1 (0.5–55)
Other substance abuse	4 (11)	(undefined)‖	(excluded)‖
Number of medical problems	444 (all)	1.51 (1.28–1.80)§	1.13 (0.85–1.50)
Number of medications	444 (all)	1.20 (1.11–1.29)§	1.22 (1.10–1.35)§

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Table 2—Predictors of high emergency medical services use among elderly persons requiring at least one paramedic transport during 1999
Odds ratios refer to the odds of being a high user of EMS services (4 or more paramedic transports in 1993) compared to a low user (1–3 transports). Odds ratios are estimated using logistic regression model; *p <0.05; †p <.001; §p <0.001; ‖The four substance users were all high EMS users, so the odds ratio is undefined (exact p = 0.057). The multivariable adjusted model, therefore, was fit excluding the 4 substance users; EMS = emergency medical services

https://doi.org/10.1017/S1049023X0000813X Published online by Cambridge University Press



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Figure 2—Primary care physician access among low and high emergency medical services users with and without asthma. Access to a primary care physician was much more common among asthmatics who were low users than asthmatics who were high users; this differential was not seen in non-asthmatics (p = 0.087 for interaction).

Discussion

In this case-control analysis of predictors of high EMS use among elderly patients, it was found that homelessness is the strongest predictor of high EMS use, along with higher levels of medical illness. Ethnicity also appears to predict EMS use, with blacks more and Asians less likely to be frequent users than whites. Surprisingly, psychiatric disease did not predict EMS use, nor did having a primary care physician. However, among asthmatics, having a primary care physician does seem to be protective against frequent EMS use.

Although there are other studies that have shown a connection between homelessness and reliance on the emergency departments as a regular source of care,[15,16] this may be the first study to establish the link between homelessness and frequent EMS use among the elderly. Homelessness imposes many limitations on an individual in dealing with medical problems. Routine health maintenance activities are curtailed by the lack of phone contact, difficulty in making and keeping medical appointments, lack of medical insurance, lower income and general lack of resources. Homeless individuals also lack privacy, such that they may come into more frequent interaction with other individuals who access the EMS system out of concern for the homeless person's welfare (the "cell phone Samaritan" phenomenon). Homelessness also imposes other health burdens, such as exposure to the elements and resulting environmental, illnesses such as heat or cold stress, and lack of hygiene contributing to some skin, respiratory or gastrointestinal diseases. A cause-effect relationship also may play a part in the association observed; that is, those with severe medical illness or concomitant mental illness may be at higher risk of losing their jobs and income, and become homeless. However, the association persisted even after adjusting for medical illness severity markers. Homelessness may have a particular impact on elderly patients, who tend to be frailer than younger patients and more susceptible to environmental, infectious disease, and the effects of trauma than younger persons.

The ethnicity findings in this study are reflective of the population distribution of white persons, non-Hispanic (44.6%), and black persons (7.2%) in the US.[17] However, the low utilization of ambulances by Asian persons, who make up 32.1% of the county's population, is not explained by these data. A prior study has shown white ethnicity or black ethnicity to increase the odds of EMS use for chest pain than being of Hispanic or other ethnicity.[18] Factors such as living in close proximity to a hospital or living in extended family environments with access to non-ambulance transportation to a hospital may help explain this lower utilization.

A link between psychiatric diagnosis and EMS use was expected, as at least one other study has shown a connection between depressive symptoms and frequent emergency department use among an elderly cohort.[19] The lack of a correlation between mental illness and EMS use in this study could be attributed to difficulty gathering these data. As previously mentioned, there was no check box for mental illness in the patient history area; thus, paramedics had to check the "Other" box and write a diagnosis in the blank space. Additionally, the Medication Section was examined for psychotropic medications as a means of identifying patients with mental illness. The former was limited by willingness of paramedics to check the "Other" box and the latter by the degree to which elderly patients are prescribed or report taking such medications. The assessment and transport of people experiencing a psychiatric emergency is the purview of the police department in the system examined. Paramedics, therefore, focus less on these issues and may have been less likely to document psychiatric symptoms even if they were present.

Since new or exacerbated medical problems are the primary reason for needing emergency health care, it is not surprising that the more medical problems or medications a person takes, the more often they might need EMS services. These data showing associations between numbers of medical problems or medications and frequency of EMS use are consistent with this. Taking multiple medications, especially by elderly patients, has been shown to significantly increase the likelihood of an adverse drug reaction and increases the patient's likelihood of requiring hospitalization or needing EMS services.[20,21] The number of medications should not be considered a marker of good medical care; in fact, it may be an indication of a fragmented approach to medical care with multiple prescribers treating a patient without knowing what medications the patient already is taking.

Homelessness also appeared to be a stronger risk factor for repeat EMS use than was substance abuse, which rarely was reported in this sample, or was psychiatric disease. Persons with psychiatric disease decompensation, however, also may frequent the emergency department by other means of transportation, such as via escort by police.

There was a lack of association of alcohol, substance abuse, and psychiatric disorders with the frequency of EMS use. These associations have been shown in other populations in regards to utilization of emergency departments for acute medical problems and injury—higher for young adults with alcohol use,[22] and higher for older adults with substance abuse and depression.[23] For alcohol and sub-

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stance abuse, the null association appeared to be caused primarily by the small numbers of persons abusing these substances, though this low prevalence at least partially may be due to the difficulty paramedics may have in determining the presence of alcohol or substance abuse problems, or in differentiating the underlying factors in patients who are dual and triple diagnosed (medical problem plus psychiatric disorder plus alcoholism). The lack of an association with psychiatric disease may be explained by alternate modes of arrival in the emergency department (e.g., via police) for persons with psychiatric decompensation. However, an important possibility is that homelessness itself, and not the conditions that often accompany homelessness in younger adults (psychiatric disease or substance abuse) may be driving frequent utilization among the elderly.

It is interesting that a lack of a primary care provider association was not more broadly associated with high EMS use in this population. This also may be partially attributable to documentation error. It is possible that the lack of connection between EMS and primary care providers reduces the likelihood that paramedics view this information as relevant during an emergency, thus it is not recorded. The interaction with asthma, however, is of large magnitude and in the expected direction. Asthma has been shown previously to be an "ambulatory care sensitive" condition,[24] and these data are consistent with this.

There are several limitations to this study. Documentation on prehospital care records in the system has been problematic, with quality improvement reviews finding compliance with critical data documentation as low as 40%. While this would be expected to affect cases and controls equally, it limits the ability to make determinations of factors such as "has physician" and "number of medical problems".

Determination of psychiatric problems by field providers also is difficult, especially if communications or cultural issues may be a factor. Also, approximately 15% of records selected for review from each group were missing. While the possibility of selection bias exists, records are not expected to be missing differentially according to case or control status. In any non-randomized study, potential confounding by unmeasured or inadequately measured factors limits the ability to draw causal inferences. Finally, the scope of this study is limited. No outcomes were evaluated of these patients, nor were costs associated with frequent EMS use determined.

Conclusions

This study established strong correlations between several risk factors and frequent EMS use among an elderly cohort while also underscoring the need for improved mechanisms for capturing data in the prehospital setting. It lays the groundwork for both future studies of how EMS experiences high-need populations and EMS-based public health efforts targeting elderly frequent users of EMS. This analysis highlights homelessness as being strongly associated with frequent EMS use among the elderly, and downplays other associated factors, such as psychiatric disease and substance use. Medical illness severity, and particularly asthma when no primary care physician is available, also appears to drive frequent EMS use. Although there are several potential explanations for the lack of a correlation between psychiatric illness and frequent EMS use, findings strongly suggest poor documentation as a contributing factor in evaluating this link. The possible link between poor documentation and inability to adequately establish this correlation further bolsters demands to improve both the technology used to capture prehospital findings and documentation training.

The results of this study suggest additional examination of frequent EMS and other populations as well. It would be interesting to see if the findings around homelessness and asthma remained as well as the lack of correlation between other factors such as psychiatric illness and substance abuse after instituting improved methods and training for documentation. Similar examinations should be made for younger cohorts to see if similar correlations exist between homelessness and lack of primary care for asthmatics, which would strongly implicate these as public health problems requiring intervention.

The links between homelessness and lack of a primary care physician among elderly asthmatics with frequent EMS use have implications in terms of targeting of public resources: providing housing to medically ill elderly and primary care to asthmatics in particular may provide dividends not only in terms of social welfare and medical care, but in preventing frequent EMS use in the elderly. Future studies should examine the utility of homelessness reduction strategies in terms of "downstream" cost savings for EMS systems and local governments if EMS use is reduced and patient medical needs are met with less costly medical care alternatives.

Acknowledgements

The authors thank the Records Division of the San Francisco Fire Department EMS Division for their assistance with obtaining data for this study.

https://doi.org/10.1017/S1049023X0000813X Published online by Cambridge University Press

References

1. Shah MN, Glushak C, Karrison TG, *et al*: Predictors of emergency medical services utilization by elders. *Acad Emerg Med* 2003;10(1):52–58.
2. Reeder T, Locascio E, Tucker J, *et al*: ED utilization: The effect of changing demographics from 1992 to 2002. *Amer J Emerg Med* 2002;20(7):583–587.
3. Machlin SR: Expenses for a Hospital Emergency Room Visit 2003. Statistical Brief #111, January 2006. Agency for Healthcare Research and Quality, Rockville, Md. Available at http://www.meps.ahrq.gov/papers/st111/stat111.pdf.
4. Schull MJ, Morrison LJ, Vermeulen M, Redelmeir DA: Emergency department overcrowding and ambulance transport delays for patients with chest pains. *CMAJ* 2003;168(3):277–287.
5. Ruger JP, Richter CJ, Spitznagel EL, Lewis LM: Analysis of costs, length of stay, and utilization of emergency department services by frequent users: Implications for health policy. *Acad Emerg Med* 2004;11(12):1311–1317.
6. Weiss SJ, Ernst AA, Miller P, Russell S: Repeat EMS transports among elderly emergency department patients. *Prehosp Emerg Care* 2002;6(1):6–10.
7. Pope D, Fernandes CMB, Bouthillette F, Etherington J: Frequent users of the emergency department: A program to improve care and reduce visits. *CMAJ* 2000;162(7):1017–1020.
8. Derlet RW, Richards JR: Overcrowding in the nation's emergency departments: Complex causes and disturbing effects. *Ann Emerg Med* 2000;35(1):63–68.
9. Cook LJ, Knight S, Junkins Jr, EP, *et al*: Repeat patients to the emergency department in a statewide database. *Acad Emerg Med* 2004;11(3):256–263.
10. Sun BC, Burstin HR, Brennan TA: Predictors and outcomes of frequent emergency department users. *Acad Emerg Med* 2003;10(4):320–328.
11. Hansagi H, Olsson M, Sjoberg S, *et al*: Frequent use of the hospital emergency department is indicative of high use of other health care services. *Ann Emerg Med* 2001;37(6):561–567.
12. Kerr T, Wood E, Grafstein E, Ishida T: High rates of primary care and emergency department use among injection drug users in Vancouver. *J Pub Health* 2004;10(1093):189–194.
13. Byrne M, Murphy AW, Plunkett PK, *et al*: Frequent attenders to an emergency department: A study of primary health care use, medical profile and psychosocial characteristics. *Ann Emerg Med* 2003;41(3):309–318.
14. Lang T, Davide A, Diakite B, *et al*: Using the hospital emergency department as a regular source of care. *Europ J Epidemiol* 1997;13(2):223–228.
15. Pearson DA, Brugman RA, Haukoos JS: Out of hospital and ED utilization by adult homeless patients. *Ann Emerg Med* 2007;50(6):646–652.
16. Gallagher TC, Andersen RM, Koegel P, Gelberg L: Determinants of regular source of care among homeless adults in Los Angeles. *Medical Care* 1997;35(8):814–830.
17. US Census Bureau: State and County QuickFacts, 2006.
18. Osganian SK, Zapka JG, Feldman HA, *et al*: Use of emergency medical services for suspected acute cardiac ischemia among demographic and clinical patient subgroups: The REACT trial. *Prehosp Emerg Care* 2002;6(2):175–185.
19. Patrick, DL, Unutzer J, Simon G, *et al*: Depressive symptoms and the cost of health services in HMO patients aged 65 years and older: A four year perspective study. *JAMA* 1997;277(20):1618–1623.
20. Passarelli MC, Jacob-Filho W, Figueras A: Adverse drug reactions in an elderly hospitalised population: Inappropriate prescription is a leading cause. *Drugs Aging* 2005;22(9):767–777.
21. Hanlon JT, Pieper CF, Hajjar ER, *et al*: Incidence and predictors of all and preventable adverse drug reactions in frail elderly persons after hospital stay. *J Gerontol A Biol Sci Med Sci* 2006;61(5):511–515.
22. Barnett NP, Spirito A, Colby SM, *et al*: Detection of alcohol use in adolescent patients in the emergency department. *Acad Emerg Med* 1998;5(6):607–612
23. Craig RJ: Emergency room admissions for acute drug reactions in a VA hospital. *Am J Drug Alcohol Abuse* 1979;6(1):73–78.
24. Bindman AB, Grumbach K, Osmond D, *et al*: Preventable hospitalization and access to health care. *JAMA* 1995 274(4):305–311.

https://doi.org/10.1017/S1049023X0000813X Published online by Cambridge University Press