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EMS-STARS: EMERGENCY MEDICAL SERVICES “SUPERUSER” TRANSPORT ASSOCIATIONS: AN ADULT RETROSPECTIVE STUDY

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ABSTRACT

Objective. Emergency medical services (EMS) “superusers” – those who use EMS services at extremely high rates – have not been well characterized. Recent interest in the small group of individuals who account for a disproportionate share of health-care expenditures has led to research on frequent users of emergency departments and other health services, but little research has been done regarding those who use EMS services. To inform policy and intervention implementation, we undertook a descriptive analysis of EMS superusers in a large urban community. In this paper we compare EMS superusers to low, moderate, and high users to characterize factors contributing to EMS use. We also estimate the financial impact of EMS superusers. **Methods.** We conducted a retrospective cross-sectional study based on 1 year of data from an urban EMS system. Data for all EMS encounters with patients age ≥ 18 years were extracted from electronic records generated on scene by paramedics. We identified demographic and clinical variables associated with levels of EMS use. EMS users were characterized by the annual number of EMS encounters: low (1), moderate (2–4), high (5–14), and superusers (≥ 15). In addition, we performed a financial analysis using San Francisco Fire Department (SFFD) 2009 charge and reimbursement data. **Results.** A total

of 31,462 adults generated 43,559 EMS ambulance encounters, which resulted in 39,107 transports (a 90% transport rate). Encounters for general medical reasons were common among moderate and high users and less frequent among superusers and low users, while alcohol use was exponentially correlated with encounter frequency. Superusers were significantly younger than moderate EMS users, and more likely to be male. The superuser group created a significantly higher financial burden/person than any other group, comprising 0.3% of the study population, but over 6% of annual EMS charges and reimbursements. **Conclusions.** In this retrospective study, adult EMS “superusers” emerged as a distinct, predominantly male population and their EMS encounters were associated with alcohol use. Continued analysis of this unique, high-cost, and frequently transported population will likely illuminate specific intervention strategies. **Key words:** frequent user; emergency medical services; health services; alcohol abuse; cost analysis

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INTRODUCTION

Background

With increased visits and a declining number of hospital-based emergency departments (EDs), the emergency care system is becoming increasingly strained beyond capacity.¹ Emergency medical services (EMS) are an important component of health and emergency care, and patients treated and transported by EMS account for an increasing portion of all patients cared for in EDs.^{2,3}

As such, considerable attention is being turned toward frequent users of EDs and EMS systems in the lay media as well as the scientific community.^{4–14} Using a definition of greater than 4 ED visits per year, adult frequent ED users are known to require more ED resources, have a greater length of stay, and have greater morbidity than those who do not use the ED frequently.^{5,9,13–16} However, literature regarding frequent EMS users is far more limited, and focuses on small numbers of patients. These studies suggest that patients who frequently access EMS services experience barriers to accessing care and are often affected by substance use and homelessness.^{17–19} Only one study to date has examined patients who have far more than 4 EMS encounters per year by defining a very high-use population with 10 or more transports per year.¹⁴ By focusing on a highly frequent user

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group, Tangherlini et al. identified several characteristics distinguishing them from the classically defined (more than 4 visits/year) frequent-user population, including strikingly high odds of alcohol use and younger age.^{4,14} However, in this study alcohol use was likely underreported and did not reach statistical significance.¹⁴ In addition, elderly populations may be different than other adult users, with higher numbers of EMS activations due to falls, and distinct nontransport rates.²⁰ Although the Tangherlini et al. study focused only on elderly users, their data parallel the ED literature on highly frequent users,⁸ suggesting that closer examination of this group may identify a unique, high-cost, very frequent use population amenable to intervention.

Rationale

Many cities have begun to implement interventions to assist frequent EMS users at the point of EMS contact,^{16,21} especially as new findings begin to reveal that these patients have significant unmet needs.^{17,18,22} Yet beyond anecdotal evidence or reports from the lay press, little is known about highly frequent “superusers” of EMS services. In this regard, a preliminary understanding of the population served by EMS, including its characteristics and impact on health-care finances, is critical if interventions to improve care are to be developed and implemented.

Objectives

In this cross-sectional study of adult EMS users, we identify characteristics associated with increased EMS use and estimate its financial impact. Based on the trends from previous EMS literature and from the Tangherlini et al. study, we hypothesized a priori that EMS superusers would be younger, be less likely to have field paramedic impressions related to general medical conditions, and have more recorded alcohol use than nonfrequent users of EMS.

METHODS

Study Design and Setting

We defined characteristics associated with frequent EMS use within an urban EMS system in the city and county of San Francisco in this retrospective cross-sectional study. The county serves a community of 1.4 million daytime and 805,000 resident populations. Our two-tier advanced life support EMS system responded to 81,437 calls in 2009, with 62,586 patients transported to receiving facilities (10 hospitals and 1 free-standing sobering center that offers acute care for intoxicated individuals).¹⁹ Of the three EMS providers active in San Francisco in 2009, the San Francisco Fire Depart-

ment (SFFD) was responsible for the majority of EMS encounters (53.5%).

EMS Encounter Frequency Groupings

We categorized EMS users ≥ 18 years of age by their number of EMS encounters for a 12-month period: low users (1 EMS encounter), moderate users (2–4 EMS encounters), high users (5–14 EMS encounters), and “superusers” (≥ 15 EMS encounters) in similar fashion to previous ED studies that define “highly frequent users.”

Selection of Participants

We reviewed all SFFD records from January 1 until December 31, 2009 as a representative sample of EMS encounters, where an encounter is defined as a paramedic generating a patient care chart on scene. All ePCR records in the SFFD database of persons aged 18 and over were included in the analysis. All records for individuals without a unique identity (e.g., John Doe, Jane Doe) were excluded from the study ($n = 427$ encounters), since the number of unique individuals contributing to these encounters was unknown, and frequency of EMS use by each individual could not be quantified.

Descriptive Analyses

We calculated summary statistics based on age, gender, paramedic primary impression, and transport status as recorded by paramedics in the ePCR at the time of EMS encounter. These summary statistics were further sorted by encounter frequency group. Frequencies, cross-tabulations, and percentages were used to summarize categorical variables, and means with 95% confidence intervals were used to summarize continuous variables.

Paramedic impressions fell into 132 distinct subcategories, which we collapsed into seven categories: general medical, trauma, poisoning or drugs, alcohol, no medical complaint, dead, and other. The “other” category includes primary impression subcategories that comprise a very small percentage of encounters, shock, environment, and ob/gyn.

Analysis of Alcohol-related EMS Use

In a secondary analysis, we categorized an EMS encounter as alcohol-related if paramedics recorded “alcohol” or “alcohol abuse” in either of two patient ePCR fields: paramedic primary impression or “description” (used by paramedics to describe past or chronic medical conditions). Using these search criteria, we calculated summary statistics for alcohol

involvement in EMS encounters, and odds ratios to describe the relationship between alcohol and EMS use.

Financial Analysis

Few reliable estimates of true EMS costs exist in the literature, and it is clear that costs, charges, and reimbursements vary nationally by locality based on multiple factors, including payer mix, rural vs. urban location, and market forces. The ability of EMS systems to operate is based at least in part on reimbursements for services. As a result, we examined the average reimbursement per transport for 2009 as a basis for understanding the difference between billed amount and collected amount for each EMS transport group. The de-identified aggregate charges and reimbursements used in the study were supplied by the SFFD EMS Division. Additionally, to determine whether the group of 100 superusers in 2009 was made up of a similar payer mix, we examined the payment source recorded in the administrative database of the San Francisco General Hospital during the last hospital record of 2009, or the closest available record to 2009 if data from the year of interest were not available.

Statistical Testing

Bivariate analyses were performed comparing differences in encounter frequency group, gender, age, and primary impression category using chi-square statistics and odds ratios for categorical data, independent groups t-tests were used for analyses of encounters by categorical variables such as gender. Analysis of variance (ANOVA) with multiple comparisons was used to

compare continuous variables by encounter frequency group, impression category, or paramedic description. All tests were two-sided with an overall *p*-value of 0.05 (adjusted for multiple comparisons as necessary). All analyses were performed using STATA, version 11.2 (Stata, College Station, Texas, USA).

The University of California at San Francisco institutional review board approved this study and granted a waiver of consent.

RESULTS

Population Demographics

The 2009 database contained 43,559 EMS encounters generated by 31,462 adult individuals. A total of 39,107 encounters (90%) resulted in transports. The EMS superuser group comprised 100 individuals (0.3% of total) who generated 2,668 (6.1%) of 2009 EMS encounters, and 2,574 of these encounters (96%) led to transports. Similarly, the high EMS use group comprised 605 (1.9% of total) individuals who generated 4,436 (10.2% of total) encounters and 4,424 transports.

Descriptive analyses were performed to examine relationships between encounter frequency group and age and are represented in Figure 1. Individuals with 2–4 encounters were significantly older than those in all other frequency groups (*p* < 0.001). In order to discern age-related characteristics that might impact EMS use, we also examined the relationship between greater age and general medical paramedic primary impression, and found that these two variables were highly correlated (Supplemental Table 1, available online; *p* < 0.0001).

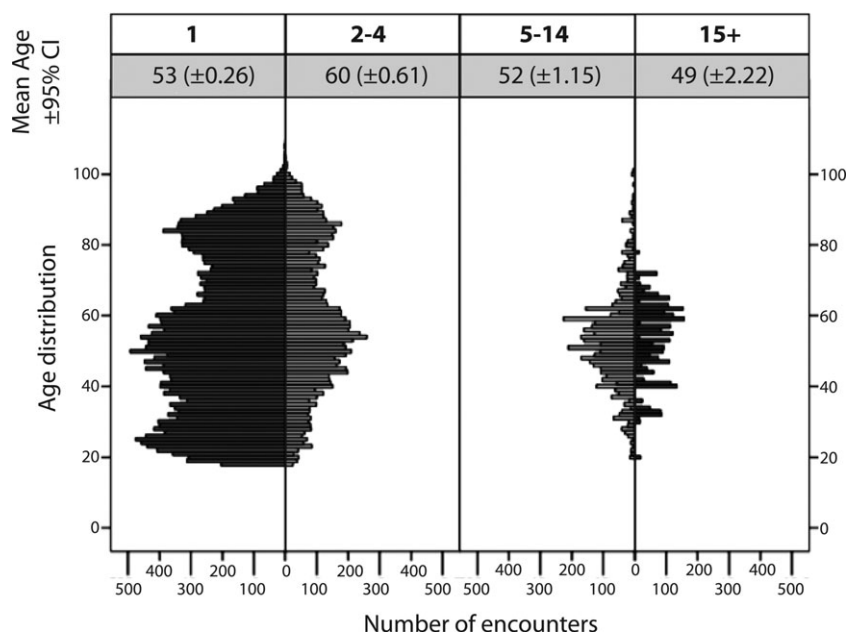


FIGURE 1. The number EMS activations by age.

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TABLE 1. Characteristics by frequency group

		Encounter frequency group				Total
		Low (1)	Moderate (2-4)	High (5-14)	Superuser (≥15)	
Gender						
Male	Count	14,807	2,307	379	68	17,561
	% of group	55.5	56.6	62.6	68.0	55.9
Overview of paramedic primary impressions						
General medical	Count	15,488	7,221	3,360	1,910	27,979
	% of group	58.0	73.9	75.7	71.6	64.2
Trauma	Count	7,946	1,427	466	248	10,087
	% of group	29.8	14.6	10.5	9.3	23.2
Alcohol	Count	916	303	293	380	1,892
	% of group	3.4	3.1	6.6	14.2	4.3
No medical complaint	Count	816	380	166	91	1,453
	% of group	3.1	3.9	3.7	3.4	3.3
Dead	Count	626	106	15	4	751
	% of group	2.3	1.1	.3	.1	1.7
Poisoning/ drugs	Count	607	266	114	24	1,011
	% of group	2.3	2.7	2.6	.9	2.3
Other	Count	283	70	22	11	386
	% of group	1.1	.7	.5	.4	.9
Alcohol (secondary analysis)						
Alcohol use	Count	1,752	965	958	994	4,669
	% of group	6.6	9.9	21.6	37.3	10.7

Descriptive analyses were also performed on gender as related to EMS encounter frequency. Males had a higher mean frequency of 1.42 encounters (95% CI = 0.03) over the study period and accounted for a higher number and percentage of encounters overall, with 17,561 (55.8%) encounters. Males also represented the majority of the high-use and superuser groups, with the ratio of males to females increasing across the use groups as follows: 1.25, 1.31, 1.69, and 2.13 (Table 1).

Reasons for Encounter

We found that general medical encounters were a major contributor to EMS system activations for all encounter frequency groups (Table 1). The low encounter frequency group had a significantly higher percentage of EMS encounters categorized as traumas ($p < 0.0001$) compared to other encounter frequency groups, while the superuser group had a significantly higher rate of EMS encounters related to alcohol use ($p < 0.001$). We also found that moderate and high encounter frequency groups had a significantly higher percentage of general medical EMS encounters than both the low-user and superuser groups ($p < 0.001$).

Alcohol-related EMS Use

Alcohol involvement highly correlated with EMS encounter frequency (Table 1; $p < 0.001$). Odds of alcohol-related encounters (where alcohol was entered into either of the two relevant ePCR fields by on-scene paramedics) increased exponentially with EMS use frequency, with odds ratios rising from OR = 1.6 (95% CI 1.4–1.7) among moderate EMS users, to OR = 3.9 (95% CI 3.6–4.3) among high EMS users, and to OR = 8.51 (95% CI 7.8–9.3) among superusers.

Charge and Estimated Reimbursement Data

Using the actual aggregate SFFD average charges and reimbursements per transport for 2009, the average charge per transport across all encounters was \$1,507, while the average reimbursement was \$413 per transport. Total annual reimbursements (\$16,151,191) were 27% of the total charges (\$58,934,249) for the study period. The superuser group had a significantly higher charges/person than other groups ($p < 0.001$) and represented a disproportionate share of estimated annual charges, comprising 0.3% of the study population, but over 6% of charges. These findings are reflected in Table 2.

TABLE 2. 2009 SFFD EMS charges and reimbursements by EMS user group

	Encounter frequency group				Total
	Low (1)	Moderate (2-4)	High (5-14)	Superuser (≥15)	
Number of individuals	26,682	4,075	605	100	31,462
Number of transports	23,311	8,998	4,224	2,574	39,107
Total annual charges (\$)	35,129,677	13,559,986	6,365,568	3,879,018	58,934,249
Estimated total annual reimbursements (\$)	9,627,443	3,716,174	1,744,512	1,063,062	16,151,191
Average annual charge per person (\$)	1,317	3,328	10,522	38,790	1,873

TABLE 3. 2009 SFFD EMS user and superuser payer mix

Payment type	Percentage of individuals	
	All EMS users	EMS superusers
Self-pay/other ^a	29	16
Medicare	24	26
Medicaid	21	53
Private insurance	26	5
Total	100	100

^a“Other” includes patients with unknown insurance status and patients covered by local programs such as Healthy San Francisco.

Our estimates of charges and reimbursements were based on averages taken across the entire 2009 study population, a payer mix comprising nearly equal proportions of Medicare, Medicaid, private insurance (including workers' compensation), and self-pay payer types. In contrast, the superuser population was represented by a higher proportion of Medicaid recipients and a lower proportion of self-pay and private insurance payer types as compared to the average 2009 EMS population (Table 3).

DISCUSSION

In surveying and analyzing over 40,000 adult EMS encounters, we found that several factors were statistically associated with frequency of EMS use, including gender, age, and paramedic impressions of trauma, general medical problems, and alcohol use. Our study also identified an EMS superuser population distinct from all other EMS use groups.

In the population of EMS users studied, 55.9% were male, yet this proportion reached 62.6% in the high-frequency use group, and up to 68.0% in the superuser group. These results are similar to another San Francisco based study focused on elderly EMS patients, which found that male gender was associated with higher frequency of use.¹⁴ While some work on ED frequent users has shown a female predominance, other research has shown that frequent users are about equally likely to be male or female and that highly frequent ED users are more likely to be male.^{9,17}

Interestingly, each EMS encounter frequency group had specific age-related patterns. Those with only one EMS encounter were more likely to have a traumatic reason for EMS activation, and were also younger. These two characteristics may be correlated, as supported by previous literature, which lists unintentional injuries as the number one cause of mortality among young adults.^{23,24}

Moderate EMS users were more likely to be middle-aged (mid 50s), and elderly (80s). Our data may reflect a trend observed in previous reports that show frequent ED users (defined by lower frequency cut-off values of ≥ 4 ED visits) also have a bimodal age distribution.^{7,11} Those with moderate EMS use were

significantly more likely to have general medical reasons for EMS encounter documented. It may be that this group, given its older age range, has higher underlying rates of chronic disease (Supplemental Table 1).

Nearly all EMS superusers were middle-aged, and a large proportion had alcohol use documented by paramedics during their EMS encounters. These results are similar to those found in recent studies of ED “very high users” (≥ 18 visits), who also tend to be middle-aged and are characterized by a high prevalence of drug and alcohol use.^{8,25} Drug and alcohol use has been repeatedly shown to be strongly associated with frequent use of services in a variety of emergency settings.^{8,11,22,26–29} Thus, the disproportionately high alcohol involvement in EMS superusers is not surprising. However, our study provides empirical evidence that alcohol involvement increases exponentially in moderate-use, high-use, and superuser EMS groups when compared to the low-use group, suggesting that superusers have distinct characteristics and health-care demands.

Despite comprising only 0.3% of the study population, superusers accounted for approximately 6% of charges and reimbursements. Our estimates of charges and reimbursements do not take into account the cost of EMS medical treatment or EMS response without transport. The amount of reimbursement varies depending on the payer, and thus it is important to take insurance coverage into consideration when attempting to understand the financial impact of health services use. To determine whether the group of 100 superusers in 2009 was made up of a similar payer mix, we examined the coverage for each patient during 2009 using the administrative database of the San Francisco General Hospital. We found the superuser population was represented by a much higher proportion of Medicaid recipients than the average 2009 EMS population, which has important implications for state Medicaid agencies attempting to reduce expenditures. Previous studies have demonstrated that publicly insured individuals disproportionately use ambulance transport and ED services,^{25,30} especially for low-acuity conditions³¹ or alcohol-related disorders.²⁵ However, in many communities EMS personnel are left with no alternative transport destination apart from the ED.^{32,33}

Our results show that highly frequent ED users and EMS superusers had particularly high rates of alcohol involvement. However, it is worth noting that even in the low (single-encounter) user group, alcohol-related encounters comprised over 6% of activations, highlighting the impact that alcohol has on EMS use and the EMS workforce. Inebriate case-worker programs in San Francisco and San Diego have both demonstrated a reduction in resources used, ED visits, and hospitalizations, as well as reductions in spending, when using the ED as the reference point.^{9,34,35} In San Francisco a

“sobering center” will accept individuals who are intoxicated and for whom EMS has been called, but who may not require hospital care. While use of the sobering center may not defray short-term transport costs, downstream costs might be eventually be reduced via improved care management and coordination for specific patients. While efforts such as these have garnered support in the popular press, lack of published data has prevented the promulgation of EMS based outreach and prevention strategies, which are commonly referred to as community paramedicine.^{16,36} We provide quantitative evidence to inform public health policy, support implementation of preventative medicine, and justify changes to health care budgeting to serve this unique population.

LIMITATIONS

Our study has some important limitations. Our analysis was restricted to adults; as such our findings cannot be generalized to pediatric EMS superusers who are relatively unstudied, but likely have chronic conditions.³⁷ Additionally, our findings may not reflect more rural EMS systems and populations. The paramedic administrative records used were created for patient care purposes and not for research purposes; therefore, our analysis is limited by the accuracy of the data input by the paramedic arriving on scene. We were unable to capture other potentially important variables affecting EMS use, including housing status.

In analyzing reasons for EMS encounter, we included the primary impression entered by paramedics from prepopulated lists. The diagnostic accuracy of these impressions is unknown. Other studies have suggested that paramedic assessment of need for transport does not correlate with a physician’s decision to admit or order advanced imaging studies.^{38,39} Additionally, there may be differences between patients transported by SFFD versus those who choose to be transported by other paramedic companies. Patients that have the resources to call a specific company may represent a group with a higher standard of living and less socioeconomic stressors than the population using standard dispatch services from a 9-1-1 call center. However, the majority of EMS activations are through 9-1-1 dispatch, which randomly assigns the closest paramedic unit.

Our study did not examine situations in which no patient contact was made by the transport unit personnel, which may be due to unit cancellation by a caller, inability to locate a patient, or refusal of treatment by the patient prior to the arrival of the transport unit. It is unknown to what extent EMS frequent users account for these EMS activations.

Threats to internal validity include error for all self-reported fields (e.g., date of birth) caused by false re-

porting, language barriers, and difficulties with communication upon arrival of EMS.^{40–42}

CONCLUSION

Our study examined an urban EMS system and found several areas of overlap between adult ED and EMS users, including a heterogenous frequent-use group and a less heterogenous “superuser” population characterized by predominantly publicly insured, middle-aged men with high incidence of alcohol use who were substantial contributors to annual charges and reimbursements. These findings will be important when developing future prospective studies and targeting health service interventions to improve care coordination for this high-need population.

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SUPPLEMENTARY MATERIAL AVAILABLE ONLINE

Supplementary Table 1: Age and Paramedic Primary Impression

Supplementary material can be viewed and downloaded at <http://www.informahealthcare.com/pec>.