Title

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Journal

Annals of Emergency Medicine, 70(4)

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Publication Date

2017-10-01

DOI

10.1016/j.annemergmed.2017.03.058

Peer reviewed

HHS Public Access

Author manuscript

Ann Emerg Med. Author manuscript; available in PMC 2018 October 01.

Published in final edited form as:

Ann Emerg Med. 2017 October ; 70(4): 506–515.e3. doi:10.1016/j.annemergmed.2017.03.058.

Repeat Emergency Medical Services Use by Older Adults: Analysis of a Comprehensive Statewide Database

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Abstract

OBJECTIVE—The objective of this study was to characterize repeat Emergency Medical Services (EMS) transports among older adults across a large and socioeconomically diverse region.

METHODS—Using the North Carolina Prehospital Medical Information System (PreMIS), we analyzed the frequency of repeat EMS transports within 30 days of an index EMS transport among adults aged 65 years and older from 2010–2015. We used multivariable logistic regressions to determine characteristics associated with repeat EMS transport.

RESULTS—Over the 6-year period, EMS performed 1,711,669 transports for 689,664 unique older adults in North Carolina. Of these, 303,099 (17.7%) transports were followed by another transport of the same patient within 30 days. The key characteristics associated with an increased adjusted odds ratio of repeat transport within 30 days include: transport from an institutionalized setting (OR 1.42, 95% Confidence Interval (CI) 1.38–1.47), Blacks compared to Whites (OR 1.29,

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Meetings: None

Conflicts of Interest: None

Author Contributions: CE, TPM, AF, JG, JC, MP, GV, JB contributed to study concept, study design, interpretation of data and preparation of the manuscript. CE, TPM, and AF were responsible for data acquisition and data analysis. CE and TPM take responsibility for the paper as a whole.

95% CI 1.24–1.33), a dispatch complaint of psychiatric problems (OR 1.38, 95% CI 1.25–1.52), back pain (OR 1.35, 95% CI 1.26–1.45), breathing problems (OR 1.21, 95% CI 1.15–1.30), and diabetic problems (OR 1.14, 95% CI 1.06–1.22). Falls accounted for 15.6% of all transports and had a modest association with repeat transports (OR 1.07, 95% CI 1.00–1.14).

CONCLUSIONS—More than 1 in 6 EMS transports of older adults in North Carolina are followed by a repeat transport of the same patient within 30 days. Patient characteristics and chief complaints may identify increased risk for repeat transport and suggest the potential for targeted interventions to improve outcomes and manage EMS utilization.

INTRODUCTION

Repeated utilization of a healthcare service by a small group of patients is costly[1,2] and also suggests that the medical care those patients are receiving is not adequately addressing their needs.[3,4] Frequent utilization of emergency department (ED) services have been extensively studied,[5–13] in part because ED care is more expensive than primary care and these two types of care may be substitutes for one another in some cases.[14] Findings from this research indicate that frequent ED use is by a heterogeneous group of patients but typically includes the following patient characteristics: older age, insured through Medicare or Medicaid, having access to regular sources of care, higher severity of illness, comorbidities, and poor health status.[3,15] Among ED patients, an estimated 15–25% arrive by ambulance, hereafter referred to as emergency medical service (EMS) care.[16,17] Despite the close interface of EMS and ED care, much less is known about the frequent use of EMS. Furthermore, it is unclear what similarities are present between patients who frequently use EDs and EMS, making interventions aimed at reducing frequent use challenging.[3,4,18]

Among EMS users, older adults are a distinct, large, and growing subgroup. Adults aged 65 years and older disproportionally use EDs and EMS compared to younger patients,[19–21] and are expected to comprise 20% of the total US population by 2030.[22] At present in the U.S., an estimated 38% of EMS transports are for older adults, and this number is projected to increase to 50% by 2030.[21] Previous studies of repeat EMS use in older adults have been limited to specific conditions such as falls,[23,24] populations living in rural[25] or discrete urban areas,[26,27] or those receiving care from a single ED.[28] Little is known about characteristics associated with repeat EMS use among older adults on a population level.

The objective of this study was to determine the proportion of older adults receiving a repeat EMS transport to the hospital within 30 days of an initial transport and to identify patient and transport characteristics associated with repeat utilization. We achieved this objective by analyzing a unique, comprehensive database which includes all EMS transports in the state of North Carolina.

METHODS

Study Design and Selection of Participants

This was a retrospective analysis of EMS transports in North Carolina from calendar years 2010–2015. Data were obtained from the North Carolina Prehospital Medical Information Systems (PreMIS) using the National EMS Information System Version 2 standard [29] and

collected by the EMS Performance Improvement Center (EMSPIC).[30] PreMIS data collection is state-mandated, requiring 100% collection of prehospital care reports within 24 hours of the incident.[31] PreMIS collects 200 data elements on all EMS calls from over 700 EMS agencies, totaling one million EMS calls annually.[32,33] We limited our analysis to EMS encounters recorded as responses to 911 calls for adults 65 years and older that resulted in transport to a North Carolina hospital. Non-911 responses included interfacility transfers, intercepts, mutual aid, medical transports (non-scene response), and standby. We excluded EMS encounters without a visit time recorded or with dispatch complaints of "Pregnancy/Childbirth" or "Transfer/Interfacility/Palliative Care." The study was exempted from review by the University of North Carolina at Chapel Hill Institutional Review Board.

Measures

The primary outcome was repeat EMS transport within 30 days. To further characterize repeat EMS use and allow comparison to other studies, we also described the frequency of repeat EMS transport within 7 days, 90 days, and 6 months. A secondary analysis which stratified patients by the total number of transports during the entire study period was also performed for frequency of repeat transport at 30 days. Repeat transports are estimated on the transport level and included all EMS transports. For example, if a patient has only two transports within the study period, separated by two weeks, the first transport would count as having had a repeat transport within 30 days and the second transport would not count as having had a repeat transport within 30 days. For comparison to prior work by Hall et al.,[34] older adults with five or more EMS transports in a calender year were also examined. Lastly, a separate analysis was also performed to estimate the frequency of transport in the 30 days following an initial EMS transport refusal. EMS transports by the same individual were linked using a matching algorithm which required agreement for at least two of the following three elements: patient full name, date of birth, and social security number. These elements were used to generate a unique patient identifier for matching of transports by EMSPIC staff; these elements were then removed from the data to provide a de-identified dataset for analysis. In the case of transports with identical patient identifiers and identical incident date and time (typically the result of more than one EMS unit responding to and generating a patient record for a single scene), the record with the most complete data was used for analysis. To limit the possibility of duplication on a single EMS care incident, at least two hours must have elapsed since the prior EMS transport.

Patient demographics examined included age, sex, race/ethnicity (White, Black, Latino/Hispanic, Asian, and other), and expected payment source (Medicare, private insurance, Medicaid, and other). EMS incident characteristics examined included Centers for Medicare Services (CMS) service level (advanced life support (ALS), basic life support (BLS), and Air/Specialty), incident location (home, healthcare or residential institution, street or highway, and other) and dispatch complaint. Dispatch complaints were presented following the groupings provided by EMSPIC,[29] with the additional simplification that 1) the 'other trauma' category included animal bite, assault, burns, electrocution, hemorrhage/laceration, and stab/gunshot wound and 2) the 'exposure' category including CO poisonings/hazmat, heat/cold exposure, industrial accident/inaccessible, and ingestion/poison. This approach yielded twenty categories: abdominal pain, allergies, back pain, breathing problem, cardiac

problem, cardiac arrest, choking, convulsions/seizures, diabetic problem, eye problem, exposure, falls, headache, psychiatric problem, sick person, stroke, traffic accident, other trauma, unconscious/fainting, and unknown man down.

Data Analysis

Descriptive summary statistics of patient-level and transport-level characteristics were calculated. For patients with multiple EMS encounters, the encounter with the most complete data reported for sex, race/ethnicity, and expected payment source regarding demographics was used. When multiple complete records were available, we used the earliest record available. The remaining characteristics were summarized on transport-level data. Categorical variables were reported using frequencies and proportions.

Bivariate analyses examined the relationship between each characteristic and repeated EMS transport using Student's t-test and Pearsons' chi squared, for continuous and categorical variables, respectively. A multivariable logistic regression model was used to calculate adjusted odds ratios (ORs) and 95% confidence intervals (CIs) of repeat EMS transport within 30 days. Potential predictors of repeat EMS transport included in the model were age, sex, race/ethnicity, incident location, and presence or absence of each dispatch complaint. Given the large number of covariates, multicollinearity was assessed using variance inflation factors (VIFs). All covariates were acceptable with VIFs less than 3. Since correlations between variables were not a concern, all covariates were retained in the final model. Expected payment source and CMS service level were omitted from the predictive modeling because of the amount of missing data from these two variables and the possibility that excluding patients missing these data could result in a biased sample. For the primary outcome we used complete case analysis without imputation of data for multivariable modeling. A subset analysis was also performed using a multivariable model including expected payment source and CMS service level. To account for potential non-independence in observations, the logistic regression model also included clustering by county to obtain robust standard errors. To verify the accuracy of the probabilistic linkage of transports by the same individual, percent agreements were calculated across sex and race among observations with a matching patient identifier. Analyses were performed using STATA version 14 (StataCorp., College Station, TX).

RESULTS

Characteristics of study participants

Among 3,929,148 EMS encounters by adults aged 65 years and older in North Carolina from 2010 to 2015, we identified 1,719,998 (44%) as 911 responses that resulted in hospital transport (Figure 1). After removal of duplicate records, the study sample comprised 1,711,669 EMS transports of 689,664 older adults. Most patients were female (59%), White (79%), and had Medicare as their expected method of payment (62%; Table 1). Over half of all EMS transports were for patients at home (61%), and the three most common dispatch complaints were sick person, fall victim, and breathing problem (20.9%, 15.6%, and 13.8%, respectively). The matching algorithm showed a high level of agreement (98.8% agreement for sex; 97.6% agreement for race).

Main Results

Among 1,711,669 EMS transports in older adults, 303,099 (17.7%) had at least one repeat transport within the subsequent 30 days. Repeat transports occurred in 7.3% of transports within 7 days of the initial transport, 30.6% within 90 days, and 39.8% within 6 months. When assessed on an individual patient level rather than EMS transport level, similar estimates of repeat EMS transport were found. Among the 689,664 older adults in the study, 20.6% (141,852 older adults) had a repeat transport within 30 days, and a range of 9.6–33.4% for repeat transport in 7 days and 6 months, respectively.

The percentage of transports with a repeat transport within 30 days was higher for Blacks than Whites (20.8% vs. 17.0%, respectively), for Medicaid patients than Medicare patients (24.1% vs. 18.3%, respectively), for patients transported by BLS compared to ALS (21.6% vs. 18.0%, respectively), and for patients residing in healthcare/residential institutions compared to private homes (21.9% vs. 16.8%, respectively; Table 2). After adjusting for sex, age, race/ethnicity, incident location, and dispatch complaint, odds of repeat transport within 30 days remained higher for healthcare/residential institution vs. private home (OR 1.42 95% CI 1.38–1.47, and Blacks vs. Whites (OR 1.29 95% CI 1.24–1.33); Table 3). Appendix 1 shows the characteristics of transports associated with repeat or frequent EMS transport using the definition of 5 or more EMS transports in a calendar year as has been used in prior studies by Hall et al.[34] Characteristics associated with this alternate outcome were similar to the associations observed for patients with repeat transports within 30 days (Appendix 1).

Patients with breathing problems, back pain, and psychiatric problems had the highest rates of repeat transport in 30 days, each above 20%. On multivariable logistic regression, the following dispatch complaints were associated with increased odds of repeat transport: pyshciatric problem, back pain, breathing problem, diabetic problem, headache, abdominal pain, sick person, and unknown man down. Cardiac arrest, traffic accident, unconscious/fainting, allergies, stroke, choking, exposures, and seizure were associated with decreased odds of repeat transport.

When expecected payment source and CMS service level were included the logistic regression model, the number of transports with complete case data available decreased substantially (384,257 transports of the 1,711,669 total transports), but yielded similar associations with repeat transport at 30 days if the logistic regression model omitted these variables. Of note, transports with payment of Medicaid were associated with repeat transport at 30 days (OR 1.28 95% CI 1.20–1.37).

When stratified by total number of transports by patients over the study period, the proportion of EMS transports with a repeat transport in the following 30 days varied greatly (Table 4). Among older adults with only two transports during the study period, 9.6% (24,062 of 249,718) had repeat transports within 30 days. In older adults with greater than 11 transports during the study period, 40.5% (106,687 of 263,320) of the transports were followed by a repeat within 30 days.

Among all trasnsports, most of the observed associations between patient characteristics and repeat transport were stable across age group (Appendix 2) and payment source (Appendix

3). However, the proportion of transports for dispatch complaint recorded as breathing problem that resulted in repeat transport within 30 days decreased as age increased (22.3% in 65–74 year olds vs. 18.4% in patient aged 85 years or greater). In contrast, repeat transports for patients with a dispatch complaint of fall increased modestly with increasing age. When compared to Medicare patients, transports by Medicaid patients across most dispatch complaints were more likely to result in repeat transport, reflecting the higher overall rate of repeat transports in this subgroup of patients.

To assess the crude proportion of older adults who initially refuse transport and then subsequently require EMS transport in the following 30 days, we performed a separate analysis. This subset of patients was similar to the study population but only included EMS encounters that resulted in the patient refusing EMS transport to the hospital. Among the 6,559 EMS encounters which resulted in refusal of transport by the patient at index EMS encounter, 1,271 (19.3%) were subsequently followed by EMS transport within 30 days.

LIMITATIONS

This study has several limitations. It is possible that some repeat transports were not identified due to errors in the entry of the data used for matching (date of birth, social security number, and full name). Among records for which a match was identified, we found excellent percent agreement for sex and race. Additionally, the multivariable logistic regression did not include payment source or CMS service level because of the large amount of missing data in these data elements. Furthermore, we used a complete case analysis and thus only included 1,554,653 of the 1,711,669 total transports (90.8%). Missing data in the logistic regression model may have resulted in some bias in the observed associations between visit characteristics and repeat EMS transport. However, the degree of missing data was similar when compared between repeat and non-repeat transports (Appendix 1). Dispatch complaints such as breathing problems may be due to several etiologies including cardiac or pulmonary disease, and as such are less precise in terms of characterizing a patient’s medical problem than EMS provider impression. However, dispatch complaints were more consistently recorded than provider impression in PreMIS. Also, using dispatch complaints to identify repeat EMS users has the potential to support interventions that occur at the time of EMS dispatch including alternative evaluation and transport strategies. Race and ethnicity were recorded as a single variable which limits our ability to define a distinct group of individuals of Hispanic ethnicity including both Whites and Blacks. Among EMS transports with an expected payment source recorded, Medicare was only recorded in 62% of cases. Although not possible to verify, the lower than expected rates of medicare coverage may be a result of differing practices of recording payment source in adults with both Medicare and supplemental insurance coverage.

As an administrative dataset, PreMIS does not include information about socioeconomic status, disability, social support at home, comorbidities, medication use, or access to primary care services. This information likely would improve the identification of patients with repeat EMS transports, would be available to EMS and ED providers at the time of the initial visit, and may shed additional insights into which patients are at highest risk for repeated EMS transports. This study was restricted to 911 transports only, which potentially

underestimates the repeat utilization of residents living in nursing homes or skilled nursing facilities if the facilities had contracts for urgent transport that do not go through 911 dispatch. Some older adults died during the hospitalization that followed their initial EMS transport, and so were no longer at risk for a repeat transport by EMS. This was probably particularly common for patients with cardiac arrest as their initial chief complaint. Information about mortality during the initial hospitalization was not available in these data, so we were unable to exclude these patients from analysis. Finally, this study did not attempt to determine the appropriateness of an EMS transport, but rather assessed on a population level the types of patients who are repeatedly transported.

DISCUSSION

We found that among older adults in North Carolina who are transported by EMS to the hospital, 17.7% received a repeat EMS transport within 30 days. To our knowledge, this is the first work to describe repeat EMS use specifically among older adults on a population level. Our findings indicate that a large proportion of older adults make requests for and receive 911 transport during the month following an initial transport to the hospital via ambulance. We identify specific groups of patients at increased risk for requiring EMS transport, which might potentially be used for targeted care and educational interventions to improve outcomes and reduce the demand for EMS services in this population.

Our estimate of repeat EMS use among older adults is substantially higher than that of Weiss et al. who examined repeat EMS transport for older adults receiving care at a single urban ED in Sacramento, CA in 1997. Whereas Weiss et al. found 23% had a repeat EMS transport during one year of follow-up,[28] we found 39.8% of patients with had a repeat transport within 6 months. The higher rate of repeat transports in our sample may be due to differences in the overall health of the populations studied or changes over time in access to primary care, alternative methods of transportation, differences in EMS use for an urban population versus the population of an entire state with large rural areas, or differences in perceptions about the appropriate threshold for calling 911.

Contrary to prior research,[19] our study did not find an association between repeat EMS transport and age within the older adult population. Further, with few exceptions, rates of repeat transports by dispatch complaints were similar across the three age categories. Our findings that black older adults, and those insured through Medicaid had higher odds of repeat transport are consistent with other studies.[28] Our findings that Latinos/Hispanics and Asians had lower likelihood of repeat EMS transport relative to Whites, while Blacks had higher likelihood, suggest cultural differences in how EMS use is perceived, the degree of social support available, the availability of outpatient healthcare access, or alternative transport methods across racial/ethnic groups. Similar to previous studies, we found that EMS transports by older adults were more common in women, reflecting the greater number of older women in the population.[35] On bivariate analysis, approximately the same proportion of visits by men and women resulted in repeat transport. A higher rate of repeat transport for males was observed in the multivariable model, but the association was small. The higher rate of repeat transports for older adults in health or residential institutions compared to home dwelling older adults is also consistent with prior work,[36] and suggests

this population as a potential target for interventions. Our data do not include patient characteristics such as comorbidities and functional status that likely at least partially explain the observed association between living in a residential institution and repeat EMS transports.

Previously published definitions of repeat or frequent EMS use differ[37] including: five or more EMS encounters in one year,[34,38] six or more EMS encounters in a 23 month period,[26] ten or more EMS transports in one year,[39] and three or more EMS transports in one year.[40] We chose to focus on repeat use of EMS within 30 days because 30 days is a commonly used outcome for decision instruments in emergency medicine,[41,42] and is the time frame used by the Centers for Medicare and Medicaid Services as a quality measure for hospital readmissions.[43] Analyses using five or more EMS transports in a calendar year as the outcome identified similar associations with repeat EMS use (Appendix 1). Our finding that 19% of older adults who initially refused transport, but had subsequent EMS transport in the following 30 days is comparable to estimates reported in previous studies. Knight et al. studied repeat EMS encounters in the 7 days following a refusal of EMS transport and found a rate of repeat EMS encounters of 3.3% across all age groups, and 6.2% among adults aged 65 years or older.[44] Based on our estimates for the larger sample of transported patients (7% at 7 days, 17% at one month), we think that 6% at 7 days as observed by Knight is pretty similar to our finding of repeat EMS transports of 19% at one month.

Future research might use the results presented here to develop targeted interventions to reduce the demand for EMS transports. These interventions might include patient education, home assessments, discussion of symptoms with a provider who can visualize the patient by telemedicine, coordination of alternative care pathways with senior living facilities, or increased access to primary care. Additionally, public awareness campaigns aimed at educating the public about appropriate and inappropriate use of EMS may be effective in limiting demand for EMS.[45] Ideally, such campaigns would provide older adults and their families with alternatives in regard to transportation methods to the emergency department, as well as use of outpatient care settings other than the emergency department. Attention to the non-medical problems such as social isolation, malnutrition, poor health literacy, and neglect, which have strong influences on health behaviors and outcomes may be necessary to meet older adults' needs and reduce EMS demand in this population.[46,47] Patients with these problems might benefit from education regarding alternatives to calling 911 for these symptoms or efforts to develop non-EMS transport options. Additionally, alternative healthcare delivery models such as mobile integrated health care and community paramedicine programs have been proposed and are currently being studied, particularly for patients with chronic conditions such as congestive heart failure.[48] Tangherlini et al. have shown a reduction in EMS utilization among frequent users after the implementation of the Homeless Outreach and Medical Emergency (HOME) team, a community paramedicine based intervention with the San Franscisco Fire Department.[27]

Dispatch complaints associated with higher rates of repeat EMS transport included breathing problems, diabetic problems, back pain, and psychiatric problems. Falls were a common dispatch complaint, a finding consistent with that from other studies (Simpson et al.[23] and

Tiedemann et al.[24]). However, an initial dispatch complaint of fall was only modestly associated with repeat EMS transports.

This study has several strengths. The use of PreMIS data allowed for statewide population-based analysis of all older adults who were transported to the hospital over a six-year study period regardless of the hospital to which they were transported. Our study findings' generalizability is also improved by including a socioeconomically diverse population living in rural and urban counties receiving care from hundreds of EMS agencies. Furthermore, our findings concerning the overall frequencies of repeat EMS use across two different definitions are in agreement with other work that has been described in smaller populations of older adults, but with varied data sources.

In summary, more than one in six older adults who were transported to North Carolina hospitals between 2010 and 2015 had a repeat EMS transports within 30 days. Rates of repeat EMS transportation were highest for older adults living in a healthcare or residential institutions and those with dispatch complaints of breathing problems, back pain, diabetic problems, and psychiatric problems. For these patients, interventions which educate patients regarding alternatives to requesting EMS transport or offer patients alternative care pathways may improve health outcomes and the appropriateness of EMS utilization.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The NC OEMS and the NC EMS Data System supports state, regional and local EMS and healthcare related service delivery from a patient care, resource allocation, and regulatory perspective. This manuscript has been reviewed by NC EMS Data System investigators for scientific content and consistency of data interpretation with previous NC EMS Data System publications and significant comments have been incorporated prior to submission for publication. The authors would also like to thank Anthony Viera MD, MPH for his contributions to the initial study design and literature review.

Funding Sources: Dr. Platts-Mills is supported by a K23 career development award from the National Institute on Aging (K23AG038548).

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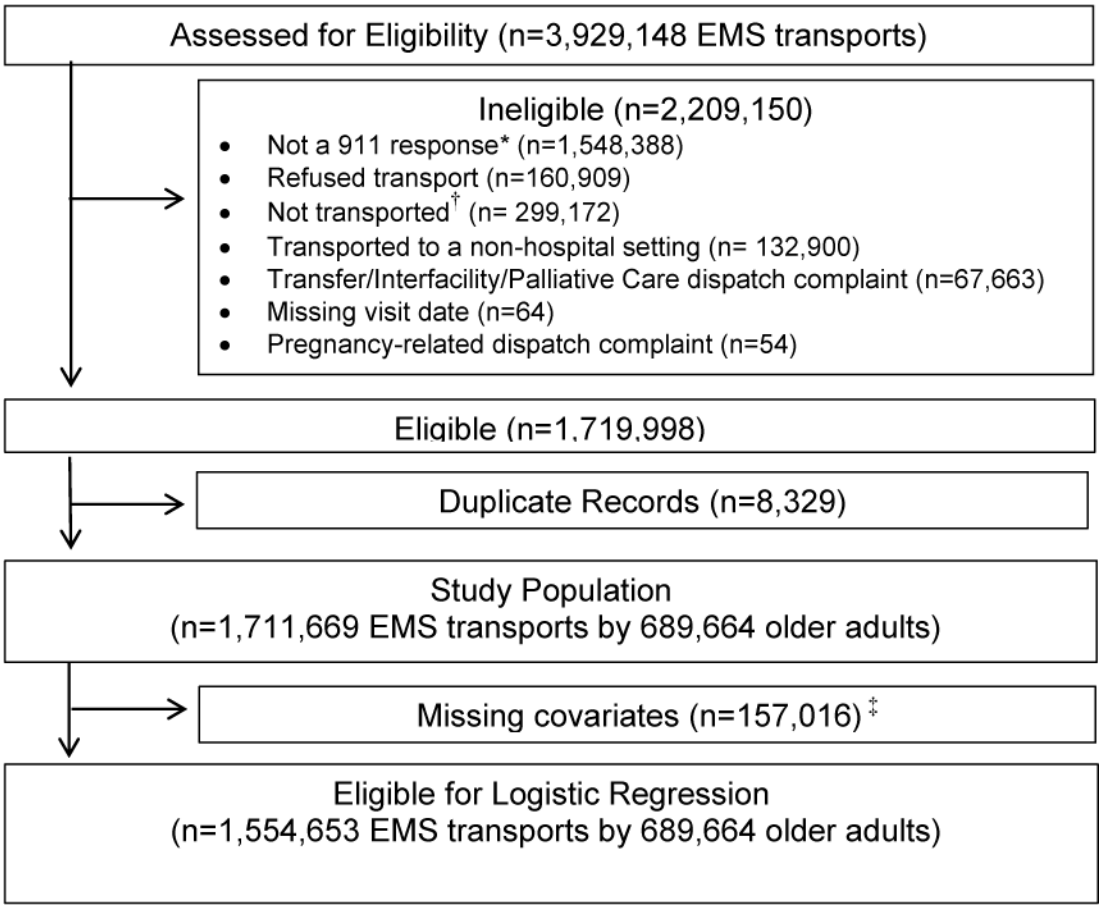

Figure.

Flow diagram of current study, which includes only EMS transports to an ED for patients aged 65 years and older during 2010 to 2015, North Carolina.

*EMS transports not initiated by a 911 call include interfacility transports and those for scheduled medical care.

†Nontransport disposition includes cancelled calls, dead at scene, no patient found, no treatment required, treated and released, treated and transported by law enforcement, treated and transported by private vehicle, and treated with transferred care.

‡EMS transports missing at least one of the following covariates: sex, race or ethnicity, incident location, and dispatch complaint.

Table 1

Characteristics of adults aged 65 years and older transported by EMS in North Carolina, 2010 to 2015 (n=689,664 patients).*

Characteristic	No.	%
Age, y		
65–69	145,683	21
70–74	125,319	18
75–79	122,371	18
80–84	120,370	17
≥85	175,920	26
Female patient	405,893	59
Race/ethnicity		
White	522,392	78
Black	125,736	19
Latino/Hispanic	8,465	1
Asian	5,936	<1
Other	8,931	1
Expected payment method		
Medicare	235,228	62
Private insurance	72,539	19
Other	51,083	13
Medicaid	20,009	5

*Numbers are for individual patients; patients with multiple transports are counted only once.

Table 2

Proportion of EMS transports that resulted in repeated transport in the subsequent 30 days (N=1,711,669 EMS transports).

		Repeated Transport in 30 Days	
	Total N	**No.**	**%***
All transports	1,711,669	303,099	17.7
Age, y			
65–69	315,710	56,031	17.8
70–74	299,973	52,802	17.6
75–79	306,891	54,492	17.8
80–84	314,339	55,551	17.7
≥85	474,738	84,210	17.7
Missing	18	13	72.2
Sex			
Male	654,041	116,128	17.8
Female	1,052,121	186,237	17.7
Missing	5,507	733	13.3
Race/ethnicity			
White	1,246,822	211,687	17.0
Black	359,385	74,588	20.8
Latino/Hispanic	17,489	2,610	14.9
Asian	11,296	1,610	14.3
Other	25,233	5,144	20.4
Missing	51,444	7,460	14.5
Expected payment method			
Medicare	488,798	89,356	18.3
Private insurance	137,138	22,017	16.1
Other	86,108	11,539	13.4
Medicaid	49,577	11,954	24.1
Missing	950,048	168,209	17.7
CMS service level			
ALS	810,409	145,794	18.0
BLS	213,143	45,962	21.6
Other (air/specialty)	1,739	79	4.5
Missing	686,378	111,264	16.2
Incident location			
Home	986,058	165,420	16.8
Health care/residential institution	490,919	107,620	21.9
Street/highway	37,673	2,353	6.2
Other	85,455	8,651	10.1
Missing	111,564	19,063	17.1
Dispatch complaint			

		Repeated Transport in 30 Days	
	Total N	**No.**	**%***
Sick person	357,651	68,928	19.3
Breathing problem	235,685	48,807	20.7
Falls	267,202	48,802	18.3
Cardiac	190,468	31,419	16.5
Unconscious/fainting	108,600	14,600	13.4
Stroke/CVA	75,933	10,027	13.2
Trauma (other)†	69,110	11,852	17.1
Abdominal pain	49,668	9,838	19.8
Unknown problem/person down	27,401	5,123	18.7
Diabetic problem	31,124	6,151	19.7
Traffic accident	27,784	1,115	4.0
Back pain	19,585	4,190	21.4
Convulsions/seizure	19,537	3,251	16.6
Cardiac arrest	12,242	659	5.4
Psychiatric problem	13,865	3,255	23.5
Headache	9,273	1,821	19.6
Allergies	6,277	825	13.1
Exposure	5,269	712	13.5
Choking	3,621	534	14.7
Eye problem	837	159	19.0
Missing	180,537	31,029	17.2

*Percentages are determined by using N divided by total N for the corresponding row.

†Trauma (other) includes animal bite, assault, burns, electrocution, hemorrhage/laceration, and multicasualty incident.

Table 3

Adjusted odds ratios for repeated EMS transports within 30 days in North Carolina in 2010 to 2015 (n=1,554,653 EMS transports).*

	Adjusted OR	95% CI
Male patient	1.03	1.01–1.06
Age, y		
65–69	1 [Reference]	
70–74	0.97	0.94–0.99
75–79	0.96	0.93–0.99
80–84	0.93	0.91–0.96
≥85	0.90	0.87–0.93
Race/ethnicity		
White	1 [Reference]	
Black	1.29	1.24–1.33
Latino/Hispanic	0.88	0.82–0.95
Asian	0.86	0.79–0.93
Other	1.30	1.09–1.54
Incident location		
Home	1 [Reference]	
Health/residential institution	1.42	1.38–1.47
Street/highway	0.56	0.49–0.63
Other	0.59	0.56–0.63
Dispatch complaint†		
Sick person	1.11	1.03–1.20
Falls	1.07	1.00–1.14
Breathing problems	1.21	1.15–1.30
Cardiac	0.94	0.88–1.01
Unconscious/fainting	0.74	0.69–0.80
Stroke/CVA	0.75	0.70–0.80
Trauma (other)‡	0.98	0.91–1.05
Abdominal pain	1.15	1.07–1.24
Diabetic problem	1.14	1.06–1.22
Traffic accident	0.34	0.29–0.40
Unknown person down	1.11	1.03–1.20
Back pain	1.35	1.26–1.45
Seizure	0.90	0.82–0.98
Psychiatric problem	1.38	1.25–1.52
Cardiac arrest	0.26	0.22–0.30
Headache	1.16	1.05–1.28
Allergies	0.74	0.66–0.83
Exposure	0.83	0.73–0.94
Choking	0.82	0.73–0.93

	Adjusted OR	95% CI
Eye problem	1.11	0.90–1.37

*Odds ratios are generated from a single logistic regression model; each odds ratio is adjusted for all other variables reported and clustering by county.

†Each dispatch complaint is a discrete variable in the model. The referent group for each complaint is patients without the dispatch complaint.

‡Trauma (other) includes animal bite, assault, burns, electrocution, hemorrhage/laceration, and multicasualty incident.

Table 4

Proportion of EMS transports that resulted in repeated transport in the subsequent 30 days, stratified by total number of transports of individual patients during the 6-year study period (N=1,711,669 EMS transports of 689,664 patients).

		Repeated Transport in 30 Days	
Number of Transports of Same Individual During Study Period	**Total Transports**	**No.**	**%**
1	370,431	0	
2	249,718	24,062	9.6
3–4	357,979	57,673	16.1
5–10	470,221	114,677	24.4
≥11	263,320	106,687	40.5