At-Risk Populations and the Critically Ill Rely Disproportionately on Ambulance Transport to Emergency Departments

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Study objective: Emergency department (ED) crowding increases ambulance diversion. Ambulance diversion disproportionately affects individuals who rely on ambulance transport. The purpose of this study is to determine which populations rely most on ambulance transport.

Methods: We queried the National Hospital Ambulatory Medical Care Survey database for 1997 to 2000 and 2003 to 2005 for patients who arrived by ambulance or personal transport. We performed bivariate analysis to assess the extent to which all patients and a subset of critically ill patients use ambulance transport relative to self-transport.

Results: In our sample, 30,455 (15%; 95% confidence interval [CI] 15% to 16%) patients arrived by ambulance and 162,091 (85%; 95% CI 84% to 85%) arrived by walk-in/self-transport. Overall, patients with Medicare insurance were more likely to rely on ambulance transport, at 34% (95% CI 33% to 35%), than the privately insured, at 11% (95% CI 10% to 11%). Among the critically ill, privately insured patients were less likely to rely on ambulance transport, at 47% (95% CI 42% to 52%), than those with Medicare insurance (61%; 95% CI 58% to 65%), the publicly insured (60%; 95% CI 52% to 67%), or the uninsured (57%; 95% CI 49% to 64%). Among the critically ill, patients aged 15 to 24 years and those older than 74 years were most likely to rely on ambulance transport, at 63% (95% CI 53% to 72%) and 67% (95% CI 62% to 71%), respectively. Fifty-seven percent (95% CI 54% to 59%) of the critically ill used ambulance versus 15% (95% CI 14% to 15%) of noncritical patients.

Conclusion: Patients with Medicare insurance or public insurance, the uninsured, the elderly, and the critically ill disproportionately rely on ambulance transport to the ED. Ambulance diversion may disproportionately affect these populations. [Ann Emerg Med. 2010;56:341-347.]

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INTRODUCTION

Emergency department (ED) crowding is a growing epidemic affecting the US health care system.[1,2] Ambulance diversion is a common practice that hospitals of all types rely on to temporarily relieve excessive demands on ED resources.[3] Although ambulance diversion extends transport time, there is a paucity of literature about its effects on access to care, distribution of hospital resources, and appropriate prioritization of patients according to severity.[4,5]

In its 2006 report *Hospital Based Emergency Care: At the Breaking Point*, the Institute of Medicine identified ambulance diversion as one of the major challenges facing emergency care.[6] Although the goal of ambulance diversion is to improve the quality and timeliness of care for patients already in the ED, diversion may adversely affect patients in ambulances whose care is delayed by longer transport times.[4,7-9] If patients arriving by ambulance are likely to be higher acuity than patients in the waiting room, ambulance diversion may inappropriately delay their care. Conversely, if patients arriving by ambulance are no more ill than those already in the waiting room, then ambulance diversion allows appropriate prioritization of those patients in the waiting room. Furthermore, if patients with barriers to care, such as racial/ethnic minorities, the elderly, and the uninsured, disproportionately rely on ambulance transport, then diversion may disproportionately affect those who already have substantial barriers to care. Although some evidence suggests that a high percentage of ambulance transports include older patients, high-acuity patients, the mentally ill, and relatively fewer privately insured,[10,11] it is unclear whether at-risk populations, such as racial/ethnic minorities, the uninsured, the elderly, or the

Editor's Capsule Summary

What is already known on this topic

Ambulance diversion is sometimes used to limit effects of emergency department (ED) crowding.

What question this study addressed

The proportion of ED patients who arrived by ambulance, stratified by type of insurance, age, race/ethnicity, and presence of a critical illness.

What this study adds to our knowledge

Fifteen percent of patients in the 192,000-patient National Hospital Ambulatory Medical Care Survey database arrived by ambulance. Ambulance use was not affected by race/ethnicity but was higher in older patients and those with critical illnesses. Among patients with a critical illness, those with Medicare, Medicaid, or no insurance were more likely to use an ambulance than patients with private insurance.

How this is relevant to clinical practice

Because ambulance use varies by patient characteristics, including insurance and acuity of illness, ambulance diversion may have differential effects on specific patient populations.

critically ill, disproportionately rely on ambulance transport for ED utilization.

We hypothesized that patients with lower socioeconomic status, ie, racial/ethnic minorities and the uninsured, are less likely to have a private automobile available and must therefore rely disproportionately on ambulance transport. Similarly, we hypothesized that the elderly, with less availability of private automobile transport because of financial constraints or limitations of physical driving ability,[12-14] would rely on ambulance transport. Finally, private automobile transport may require too much time for the critically ill to obtain medical care, and such patients may turn to ambulance transport. An understanding of these dynamics is critical for policymakers to design informed ambulance diversion criteria.

Therefore, the purpose of this study was to determine whether at-risk populations disproportionately rely on ambulance transport (eg, racial/ethnic minorities, the uninsured, the elderly) and whether the critically ill disproportionately rely on ambulance transport.

MATERIALS AND METHODS

Study Design

We combined data from the 1997 through 2005 National Hospital Ambulatory Medical Care Survey (NHAMCS). The NHAMCS is a nationally representative sample of visits to nonfederal, short-stay hospital EDs, conducted by the National Center for Health Statistics (NCHS).[15-17] The NHAMCS used a 4-stage probability sampling procedure that selected counties (or equivalents), then hospitals, and then emergency service areas. Between 352 and 406 nationally representative hospital EDs completed the survey each year during our study period.[15,17-22] Hospital staff trained by NCHS personnel prospectively selected a random sample of patient visits during a randomly assigned 4-week reporting period.

The patient record form was completed by hospital staff, beginning when the patient arrived; additional information was later abstracted from patients' charts. All data were reviewed and validated by the NCHS staff. The NHAMCS used routine quality control measures. An NCHS field representative reviewed the log or other records selected for visit sampling to determine whether any cases were missing and also edited completed forms for missing data. Attempts were made to retrieve both missing cases and missing data on specific cases, either by consulting with the appropriate hospital staff or by reviewing the pertinent medical records.

All medical and drug coding and keying operations were subject to quality control procedures. Quality control for the medical- and drug-coding operation, as well as straight-key items, involved a 2-way 10% independent verification procedure. As an additional quality control, all patient record forms with differences between coders or with illegible entries for reason for visit, diagnostic and therapeutic procedures, diagnosis, E-code (cause of injury), or medication items were reviewed and adjudicated at the NCHS. The data from the NHAMCS can be used to produce national estimates through the weighting procedure that accounts for the sample design, nonresponse, and fixed totals. We identified all individuals with a mode of arrival of ambulance or personal transport. We excluded survey years 2001 and 2002 because mode of arrival was not collected.

The NHAMCS data set is publicly available and, because it contains no patient identifiers, is HIPAA compliant. The NHAMCS has been approved by the NCHS Research Ethics Review Board.[23]

Mode of arrival was abstracted from the patient record form by NHAMCS protocol. The coding options for mode of arrival changed slightly during the study period, so we limited our analyses to those whose mode of arrival was ambulance versus those who arrived by self-transport or personal transport. We excluded transfers, patients with unknown or blank mode of arrival, and public/police/county transport.

We were primarily interested in exploring the reliance on ambulance transport by at-risk populations and the critically ill. According to a review of the literature, we explored race/ethnicity, insurance status, and age to determine whether patients at risk for poor access to health care disproportionately rely on ambulance transport. The race and ethnicity recorded in NHAMCS likely reflect the hospital staff's perception of the patient's race and ethnicity, not necessarily the classification that

the patient might choose. The NHAMCS classified the patient's race as white, black, American Indian or Alaskan Native, or Asian or Pacific Islander, as determined by the hospital staff, with explicit instructions from NHAMCS not to ask the patient unless it was hospital procedure to do so. The patient's ethnicity was categorized as Hispanic or non-Hispanic. According to this, we created 4 racial/ethnic groups that we refer to as black, Latino, white, or other.[24] Patients initially coded as being Asian, American Indian or Alaskan Native, Pacific Islander, or multiple races were categorized as "other." We considered any patient recorded as being Hispanic or Latino ethnicity to be Latino, regardless of other racial classifications. Health care providers' impressions of patients' appearance are likely to be based on an individual's race and ethnicity, and we therefore use the term race/ethnicity. The patient's insurance reflected expected source of payment at initial registration and was categorized into 4 types: (1) any private insurance or worker's compensation, (2) Medicare, (3) any public insurance besides Medicare, and (4) self-pay/uninsured. The patient's age was recorded from the medical chart, and we categorized it as aged younger than 15 years, 15 to 24 years, 25 to 44 years, 45 to 64 years, 65 to 74 years, and 75 years and older.

Because previous research has shown a positive association between acuity of illness and reliance on ambulance transport,[11] we planned a subgroup analysis of critically ill patients to control for possible confounding between patient acuity and other independent variables. This subgroup of critically ill patients was defined before data analysis. We categorized patients as critically ill if they were admitted to an ICU from the ED, went to the operating room directly from the ED, went to the cardiac catheterization laboratory from the ED, were intubated in the ED, had cardiopulmonary resuscitation performed in the ED, or died in the ED.

Primary Data Analysis

We performed bivariate analysis to assess the extent to which the variables of interest were associated with ambulance versus private transport. It is possible that at-risk populations rely on ambulance use for less acute conditions. To determine whether at-risk populations who are critically ill disproportionately rely on ambulance transport, we performed bivariate analysis of the at-risk population among the subpopulation of critically ill patients. All analyses were adjusted for sample weights and the complex survey design of the NHAMCS by using the survey modules in Stata 9.2/SE (StataCorp, College Station, TX). The a priori significance level was set at $\alpha=.05$. Because of very large sample sizes, some statistically significant differences may not be clinically meaningful.

RESULTS

Of the 203,556 patient visits in our sample, 6,252 (3%) were coded "unknown" and 4,758 (2.3%) had mode of arrival left blank, leaving 192,546 (95%) with a known arrival by ambulance or walk-in/self-transport. Among the 192,546 patients with a known mode of arrival, 30,455 (15%; 95% confidence interval [CI] 15% to 16%) arrived by ambulance and 162,091 (85%; 95% CI 84% to 85%) arrived by walk-in/self-transport (Table).

In bivariate analysis of the overall population, the association between race/ethnicity and reliance on ambulance transport was not clinically significant, with rates of ambulance use ranging from 13% to 16% (Table). Among the subpopulation of critically ill patients, Latinos were slightly less likely to rely on ambulance transport than whites or blacks (Table).

Overall, patients with Medicare insurance were dramatically more likely to rely on ambulance transport, at 34% (95% CI 33% to 35%), than the privately insured, at 11% (95% CI 10% to 11%) (Figure 1). Among the critically ill, privately insured patients were less likely to rely on ambulance transport, at 47% (95% CI 47% to 52%), than those with Medicare insurance (61%; 95% CI 58% to 65%; $P<.001$), the publicly insured (60%; 95% CI 52% to 67%; $P=.004$), or the uninsured (57%; 95% CI 49% to 64%; $P=.014$) (Figure 2).

Overall, use of ambulance transport increased with age from 6% (95% CI 5% to 6%) among patients younger than 15 years to 45% (95% CI 43% to 46%) for those older than 74 years (Figure 3). Among the critically ill, patients aged 15 to 24 years and those older than 74 years were most likely to rely on ambulance transport, at 63% (95% CI 53% to 72%) and 67% (95% CI 62% to 71%), respectively (Figure 4).

Among the entire population, 57% (95% CI 54% to 59%) of critically ill patients used the ambulance versus 15% (95% CI 14% to 15%) of the noncritical patients. Forty-three percent (95% CI 41% to 46%) of the critically ill patients arrived by walk-in or self-transport.

LIMITATIONS

Although this study uses a robust nationally representative data set to examine the populations who rely on ambulance transport, there are several important limitations. First, we have neither demonstrated which patients were actually diverted nor the social, financial, or health effects of being diverted. It may be reasonable to assume that those groups who disproportionately rely on ambulance transport will be disproportionately affected by ambulance diversion, but this is not conclusively demonstrated by the current study.

Second, although groups who rely on ambulance transport are disproportionately affected by ambulance diversion, the effect on delay in care is not well established[5] and is not addressed in the present study. If ambulance patients are accurately and efficiently triaged in the same pool as self-transported patients, then care of low-acuity patients should never delay the care of high-acuity patients, regardless of mode of arrival.[25] When such efficient triage happens, then there is little justification for any ambulance diversion. On the other hand, if receiving ambulance patients delays the evaluation and treatment of the minority of critically ill patients who walked in or self-transported, then ambulance diversion of less ill patients appropriately distributes

Table. Participants in the NHAMCS (1997 to 2000, 2003 to 2005) by mode of arrival.*

	Full Population					Subpopulation of Critically Ill Patients†				
		Arrived by Ambulance		Walk-in or Self-Transport			Arrived by Ambulance		Walk-in or Self-Transport	
Patient Characteristics	**Total N**	**N**	**Weighted % (95% CI)**	**N**	**Weighted % (95% CI)**	**Total N**	**N**	**Weighted % (95% CI)**	**N**	**Weighted % (95% CI)**
All ED visits	192,546	30,455	15 (15–16)	162,091	85 (84–85)	2,987	1,660	57 (54–59)	1327	43 (41–46)
All race/ethnicity	192,546	30,455	15 (15–16)	162,091	85 (84–85)	2,987	1,660	57 (54–59)	1327	43 (41–46)
White	100,277	19,700	16 (16–17)	100,277	84 (83–85)	2,170	1,218	57 (54–60)	952	43 (40–46)
Black	40,742	6,230	15 (14–16)	34,512	85 (84–86)	439	255	59 (53–65)	184	41 (35–47)
Latino	25,386	3,489	13 (12–14)	21,897	87 (86–88)	262	124	45 (37–53)	138	55 (47–63)
Other	6,441	1,036	16 (14–18)	5,405	84 (82–86)	116	63	60 (49–71)	53	40 (29–52)
All insurance	175,487	27,368	15 (15–16)	148,119	85 (84–85)	2,743	1,515	56 (53–59)	1228	44 (41–47)
Private	77,351	8,386	11 (10–11)	68,965	89 (89–90)	902	426	47 (42–52)	476	53 (48–58)
Medicare	27,510	9,393	34 (33–35)	18,117	66 (65–67)	1,161	711	61 (58–65)	450	39 (35–42)
Public	40,404	5,222	12 (11–13)	35,182	88 (87–89)	397	221	60 (52–67)	176	40 (33–48)
Uninsured	30,222	4,367	14 (13–15)	25,855	86 (85–87)	283	157	57 (49–64)	126	43 (36–51)
All ages, y	192,546	30,455	15 (15–16)	162,091	85 (84–85)	2,987	1,660	57 (54–59)	1327	43 (41–46)
<15	39,503	2,222	6 (5–6)	37,281	94 (94–95)	125	59	47 (35–59)	66	53 (41–65)
15–24	30,409	3,521	11 (11–12)	26,888	89 (88–89)	147	85	63 (53–72)	62	37 (28–47)
25–44	58,308	7,306	12 (12–13)	51,002	88 (87–88)	456	214	51 (45–57)	242	49 (43–55)
45–64	35,435	6,575	18 (18–19)	28,860	82 (81–82)	844	416	48 (43–53)	428	52 (47–57)
65–74	11,807	3,266	27 (26–28)	8,541	73 (72–74)	508	281	58 (53–63)	227	42 (37–47)
≥75	17,084	7,565	45 (43–46)	9,519	55 (54–57)	907	605	67 (62–71)	302	33 (29–38)
All acuity	192,546	30,455	15 (15–16)	162,091	85 (84–85)					
Noncritical	189,559	28,795	15 (14–15)	160,764	85 (85–86)					
Critical	2,987	1,660	57 (54–59)	1,327	43 (41–46)					

*N represents the number of unweighted observations in the data set. Percentages may not add to 100 because of weighting to account for survey design and rounding. Not all total N are equal because of missing data.

†Critically ill patients were identified as patients admitted to an ICU from the ED, went to the operating room from the ED, went to the cardiac catheterization laboratory from the ED, were tracheally intubated in the ED, had cardiopulmonary resuscitation performed in the ED, or died in the ED.

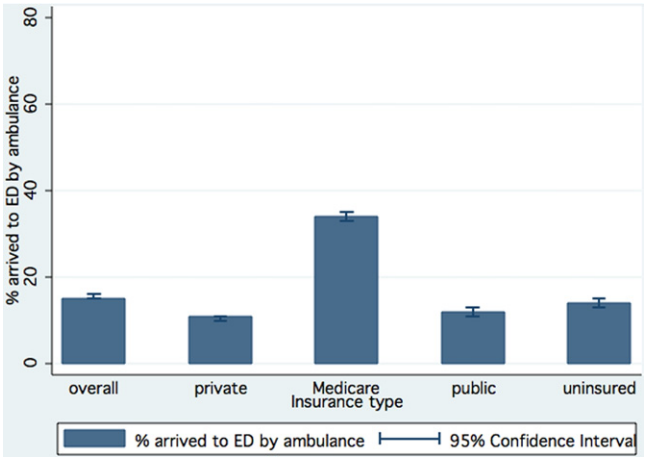

Figure 1. Percentage of all patients arriving by ambulance, by insurance type. Error bars represent 95% CIs.

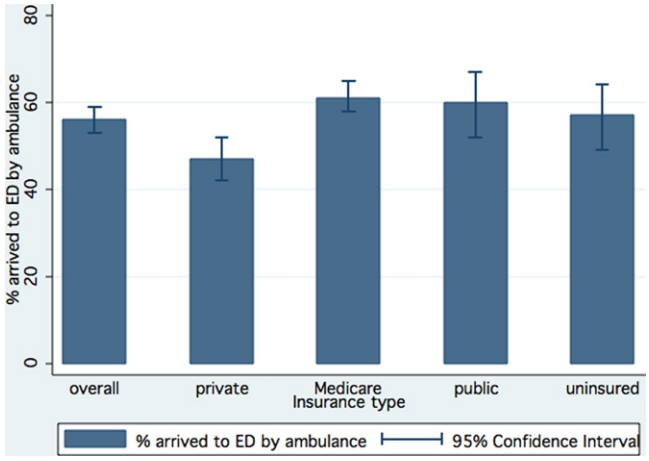

Figure 2. Percentage of critically ill patients arriving by ambulance, by insurance type. Error bars represent 95% CIs.

resources. It is also possible that ambulance patients who are diverted receive improved care by arriving at an ED that is not overburdened and is therefore able to provide better and more prompt care.

Third, we used an extreme definition of critically ill patients. Although our definition of critically ill patients accurately excludes mild illness, there is likely a much larger pool of patients requiring emergency medical care who were not included and may be disproportionately distributed across our study groups. Such a categorization error would lead to erroneous conclusions about reliance on ambulance transport. However, we believe that the results of the general population, coupled with the analysis of the very critically ill, provide a complete representation.

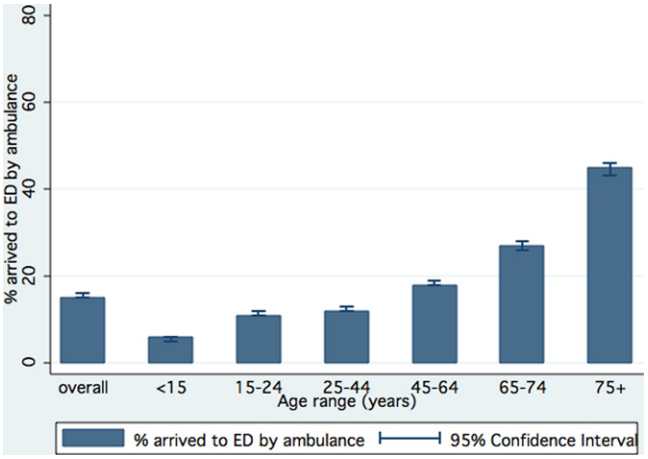

Figure 3. Percentage of all patients arriving by ambulance, by age group. Error bars represent 95% CIs.

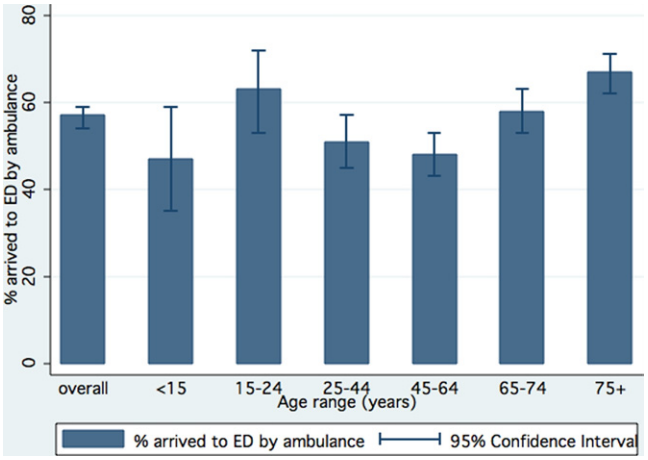

Figure 4. Percentage of critically ill patients arriving by ambulance, by age group. Error bars represent 95% CIs.

DISCUSSION

This study demonstrated that patients insured by Medicare and the elderly disproportionately relied on ambulance transport, whereas racial/ethnic minorities did not. Among the critically ill, patients with Medicare insurance, public insurance, or no insurance were more likely to rely on the ambulance than the privately insured. Overall, the majority of critically ill patients used an ambulance for transport to the ED, but a minority of critically ill patients walked in or self-transported. Although the effects of ambulance diversion on patients diverted are not yet well elucidated, our findings suggest that these effects will be disproportionately experienced by patients with Medicare insurance, public insurance, or no insurance; by the elderly; and by the critically ill.

The effect of race/ethnicity on ambulance use is clinically insignificant among the general population, but there is a notably decreased rate of ambulance use by critically ill Latino patients. Possible explanations for lower ambulance utilization by Latinos are decreased awareness of availability of emergency services, concerns over ambulance bills, or fear of deportation among undocumented residents.[26] These results suggest that ambulance diversion is unlikely to contribute to existing barriers to care based on patient race/ethnicity, although further research is needed to explore this finding. Because the categorization of race reflects the hospital staff's perception of the patient's race and ethnicity rather than the patients' self-identification, misclassification of race may exist in this database.

Among the entire ED population, patients insured by Medicare were approximately 3 times more likely to use ambulance transportation than those with any other form of insurance, which could be due to an increased proportion of these patients arriving to the ED from long-term-care facilities (eg, skilled nursing facilities, assisted living homes), decreased use of private vehicles by this population (ie, less car ownership because of physical driving abilities or limited financial resources, or reluctance to drive at night or when ill),[12-14] chronic health problems requiring specialized transport, or decreased concern about ambulance bills compared with that of other groups.[27] When the subset of patients who were critically ill was considered, approximately one-quarter fewer privately insured patients used ambulance transport than those with Medicare insurance, the publicly insured, or the uninsured, which may reflect easier access to privately owned cars or financial disincentives caused by insurance copayments for ambulance transport. These data imply that ambulance diversion will disproportionately affect emergency care for Medicare beneficiaries regardless of acuity and for all critically ill patients without private insurance.

There is a nearly linear trend of increasing reliance on ambulance transport to the ED as age increases, with nearly half of all patients older than 74 years relying on ambulance transport. Although there is not a similar trend among the critically ill, this trend in the general population suggests that demand for ambulance transport will increase substantially as the population ages. The proportion of US residents aged 65 years and older is expected to increase from 12% in 2006 to 16% in 2020,[28] and the need for ambulance transport can be expected to increase concomitantly.[29] The increasing demands on ambulance transport and EDs from an aging population indicate that ambulance diversion is likely to worsen and the elderly will be most affected.

Although critically ill patients rely on ambulance transport more than the noncritically ill, nearly half of the critically ill patients still arrived by walk-in or self-transport, which indicates that patients with critical illness are more dependent on ambulance transport, but it also illustrates that patients who walk in or self-transport may be critically ill. This suggests that although ambulance diversion disproportionately affects the critically ill who rely on the ambulance for transport to the ED, the critically ill in the waiting room may have wait times inappropriately extended if an already burdened ED continues to accept ambulance traffic.

In 2003, of 16.2 million patients transported to the ED by ambulance, 501,000 (3.1%) were diverted away from the closest ED.[3] Ambulance diversion may delay patient care by multiple mechanisms. First, each additional minute a patient spends in transit delays evaluation and treatment by an emergency physician.[4,7-9] Second, by increasing transport times and distances, diversion decreases the number of ambulances and paramedic units available to respond to 911 calls in their service area, thereby potentially increasing emergency response times. Third, diversion may also delay appropriate patient care by interrupting continuity of care when patients are taken to a hospital away from where their records are kept and where their primary physicians might not have privileges. The extra time required to transmit patient records and collect a complicated medical history may delay timely diagnosis and treatment of the patient. Fourth, patients diverted to hospitals farther from their residence may need to be transferred for admission to a different hospital because of insurance restrictions or limitations, thus further delaying care and increasing the likelihood of an additional ambulance transport. Fifth, diverted patients who are taken to hospitals farther from their homes create difficulties for family members to visit and participate in the patient's recovery. Because of concern about possible negative consequences of ambulance diversion, various strategies have been developed to decrease the number of patients diverted.[30-32] The effect of these strategies on individual patients or groups of patients is an area for future investigation.

Despite theoretic consequences of ambulance diversion, there is a paucity of literature about the influence of diversion on patient outcomes. ED crowding has been shown to be associated with lower-quality care and increased mortality;[33-36] therefore, it may benefit a patient to be diverted to a less crowded hospital. Furthermore, ambulance diversion may paradoxically increase the availability of first-response ambulances by decreasing the delays in waiting to offload a patient at a crowded ED. Future research examining the effect of ambulance diversion on patient outcomes is needed.

In summary, this study demonstrates that patients with Medicare insurance or public insurance, the uninsured, the elderly, and the critically ill disproportionately rely on ambulance service for transport to the ED. These results imply that ambulance diversion may disproportionately affect these populations. Ambulance diversion policies and criteria should be designed to address possible disparities in care created by diversion and maximize resource allocation. Future studies are required to better understand the effects of ambulance diversion on the morbidity, mortality, and cost of the populations served.

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