Impact of Ambulance Diversion Policies in Urban, Suburban, and Rural Areas of Central Maryland

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Abstract. As a method to control patient flow to overburdened hospitals, effective emergency medical services (EMS) systems provide policies for ambulance diversion. The Maryland state EMS system supports two types of alert for general hospital use: red alert, aimed at limiting the delivery of patients who may require intensive care unit (ICU) admission, and yellow alert, aimed at preventing further overload of already overtaxed emergency departments (EDs). **Objective:** To examine the effect of those alert policies in different geographical environments, urban, suburban, and rural. **Methods:** Alert data for 23 hospitals in Central Maryland and ambulance arrival data for approximately 138,000 ambulance calls during calendar year 1996 were combined and analyzed. The impacts of diversion practices in the geographic areas were compared. **Results:** Red alert reduced volume in all patient acuity levels in all geographic areas by a statistically significant 0.4 patient/hr. Yellow alert diverted low-acuity patients at the rate of 0.13 patient/hr ($p < 0.001$) in urban areas and at the rate of 0.16 patient/hr ($p < 0.001$) in suburban areas, but had minimal impact in the flow of patients in the rural environment. **Conclusions:** The ED diversion policy has some limited effect in preventing further patient volume in urban and suburban areas, but has virtually no impact in rural areas. However, an ICU diversion policy diverts patients of all acuities uniformly and inordinately diverts patients not likely to require ICU admissions while having only minimal impact on patients who do require ICU resources. The impact of red alert is uniform in all geographic areas. The impact and efficacy of ambulance diversion policies should be evaluated to ensure they are having the intended effect. While perhaps initially effective, the impact of alert policies may change over time. **Key words:** ambulance; ambulatory care; emergency medical services; emergency medicine; medical administration. ACADEMIC EMERGENCY MEDICINE 2001; 8:36–40

AMBULANCE diversion policies are created to control patient flow within an emergency medical services (EMS) system. These policies allow individual hospitals or specialty referral centers to declare themselves as "unavailable" to the EMS community if their resources are overwhelmed. Many EMS systems have in place a number of different types of alert that allow specific portions of the system to be "closed" while other portions of the system remain available to out-of-hospital providers. Effective diversion policies should redirect a significant number of patients; however, it is unclear whether diversion policies result in the intended effect. Inappropriate use of diversion policies by hospitals or misapplication of diversion policies by out-of-hospital providers may have significant impact on hospital operations.

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This study examined whether existing bypass policies in a mature EMS environment have the intended effect on patient flow. As well, this study asked whether the impact of the ambulance diversion policies is the same in different geographic areas, urban, suburban, and rural.

METHODS

Study Design. A retrospective review of the Maryland EMS database for calendar year 1996 correlated ambulance run sheet information regarding the destination of ambulances with the alert status of individual hospitals. The Maryland EMS database is a centrally maintained database that includes multiple data from across the State of Maryland. This database includes information from EMS ambulance run sheets submitted for all ambulance calls. The state EMS office records all hospital alert utilization and maintains the data. Receiving hospitals were categorized according to state EMS protocol as operating in urban, suburban, or rural areas based on location and population served by those hospitals. The specific study area within Maryland is the most populated and geographically diverse area, metropolitan Balti-

more and Central Maryland. Because this study used archival data, it was considered exempt from informed consent.

Study Setting and Population. The State of Maryland operates a fully developed EMS system. Operating a paid and volunteer municipal fire/EMS model, Maryland EMS personnel transport patients to 52 acute care hospitals with functional emergency departments (EDs). The system includes specialty centers for adult trauma, burn care, pediatric trauma, eye trauma, hand trauma, neonatal care, and other injury-related specialties. In order to tailor the service to specific areas, the state is divided into five regions.

This study examined activity in the central portion of the state, the most populated area, region III. Region III includes the urban and suburban Baltimore metropolitan area, as well as rural areas with low population and longer transport times and distances. There are 23 hospitals in region III; out-of-hospital providers in this region manage approximately 138,000 ambulance transports per year.

Study Protocol. Using alert data from 23 hospitals and all ambulance calls recorded in the study area, a patient (ambulance)-per-hour arrival rate was calculated and was further stratified by EMS level of acuity. Data were generated for each geographic area when "off" alert and compared with time periods when "on" yellow or red alert, respectively, using chi-square analysis.

Complementing the larger study, in order to more completely assess the impact of red alert alone, a separate retrospective analysis of patients delivered to a single, urban ED was performed. In order to get data approximating a month's activity while minimizing the impact of using data from a single month, ambulance run sheets for patients delivered to the hospital from 31 random days over a three-month period were reviewed. The EMS priority of each patient was correlated with the location of hospital admission, obtained from hospital records. Descriptive statistics were developed to describe this patient population, allowing us to begin to assess the value of red alert vs the cost in terms of patient volume.

This study did not measure the impact of multiple area hospitals using diversion at the same time. Typically, patients diverted from their primary destinations are transported to the next closest hospital, usually within the same region. Multiple hospitals in one area being on alert may cause out-of-hospital providers to ignore the alert status.

Definitions. The Maryland system uses two general hospital bypass policies aimed at preventing overutilization of hospital resources. "Yellow alert" is declared by a hospital when ED capacity to care for additional patients is severely limited. The need for yellow alert is defined by ED personnel. According to state policy, having declared "yellow alert," the ED temporarily requests that it receive absolutely no patients in need of urgent medical care. However, because of the critical nature of EMS priority 1 patients, the closest hospital, even if on yellow alert, will continue to receive the highest-acuity patients unless there is another hospital within 2 to 3 minutes. Priority 2 and 3 patients will be diverted to another facility unless transport time will be lengthened by more than 15 minutes or the next nearest hospital is also on yellow alert.

The second type of alert, "red alert," is aimed at limiting access to a hospital that has limited intensive care unit (ICU) or monitored bed capacity. By invoking "red alert," the hospital is declaring that no electrocardiogram (ECG)-monitored beds, including all inpatient critical care and telemetry beds, are available. Under "red alert" the hospital again continues to receive priority 1 patients unless another hospital is within 2 to 3 minutes. Priority 2 and 3 patients who require ECG monitoring are to be diverted unless transport time is lengthened by more than 15 minutes. The patient level of acuity (priority level) used in this study is assigned by the out-of-hospital provider.

A key component of the study is the EMS priority assigned to patients. The definitions of each level of priority are described below:

- *Priority 1*—Critically ill or injured person requiring immediate attention; unstable patients with potentially life-threatening injury or illness.
- *Priority 2*—Less serious condition, necessitating emergency medical attention but not immediately endangering the patient's life.
- *Priority 3*—Nonemergency condition, necessitating medical attention but not on an emergency basis.
- *Priority 4*—Patient does not require medical attention.

Data Analysis. Descriptive statistics were used to describe all data categories with statistical significance set at $p < 0.05$.

RESULTS

In the study region, EMS-transported patients arrived at local EDs at an overall rate of 0.7 patients/hr. The largest difference in arrival rates, 0.79 patient/hr vs 0.56 patient/hr, occurred between the suburban and rural areas (Table 1). Urban and suburban area hospitals managed a similar num-

TABLE 1. Ambulance Arrival Rate (Patients/Hr) to the Emergency Department while *Off* Alert, Maryland, 1996

	Geographic Area			
Acuity/Priority	Urban	Suburban	Rural	Region Total
1	0.08	0.11	0.07	0.09
2	0.18	0.24	0.21	0.20
3	0.42	0.43	0.28	0.40
TOTAL	0.68	0.79	0.56	0.70

ber of low-acuity priority 3 patients, while in rural areas a lower number of priority 3 patients were transported. However, in all areas, priority 3 patients accounted for the largest patient group.

Differences in the arrival rates of priority 1 patients when the EDs in any of the areas under review were on yellow alert were minimal and statistically indiscernible (Table 2). In rural areas, yellow alert did not affect the arrival rates of patients in any category (priority 1, 2, and 3). However, in the urban and suburban areas, priority 2 and 3 patients were diverted in significant volumes.

The diversion pattern for red alert is different from that of yellow alert (Table 3). At the regional level, the overall impact of red alert is significantly greater than the impact of yellow alert, reducing patient flow to the ED by 0.4 patient/hr vs a reduction of 0.18 patient/hr under yellow alert. The impact of red alert was that patients of all priorities, 1, 2, and 3, were diverted in significant numbers in all areas under study. Low-acuity patients were diverted from the ED in significant numbers despite the stated purpose of red alert, to control the flow of patients requiring monitored or ICU bed care.

The high diversion rate for low-acuity patients by an alert status aimed at controlling ICU volume caused us to further assess the potential impact of red alert. Our review of patients arriving by ambulance to the study hospital revealed 703 transported patients during the 31 selected days. Of those, 593 patients had medical complaints, and 397 of these patients were EMS priority 2 or 3. Of the 397 medical priority 2 or 3 patients, 124 (31.2%) required hospital admission and only six (1.5%) required hospital admission to an ICU; an additional eight required admission to a telemetry monitored bed.

DISCUSSION

It is incumbent upon an EMS system to consider efficient utilization of resources. For this reason, it is common for systems to create diversion policies that are meant to control patient flow. These policies should be selective, each aimed at controlling flow to a specific portion of the EMS system.[1] While of growing interest, the literature is limited in its analysis of the impact of diversion policies. Much of the initial literature is limited to discussion of the underlying causes for ED diversion, but does not examine the issue from a regional level.[2–4] The Maryland state EMS system provides for a number of diversion policies, including policies aimed at controlling patient flow for trauma centers and specialty centers (burn, eye, hand trauma), as well as general hospital bypass policies.

The data suggest that the use of diversion policies aimed at controlling ED volume does, as intended, divert a small but significant number of lower-acuity patients from the ED when it is overtaxed. Also as intended, there is no change in the arrival rate of patients with potentially life-threatening emergencies. It is also apparent that out-of-hospital providers in rural areas are commonly forced to ignore the alert status of local hospitals since there are few, if any, alternatives within a reasonable distance (<15 minutes transport time). What was surprising was the relatively low number of patients apparently diverted. It is a commonly held tenet among ED providers that alerts aimed specifically at managing ED volume do, in fact, divert significant patient volume. Our study suggests that overall, about one patient is diverted for each five hours on alert. While statistically significant, this alert may not be providing the anticipated or required relief in all settings.

The impact of the alert aimed at controlling ICU volume (red alert) was greater and more generalized than expected. Patients of all acuities were being diverted from hospitals on red alert, including patients requiring outpatient ED care or general hospital admission and not admission to ICU beds.

Recalling that red alert is intended to divert patients who may require ICU admission, one must question the value of diverting priority 2 and 3 patients, since it is generally believed that those patients only infrequently require admission to intensive care areas. The minimal likelihood for admission of priority 2 and 3 patients to ICU beds was confirmed by our review of ambulance run sheet data that examined the disposition of priority 2 and 3 patients delivered to an academic urban medical center. Of the patients (priority 2 and 3) delivered, approximately 31.2% required admission to inpatient units; however, only 1.5% required admission to ICU beds. An additional 1.8% required admission to a telemetry monitored bed. This would suggest that the risk of removing red alert is minimal; if red alert were eliminated or never used, there would exist a 3% chance of having a patient arrive who would require either a

monitored or ICU bed admission when one of these beds is not immediately available. Hospitals using high levels of this kind of alert would seem to be diverting significant numbers of patients from their EDs and from their inpatient units unnecessarily. The value of red alert (ICU diversion) should be reexamined in light of this information.

LIMITATIONS AND FUTURE QUESTIONS

The primary limitation of this study is that the data used are not mutually exclusive of all types of alert. For example, it is possible that a hospital (or a series of hospitals) could be on yellow and red alert simultaneously. We expect the impact of any "double alert" to be minimal when measured in any geographic area or across the region. However, an individual hospital's data could be impacted by significant levels of both red and yellow alert.

The impact of other types of alert (trauma, burn, etc.) is expected to be minimal given the relatively small number of patients in these categories and the low levels of use of alert by specialty centers. Although we expect minimal impact, the data are not controlled for season or time of day. Further studies should isolate the types of alert and should focus on alert use trends.

The brief review of the disposition of low-acuity patients delivered by ambulance should be expanded and confirmed. Although these results point to questionable value of red (ICU) alert, that conclusion is based on a retrospective review of the experience at a single, urban academic center.

Finally, this report is based on a specific set of diversion policies. Policies and practices differ between EMS systems, so those results may not be generalizable.

TABLE 2. Change in Ambulance Arrival Rate (Patients/Hr) as a Result of Yellow Alert (ED Diversion Policy), Maryland, 1996

Geographic Area	EMS Acuity Level			
	Priority 1	Priority 2	Priority 3	Total
Urban				
Off alert	0.08	0.18	0.42	0.68
On alert	0.10	0.14	0.29	0.52
Difference	0.02	−0.04	−0.13	−0.16
p	<0.01	<0.001	<0.001	<0.001
Suburban				
Off alert	0.11	0.24	0.43	0.79
On alert	0.12	0.15	0.27	0.55
Difference	0.01	−0.09	−0.16	−0.24
p	NS	<0.001	<0.001	<0.001
Rural				
Off alert	0.07	0.21	0.28	0.56
On alert	0.06	0.22	0.34	0.62
Difference	−0.01	0.01	0.06	0.06
p	NS	NS	NS	NS
Region total				
Off alert	0.09	0.20	0.40	0.70
On alert	0.10	0.13	0.28	0.52
Difference	0.01	−0.07	−0.12	−0.18
p	NS	<0.001	<0.001	<0.001

TABLE 3. Change in Ambulance Arrival Rates (Patients/Hr) as a Result of Red Alert (ICU Diversion Policy), Maryland, 1996

Geographic Area	EMS Acuity Level			
	Priority 1	Priority 2	Priority 3	Total
Urban				
Off alert	0.08	0.18	0.42	0.68
On alert	0.04	0.07	0.21	0.32
Difference	−0.04	−0.11	−0.21	−0.36
p	<0.001	<0.001	<0.001	<0.001
Suburban				
Off alert	0.11	0.24	0.43	0.79
On alert	0.05	0.09	0.18	0.33
Difference	−0.06	−0.15	−0.25	−0.46
p	<0.001	<0.001	<0.001	<0.001
Rural				
Off alert	0.07	0.21	0.28	0.56
On alert	0.02	0.06	0.10	0.17
Difference	−0.05	−0.15	−0.18	−0.39
p	<0.01	<0.01	<0.01	<0.01
Region total				
Off alert	0.09	0.20	0.40	0.70
On alert	0.04	0.07	0.18	0.30
Difference	−0.05	−0.13	−0.22	−0.40
p	<0.001	<0.001	<0.001	<0.001

CONCLUSIONS

Emergency medical systems should create and monitor methods to control patient flow. The policy developed in the State of Maryland to control patient flow to an overwhelmed ED appears to have the intended effect, although the impact is relatively small. In rural areas, where few if any alternate destinations exist, the impact of yellow alert is minimal.

The overall impact of red alert (aimed at controlling ICU volume) is greater than that of yellow alert, and the impact is the same regardless of geography. Red alert has an inordinate effect on patients who do not need to be diverted from the ED, which may result in a significant loss of inpatient volume. The application and the value of diversion policies aimed at controlling ICU volume should be reexamined. It is important for EMS systems to evaluate the efficacy of bypass policies and to be certain that these policies are providing the intended outcome.

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REFLECTIONS

Confessions

Thin and frail, eyes downcast, he sits on the side of the bed.
I ask the questions.
He moves his hand across a taut belly,
gently holding in his pain.
"Four days," he says, "for four days I've been swelling.
It hurts and I can't eat."

His hand shakes as he steadies himself on the side of the bed.
I ask the questions.
"Yes," he says quietly, "Yes, I drank for many years—
Forty years, a carton and a six pack a day.
I stopped for a while,
but now it's the same."

Later.
Thin and frail, eyes downcast, he lies on the length of the bed.
I hold the needle. Paracentesis.
We watch together as warm liquids flow.
Relief.
Whispering, he offers, "I had quit . . . two years I had quit.
My son came to live with me, had cerebral palsy.
I took good care of him, I did.
Then there was a fire . . ." his voice trails.
"Next week Mama died.
Then it was just me,
and now it's the same."
And he moves his hand across a now softer belly,
gently holding in his pain.

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