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WHICH EMERGENCY MEDICAL DISPATCH CODES PREDICT HIGH PREHOSPITAL NONTRANSPORT RATES IN AN URBAN COMMUNITY?

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ABSTRACT

Background. The Medical Priority Dispatch System (MPDS) is a commonly used computer-based emergency medical dispatch (EMD) system that is widely used to prioritize 9-1-1 calls and optimize resource allocation. There are five major priority classes used to dispatch 9-1-1 calls in the San Francisco System; Alpha codes are the lowest priority (lowest expected acuity) and Echo are the highest priority. Objective. We sought to determine which MPDS dispatch codes are associated with high prehospital non-transport rates (NTRs). Methods. All unique MPDS call categories from 2009 in a highly urbanized, two-tier advanced life support (ALS) system were sorted according to highest NTRs. There are many reasons for nontransport, such as “gone on arrival,” and “patient denied transport.” Those categories with greater than 100 annual calls were further evaluated. MPDS groups that included multiple categories with NTRs exceeding 25% were then identified and each category was analyzed. Results. EMS responded to a total of 81,437 calls in 2009, of which 18,851 were not transported by EMS. The majority of the NTRs were found among “cardiac/respiratory arrest/death,” “unknown problem/man down,” “traffic/transportation accidents,” and “unconscious/fainting” categories. The higher the priority code within each subset (AB vs. CDE), the less likely the patient was to be transported. Charlie priority codes were therefore the strongest predictors of hospital transport, while Echo codes (highest priority) were those with the highest nontransport rates and were the worst predictors of hospital transport in the emergency subset. Key words: ambulance/utilization; emergencies/classification; Emergency Medical Dispatch; Emergency Medical Service Communication Systems/standards; Emergency Medical Services/standards; Emergency Medical Services/utilization; risk assessment; triage

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INTRODUCTION

Emergency Medical Dispatch (EMD) is an internationally utilized system of categorizing and prioritizing emergency calls in order to send an appropriate and timely prehospital response. A variety of studies in differing systems with both health and non-health-trained dispatchers have been published using a variety of different clinical measures to gauge success.1–14

The Medical Priority Dispatch System (MPDS) is a computer-based EMD system that uses callers’ responses to scripted questions to categorize cases into numerical codes. The MPDS system is used in 71% of major U.S. cities. 9-1-1 callers are asked a series of scripted questions that include the patient’s level of consciousness, age, chief complaint, and other complaint-specific questions. Emergency Medical Service (EMS) calls are each assigned a dispatch code using the Medical Priority Dispatch System (MPDS, Version 11.3, Medical Priority Consultants, Salt Lake City, UT) when adequate information is available. The computer-aided dispatch system records general information regarding each call, including date, time, and location of call, dispatch time, dispatch code, and disposition (e.g., “Transported Code 2”). Disposition codes are assigned when the on-scene unit has updated the call status.

Using the MPDS system, callers’ responses to scripted questions are used to categorize cases into numerical complaint-based categories called protocols, which are further assigned a priority (Alpha, Bravo, Charlie, Delta, or Echo) based on their perceived acuity. Alpha and Bravo represent the lowest acuity calls;
These calls generally receive a no lights and sirens or “code 2” response in our system. Charlie, Delta, and Echo represent higher acuity calls that receive a lights and sirens or “code 3” response in our system. Calls may be further assigned a numerical subgroup and a modifier, which provide responders with more specific details about the call. Together, the numerical protocol, priority (Alpha through Echo), subgroup, and modifier (when present) make up the MPDS category. For example, a call may be assigned to the MPDS category 12D3E. The number 12 is the complaint-based category for seizure, D (or Delta) represents priority, 3 is a subcategory that informs prehospital providers that the patient has irregular breathing, and E is a modifier that indicates the patient has a history of epilepsy.

Several studies have examined the predictive accuracy of MPDS and other EMD systems for a variety of outcomes, including paramedic-assigned acuity score, physician diagnosis of an acute illness, cardiac arrest, “code 3” or “lights and sirens” return, and the need for advanced life support (ALS) intervention.9,15–20 Most research has demonstrated that MPDS and other EMD systems identify most but not all urgent calls with a considerable degree of overtriage.7–9,11,16,18,21–23

One intriguing study that linked dispatch, prehospital, and emergency department records of over 28,000 patients noted that a small subset of MPDS codes were associated with a greater than 90% predictive ability for ED discharge. This same study also noted an increased risk for admission or death for older patients.24 Another study attempted to direct specific 9-1-1 callers to an advice line with mixed results.25 Other recent studies have questioned any decrease in mortality with advanced life support or basic life support (BLS) assessment as well as the required timeliness (hot vs. cold response). Alpha calls are to be dispatched as BLS cold, Bravo as BLS hot, Charlie as ALS cold, and Delta as ALS hot. Omega calls represent those calls that are not time dependent (poison control center consults and those with obvious death). Echo calls are the sickest patients that require the most rapid response. This is accomplished by a variety of methods such as an engine response or police vehicle with an automatic external defibrillator.

We intended to determine if specific MPDS dispatch groups, priorities, or categories are associated with higher prehospital nontransport rates. There are both cost and safety issues associated with EMS responses. We aim to better match resources with anticipated patient need. Currently, just over 60% of EMS responses in our system are dispatched as highest priority (multiple resources at maximum speed). If patient nontransport rates can be predicted by these categories, we can utilize fewer resources at safer speeds to respond to these calls and reserve additional resources for higher priority calls. We recognize that this does not predict the need for ALS assessment. We would expect a consistent and step-wise decrease in nontransport rates as we progress from Alpha through Echo priorities within each MPDS group (i.e., “chest pain”).

**METHODS**

The city of San Francisco is an urban area with a daytime population of 800,000 and a size of 47 square miles that receives approximately 80,000 calls for emergency medical assistance annually. All calls receive an advanced life support response. High-priority or “code 3” calls receive a “lights and sirens” response consisting of a fire department (SFFD) engine (most are staffed with at least one paramedic) and a paramedic-staffed ambulance. Fire department personnel staff most ambulances, but a small percentage of calls receive private paramedic-staffed ambulances. In this one-year retrospective cohort study, we analyzed all calls for emergency medical service care in San Francisco between January 1 and December 31, 2009. All calls that were assigned a run number and an EMD category were sorted by call dispositions. Call disposition codes were assigned to one of three categories: (1) transport (patient was transported to hospital by SFFD or private ambulance), (2) nontransport (no transport occurred), or (3) discard (disposition was discarded from analysis due to uncertain outcome, misreporting of disposition, or other unknown error prohibiting accurate inclusion). See Table 1 for a comprehensive list of nontransport disposition codes. In our EMS system, cardiac arrest patients who do not achieve a pulse within 30 minutes and without persistent ventricular fibrillation are commonly pronounced in the field and not transported.

The University of California at San Francisco Committee on Human Research decided that approval was not required for this study because the data were extracted from a publically available dataset with no identifiable personal information. Nontransport rates (NTRs) were then calculated from the number of nontransports and total calls ran with the same, unique subcategory. All unique MPDS call categories from 2009 were sorted according to highest NTRs. MPDS groups (e.g., traffic/transportation accidents) that included multiple categories (injuries, pinned victims, etc.) with NTRs exceeding 25% were then identified and each category within that group was analyzed by their respective NTR and dispatch priority.

**RESULTS**

There were a total of 81,437 EMS calls in 2009, of which 56,707 were transported and 18,851 were not transported (24.95% overall nontransport rate). Of these, 52
TABLE 1. Nontransport disposition codes

<table>
<thead>
<tr>
<th>Disposition Codes</th>
<th>Category assigned</th>
<th>Total</th>
<th>Description</th>
<th>Expanded description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADV</td>
<td>Nontransport</td>
<td>1</td>
<td>Advisement</td>
<td>Advice</td>
</tr>
<tr>
<td>CIT</td>
<td>Nontransport</td>
<td>2</td>
<td>Cancel</td>
<td>Multiple reasons, usually cancelled in route</td>
</tr>
<tr>
<td>MAP</td>
<td>Nontransport</td>
<td>321</td>
<td>Mobile Assistance Program</td>
<td>Patient turned over the MAP</td>
</tr>
<tr>
<td>GOA</td>
<td>Nontransport</td>
<td>369</td>
<td>Gone on arrival</td>
<td>Patient gone on arrival</td>
</tr>
<tr>
<td>CAN</td>
<td>Nontransport</td>
<td>675</td>
<td>Cancel</td>
<td>Multiple reasons, canceled</td>
</tr>
<tr>
<td>CLI</td>
<td>Nontransport</td>
<td>754</td>
<td>Cancel</td>
<td>Multiple reasons, usually canceled at scene</td>
</tr>
<tr>
<td>OME</td>
<td>Nontransport</td>
<td>967</td>
<td>Office of medical examiner</td>
<td>Patient is pronounced dead and the medical examiner will handle the body</td>
</tr>
<tr>
<td>UTL</td>
<td>Nontransport</td>
<td>1,216</td>
<td>Unable to Locate</td>
<td>No incident or unable to locate patient</td>
</tr>
<tr>
<td>AMA</td>
<td>Nontransport</td>
<td>1,638</td>
<td>Against medical advice</td>
<td>Patient refused transport against medical advice</td>
</tr>
<tr>
<td>NOM</td>
<td>Nontransport</td>
<td>5,467</td>
<td>No merit</td>
<td>A false report of a problem</td>
</tr>
<tr>
<td>PDT</td>
<td>Nontransport</td>
<td>7,441</td>
<td>Patient declines transport</td>
<td>The patient declined transport</td>
</tr>
</tbody>
</table>

out of 438 unique categories were identified to have a nontransport rate of greater than 25%. We further analyzed all 18 categories with greater than 40% NTR.

Five MPDS categories accounted for all of these 18 high NTR categories and included “cardiac/respiratory arrest/death” (5/18), “assault/sexual assaults” (4/18), “unknown problem/man down” (4/18), “traffic/transportation accidents” (3/18), and “unconscious/fainting” (2/12). “Cardiac or respiratory arrest/death – obvious death” had the highest overall nontransport rate, 99.25% (only 1/134 calls was transported) but was an outlier. Second was “unknown problem (man down) – medical alerts” with an NTR of 67.22%. We then analyzed all categories in each of these five groups, regardless of NTR (see Figure 1).

In these groups, we calculated nontransport rates for all subcategories. Within each group, we found that many subcategories were also associated with higher NTRs and met our 40% nontransport rate threshold. See Table 2 for a detailed description of each identifier.

We also analyzed EMD priority distribution among all calls, which revealed a nonlinear relationship...
between transports and nontransports. When we examined these as nontransport rates, it was immediately noticed that the trend of nontransports increases from Alpha to Bravo, and again from Charlie to Echo (see Figure 2). As predicted, the higher priority subgroup (CDE) indicated a higher likelihood of patient transport than the AB subgroup. However, it was surprising that the higher the priority of the call within each subset (AB and CDE), the greater the nontransport rate and therefore the less likely for the patient to be transported. This pattern did not adhere to the stepwise fashion of decreasing nontransport rates we expected to progressively see from A to E priorities (see Figure 2).

The two MPDS categories with the lowest nontransport rates were “stroke – speech or movement problems,” 4.35%, and “stroke – not alert,” 5.17% (154/161 and 257/271 calls were transported, respectively)

The following 5,879 EMS calls were excluded from analysis: (1) calls in which duplicate run numbers were assigned (48); (2) calls in which there was no disposition recorded (3,363); (3) calls assigned a public service disposition code (e.g., caller needs assistance being lifted into bed) (1,051); (4) calls that were dispatched as law-enforcement-only response or calls in which the patient was in law enforcement custody and transport status could not be determined (1,223), (5) other/unknown/unidentifiable call outcomes (194), and (6) those categories with fewer than 100 total calls.

**DISCUSSION**

The goal of using the EMD system is to categorize and prioritize emergency calls in order to send an appropriate response. The nontransport rates of individual MPDS categories vary considerably and should be considered in any system design. The MPDS system is designed such that Alpha calls are to be dispatched as BLS cold, Bravo as BLS hot, Charlie as ALS cold, and Delta as ALS hot. Therefore, on a linear scale, higher-priority codes should have higher-acuity patients, and thus lower nontransport rates (Echo should be transported the most consistently, Alpha the least). This was not seen in the 2009 San Francisco MPDS
FIGURE 2. MPDS dispatch priorities and associated nontransport rates (all calls).

system. Higher-priority codes (Charlie through Echo) were strongly predictive of increased hospital transport rates compared to lower priority codes (Alpha and Bravo), but the opposite was seen within each priority subset. The higher the priority code within each subset, the less likely it was for the patient to be transported (i.e., in terms of transports: \([C > D > E] > [A > B]\)). Charlie priority codes had the lowest nontransport rates and were therefore the strongest predictors of hospital transport, while Echo codes were those with the highest nontransport rates and the worst predictors of hospital transport.

Despite the limitations of EMD, the Medical Priority Dispatch System has multiple advantages, including its computerization, the consistency of the education and usage, as well as its quality improvement process. Prior studies have demonstrated its ability to improve the diagnosis of cardiac arrest.\(^2\) In the case of predicting hospital transport, both trends discussed above were strongly predictive but not in the expected linear fashion. We also identified five major MPDS categories (cardiac/respiratory arrest/death, assault/sexual assaults, traffic/transportation accidents, unknown problem/man down, and unconscious/fainting) with increased nontransport rates. The great variance between different MPDS groups and their associated nontransport rates suggest that there may be unique differences specific to these types of calls or, alternatively, that certain MPDS groups may be better at predicting hospital transport. Additional research is needed to determine the cause of increased nontransport rates in these groups.

While we demonstrated that higher nontransport rates are not linearly correlated with lower priority calls, we cannot establish from this dataset that categories with high nontransport rates have lower medical priority. This population of categories with higher nontransport rates needs further analysis to qualify medical need. We did not assess each nontransport to determine that it did not require an advanced life support assessment or intervention prior to assignment of a nontransport disposition. Certain dispositions, such as “patient declines transport,” lend suspicion to the possibility of lower intervention requirements, but are outside the scope of this dataset. Conversely, even though “cardiac or respiratory arrest/death” had many identifiers in the highest groups of nontransport rates, we also know from previous research conducted in the San Francisco MPDS system that this same group in 2009 was found to have a high advanced life support medication administration rate (28.4%). This is evidence that despite high nontransport rates, many of these calls still have high-acuity patients.\(^23\)
LIMITATIONS
A number of limitations of our study must be noted. A major limitation is the fact that all of our calls receive an ALS response. The findings in our two-tiered all-ALS EMS system may thus differ from those derived in multitiered ALS/BLS systems. A large number of calls were not put through the EMD process and were not assigned a subcategory.

Several incoming 9-1-1 calls were issued a temporary dispatch code of MED, XM, or XR. Many of these rapid response codes were updated to a specific category, but 13,496 of them were not (>16% off all calls dispatched). The overall nontransport rates in these categories were XM = 25.39%, XR = 38.23%, and MED = 47.14%.

The nontransport rate among those in cardiac or respiratory arrest is explained by those with an expected death or those who were unresponsive to ACLS. It is our practice in San Francisco to not transport those who do not achieve a pulse within 30 minutes and without persistent ventricular fibrillation.

Another limitation was that 3,363 calls were discarded because no disposition code was recorded. Additionally 9,079 calls were recorded as either “against medical advice” (1,638) or “patient declines transport” (7,441). From this database, there is no way to determine what treatments or interventions were administered at scene prior to assignment of these disposition codes.

CONCLUSIONS
Emergency Medical Services (EMS) responded to a total of 81,437 calls in 2009, of which 18,851 were not transported by EMS (including 438 unique categories), with an overall nontransport rate of 24.95%. Fifty-two unique categories were identified to have a 25% or greater NTR, 18 of which exceeded 40%. Five MPDS groups were identified to have recurring categories exceeding 40%: cardiac/respiratory arrest/death, assault/sexual assaults, unknown problem/man down, traffic/transportation accidents, and unconscious/fainting. Delta priority calls were the most common priority among nontransports and (37%) and Echo was the least common (4%).

References


