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Journal

Prehospital Emergency Care, 18(1)

ISSN

1090-3127

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Publication Date

2014

DOI

10.3109/10903127.2013.825349

Peer reviewed

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 nontransport 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," "assault/sexual assaults," "unknown problem/man down," "traffic/transportation accidents," and "unconscious/fainting." "Cardiac or respiratory arrest/death – obvious death" (9B1) had the highest overall nontransport rate, 99.25% (1/134), most likely due to declaration of death. "Unknown problem – man down – medical alert notification" had the second highest NTR, 67.22% (138/421). However, Echo priority codes had the highest overall nontransport rates (45.45%) and Charlie had the lowest (13.84%). **Conclusions.** The nontransport rates of individual MPDS categories vary considerably and should be considered in any system design. We identified 52 unique call categories to have a 25% or greater NTR, 18 of which exceeded 40%. The majority of NTRs occurred among the "cardiac/respiratory arrest/death," "assault/sexual assaults," "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 had a lower NTR than Delta, and Delta was lower than Echo. Charlie 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 emergent subset. **Key words:** ambulances/utilization; emergencies/classification; Emergency Medical Dispatch; Emergency Medical Service Communication Systems/standards; Emergency Medical Services/standards; Emergency Medical Services/utilization; risk assessment; triage

PREHOSPITAL EMERGENCY CARE 2014;18:28–34

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;

Received March 14, 2012, from the University of California, San Francisco, School of Medicine (EMH), San Francisco, California, USA; the Department of Emergency Medicine (JFB), University of California, San Francisco, California, USA; and Alameda County EMS Agency (KAS), Oakland, California, USA. Revision received June 27, 2013; accepted for publication June 27, 2013.

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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doi: 10.3109/10903127.2013.825349

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 the less than 8-minute response times.[26] The MPDS system attempts to predict the need for either advanced life support or basic life support (BLS) assessment as well as the required timeliness (hot or 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

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

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

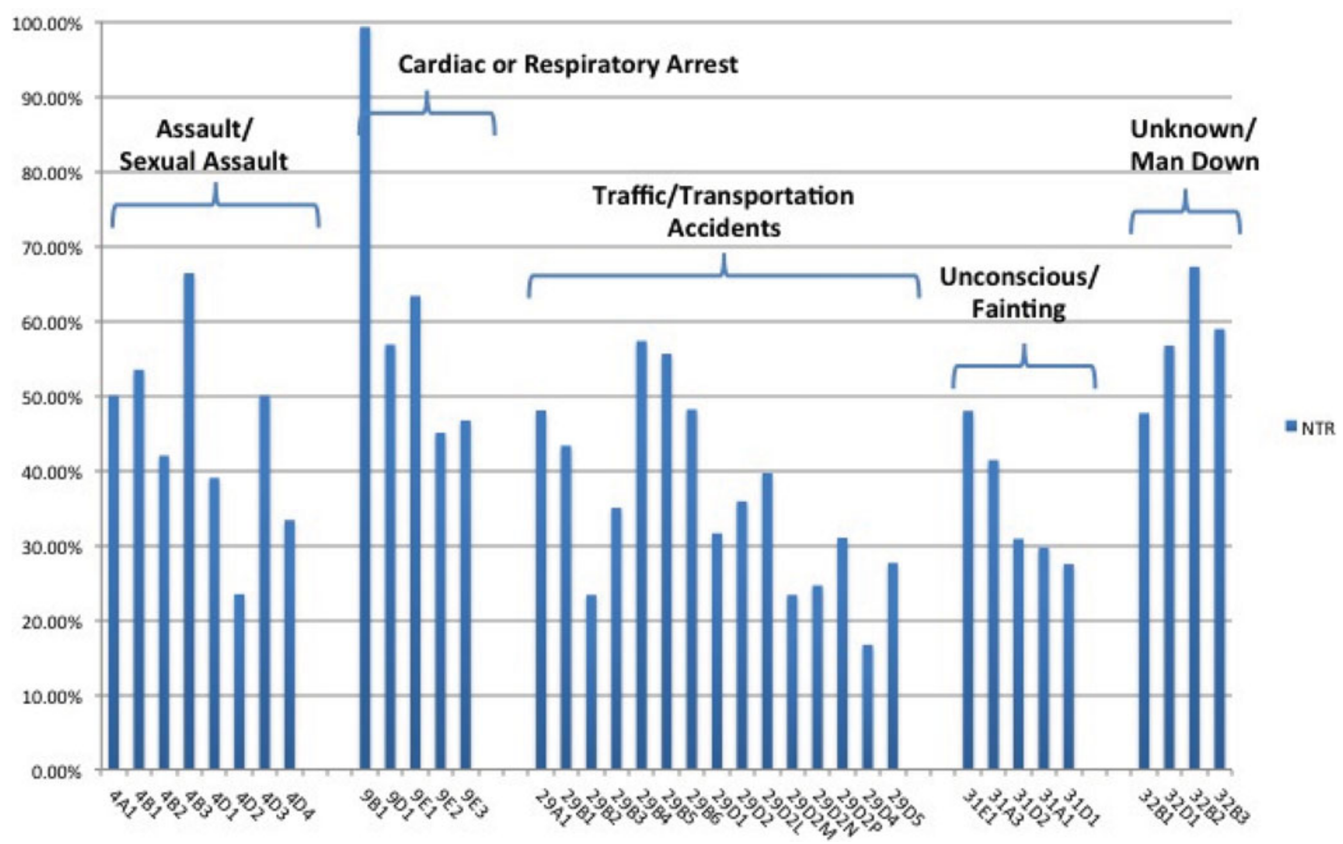

FIGURE 1. Recurring MPDS groups with two or more NTRs > 40%.

TABLE 2. Nontransport rates among the five highest groups

Determinant	Total calls	NTR	MPDS determinant description
4D3	10	50%	Assault/sexual assault – abnormal breathing
4D4	9	33%	Assault/sexual assault – dangerous body area
4D2	64	23%	Assault/sexual assault – not alert
4A1	42	50%	Assault/sexual assault – not dangerous body area (extremity injury)
4B1	378	53%	Assault/sexual assault – possibly dangerous body area
4B2	31	42%	Assault/sexual assault – serious hemorrhage
4D1	59	39%	Assault/sexual assault – unconscious or arrest
4B3	113	66%	Assault/sexual assault – unknown status (3rd-party caller)
9D1	162	57%	Cardiac or respiratory arrest/death – ineffective breathing
9B1	134	99%	Cardiac or respiratory arrest/death – obvious death
9E2	211	45%	Cardiac or respiratory arrest/death – workable arrest, breathing uncertain
9E3	15	47%	Cardiac or respiratory arrest/death – workable arrest, hanging
9E1	643	63%	Cardiac or respiratory arrest/death – workable arrest, not breathing
29A1	50	48%	Traffic/transportation accidents – extremity injury
29D2	184	36%	Traffic/transportation accidents – high mechanism
29B1	926	43%	Traffic/transportation accidents – injuries
29D1	19	32%	Traffic/transportation accidents – major incident
29B2	30	23%	Traffic/transportation accidents – multiple victims
29B3	20	35%	Traffic/transportation accidents – multiple victims (additional units)
29D5	105	28%	Traffic/transportation accidents – not alert
29B5	9	56%	Traffic/transportation accidents – other hazards
29D4	66	17%	Traffic/transportation accidents – pinned victim
29B4	260	57%	Traffic/transportation accidents – serious hemorrhage
29B6	160	48%	Traffic/transportation accidents – unknown status (3rd-party caller)
29D2L	573	40%	Traffic/transportation accidents -MVA-other-bike mca
29D2N	61	25%	Traffic/transportation accidents -MVA-other-ejection
29D2M	450	23%	Traffic/transportation accidents -MVA-other-ped
29D2P	71	31%	Traffic/transportation accidents -MVA-other-rollover
31E1	121	48%	Unconscious/fainting – fainted, change in color
31A3	133	41%	Unconscious/fainting – fainting alert less 35 yo no cardiac hx
31D2	2,056	31%	Unconscious/fainting – severe respiratory distress
31A1	465	30%	Unconscious/fainting – single or near fainting episode and alert < 35 y/o
31D1	1,491	27%	Unconscious/fainting – unconscious
32B1	716	48%	Unknown problem (man down) – awake
32D1	1,435	57%	Unknown problem (man down) – life status questionable
32B2	421	67%	Unknown problem (man down) – medical alert notifications
32B3	888	59%	Unknown problem (man down) – unknown status (3rd-party caller)

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

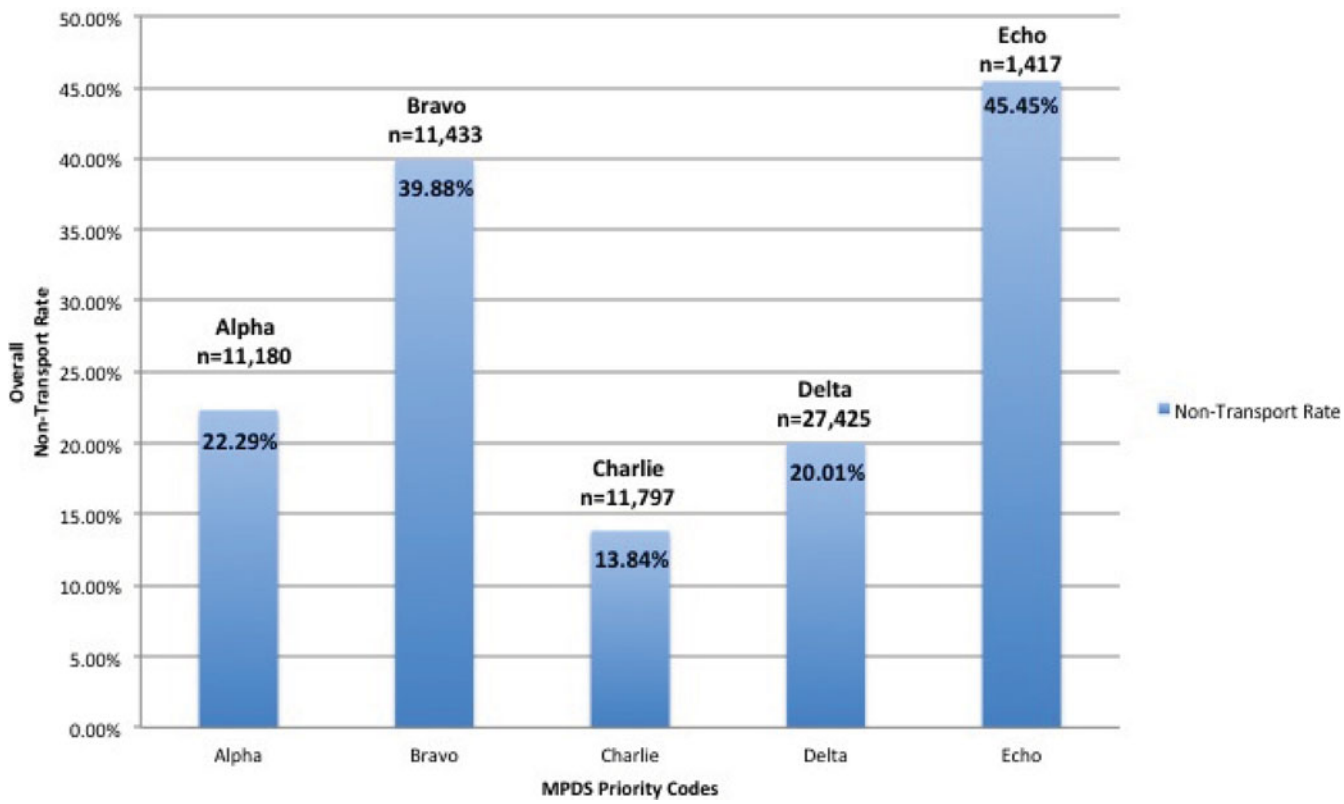

FIGURE 2. MPDS dispatch priorities and associated nontransport rates (all calls).

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 not to 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

1. Bailey ED, O'Connor RE, Ross RW. The use of emergency medical dispatch protocols to reduce the number of inappropriate scene responses made by advanced life support personnel. Prehosp Emerg Care. 2000;4:186–9.
2. Flynn J, Archer F, Morgans A. Sensitivity and specificity of the Medical Priority Dispatch System in detecting cardiac arrest emergency calls in Melbourne. Prehosp Disaster Med. 2006;21:72–6.
3. Shah MN, Bishop P, Lerner EB, Czapranski T, Davis EA. Derivation of emergency medical services dispatch codes associated with low-acuity patients. Prehosp Emerg Care. 2003;7:434–9.
4. Myers JB, Hinchey P, Zalkin J, Lewis R, Garner DG. EMS dispatch triage criteria can accurately identify patients without high-acuity illness or injury. Prehosp Emerg Care. 2005;9:119.
5. Shah MN, Bishop P, Lerner EB, Fairbanks RJ, Davis EA. Validation of EMD dispatch codes associated with low-acuity patients. Prehosp Emerg Care. 2005;9:24–31.
6. Michael GE, Sporer KA. Validation of low-acuity emergency medical services dispatch codes. Prehosp Emerg Care. 2005;9:429–33.
7. Palumbo L, Kubincanek J, Emerman C, Jouriles N, Cydulka R, Shade B. Performance of a system to determine EMS dispatch priorities. Am J Emerg Med. 1996;14:388–90.
8. Neely KW, Eldurkar J, Drake ME. Can current EMS dispatch protocols identify layperson-reported sentinel conditions? Prehosp Emerg Care. 2000;4:238–44.
9. Feldman MJ, Verbeek PR, Lyons DG, Chad SJ, Craig AM, Schwartz B. Comparison of the medical priority dispatch system to an out-of-hospital patient acuity score. Acad Emerg Med. 2006;13:954–60.
10. Sporer KA, Youngblood GM, Rodriguez RM. The ability of emergency medical dispatch codes of medical complaints to predict ALS prehospital interventions. Prehosp Emerg Care. 2007;11:192–8.
11. Sporer KA, Johnson NJ, Yeh CC, Youngblood GM. Can emergency medical dispatch codes predict prehospital interventions for common 9-1-1 call types? Prehosp Emerg Care. 2008;12:470–8.
12. Craig AM, Verbeek PR, Schwartz B. Evidence-based optimization of urban firefighter first response to emergency medical services 9-1-1 incidents. Prehosp Emerg Care. 2010;14:109–17.
13. Johnson NJ, Sporer KA. How many emergency dispatches occurred per cardiac arrest? Resuscitation. 2010;81:1499–504.
14. Sporer KA, Craig AM, Johnson NJ, Yeh CC. Does emergency medical dispatch priority predict delphi process-derived levels of prehospital intervention? Prehosp Disaster Med. 2010;25:309–17.
15 Ramanujam P, Guluma KZ, Castillo EM, Chaco M, Jensen MB, Patel E, Linnick W, Dunford JV. Accuracy of stroke recognition by emergency medical dispatchers and paramedics—San Diego experience. Prehosp Emerg Care. 2008;12:307–13.
16. Clawson J, Olola C, Heward A, Patterson B. Cardiac arrest predictability in seizure patients based on emergency medical dispatcher identification of previous seizure or epilepsy history. Resuscitation. 2007;75:298–304.
17. Clawson J, Olola C, Heward A, Patterson B, Scott G. Ability of the medical priority dispatch system protocol to predict the acuity of "unknown problem" dispatch response levels. Prehosp Emerg Care. 2008;12:290–6.
18. Clawson J, Olola C, Heward A, Patterson B, Scott G. The Medical Priority Dispatch System's ability to predict cardiac arrest outcomes and high acuity pre-hospital alerts in chest pain patients presenting to 9-9-9. Resuscitation. 2008;78:298–306.
19. Clawson J, Olola C, Scott G, Heward A, Patterson B. Effect of a Medical Priority Dispatch System key question addition in the seizure/convulsion/fitting protocol to improve recognition of ineffective (agonal) breathing. Resuscitation. 2008;79: 257–64.
20. Clawson J, Olola CH, Heward A, Scott G, Patterson B. Accuracy of emergency medical dispatchers' subjective ability to identify when higher dispatch levels are warranted over a Medical Priority Dispatch System automated protocol's recommended coding based on paramedic outcome data. Emergency Med J EMJ. 2007;24:560–3.

21. Neely KW, Eldurkar JA, Drake ME. Do emergency medical services dispatch nature and severity codes agree with paramedic field findings? Acad Emerg Med. 2000;7:174–80.
22. Calle P, Houbrechts H, Lagaert L, Buylaert W. How to evaluate an emergency medical dispatch system: a Belgian perspective. Eur J Emerg Med. 1995;2:128–35.
23. Durant E, Fahimi J. Factors associated with ambulance use among patients with low-acuity conditions. Prehosp Emerg Care. 2012;16:329–37.
24. Hettinger AZ, Cushman JT, Shah MN, Noyes K. Emergency medical dispatch codes association with emergency department outcomes. Prehosp Emerg Care. 2013;17:29–37.
25. Studnek JR, Thestrup L, Blackwell T, Bagwell B. Utilization of prehospital dispatch protocols to identify low-acuity patients. Prehosp Emerg Care. 2012;16:204–9.
26. Blanchard IE, Doig CJ, Hagel BE, Anton AR, Zygun DA, Kortbeek JB, Powell DG, Williamson TS, Fick GH, Innes GD. Emergency medical services response time and mortality in an urban setting. Prehosp Emerg Care. 2012;16:142–51.