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BACKGROUND

Emergency medical services (EMS) systems are configured differently depending on several factors, including the size, demographics, geography and politics of the local communities they serve. Although some information exists about the organization, financing, and delivery of EMS in 200 of the Nation's largest cities (Williams, 2007), this information is incomplete and does not provide any information on how services are organized for proportion of the nation's population (75%) who resides outside of these urban areas. What we do know, however, is that there is wide variability in how systems are structured and organized with little evidence to support alternative configurations in terms of their impact on the effectiveness and efficiency of service delivery (IOM, 2007).

OBJECTIVE

To understand which EMS systems work well, an important first step is the development of a typology of system configurations so they may be evaluated on a common basis. This pilot research is a first step toward developing such a typology by characterizing local EMS systems in the Mid-Atlantic region of the United States.

METHODS

The Mid-Atlantic region chosen for this pilot study consists of seven States (Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, and West Virginia) and the District of Columbia. This geographic region was chosen for the pilot study for several reasons. First and perhaps most important, we expected that most of the archetypal systems mentioned above would be present in one or more of these States. In addition, the States themselves vary with respect to how EMS is organized at State and regional levels. Moreover, the region is diverse in terms of geography and demographic composition of the resident population. This diversity would allow an examination of variations in EMS configurations by level of rurality and size of the service area.

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The States vary considerably by size and population demographics as well as how EMS is organized at the State and regional levels. The total percent of the population that lives within large metropolitan areas ranges across States from over 85% (Maryland and District of Columbia) to less than 20% (West Virginia, North Carolina and Delaware). The only States with more than 1% of the population living in completely rural areas are West Virginia, and North Carolina. A total of 81 counties in the study region are categorized as large metropolitan; 100 as small metropolitan; 31 as large non-metropolitan; 112 as small non-metropolitan and 81 as completely rural.

Traditionally, an EMS system has been defined as a comprehensive, coordinated arrangement of resources and functions organized to respond to medical emergencies in a timely manner (P.L. 93-154, 1973). In order to promote some level of consistency between systems and to ensure potential respondents would have a sufficiently broad perspective (e.g., including areas such as policy development or regionalization of services), this definition needed to be refined. For the purpose of this study, an EMS system is operationally defined as present when there is an identifiable local entity within a State EMS system's administrative hierarchy below the State level (if the State is sufficiently large enough) and immediately above the level of an individual provider agency. In instances where an agency is the sole provider for a jurisdiction and/or that agency serves in a leadership capacity to other services (i.e., there is not an independent administrative body for the jurisdiction), it is regarded as an EMS system. At the core of this particular definition is a desire to evaluate EMS at a level sufficiently close to the localities served by care personnel, but also a need to ensure that we could measure features that looked beyond the organizational boundaries of just a single agency. It should be noted that aeromedical and inter-facility transport service entities were not considered as part of this study.

The identification of systems within the participating States involved the following steps. First, each State EMS office was contacted several times in person, by phone, and by e-mail to learn more about the unique EMS environment and organization within the State. After being informed of the project, its overall goals, and our working system definition, every State EMS official provided contact information for each EMS system in their respective areas. The majority of systems identified were at a county (or equivalent) level, with a handful of additional systems representing multi-jurisdictional areas, independent cities or miscellaneous systems (e.g., an airport authority, or military installation or facility).

In three States (New Jersey, Virginia, and West Virginia), there were geographic areas identified that contained no EMS systems based on our definition. Conversations with the relevant State EMS offices revealed that while there were EMS agencies operating within these areas, they did not do so under a coordinated, local administration. As a result, these EMS agencies operated almost completely independent of each other and would interact directly with the State EMS agency on any matters (e.g., protocols, certification) that was outside the scope of its organizational walls. To characterize areas such as these at some cursory level, contact information for these counties (often an emergency services, public health or related contact) was obtained from the National Association of Counties (NACO).

All EMS systems, as defined using the criteria above, were mailed a 20-question survey, along with a postage-paid return envelope. The survey addressed the following topics:

- Overall size of the system, as characterized by the annual number of EMS responses and transports, as well as the total number of EMS personnel;
- Access to the system through 911;
- Provider and dispatch agency types;
- Response configurations, operating procedures, and use of volunteers;
- Mutual aid agreements and response to calls outside the primary service area;
- Medical control;
- Source of funding for the system.

The survey also contained a series of opinion questions focusing on resource levels, system support, system environment, and system change. Counties without systems meeting our criteria were sent an abbreviated 6-question survey designed to gather basic EMS information.

Analyses were primarily of a descriptive nature, focusing on frequencies of characteristics and exploration of differences across the States. Differences between geographic and demographic categories were also examined using chi-square and analysis of variance techniques as appropriate.

RESULTS

A total of 273 systems and 82 non-system counties were identified across the 7 States and the District of Columbia. No systems were identified in New Jersey. Of the 273 system surveys sent out, 235 were returned, yielding a response rate of 86.1%. Response rates among systems did not vary significantly by State or rurality, though the response rate among the ‘non-system’ counties was considerably lower (56%).

The size of the systems included in the survey is characterized by self-reported information on: (1) number of EMS care personnel (at all levels, including volunteers); (2) annual number of EMS responses; and (3) annual number of EMS transports. Given the skewed distributions of these variables, as well as extreme outlier data pushing up the value of the means, the standard deviations observed are quite large. As a measure of central tendency, the median is thought to better represent the size of a typical EMS system within a particular category. Mean (standard deviation) and median statistics for the size measures broken down by rurality are shown below:

		Large Metro (n=52)	Small Metro (n=60)	Large Non-Metro (n=23)	Small Non-Metro (n=61)	Completely Rural (n=39)
Annual EMS Responses	Mean (SD)	42,001 (76,406)	23,049 (43,250)	19,374 (26,218)	6,055 (4,103)	2,417 (3,229)
	Median	17,000	13,000	11,000	4,844	1,500
Annual EMS Transports	Mean (SD)	27,853 (56,837)	14,804 (19,291)	12,258 (14,463)	4,256 (2,491)	1,779 (2,432)
	Median	9,300	9,500	8,321	3,900	1,200
Number of Personnel	Mean (SD)	1,032 (2,284)	634 (1,349)	470 (816)	147 (229)	136 (476)
	Median	283	250	254	91	40

Nearly all respondents (94%) report the availability of E-911, although only 59% note access is available through wireless. Access through wireless E-911 varies by both State and rurality. As expected, wireless E-911 is less available in more rural systems and in smaller systems.

Most respondents (60%) report that more than one type of agency is involved in first response as well as transport activities. Of those systems using first responders (98% of all systems report using first responders), 70% of respondents indicate use of a fire department to provide these services and 52% report that the fire service is the primary group responsible for first response. Additionally, large systems are significantly more likely to use fire-based first response than their smaller counterparts. Nearly two-thirds of respondents in large metro areas report a fire department as the primary agency used for transport. In less urban areas, the use of a third service agency is more typical. Emergency dispatch functions are primarily handled by a city or county communications department for nearly half (48%) of responding systems, with an additional 22% served by a public safety department. The primary type of agency used for first response, transport, and dispatch varies across and within States.

First response personnel are used nearly all systems (98%). However, the results indicate that only 36% of first response workers are dispatched to all 911 calls. The results indicate that first responders were most likely (93%) to be dispatched to 911 calls in conjunction with a transport ambulance.

Advanced life support (ALS) was the primary form of EMS transport in over 80% of the systems. In general, large metro areas included ALS first response and transport to a greater extent to less urban systems (52% compared to 25% to 41% elsewhere). Estimates of population coverage associated with primary agency types and response configurations are shown below:

	Resident Population Coverage (%)
Primary First Response	
Private	11.6
Fire department	67.2
Government-based/third service	8.6
Other (or no 1 st response)	12.6
Primary Transport Agency	
Private	31.0
Fire department	36.1
Government-based/third service	20.2
Other	12.7
Primary Dispatch	
City/County	63.2
Public safety	16.9
Other	19.8
Primary Configuration	
BLS 1st response/BLS transport	7.9
BLS 1st response/ALS transport	40.9
ALS 1st response/BLS transport	7.6
ALS 1st response/ALS transport	36.0
BLS transport only	1.6
ALS transport only	5.9

The majority of respondents (86%) report the use of volunteers, although the percentage of personnel serving in such a capacity has a tendency to be lower in larger systems. Over two-thirds of respondents note that call coverage is of major concern due to staffing shortages, however this unease was more prevalent among less urban systems (over 80% of the small non-metro and completely rural counties indicate call coverage as a major concern compared to only 57% of the large and small metro areas).

Nearly all respondents (94%) report their systems having mutual aid agreements, although the components addressed by these agreements vary widely across and within States. While the majority (88%) of mutual aid agreements addresses issues of service coverage, only one-half address communication linkages and merely one-third address licensure or certification of personnel, financial reimbursement or liability issues. Over one-quarter (29%) of respondents indicate that their primary transport agency *often* responds to calls outside the primary service area; an additional 44 % indicate they *sometimes* respond to these calls.

Nearly all respondents (96%) indicate medical direction is present at the system level. In 40% of these systems, this leadership is provided by a system-wide, “in-house” medical director who is a physician chosen or hired by the system’s coordinating organization (as opposed to being imposed or required by some external entity). For another 50% of the systems, medical oversight is provided by an external director who is a physician administering from a remote organization, such as a local hospital.

Multiple sources of funding are used to finance EMS systems. The majority of respondents in 4 States as well as the District of Columbia indicate their primary source of funding stems from tax subsidies, while in two other States (Pennsylvania and West Virginia), systems are primarily financed by fees or billing for services. There is a strong relationship between the source of primary funding (tax subsidies versus fee for service) and the rural-urban continuum, with more urban areas depending more extensively on tax subsidies. Most systems also report that they receive donations.

Opinion-based questions allowed respondents to rank their agreement with statements on a 5-point Likert scale ranging from strong disagreement (1) to strong agreement (5). Mean summary scores were generated for each of four topical areas (resource levels, public participation, system support, and system environment). The subjective assessments of the respondents reflect a generally positive outlook on EMS systems in their areas.

DISCUSSION

Following a surge of activity in the 1960s and 1970s, Federal support of EMS systems has steadily declined, leaving State and local governments to take the lead in program development and system design. In addition to dwindling Federal support, heterogeneity across regions with regard to factors such as population size, rurality, geographic layout, and funding sources affects EMS priorities in these regions. The lack of centralized funding coupled with the qualitative differences across regions that dictate different needs have led authors to conclude that EMS configurations vary significantly across the nation (IOM, 2006; Shah, 2006). The results of this study support these earlier conclusions with the exception of a few variables that were universally skewed, such as the use of first responders and the presence of medical control.

The rural – urban continuum is useful for establishing patterns of various features of EMS configurations. Urban systems have higher call volumes, use volunteers less frequently, support greater use of a tiered response structure and non-response vehicles, have increased non-emergent use, and have more-developed administrative structures (Giordano & Davidson, 1994). Rural jurisdictions often must rely on volunteers, have longer response times, face high personnel turnover and service coverage issues, lack quality medical direction, and may lack advanced prehospital care. Further, rural areas often encounter greater financial constraints and sometimes even lack the infrastructure for complete public access to the emergency care system (IOM, 2006; NHTSA, 2004; Garnett & Spoor, 1994). This study supports some of these characterizations; for example, urban areas rely on fire-based agencies for transport, whereas rural systems tended to use private and third-service agencies to provide transport. However, some factors did not vary as a function of rurality. Nearly all respondents reported the use of first responders (98.3%) and ALS personnel (97.9%) within their systems.

Medical control was present at the system level for over 96% of systems; however, the likelihood that the director was in-house was higher for more urbanized systems. More rural systems were more often supported by an external director. This may be because urbanized systems have complex administrative structures in place to support their size, personnel, and budgets. As anticipated, urban and suburban systems have a significantly higher presence of operating protocols that allowed for response to the scene and patient transports without the use of lights and sirens for less emergent cases.

Availability of wireless E-911 in the EMS system differed significantly by rurality. This is an important issue for rural areas and our data indicate this difference to be largely dependent on the availability of wireless 911. It is notable that despite this variation, 90% or more the small non-metro and completely rural areas could still use the EMS system through hardwire-enhanced 911.

Although the primary source of system funding did not vary by rurality, there were significant differences in individual finance categories. With the exception of Pennsylvania, the use of taxes to finance EMS generally increases as the system becomes more urban. A similar trend was observed for systems in receipt of non-homeland security grants. Whereas the commitment of municipal or county funding is often logically a matter of having a large enough population to support the tax base, the difference in grant funding may be a result of

having the more sophisticated administrative systems generally needed to apply for and manage these funding streams. It is also possible that this difference may reflect a divide in the focus areas of those organizations awarding the grants. The true source of this difference in grant funding warrants further study. Billing and reimbursement continues as a source of significant funding, and it is interesting that rural systems receive a higher proportion from these sources. Although rural systems may be thought to rely more often on fundraising and donations, these data may indicate that the EMS industry is evolving and systems of all backgrounds are learning to “make do” with new tools and services.

At its core, health care is local, so variation in system configurations is expected. We recognize that no single model, design, or delivery system is suitable for every locality. Local systems must select elements of EMS based on needs and available resources to survive and provide essential community services. As a result, EMS systems incorporate multiple agency types, response configurations, and funding streams, and strive to integrate these elements into a cohesive whole. This study shows significant differences between and within States and verifies many distinctions across categories of system size and rurality. Despite the variations, EMS systems presented fairly consistent views through the survey’s opinion questions, noting pervasive system change and positive environments and support structures, although adequate resources remain a key concern.

This pilot study of mid-Atlantic EMS systems, especially given the high response rate, demonstrates that a similar process could be executed on a national scale. The ability to link descriptive EMS system data on a national level with these datasets would only increase the usefulness of these data, allowing for greater comparison of system designs and outcomes.