Question 1
Which of the following is true with respect to documents that have significantly impacted EMS System Design?

A. Accidental Death and Disability (1966): The neglected disease in modern society: emphasized integration of EMS into overall health system
B. The Emergency Medical System Act (1973) stressed system development but lacked funding to support EMS systems
C. The EMS for the Future (1996) was the first document to emphasize clinical care and integration of EMS into healthcare system
D. EMS at the Crossroads IOM (2003) defined the consequences of errors in the prehospital setting and the tens of thousands of patients harmed by these errors

Question 2
Which most correctly describes a “high performance” EMS system?

a. Only responds to emergencies, leaving non-emergency calls for other EMS agencies.
b. Uses diverse fleet of ambulances and other resources, assigning differently to BLS and ALS responses.
c. Sole EMS provider for a community with accountable response times, sophisticated maximized billing practices, typically all ALS ambulance fleet, and with flexible production model.
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Answer Rationale

• Responds to emergencies and non-emergency incidents.
• Uses single type ambulance (all paramedic).
• Typically sole provider in area, focus on response time performance in contract with financial penalties, focus on billing performance, typically all ALS ambulances, and utilizes demand analysis for supply production, which can vary throughout a 24-hour period.
• Often uses SSM, but typically not a tiered response.

Learning Objectives

• Know EMS system design and deduce consequences of poor system design.
• Identify key components of an EMS system.
• Identify key historical documents that have greatly influenced EMS system design.
• Describe System Status Management
• Identify issues related to EMS response times
• Identify key features of “High Performance” systems.
Introduction

“If you’ve seen one EMS System, you’ve seen one EMS System”

• EMS encompasses diverse groups of professionals providing healthcare in every imaginable circumstance.

• Knowing the EMS system design is a key to success:
  – Who is providing care?
  – Allocation of ambulance service market rights
  – Where are they providing care?
  – How does EMS fit in the service area’s overall healthcare?

An often quoted statement, highly variable in whether viewed as a valid statement or not.

EMS is practiced in every imaginable place on this earth

Understanding systems is key successful medical direction

Who is providing care in the system, professionals vs. volunteers, BLS vs. ALS, Fire fighters vs. Private Ambulance service.

The text provides an excellent testing question with this passage “While the details vary from state to state, a city or county generally has the ability to designate who its ambulance service provider(s) is/are. This is called allocation of ambulance service market rights and is one of the most powerful tools in EMS system design.”

Where are they providing care Urban vs. wilderness, Home vs. Stadium, helicopter vs. Ground

How do they fit in the overall health care system of the region

Being aware of each system’s attributes, its limitations, and its advantages can help a medical director invest energy and resources in interventions with the greatest likelihood of improving patient outcomes.

EM structures and processes, the composition of the EMS team and the medical director influence clinical care.

EMS System Design Goals

• Clinical quality (clinical accuracy, patient outcomes)
• Service quality (patient & stakeholder satisfaction)
• Economic efficiency (“value”)
• Accountability (“standards”)
• Improvement (desire to exceed minimums)
• Resilience (flexibility, minimize disruptions)
Accidental Death and Disability: The Neglected Disease of Modern Society - 1966
Identified inadequacies of pre-hospital care
EMS was just a means of transportation

Emergency Medical Services System Act – 1973
Stressed system development and provided $300 M
15 components (lacked emphasis on patient/infrastructure)
Training, manpower, communications

EMS for the Future (1996)
Focused on integration into health care system and clinical care

EMS at the Crossroads IOM - 2006
EMS as a lifesaver and gatekeeper
EMS at the Crossroads IOM - 2003
EMS as a lifesaver and gatekeeper – Part of the health care system

In 1996, (NHTSA) made a significant move forward with the publication of the EMS Agenda for the Future. As its title indicates, the purpose of the document was to look forward and what it conveyed was a future in which EMS would need to be a functioning system, and for the first time, it would be integrated as a part of the community in the overall healthcare system

In September 2003, the Institute of Medicine (IOM) appointed the Committee on the Future of Emergency Care in the United States Health System and in May 2004 it was expanded to specifically include EMS as one of its focuses. The Committee’s findings and recommendations were released in the report Emergency Medical Services at the Crossroads, which clearly identified both the importance of EMS as provider of lifesaving care and its role of gate keeping healthcare in the community.

However, the study also found problems. Because of the historical development of EMS systems within a local setting, it identified fragmentation and profound weaknesses, especially in cases where local standards of care fall below generally accepted standard. Providing a number of recommendations, including that EMS should be firmly recognized as a healthcare provider,

Credits
http://www.nap.edu/openbook.php?record_id=9978&page=R1

Effective Medical Oversight

• Internal vs. External
• Advisory or Authoritative
• Scope of authority (Narrow vs. Broad)
• Funding (Volunteer vs. Funded)

The book would suggest that effective medical oversight is best obtained by a funded, external, authoritative medical director with a broad scope of authority.

Medical oversight

Internal vs. External – the medical director is neither hired nor compensated by any organization whose work is the subject of medical oversight.

Advisory or Authoritative – the medical director directs; he or she does not advise.

Scope of authority – a single medical director oversees all organizations and individuals participating in the EMS system i.e., First responders, rescue, tactical medics.

Funding – effective medical oversight requires commitment and continuing level of funding.
EMS System Delivery Models

- Fire Departments
  - Emergency transports only with referral of non-emergency to private ambulance agency
  - All transports
- Hospitals
- Privately Owned
- “Third Service”
- “Public Utility Model”
- Franchises
- Paid
- Volunteer
- Unionized
- Mass Gathering Care
- Wilderness
- Disaster Response
- Many more....

EMS Related Service Lines

- Prevention/Public education
- Triage
- Pre-arrival instructions
- First response
- Ambulance response
- On-scene assessment & treatment
- Ambulance transport
- Non-ambulance med transport
- Air medical transport
- Critical care transport
- Event coverage
- Disaster services
- Fire/Hazmat support
- Tactical/Law enforcement support
- Mobile integrated healthcare/community paramedicine

Physician Roles in EMS Systems

**Anglo-American**
- Non-physicians staff ambulance
- Field care limited to essentials
- Much care deferred to hospital
- Physicians are mostly in medical oversight roles
  - Direct
  - Indirect
- Key driver is cost of physicians v non-physicians

**Franco-German**
- Physician-staffed ambulances and other field-response units
- High degree of on-scene “stabilization” prior to transport
- Some patients are treat/release without transport
- Most common Europe/S America
Ambulance Fleet Considerations

Single Tier/All ALS
- Every ambulance capable of meeting need of patient(s)
- Avoids undertriage
- Every ambulance stops the "response time" clock once on-scene/at patient side

BLS Tier/ALS Tier
- May require secondary response if undertriage initially
- Could save $ in labor costs with less paramedics and ALS equip.
- Most calls in most systems don’t absolutely require ALS
- Allows more critical skills and thinking per paramedic (less medics)
- Yesterday’s ALS is today’s BLS (expanding EMT scope of practice)

Ambulance Deployment Models
- Static = positioned within fixed location stations 24/7
- Dynamic = variable numbers of ambulances throughout a 24-hour period based on demand data; location selection based on historical sites of need
- Real-time = uses ambulance GPS data to measure speed and coverage area that can be used in adjusting dynamic deployment
- Hybrid = combo of static & dynamic

Unit Hour Utilization

\[
U \text{ (Utilization)} = \frac{\text{Number of transports}}{\text{Total Hours Unit is staffed}}
\]

- Basic measure of efficiency
  - Optimal .55-.45*
  - Average .35-.25
  - *varies urban vs. rural, geography, administrative policies, etc.
- Poor predictor of quality and cost/transport
Utilization is a measure of productivity, which compares the available resources (i.e., unit hours) with the actual amount of time those units are being utilized for patient treatment and transport or productive activity. This measurement has become the standard for determining effective deployment strategies, response patterns, unit and system productivity, and even scheduling practices.

A unit hour is defined as a “fully equipped and staffed ambulance on waiting for a response for one hour.” Utilization is equal to the time the ambulance assigned to a call.

Example:
Medic 1 is staffed 24 hours a day. On an average day, the unit is actually assigned to a call for 8 hours. U = 8 UH = 24 UHU = 8/24 = 0.333

Unit hour costs are affected powerfully by economies of scale. For that reason, they are a poor predictor of clinical quality and cost per transport.
Direct labor costs comprise more than 75% of the total costs of the average unit hour. The other 25% consists of the system infrastructure, including dispatch, administration, vehicles, equipment...

Comparison of UHU between services is difficult. (Longer response times, rural vs urban, geography, administrative issues, etc.)
Typically, EMS organizations strive for the highest utilization rates possible.
- 0.55 - 0.45 – Optimal Utilization
- 0.35 - 0.25 – Average Utilization
- 0.15 - 0.01 – Poor Utilization

EMS System depends upon two inputs: patients and money. Most important input is clearly the patient, but you can’t see the patient without money.
EMS system converts money into service.

EMS outputs:
Patient assessment
Patient treatment
Medical transportation
System efficiency is how the EMS agency converts the dollars into the service (EMS outputs).

Cost of 1 hour of EMS
-75% labor
-25% infrastructure
System design -> turn financial resources into service

3 factors interlinked:
- "Sophisticated activities":
  - Prevention, CPR instruction, Pre-arrival instructions, Call prioritization, Interface with receiving facilities...
  - Medical direction
  - Response time
- The 8 minute "standard" (average or 90% fractile) *Note the book chapter still clings to this Economic Efficiency
  - Need a working knowledge of marginal cost analysis and unit hour utilization ratio
- Even a poorly structured, badly managed system can perform reasonably well on one or two measures, creating an appearance of competence when viewed from a favorable angle. For example, an unskilled administrator can limit spending by allowing clinical quality and response time reliability to deteriorate. Similarly, given enough money, even the most unskilled management team can generate something of value.
- The challenge is to simultaneously generate clinical excellence, response time reliability, and economic

Response Times

- The time it takes for an EMS unit to arrive at a call for service
  - No consistency nationally when clock starts and stops
  - Can start when call received or when unit is dispatched
  - Can stop upon arrival at call address or at patient side
- Response times are one of the three commonly identified “essential measures” of an EMS system
Response Times

• Many systems today use an 8 minute standard
• Based upon survival from v-fib arrest (1979 JAMA)
  — 4 minutes for first responders with BLS and defibrillation
    • 3rd link in chain of survival
  — 8 minutes for ALS
    • 4th link in chain of survival

response Times

• Measurement of times
  — Average time can “hide” poorer service
  — Fractile times more accurately describes performance
• $ penalties can be tied to poor response times
• Better to measure response time intervals
  — Call received until dispatch
  — Dispatch to en route
  — And so on...

Response Times

\[
\text{TABLE 11.2}
\]

| Fractile Response Time Distribution | [image of table] |
This figure shows how fractile response time better reflects response time reliability. While system A (lower line) has an average 8-minute response time, it is clearly delivering poorer response to most patients as compared to system B.
Though the Institute of Medicine found no single type superior the following characteristics are found in High Performance Systems:

Sole provider
Exclusive market rights to furnish emergency and nonemergency ambulance Service often competitively selected provider.
Local ordinance or state law bans “cream skimming” or “cherry picking” of nonemergency patients or facilities with contracts that have guaranteed payment mechanisms.

Control center operations
The ambulance provider has control of the dispatch center allowing the deployment and redeployment of resources based on soundly developed algorithms.
The dispatchers are Emergency Medical Dispatch-certified, perform priority dispatch interrogation, deliver dispatch life support using prearrival instructions.

Accountability
Performance requirements as part of ordinances or contracts with penalties.

Revenue maximization
HPEMS systems incorporate a business function into their operations. Understanding fee-for-service billings and maximizing revenues from Medicare,

Flexible production strategy
Rather than operating specialized ambulance fleets, HPEMS systems employ a single fleet of ALS unincapable of handling type of service request.

System Status Management
fixed-post locations make sense when deploying fire suppression. In contrast, temporal and geographic patterns of demand of EMS vary widely, based on the movements of people and their changing patterns of activity. To meet that demand, high-performance systems have developed a flexible deployment technique that allows for the movement of ambulances in anticipation of where each ambulance will be needed next.

HPEMS is not specific to any one type of EMS system. It could be fire-based, third service, hospital based, or private. However, one of the essential key features, which were also emphasized by the IOM, is accountability, it is rare that an HPEMS system would be implemented without an oversight body or function continually monitoring its performance indicators. For that reason, most the HPEMS operate under a contractor regulatory language that includes penalties for poor performance.

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**System Status Management**

- **An ambulance deployment model based on anticipation of need**
  - No fixed base stations
  - Posting locations based on temporal and geographical patterns of demand

- **Rational for SSM**
  - Timely transport of emergency and non-emergency patients
  - Manage deployment of resources to meet response time requirements
System Status Management

- System Status Plan
  - Protocol for deployment of system’s unit hours
    - Continuous deployment of units throughout the day
    - Peak load staffing
  - Statistical basis for protocol utilizing historical call volume
    for each hour of each day of the week
  - Considers geographical barriers
    - Rivers, traffic congested areas, time of day

System Status Management

- Success of SSM is a balance of
  - Adequate coverage of high-volume areas and peak-load periods
  - Adequate coverage of low-volume areas and off-peak periods
  - Concern for employee health, safety, skill, and job satisfaction
  - Concern for economic efficiency and financial stability

Medical Oversight of EMS pages 167-168

The basis of SSM is the development and application of a System Status Plan (SSP), an algorithm or online protocol for the deployment or redeployment of the system’s unit hours. This is developed from a demand analysis, a statistical chart showing the historical call volume for each hour of the day and day of the week.
First Hour Quintet

- Diseases where EMS “makes a difference”
  - Out-of-hospital sudden cardiac arrest*
  - Severe respiratory difficulty*
  - Severe trauma*
  - Chest pain, particularly acute coronary syndrome*
  - Stroke*

*leading causes of death in the US

Literature would suggest that EMS makes a difference

The list includes leading causes of death in US

Number of deaths for leading causes of death
Heart disease: 597,689
Cancer: 574,743
Chronic lower respiratory diseases: 138,080
Stroke (cerebrovascular diseases): 129,476
Accidents (unintentional injuries): 120,859

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Answer Rationale

- ADD identified inadequacies and EMS was more a means of transportation.
- Emergency Medical Services Act of 1973 provided $300 million in federal funding. No emphasis on patient care or physician oversight in EMS.
- EMS Agenda for the Future focused on integration into healthcare system and clinical care standards in EMS.
- EMS at the Crossroads focused on lifesaving and gatekeeper functions.

Take Home Points

- **System Design** is part of the EMS core content
  - Medical Oversight of EMS - 30% Test questions
- **Key points**
  - EMS System: Infrastructure + Vehicles + Personnel
    - Deployment Models
  - EMS Measures: Sophistication + Reliability + Efficiency
  - Effective Medical Oversight
  - High Performance Systems

Key points:
- EMS System: Infrastructure + Ambulances + Personnel
- EMS Measures: Sophistication - Reliability - Efficiency
- Sophisticated activities: Prevention, CPR instruction, Pre-arrival instructions, Call prioritization, Interface with receiving facilities...
- Response time reliability: The 8 minute “standard” (average or 90% fractile) *Note the book chapter still clings to this Economic Efficiency - Knowledge of marginal cost analysis and unit hour utilization ratios

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- Limited: the medical director is neither hired nor compensated by any organization whose work is the subject of medical oversight.
- Authoritative: the medical director directs; he or she does not advise.
- Broad scope of authority.
- Fiduciary.

**High Performance Systems**
- Sole provider
- Central control operations
- Accountability
- Revenue maximization
- Flexible production strategy
- System Status Management

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