Contemporary Transport Medicine

NAEMSP National EMS Medical Directors Course

2009

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LifeFlight of Maine

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High Acuity Transport Medicine

- Medical oversight = risk analysis at multiple levels: clinical, safety, fiscal, societal
- Access / level playing field across geography
- Alignment, continuity and integration with EMS and tertiary care resources
- Acceptable risk benefit ratio – public and clinical transparency

Medical Oversight: transport medicine

- **Is the mode of transport a medical therapy decision ?**

MEDI ONE

MILO FIRE DEPT

ldren's Mercy
HOSPITALS & CLINICS
onatal & Pediatric Transport
MAST
947M

CATHY
UCDMC
CATHY RN
FLIGHT NURS
IVAC
MedSystem III

Methodist
Hospital

ORIGINAL CONTRIBUTION

Access to Trauma Centers in the United States

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Context Previous studies have reported that the number and distribution of trauma centers are uneven across states, suggesting large differences in access to trauma center care.

Objective To estimate the proportion of US residents having access to trauma centers within 45 and 60 minutes.

Design and Setting Cross-sectional study using data from 2 national databases as part of the Trauma Resource Allocation Model for Ambulances and Hospitals (TRAMAH) project. Trauma centers, base helipads, and block group population were counted for all 50 states and the District of Columbia as of January 2005.

Main Outcome Measures Percentages of national, regional, and state populations having access to all 703 level I, II, and III trauma centers in the United States by either ground ambulance or helicopter within 45 and 60 minutes.

Results An estimated 69.2% and 84.1% of all US residents had access to a level I or II trauma center within 45 and 60 minutes, respectively. The 46.7 million Americans who had no access within an hour lived mostly in rural areas, whereas the 42.8 million Americans who had access to 20 or more level I or II trauma centers within an hour lived mostly in urban areas. Within 45 and 60 minutes, respectively, 26.7% and 27.7% of US residents had access to level I or II trauma centers by helicopter only and 1.9% and 3.1% of US residents had access to level I or II centers only from trauma centers or base helipads outside their home states.

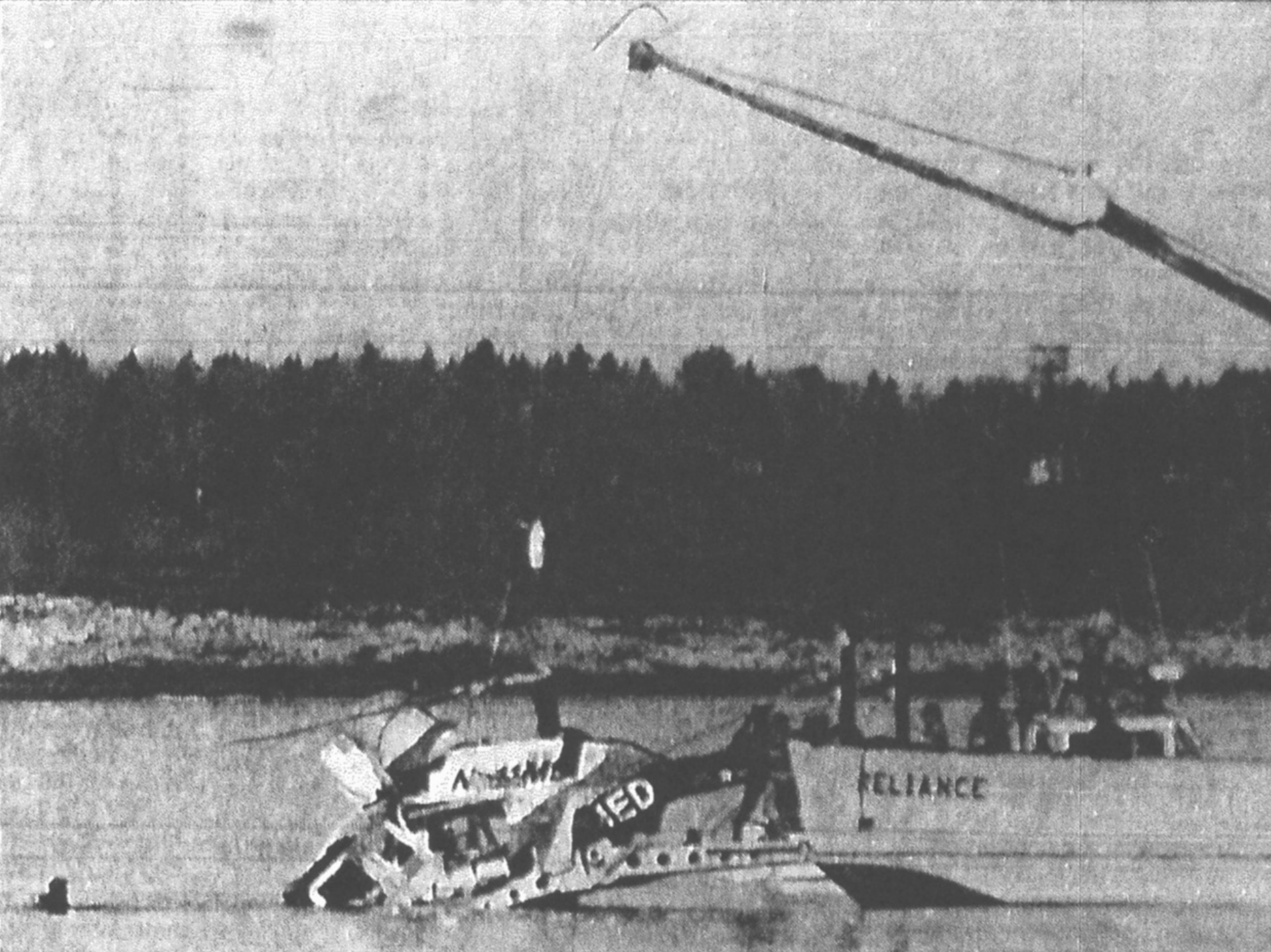
Conclusion Selecting trauma centers based on geographic need, appropriately locating medical helicopter bases, and establishing formal agreements for sharing trauma care resources across states should be considered to improve access to trauma care in the United States.

JAMA. 2005;293:2626-2633 www.jama.com

THE SYSTEMS APPROACH TO THE delivery of trauma care is widely accepted as an effective strategy for reducing death due to injury.[1-3] A critical component of this systems approach is the designation or verification of trauma center hospitals equipped to treat more severely injured patients. Although the overall number of trauma centers has increased over the last decade, recent studies have shown that their geographic distribution varies widely across states. These studies suggest that in many areas of the country residents are

46.7 million Americans have no access to Level 1 or 2 trauma centers within 1 hour

"Helicopters provide access for 81.4 million Americans who otherwise would not have been able to reach a trauma center within an hour."


ED
ELIANCE

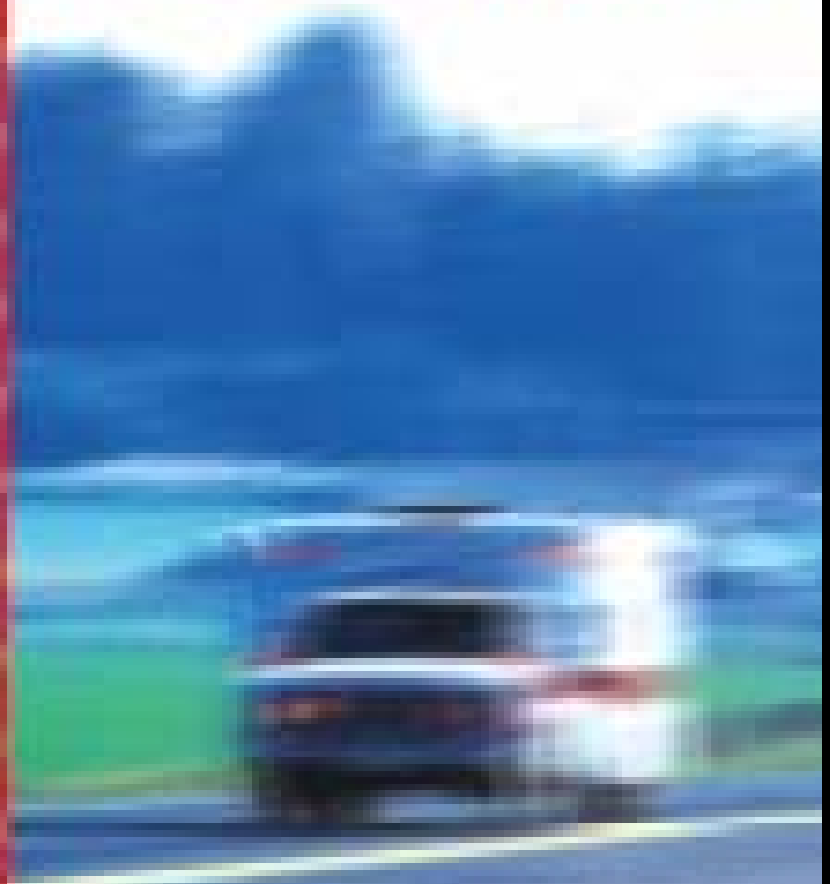
Issues in Designing System

- Access and Equity
- Medical oversight
  - Practice of medicine (non-physicians)
- Organization of services
  - dynamic environment—(organization across state lines, multi-state providers)
  - growth (iatrogenic changes in healthcare)
- Evidence base for benefits (clinical / costs)
- Use criteria
- Risk / Safety
- Quality management / practice variation

FUTURE OF EMERGENCY CARE

EMERGENCY MEDICAL SERVICES

AT THE CROSSROADS



INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

IOM EMS at the Crossroads:

Issues in air medicine:

Growth

Clinical efficacy and appropriateness

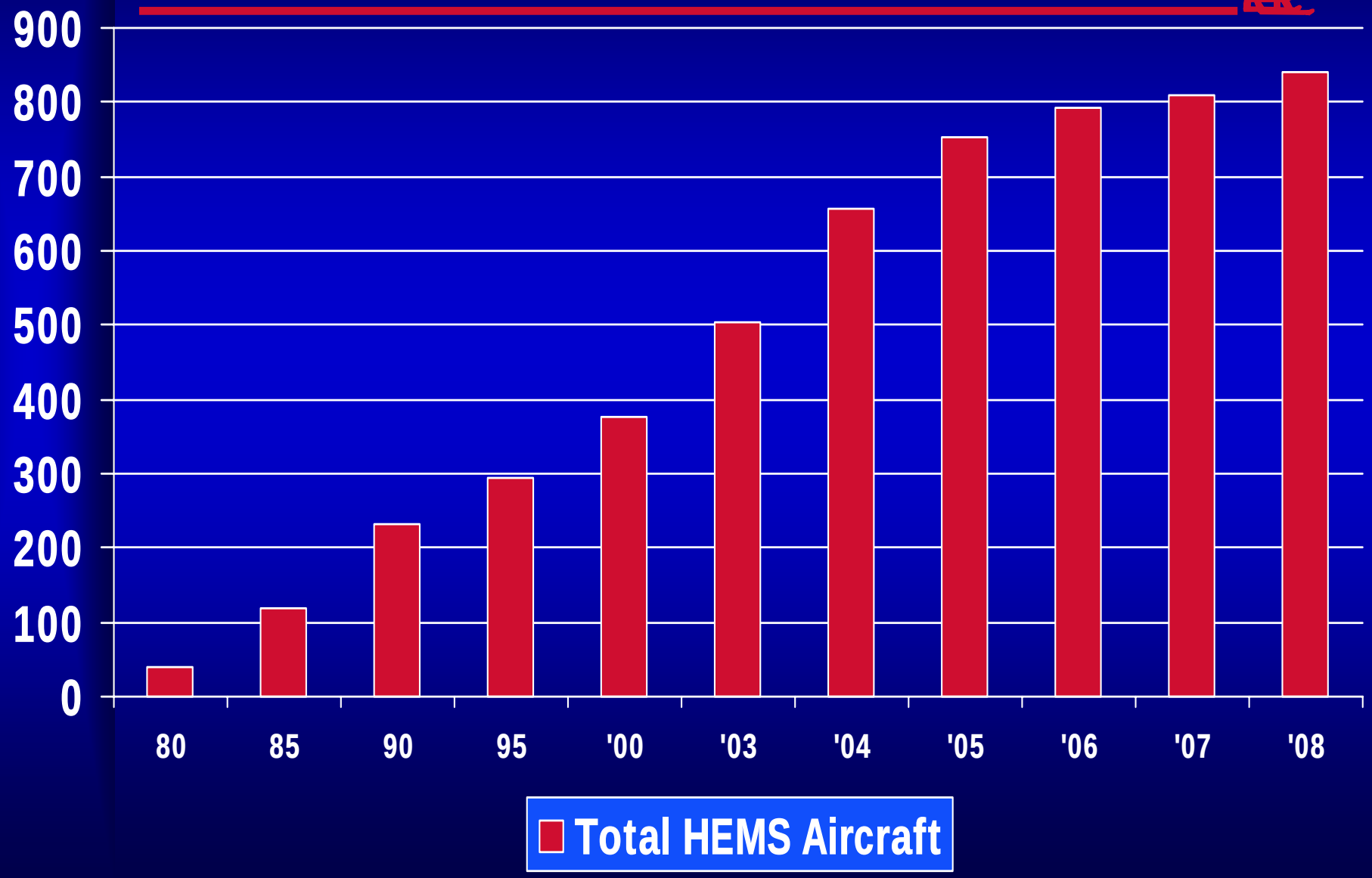
Safety

GROWTH

Issues in Designing System: Evolution

- Enthusiasm vs. design
- Demand vs. need
- Models
- Integration

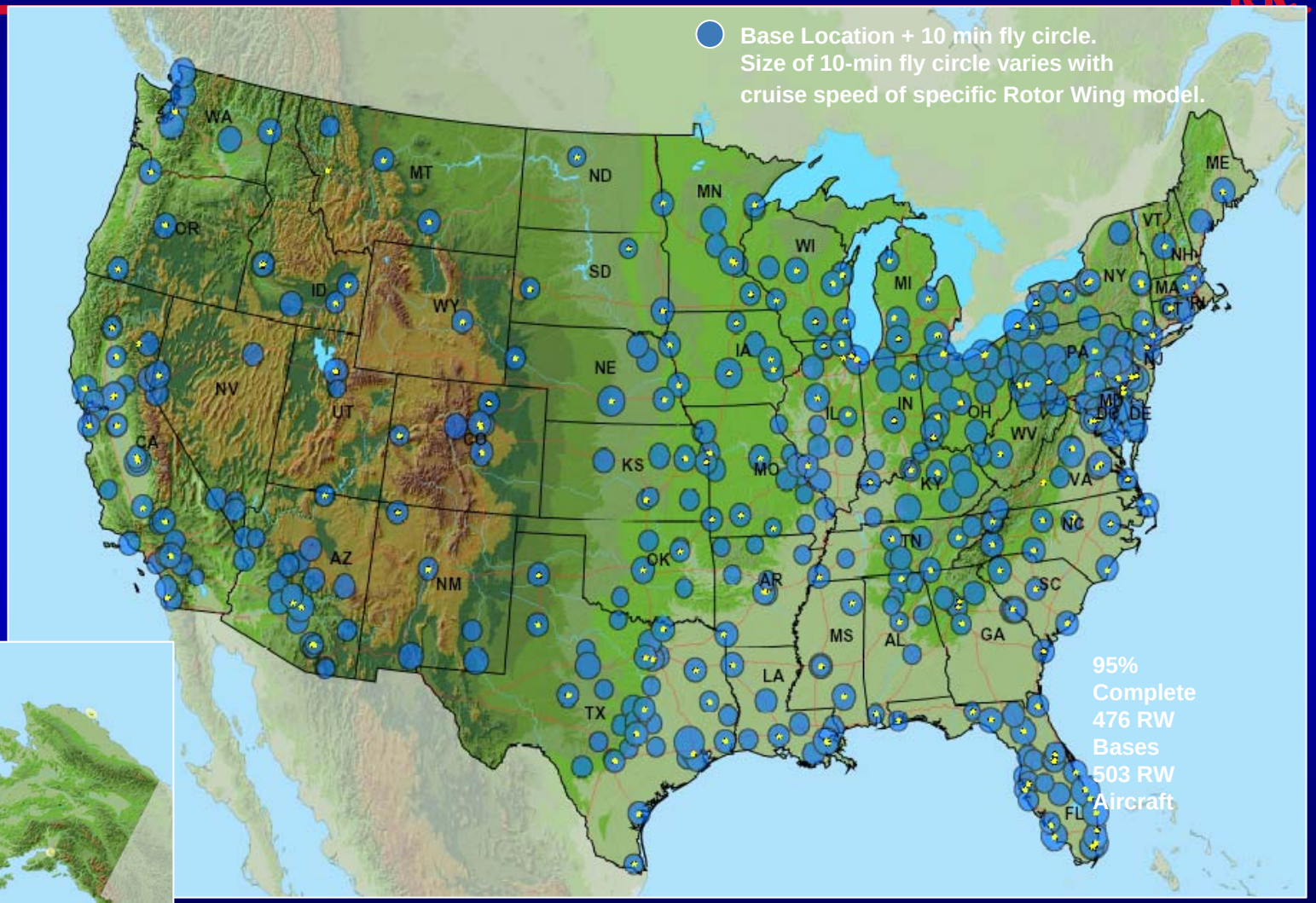
Risk vs. growth



National Air Medical Services GIS Database for Trauma Transport

Atlas & Database of Air Medical Services

ADAMS



CenTIR, AAMS, NHTSA, FHWA

Atlas & Database of Air Medical Services

Second Edition National Air Medical Services GIS Database

ADAMS

Rotor Wing (RW) Base Locations Providing Scene Response (with 10 min fly circle).
Corporate Office

WA
OR
CA
NV
ID
MT
WY
UT
AZ
CO
NM
ND
SD
NE
KS
OK
TX
MN
IA
MO
AR
LA
WI
IL
MI
IN
KY
TN
MS
AL
GA
FL
SC
NC
VA
WV
OH
PA
NY
VT
NH
ME
MA
RI
CT
NJ
MD
DC
DE

Oct. 1, 2004

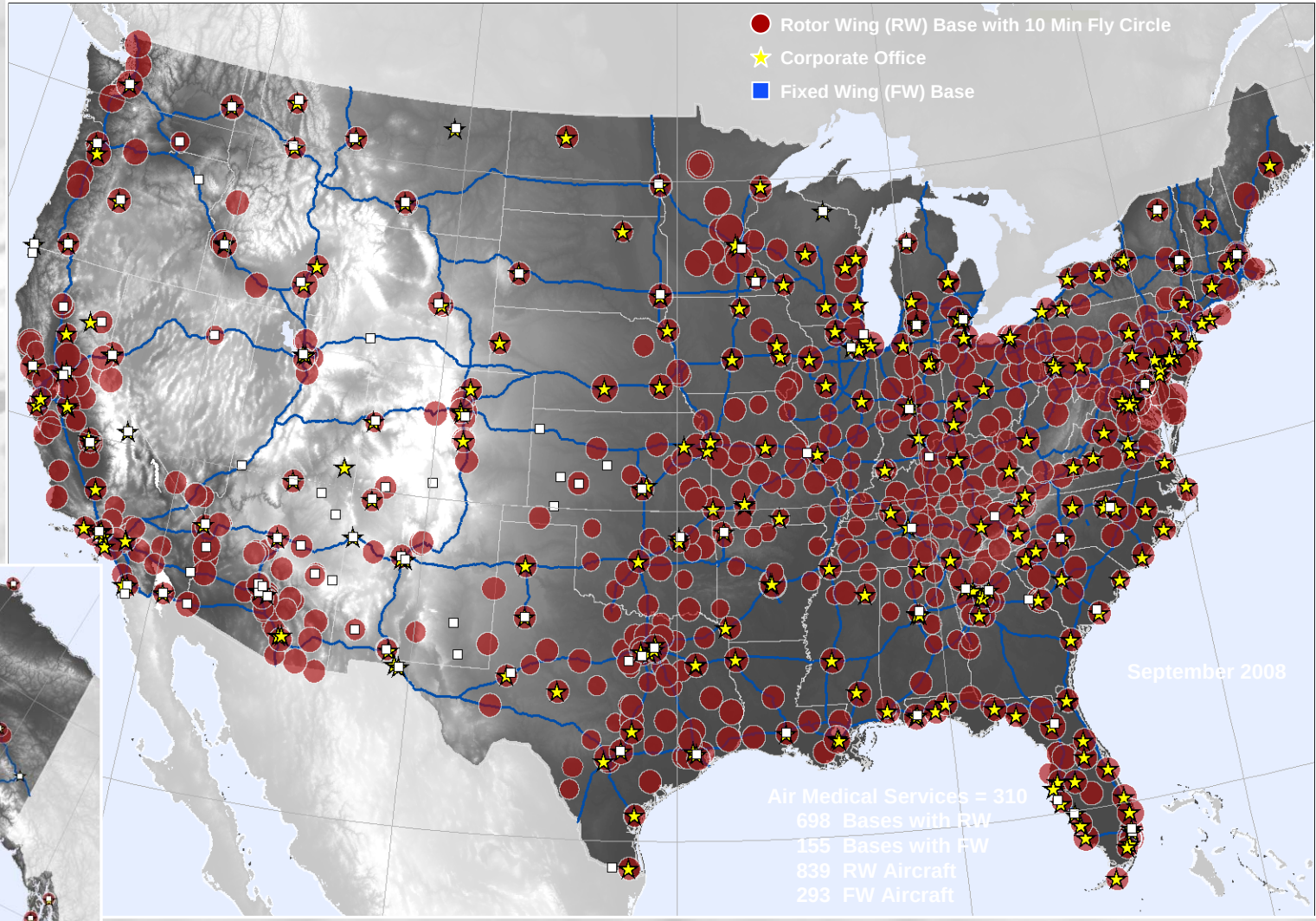
256 Services
546 RW Bases
658 RW Aircraft

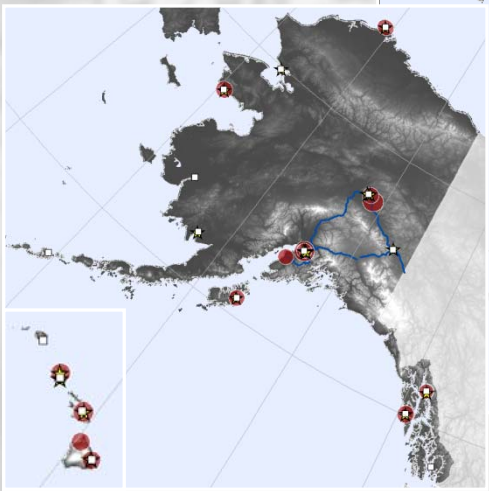
Center for Transportation Injury Research (CenTIR)
Association of Air Medical Services (AAMS)
-- Support provided by NHTSA & FHWA

Atlas & Database of Air Medical Services

Sixth Edition National Air Medical Services GIS Database

ADAMS 2008





http://www.ADAMSairmed.org

Center for Transportation Injury Research (CenTIR) at CUBRC
Association of Air Medical Services (AAMS)
-- Support provided by FHWA

Issues in growth:

- Health care financing
- The HCFA Fee Schedule
- Demographics
- Rural vs. urban
- Design / Regulation
- Health care organization
- Medical / technical imperatives
- The debate about access

Appropriateness

Air med vs. high acuity transport med

- Traditional model " trauma medevac" based on military experience—rapid transport of trauma patient in unique vehicle not tied to roads.
- Time = critical
- Evolving models: critical care teams / transport
- Care = critical
  - Deliver assets of trauma/ tertiary center directly to patient—stabilize and then transport to TC/Tertiary
  - Replacement model for rural hospital (CAH's).
  - Time dependent care: TBI, PCI, Stroke, Neonate.
  - Regional Disaster Systems and Surge Capacity
  - Airway management vs. ground

- E. Steele
- N. Dinerman
- C. McCorth
- R. Petrie
- T. Judge
- K. Hews
- N. Leow

FYI
2/27

Vermont Helicopter Review Committee Report

At the request of the Vermont Health Authority, a committee was formed to evaluate the appropriateness and effectiveness of the Dartmouth-Hitchcock air transport program known as DHART. This committee was composed of three representatives from Dartmouth-Hitchcock Medical Center, three from Fletcher Allen Health Care and three from Vermont at-large. The committee was made up of three emergency physicians, three emergency/trauma nurses, and three general surgeons. Members included Mary Margaret Ryan, RN(Rutland Regional Medical Center), David Alsobrook, MD (North Country Hospital), Gene Grabowski, MD (Southwestern Vermont Medical Center), Lori Camp, RN (FAHC), Ray Keller, MD (FAHC), Turner Osler, MD (FAHC), Judy Lombardi, RN (DHMC), John Sutton, MD (DHMC), and Norman Yanofsky, MD (DHMC). The charge to the committee was to assess the appropriateness of helicopter transports in Vermont, and to assess the benefit that resulted from helicopter transport.

The Committee met a total of six times from September, 1996 to October, 1997. Patient records from February to November of 1996 were reviewed. All patients from this time interval who were picked up from or transported to Vermont were reviewed. A total of 107 patient charts were reviewed. In some cases there was unanimous agreement on the conclusions of the case review. In many cases there was disagreement and a simple majority vote was used to make a determination.

The Committee broke its task into three components. Appropriateness was taken in two steps. First, the indications for each flight were compared to activation guidelines developed by the Association of Air Medical Serves (AAMS), the professional society representing helicopter transport programs throughout the world. In addition an assessment was made as to whether there was a reasonable possibility that the patient could survive their injury or illness. If the group voted no, then the flight was not considered to be appropriate, whether or not it met AAMS criteria.

Secondly the group felt it should take responsibility for creating new guidelines specific for the state of Vermont. This was approached by assessing each flight for potential benefit. If at the time of flight request, it could reasonably be felt that the patient could benefit from more rapid transport, or from advanced life support at the scene of an accident then it was felt to meet that category criteria. By reviewing the results of this analysis, the committee was able to revise the AAMS criteria to be more specific to Vermont. This review did not take into account however, issues relevant to interhospital transport such as length of transport time out of hospital, limitation of resources such as ambulances and critical care personnel, and the skill level which the flight crew brings to the aid of critically ill and injured patients. These are reasons that providers sometimes called the helicopter despite the fact they did not meet the criteria for potential benefit.

Activity Measures-- Vermont Study

- Flight Appropriateness
  - Meet Established Guidelines
  - Reasonable Chance of Survival
- Potential Benefit
  - Critical illness or injury at time of request thought to need life or limb-saving intervention
- Patient Benefit
  - unexpected survivors
  - emergent complex intervention
  - time saved

Test 1: meets criteria

- "met the AAMS guidelines and had a reasonable chance of survival."

Interhospital:	66/82	80.5%
Scene:	19/25	76%
Total	85/107	79.4%

Test 2: potential benefit

- "the patient must have had a critical illness or injury which at the time of transport was thought to have need of an emergent life or limb saving intervention… nic potential for deterioration during transport…."

interhospital	42/82	51.2%
scene	12/25	48%
total	54/107	50.5%

Test 3: patient benefit

- "...patients who… had likely or possibly had their life or limb saved because of the flight…."

Interhospital:	3/82	3.7%	likely
	5/82	6.1%	possibly
Scene	1/25	4%	likely
	2/25	8%	possibly
Total	11/107	10.3%	likely /possibly

policy issues:

- "at the time of the request for the helicopter that it was predictable that 50% of the patients transported by helicopter could have been safely transported by ground…60% of these patients met current AAMS activation guidelines…."
- "….52% of scene flights were made for patients with non-life threatening injuries… the helicopter should not be activated for scene transports without close medical supervision from the local hospital."

Fourth Annual AMTC Great Debate

The use of auto-launch and early activation by HEMS programs lowers the medical necessity threshold for air medical transport and results in corresponding over-utilization.

Patient Selection

Issues: Patient Selection Criteria

- ACS
- AAMS
- NAEMSP
- AMPA
- ACEP
- AAP
- CDC

POSITION PAPER

NATIONAL ASSOCIATION OF EMS PHYSICIANS

GUIDELINES FOR AIR MEDICAL DISPATCH

David P. Thomson, MD, MS, Stephen H. Thomas, MD, MPH, for the 2002–2003 Air Medical Services Committee of the National Association of EMS Physicians

INTRODUCTION

Air medical transport has become a well-established part of the emergency medical services (EMS) system. Through the use of aircraft, patients are moved swiftly and safely throughout the world. However, for a number of reasons, the use of air medical transport remains somewhat controversial. One reason for this controversy is that debate continues to surround appropriate utilization of air medical transport. Since the topics of triage to air transport were last addressed by the National Association of EMS Physicians' (NAEMSP's) Air Medical Task Force (hereafter abbreviated as "the Task Force"), there has been significant evolution of thought concerning appropriateness of air medical dispatch. Therefore, the goal of this position paper is to outline current recommendations guiding utilization of air medical transport.

This position statement builds on earlier work by the Task Force and replaces two previous position statements.[1,2] The first NAEMSP position statement on the subject was published in *Prehospital and Disaster Medicine* in January-March 1992 as a contribution of the 1992 Task Force.[1] The 1994 Task Force published a follow-up paper addressing non-trauma and pediatric considerations.[2] The current Task Force members gratefully acknowledge the work of the previous documents' authors: Drs. Nicholas Benson, Catherine Carruba, Dan Hankins, Richard Hunt, and David Wilcox. The current authors have also drawn upon the work of other organizations, including the Association of Air Medical Services (AAMS)[3] and the American Academy of Pediatrics (AAP),[4] which have produced similar documents.

This position statement has also been endorsed by the Air Medical Physician Association (AMPA), by approval of its Board of Directors.

DISCUSSION

Air medical transport has grown to the point where we commonly speak of people being "life-flighted." As of this writing, the AAMS, which represents the vast majority of U.S. air medical providers, reports 271 air medical program members, 193 of which have a helicopter EMS component.[5] The growth of air medical transport is, at least in part, due to a perception that provision of such a service results in benefits to the patients and/or regions where air transport exists. In some cases, the benefit results from the increased level of care provided by the air medical crew; these individuals are generally trained to a higher level of care than available ground EMS providers. In other cases, the putative explanation for improved outcome is the increment in speed afforded by the air transport vehicle. However, there is continued debate surrounding use of air transport.

One source of debate is cost. Economic analyses have suggested that helicopters are cost-effective,[6] and that utilization of helicopters is no more expensive than deployment of similarly configured ground ambulances with comparable staffing levels and response times.[7] However, acceptance of these premises is far from universal, and acquisition and maintenance of aircraft undoubtedly represent a significant expense in an era of limited health care dollars. Within this economic envelope, payers for health care including commercial insurance, managed care organizations, and public payers, including Medicare and Medicaid in the United States and government sup-

Dr. Thomson is in the Department of Emergency Medicine, SUNY Upstate Medical University, Syracuse, New York; and Dr. Thomas is at Boston MedFlight and in the Division of Emergency Medicine, Harvard Medical School, Boston, Massachusetts.

Approved by the National Association of EMS Physicians Board of Directors December 9, 2002; approved by the Air Medical Physician Association Board of Directors July 1, 2002; approved by the Association of Air Medical Services Board of Directors July 9, 2002. Received December 10, 2002; accepted December 10, 2002.

Address correspondence and reprint requests to: NAEMSP, P.O. Box 15945-281, Lenexa, KS 66285-5945.

Scene Triage Criteria

Table 1 Summary of the criteria for the primary deployment of the Rotterdam helicopter-transported medical team for trauma patients

Category	Criterion
General	Place difficult to reach for ambulances (> 20 min to reach injury scene)
	If, in professional opinion of dispatcher, the HMT provides additional value
Mechanism of trauma	Motor vehicle accidents with estimated speed of > 30 km/h
	Frontal collisions outside the built-up area of a town
	Fall from > 6 m or third floor
	Entrapment in vehicle
	Death of other occupant
	Ejected from vehicle
	Explosions
	Near drowning or diving accidents
	Exposure to toxic chemicals
	Inhalation trauma or severe burns
Patient condition	Penetrating injuries to head, neck or trunk
	Pelvic, spinal or femur fracture
	Comatose (Glasgow Coma Score of ≤ 8)
	Systolic blood pressure < 95 mmHg or pulse > 120 per min
	Major estimated blood loss (> 1 litre)
	Respiratory distress

Ambulances, while on scene, can always request assistance (secondary deployment). HMT, helicopter-transported medical team.

London HEMS

Fall >2m Entrap LOC Apnea Burns GSW/Stab Limb threat

POSITION PAPER

NATIONAL ASSOCIATION OF EMS PHYSICIANS

GUIDELINES FOR AIR MEDICAL DISPATCH

David P. Thomson, MD, MS, Stephen H. Thomas, MD, MPH, for the 2002–2003 Air Medical Services Committee of the National Association of EMS Physicians

Improving triage

Table 2 Variables Considered Predictors of Outcome in the Prehospital Setting

Predictor Variable	Unit of Measurement	Form for Inclusion in Model Development
Age	Years	Linear form ≤40, 41–65, >65 yr
Respiratory rate	Breaths per minute	Linear form Quadratic form ≤15, 16–20, >20 breaths/min
Pulse rate	Beats per minute	Linear form Quadratic form 75, 76–90, >90 beats/min
Systolic blood pressure	Millimeters of mercury	Linear form Quadratic form ≤120, 121–140, >140 mm Hg
Cause of injury	Motor vehicle passenger or driver Motorcycle passenger or driver Pedestrian Other cause of injury	
Glasgow Coma Scale	Motor Eye opening Verbal	Normal (6), not normal (<6) Normal (4), not normal (<4) Normal (5), not normal (<5)

Unit Stay and

Belinda J. Gabbe, BPhysio(Hons), MAppSc, PhD, Peter A. Cameron, MBBS, MD, FACEM, Rory Wolfe, BSc, PhD, Pam Simpson, BSc(Hons), Karen L. Smith, BSc (Hons), GradDipEpiBiostats, PhD, John J. McNeil, MBBS, FRACP, FAFPHM

Prediction Tool		Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Design data set	Complex model	72	78	19	97
	Categorical model	74	76	18	98
	Simple model	75	76	19	98
Trauma triage guidelines	Physiologic criteria	70	74	16	97
	Anatomic criteria	87	26	8	97
	Combined criteria	92	23	8	98

PPV, positive predictive value; NPV, negative predictive value.

Issues: Patient Selection Criteria

Criteria: American College of Surgeons: www.facs.org

- *Resources For Optimal Care of the Injured Patient: 1999 Committee On Trauma*
- Interfacility Transfer of Injured Patients: Guidelines for Rural Communities 2002
- Equipment for Ambulances 2000 (jointly issued with ACEP)

Issues: Patient Selection Criteria

- **The National Association of EMS Physicians published in Prehospital Emergency Care in 2003 and endorsed by the Air Medical Physicians Association (AMPA) and AAMS.**

- **Thompson DP, Thomas SH Guidelines for Air Medical Dispatch, Prehospital Emergency Care, April-June 2003 7;2: 265-271**

- **Available at www.peconline.org or www.naemsp.org., have been updated from earlier national consensus guidelines published by NAEMSP in 1992 and 1994 and by AAMS in 1990.**

Issues: Patient Selection Criteria

- **American Academy of Pediatrics: www.aap.org**
  Guidelines for Air and Ground Transport of Neonatal and Pediatric Patients. 2nd Edition.

- **Woodward GA, et. al. The State of Pediatric Interfacility Transport: Consensus of the Second National Pediatric and Neonatal Interfacility Transport Medicine Conference. Pediatric Emergency Care 18;1 Feb. 2002 pp. 38-43**

- **American College of Emergency Physicians: www.acep.org**
  Appropriate Utilization of Air Medical Transport in the Out of Hospital Setting (1999)

  Interfacility Transportation of the Critical Care Patient and Its Medical Direction (1999)

  Appropriate Interhospital Patient Transfer (2002)

Issues: Patient Selection AMPA Guidelines

- AMPA has also published a list of medical conditions and appropriate recommendations based upon the work done by the Medical Conditions Work Group of the NRM that developed the Medicare Fee Schedule. www.ampa.org

General guidelines for the appropriate use of air medical transport include:

- EMS regional or state-approved protocol identifies need for on-scene air transport
- EMTALA physician certified inter-facility transfer (not a patient request)
- Acute neurological emergencies requiring emergent /time sensitive interventions not available at the sending facility
- Acute vascular emergencies requiring urgent / time sensitive interventions not available at the sending facility
- Acute surgical emergencies requiring urgent / time sensitive interventions not available at the sending facility
- Critically ill patients with compromised hemodynamic / respiratory function who require intensive care during transport and whose time of transfer between critical care units must be minimized during transport

Issues: Patient Selection / AMPA Continued

- Acute cardiac emergencies requiring emergent / time sensitive intervention not available at sending facility
- Critically ill obstetric patients who require intensive care during transport and whose time of transfer between facilities must be minimized to prevent patient / fetal mortality
- Critically ill neonatal / pediatric patients with potentially compromised hemodynamic / respiratory function, a metabolic acidosis greater than 2 hours post delivery, sepsis, or meningitis
- Patient with electrolyte disturbances and toxic exposure requiring immediate life-saving intervention
- Transplant patients (fixed wing vs. helicopter)
- Patients requiring care in specialty center not available at sending facility
- Conditions requiring treatment in a Hyperbaric Oxygen Unit
- Burns requiring treatment in a specialized burn treatment center
- Potentially life or limb threatening trauma requiring treatment in a trauma center, including penetrating eye injuries.

Issues: Patient Selection Challenges

- Trauma / Medical
- Variation in practice
  - Dispatch / Triage
  - Use / Triage
- Medical oversight variability
- Utilization Review
- Time / Distance accuracy secondary to care needs
- Kinematics / vehicle technology
- Age criteria
- Local needs vs. global criteria

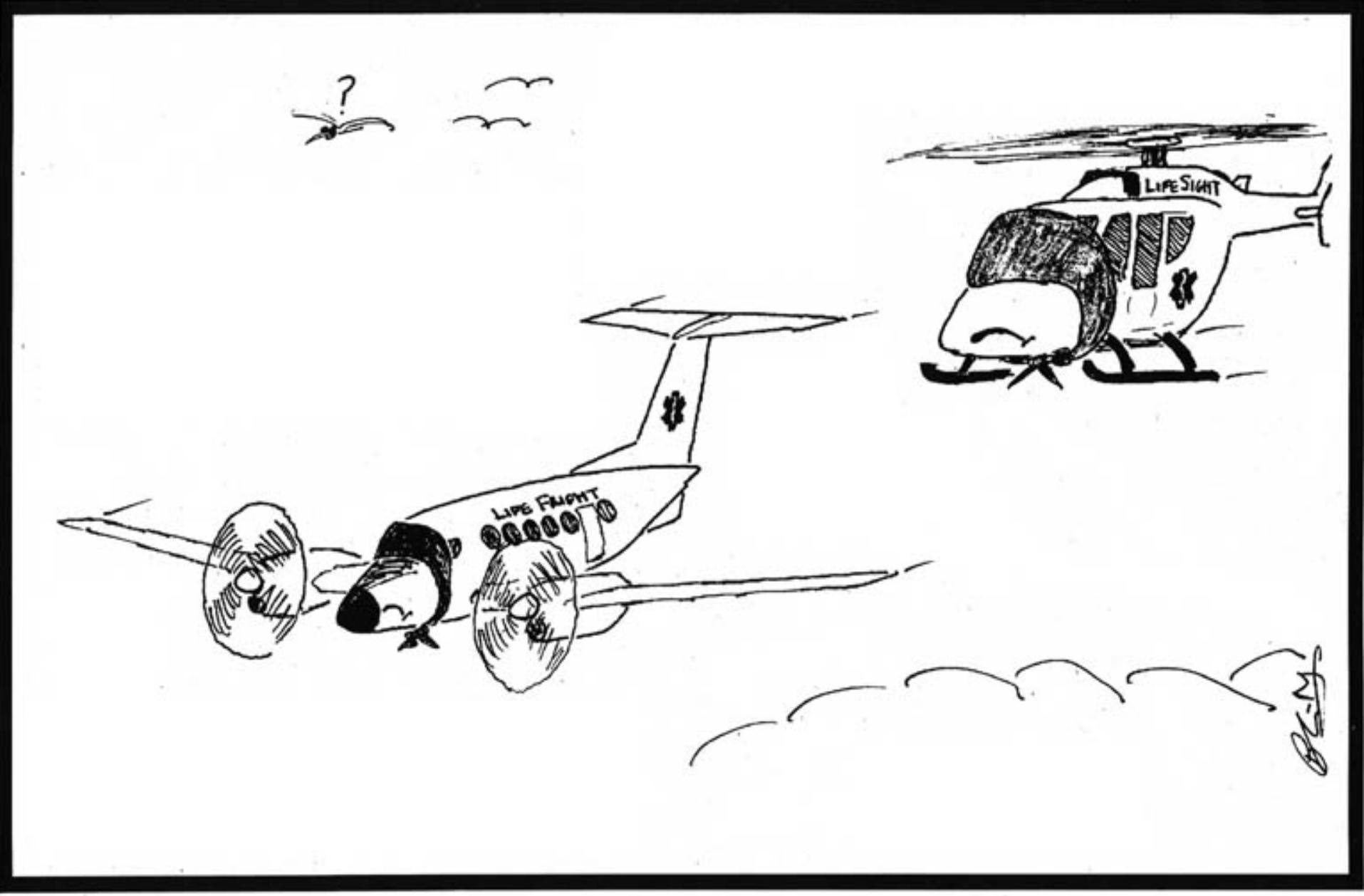
Evidence Base

Scene trauma

- Baxt (1983)
- Baxt (1985)
- Schiller (1988)
- Nardi (1994)
- Nicholl (1995)
- Moront (1996)Mix
- Cunningham (1997)
- Younge (1997)
- Cocanour (1997)
- Celli (1997)
- Braithwaite (1998)
- Thomas (2000)Mix
- DiBartolomeo (2001)
- Oppe (2001)
- Chappell (2002)
- Wang (2004)
- Frankema (2004)
- Biewener (2004)Mix
- Buntman (2005)
- Davis (2005x2)
- DiBartolomeo (2005)

Study designs

- **Panel review**
- **Cohort: Air *vs.* ground**
- **TRISS**
- **Natural experiment**
- **Population**
- **Cost-benefit**
- **Randomized control trial?**



THE DOUBLE BLIND TRIAL BETWEEN FIXED AND ROTOR WING RESPONSES WAS NOT WITHOUT ITS PROBLEMS

Methodology issues

Issues

- **Study approach**
  - **Optimizing *n***
  - **Acuity scoring**
  - **Matching**
  - **TRISS**
- **Cost:Benefit**
- **Triage**

Problems

- **Design challenges**
  - **Heterogeneity**
  - **Validity questions**
  - **Residual confounding**
  - **“Black box”**
- **Lack of consensus**
- **Available data quality**

Areas for study

- Clinical
  - Mortality, morbidity (*e.g.* GCOS)
  - Physiologic (*e.g.* hypoxemia)
  - Analgesia/pain care practices
  - Protocol adherence, error reduction
- Surrogate & logistic
  - Speed (ALS coverage, transport time)
  - Direct transport to definitive care
- Cost-benefit considerations

Issues: Evidence Base Challenges

- **Limited outcome studies:**
  - **+ Support with accurate patient selection**
  - **- Population based studies**
  - **- System wide studies vs. disease specific**

- **Limited cost benefit studies– (metrics, additional lives, life years)**

- **Limited system replacement cost studies–**
  - **ground vs. air**
  - **air vs. air**
  - **air vs. no air**
  - **air vs. rural / community hospital**

- **Few policy studies —unpublished / State of Vermont**

Issues: Evidence Base

- **Evidence mixed– (urban vs. rural, trauma vs. medical, specific injury, other changes in EMS / healthcare system, airway management)**
- **Increasing literature supporting well integrated systems / time to care**
- **(Thomas, et. al. MA (blunt trauma), Mann, et. al. UT, (IF trauma) Oppe, Netherlands, trauma and medical, Shatney CA, time to care, Winchell, CA, TBI/airway)**
- **Significant Debates on methodology**
- **Randomized Control Difficult**
- **Uncertainty in patient selection: ACS, EMS triage criteria**
- **Environmental specific**
- **Changing playing field**

Issues: Evidence Base: Recent Lit Reviews

- **Non Trauma Helicopter Emergency Medical Services Transport: Annotated Review of Selected Outcome-Related Literature** Thomas SH, Cheema F, Wedel SK, Cummings M, Thomson, D. *Prehospital Emergency Care 2002;6:242-255*

- **Trauma Helicopter Emergency Medical Services Transport: Annotated Review of Selected Outcome-Related Literature** Thomas SH, Wedel SK, Cheema F, Thomson D. Prehospital *Emergency Care 2002;6:359-371*

- **Helicopter Emergency Medical Services Transport Outcomes Literature: Annotated Review of Articles Published 2002 – 2003** Thomas SH. *Prehospital Emergency Care 2004;8:322-333*

- **Helicopter EMS Transport Outcomes Literature: Annotated Review of Articles Published 2004-2006.** Thomas SH. *Prehospital Emergency Care 2007;11:477-488*

Correlation of Medical Helicopter Transports With Consensus Utilization Guidelines

The Northeast
Evaluation of Transport
Workgroup

Issues: Patient Selection Challenges

- Time vs. geography
- Air vs. Ground
- Team vs. Speed
- The Maryland Expert Panel

Safety

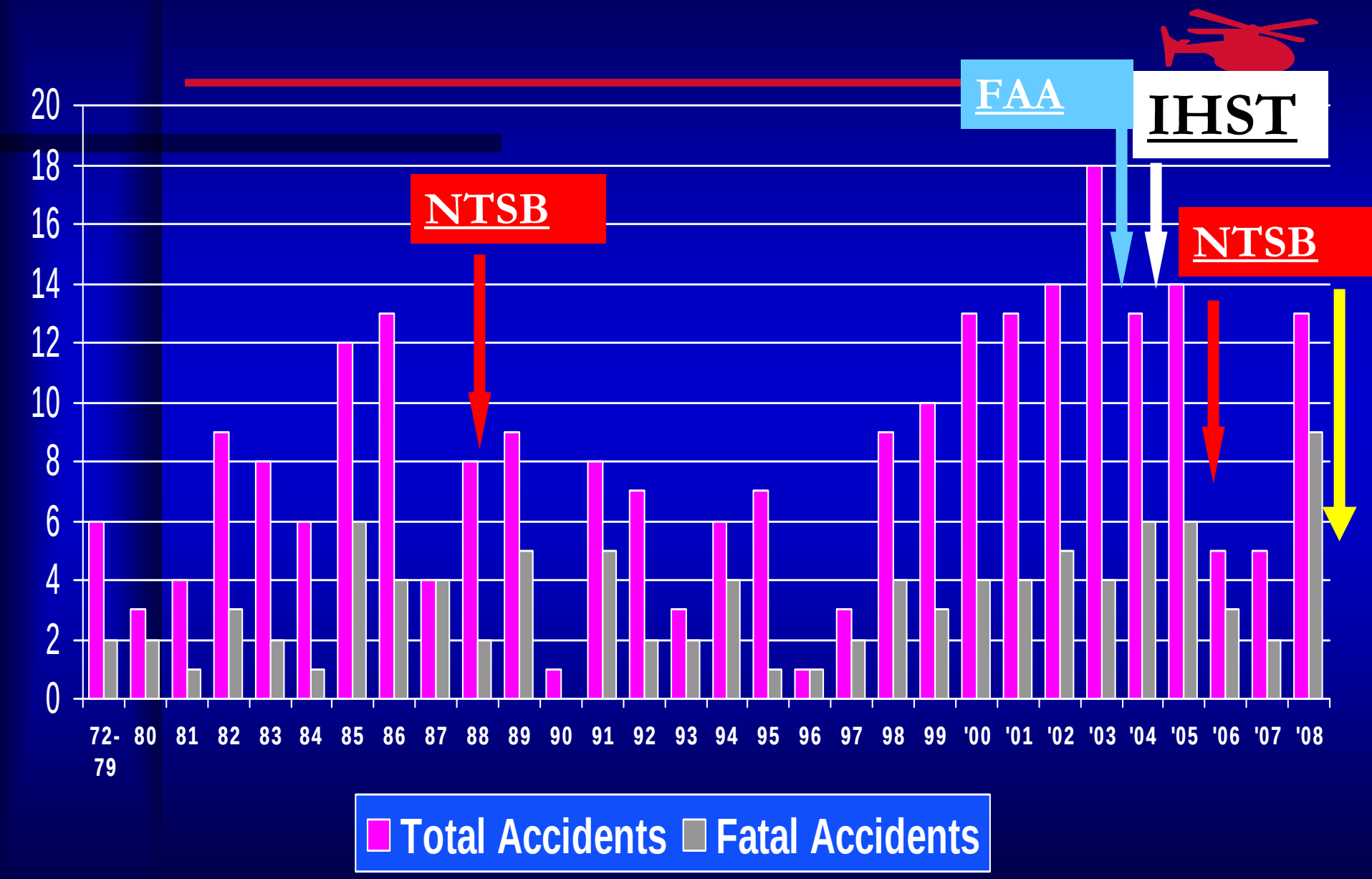
Newberry, SC July 2004
4 Fatal

Focus: 1998-2008

- 146 HEMS accidents
  - 55% off all HEMS accidents since 1972
  - 141 dedicated HEMS
  - 5 dual purpose
  - 50 (of 146) fatal
    - 47 HEMS
    - 3 dual purpose

through October 15,

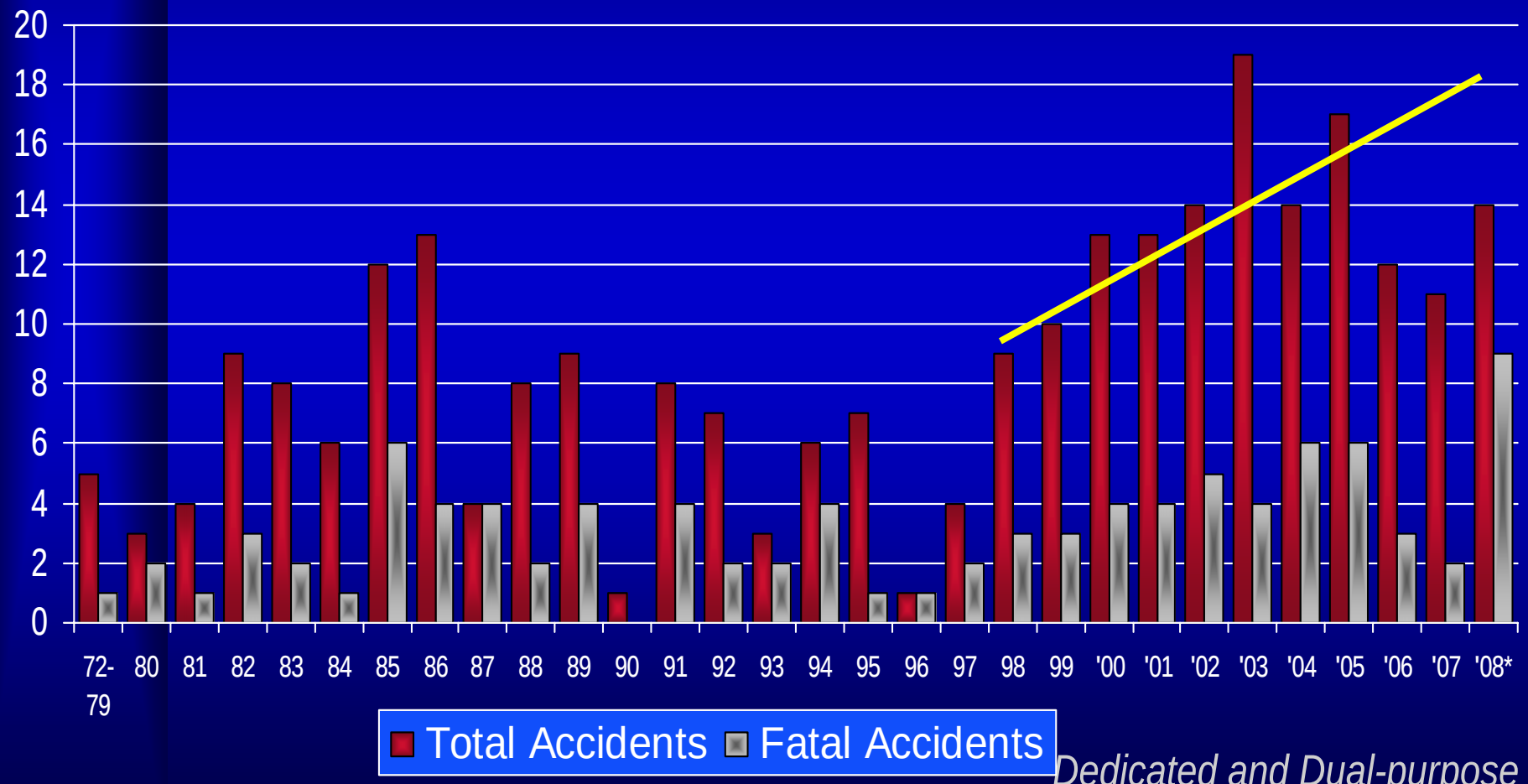
U.S. HEMS and Fatal Accidents



through October 15, 2008

HEMS: 1998-2008 (146 accidents)

Avg. accidents/yr | 1988-1997: 5.0 | 98-08: 12.4

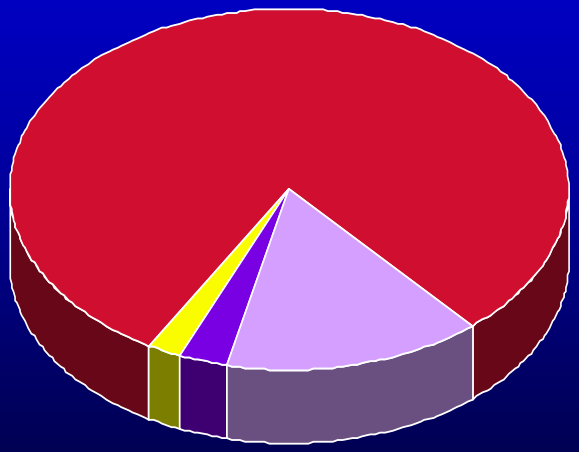


Dedicated and Dual-purpose through 1 Jan. 2009

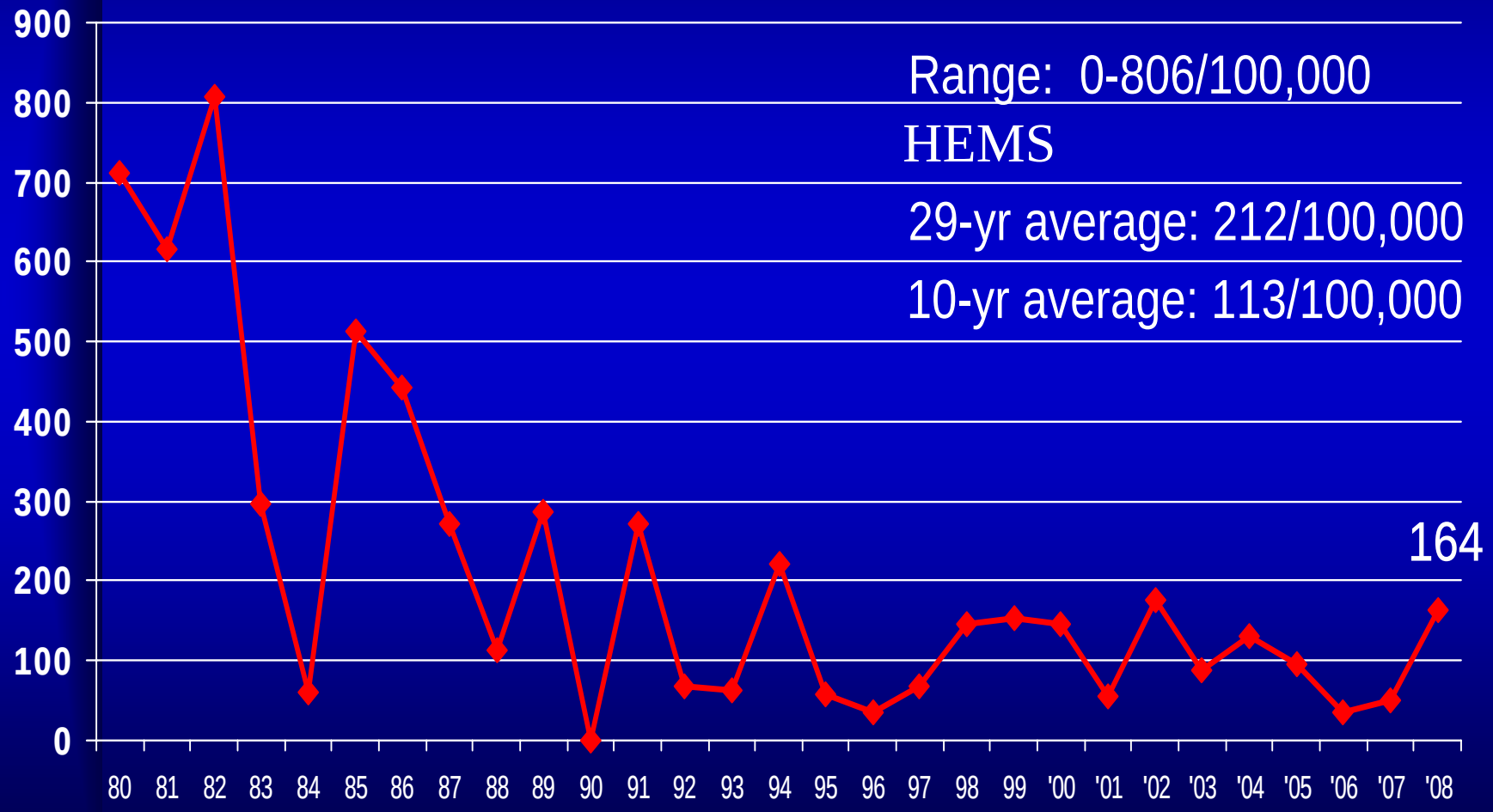
When and Why?

1998-2008

- Probable cause. . . .
  - “Human error” – 77%
    - Weather-related
    - Collision with objects
  - Mechanical – 17%
  - Other – 3%
  - Undetermined – 2%



HEMS Crew Fatalities / 100,000 Personnel



MARSHALL
VFD

NTSB National Transportation Safety Board

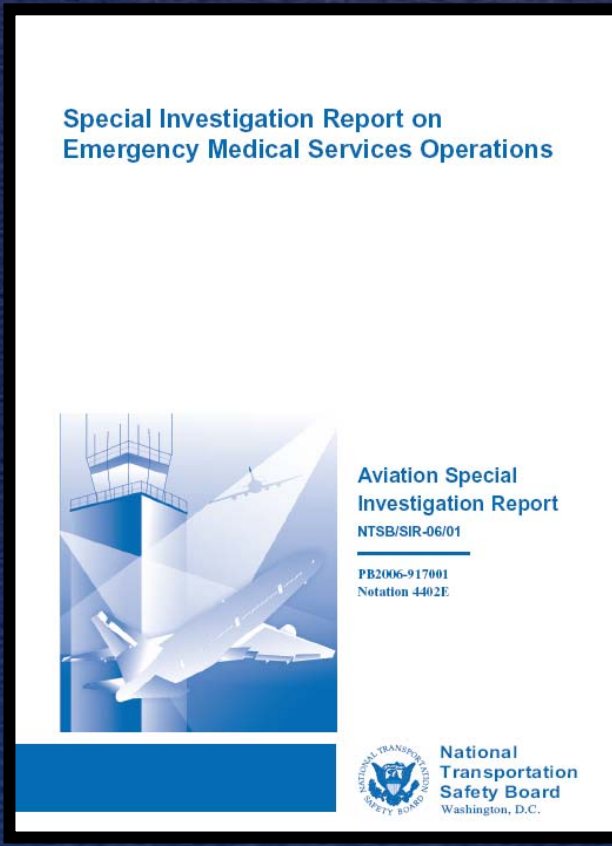
Federal Most Wanted Transportation Safety Improvements

Improve Safety of Emergency Medical Services Flights

NTSB Special Investigation Report

- Adopted January 25, 2006
- EMS provides an important service
- Pressures; challenging environment
- Analyzed 55 EMS accidents from:

  Jan. 2002 – Jan. 2005
- 54 fatalities, 19 serious injuries
- 29 of 55 accidents could have been prevented with corrective actions


Special Investigation Report on
Emergency Medical Services Operations

Aviation Special
Investigation Report
NTSB/SIR-06/01

PB2006-917001
Notation 4402E

National
Transportation
Safety Board
Washington, D.C.

NTSB MOST WANTED
Transportation Safety Improvements

Recent Fatal EMS Accidents

- ***Whittier, AK*** – Dec. 3, 2007 - BK117 - 4 fatal
- ***Cherokee, AL*** – Dec 30, 2007 - Bell 206 – 3 fatal
- ***S. Padre Island, TX*** – Feb. 5, 2008 -AS350 – 3 fatal
- ***La Crosse, WI*** – May 10, 2008 – EC135 – 3 fatal
- ***Huntsville, TX*** – June 8, 2008 – Bell 407 – 4 fatal
- ***Flagstaff, AZ*** – June 26, 2008 – Bell 407s – 7 fatal
- ***Greensburg, IN*** – Sept. 1, 2008 – Bell 206 – 3 fatal
- ***Forestville, MD*** – Sept. 28, 2008 – AS365N1 – 4 fatal
- ***Aurora, IL*** – Oct. 15, 2008 – Bell 222 – 4 fatal

Improve Safety of Emergency Medical Services Flights

Proposed Safety Board Action

- Add issue area to Most Wanted List
- Add recommendations A-06-12 thru -15
- Reclassify A-06-13 to “Open-Unacceptable”
- Assign yellow classification: Acceptable Response, progressing slowly

Timeliness Classification	**YELLOW**

EMS Safety Issue: Night Vision Devices

- Night EMS accidents over represented
- NVIS enhances ability to see and avoid obstacles & reduces spatial disorientation
- 13 of 55 accidents may have benefited from use of NVIS
- FAA encourages use of NVIS
- Feasibility of NVIS ? *(Costs, Training, Cockpit Compatibility, Ambient Lighting)*
- Action:NTSB Staff to monitor effectiveness

NTSB MOST WANTED
Transportation Safety Improvements

NTSB Public Hearing on EMS Safety Feb 3-6 2009

- Program models and reimbursement
- Corporate Oversight
- State and Federal Regulation
- Competition (including Helicopter Shopping)
- Pilot Training
- Crew Resource Management for Medical & Flight Crew
- FAA Oversight
- Instrument Flight
- Equipment: TAWS, Flight Recorders
- 135, Risk, Dispatch, TAWS (Previous NTSB Recs)

Issues: Safety / Risk Benefits

- **Transport Safety: ground / air**
- **Transport misadventure / clinical misadventure**
- **Lack of data (FAA, AAMS, EMS, Hospital, System)**
- **Periods of rapid growth associated with increased accident rate**
- **Accident rates vs. numbers**
- **Competition within vs. for markets**
- **Relationship corporate model to safety not clear**

LAURA SCHIMMING
FLIGHT PARAMEDIC

Issues: Safety Risk / Benefits

- Complex environment w/ many providers
- Service Availability in Rural Areas
- Rural Infrastructure: (wx. reporting, AIP funds, FSS)
- + night activity secondary to healthcare changes
- Technology / Cost / Availability / Incentives
  - Radar altimeters, Twin, TAWS, IFR, NVG, Simulation
  - Changes in technology vs. lowest cost = leveling down
  - (SE, VFR, limited avionics)
- Clinical Safety
- Workforce
- Regulatory oversight—FAR, States, Local

Cost Effectiveness

What is Cost-Effective?

- **Cost:** the amount or equivalent paid or charged for something
- **Effective:** producing or capable of producing a measureable / reproducible result
- **Cost-effective:** economical in terms of tangible benefits produced by money spent

Clearly a judgment.

How much is a human life or limb worth?

Four Significant Variables

1. Cost per transport
2. Hospital cost of additional survivors
3. Number of additional survivors
4. Remaining life expectancy of each survivor

Cost-Benefit

cost per life year saved

NICU (birth wt. 500-999g)	$18,000
Median, 310 medical interventions	$19,000
3-vessel CABG for severe angina	$23,000
Thrombolysis for acute MI	$32,678
Prophylactic AZT post-needlestick	$41,000
Level I TC cost per life saved	$84,000
Accepted threshold, NEJM 2005	*$40,000-50,000*

HEMS scene trauma, $W = 5$	$2500
HEMS scene trauma, $W = 1$	$9700
HEMS use: Massachusetts	$2454
HEMS system: U.K. & Norway	$10-30,000

Issues: Cost / Benefits Challenges

- "Expensive" medical therapy from single patient perspective
- ? Cost effective strategy from population perspective ?
- Provider Competition / market saturation / "Roemer's Bed Law"
- Tempting to equate lower unit costs with cost-effectiveness, and higher unit costs with "cost-prohibitiveness.".
- Funding: preparedness model challenge:
  - transport per single patient service reimbursement
  - "Fire" based funding: public support

Comparisons

- **Teng TO, et. al.**
  Five Hundred Life-Saving Interventions and Their Cost Effectiveness.
  ***Society for Risk Analysis*. 1995;Vol.**
- **Median - $42,000 per year of life saved**
- **Medical median - $19,000**
- **Prevention median - $48,000**
- **Toxin control median - $2.8M**

Comparisons of cost of medical interventions

Emergency Medical Intervention	Discounted Cost per YL 1995 $
Prehospital defibrillation by EMTs	820
Warfarin for stroke prophylaxis in patients with atrial fibrillation	8,000
Prehospital paramedic system	8,886
Neonatal ICU for infants with birth weight between 500 and 999 g.	18,000
Median for 310 medical interventions	19,000
3-vessel CABG for severe angina	23,000
t-PA treatment for acute MI	32,678
Prophylactic AZT after needlestick injury in health care workers	41,000

Yanofsky / Vermont Study - 1995/1996

Helicopter Review Committee Report, Vermont Health Authority, 1997

- **Yanofsky - Similar method to Gearhart**

  (Yanofski, N. AMTC 1998)

- **5 lives saved per hundred transports**
- **= $ 12,000 cost per year life saved**

- **236 transports - 12 lives (approx. 5/100)**

policy issues:

- Most significant benefit not published. Total costs at discharge on average for patients transported directly to tertiary care (injury or medical) average $14K less than comparable cohort via ground to community and then tertiary care. (Yanofski, N. AMTC 1998)
- Vermont / DHART Guidelines used to develop NAEMSP guidelines.

Issues: Cost / Benefits Challenges

- **Increasing evidence that cost per life year saved and cost per additional life saved validates availability of resource**
  - **At what cost is extra life saved acceptable?**
  - **At what cost is extra life year saved acceptable?**
  - **Literature 3-30% unexpected survivors**
  - **Agreed and transparent metrics**

- **Readiness / preparedness model / high fixed costs of availability**
- **Replacement models– EMS ground ratio**
- **Replacement models– rural hospitals**

NO HANDLING
camts
Commission on Accreditation of Medical Transport Systems

Regulation

Issues in Regulation: Practice Variation

- Lack of Design
- Rapid growth associated with safety concerns
- +/- integration with EMS
- +/- integration with hospitals
- Similar to traditional EMS = local demand driven
- Geographic location availability
- Patient selection: triage / use metrics
  - Discharge from ED reports rates > 60%
  - Wide variation in FARS data / rural areas most challenging
- Inter provider competition without corresponding improvements in service
- Medical oversight

IOM EMS at the Crossroads: air medicine

"While the Federal Aviation Administration is responsible for safety inspections, helicopter licensure, and air traffic control, the committee recommends that states assume regulatory oversight of medical aspects of air medical services including communications, dispatch, and air transport protocols."

A quick primer

- Aircraft
- FAA oversight (FARS public / commercial)
  - Air Carriers / Certificate Holders
  - Part 91
  - Part 135
- State
  - Scope of Practice
  - Organization of Services
  - Medical Oversight

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SPECIAL CONTRIBUTIONS

AIR MEDICAL SERVICES: FUTURE DEVELOPMENT AS AN INTEGRATED COMPONENT OF THE EMERGENCY MEDICAL SERVICES (EMS) SYSTEM

A GUIDANCE DOCUMENT BY THE AIR MEDICAL TASK FORCE OF THE NATIONAL ASSOCIATION OF STATE EMS OFFICIALS, NATIONAL ASSOCIATION OF EMS PHYSICIANS, ASSOCIATION OF AIR MEDICAL SERVICES

Kevin K. McGinnis; Thomas Judge; Benjamin Nemitz. Task Force: Dr. Robert O'Connor (Co-Chair), Dr. Robert Bass (Co-Chair); Brian Bishop; Dr. David Kim; Dr. Douglas Kupas; Ed Rupert; Edward R. Eroe; Dr. Edward Racht; Gary Brown; Gene Wikle; Jimm Murray; Johnny Delgado; Dr. Kevin Hutton; Dr. Ritu Sahni; Shawn Rogers; Tim Pickering; Dr. David Cone

INTRODUCTION AND SUMMARY

The use of air medical transport evolved from military experience, initially using fixed wing transport in the Second World War, with the widening use of helicopters initiated in the Korean conflict. Rapid trauma response systems built around helicopters were fully deployed in the Vietnam conflict. The military experience in managing trauma with rapid transport migrated to the civilian arena in the early 1970s.

As reported in a white paper by the Foundation for Air Medical Research and Education, cited and presented in Appendix 3:

> The Maryland State Police aviation program... in March, 1970, became 'the first civilian agency to transport a critically injured trauma patient by helicopter.' The first civilian hospital-based medical helicopter service was established in 1972 at St. Anthony's Hospital in Denver, Colorado.
>
> By 1980, some 32 helicopter emergency medical services (HEMS) programs with 39 helicopters were flying more than 17,000 patients a year. By 1990, this grew to 174 services with 231 helicopters flying nearly 160,000 patients. Ten years later, 231 helicopter services with 400 aircraft were flying over 203,000 patients each year. By 2005, 272 services operating 753 rotor-wing (helicopter) and 150 dedicated fixed wing aircraft were in operation. There are now approximately a half-million helicopter and fixed wing transports each year." This represents only approximately 3% of the ambulance transports to hospitals estimated to occur each year. However, being a relatively expensive and relatively rapidly growing emergency medical service provider segment which is being assimilated in traditional systems of ground EMS providers, it is of great interest.

Historically, air medical service (AMS) programs developed as components of hospital trauma programs and were owned and operated by these early trauma centers. Most early programs were staffed with nurse/nurse or nurse/physician teams with a physician level scope of practice rather than the evolving scope of practice for EMTs and paramedics predominantly housed in the public safety system. Many AMS providers focused their services on interfacility, high acuity transfers and often across state and even national borders. These characteristics often influenced the development of air ambulance systems to be in parallel with, or in isolation from, the development of the wider EMS system. As a result, today's AMS systems in many states are often regarded as peripheral components of

PREHOSPITAL EMERGENCY CARE 2007;11:353–368

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doi: 10.1080/10903120701536578

Issues: regulation

- **Federal vs. State**
- **The Airline Deregulation Act**
- **What is medical / What is aviation**

"Knowing is not enough, we must apply, willing is not enough, we must do."
Goethe
Epigraph :*EMS at the Crossoads.*
Institute of Medicine 2007

Issues in the Future: Growth

- Transport – increased numbers and acuity
- Transport Medicine = sub-specialty
- Integrated system: replacement cost model
  - Regional / multi-state
  - Medical oversight
  - Communications including tele-medicine
  - Ground, HEMS, FW transport
  - Preparedness base funding

Issues in the Future: Medicine

- Multi-factorial– changes in healthcare system
  - CAH's / Rural service availability
  - - specialists, sub-specialists, - night coverage
  - hospital specialization
  - hospital / TC / ED closure
  - med/mal, need for hospitals to off load risk and capital costs
- Patient Selection:
  - (Dx., Age, Triage Criteria, Time /Distance, Other)
- ACN triage technology
- Healthcare Technology / Time Dependent Care
  - (TBI, PCI, Cardiac, Stroke, Neonatal)
- Preparedness Costs /(availability response model)

Issues in the Future: Aviation

- Infrastructure costs
  - (IFR, wx. reporting, technology, helipads)
- Safety:
  - alignment of incentives / transport = reimbursement
- Technology costs:
  - airframes, avionics, infrastructure
- Technology Changes:
- Regulatory Consistency
  - (International / Federal / State / Local)
- Public Acceptance
- Preparedness costs (availability response model)

Issues: HEMS/Healthcare Policy

- Public expectation: demand vs. need / media
- Healthcare iatrogenic changes
- Geographical location / time to definitive care
- Urban Rural Paradox--EMS and hospital service availability / rural areas
- Air = rural access to time dependent tertiary care
- Transport medicine = subspecialty
- Healthcare replacement strategy
- Preparedness costs (availability response model)

Issues: Evidence Base / Organization / Safety

- **Rural and Frontier EMS Agenda for the Future. 2004. National Rural Health Association.** McGinnis KK. www.nrharural.org.
- **A safety review and risk assessment in air medical transport. 2002. Air Medical Physician Association.** Blumen IJ. www.AMPA.org.
- **I Have Seen the Enemy . . . . A Statistical Analysis and Update on HEMS Accidents** Blumen IJ, UCANN, University of Chicago Hospitals AMTC Austin 2005
- **Air Medical Services Future Development as an Integrated Component of the EMS System**
  McGinnis KK, Judge T, et al. Prehospital Emergency Care, 2007; 11:353=368

Issues: Future Policy

- Air Medical Leadership Congress (AMPA) Salt Lake City 2003.

- Action agenda:
  - Clinical Care
  - Safety
  - Cost Benefit
  - Regulation

- Proceedings published May 2004
- **Thomas F, Robinson K, Judge T, et. al. The 2003 Air Medical Leadership Congress: Findings and Recommendations** ***Air Medical Journal May June 2004;23;3:20-36***

Resources:

- www.aams.org
- www.ampa.org
- www.astna.org
- www.naacs.org
- www.iafp.org
- www.nemspa.org
- www.amsac.org
- http://visionzero.aams.org
- www.ihst.org
- www.faa.gov
- www.ntsb.gov

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