Introduction

- U.S. HEMS safety research project
- Comprehensive review of HEMS accidents
- Root cause analysis
  - > 140 HEMS accidents with final reports
  - 1998 through 2009
- Concrete recommendations that can
  - Prevent HEMS accidents
  - Reduce the impact of accidents that do occur

Introduction

- HEMS Industry/Community research project and working group
- Represents disciplines within the air medical ***and*** aviation communities
- Not part of US JHSAT (US Joint Helicopter Safety Analysis Team)
- "OSI-HEMS" research group
  - Several JHSAT colleagues are part of our group
  - Utilizing a modified version of the US JHSAT spreadsheet

Research Team

- >40 aviation and air medical professionals
- Representing
  - Associations
  - Air medical operators
  - Manufacturers
  - FAA
  - Aviation training
  - Aviation insurance

Research Team

- Associations
  - Air & Surface Transport Nurses Association (ASTNA)
  - Air Medical Physician Association (AMPA)
  - Air Medical Safety Advisory Committee (AMSAC)
  - American Association for Respiratory Care (AARC)
  - Association of Air Medical Services (AAMS)
  - Commission on Accreditation of Medical Transport Services (CAMTS)
  - Helicopter Association International (HAI)
  - International Association of Flight Paramedics (IAFP)
  - National Association of Air Medical Communication Specialists (NAACS)
  - National EMS Pilots Association (NEMSPA)

Research Team

- Helicopter operators
  - Air Evac Lifeteam
  - Air Methods Corporation
  - CareFlite (Dallas/Fort Worth)
  - EraMed
  - Intermountain Life Flight
  - Keystone Medflight
  - Maryland State Police Aviation
  - Med-Trans Corporation
  - Metro Aviation
  - Omniflight Helicopter, Inc
  - PHI Air Medical
  - Palm Beach County, Trauma Hawk

Research Team

- Manufacturers
  - American Eurocopter
  - Bell Helicopter
  - Turbomeca USA
- Federal Aviation Administration
- Aviation training (FlightSafety International)
- Aviation insurance (AirSure Limited)

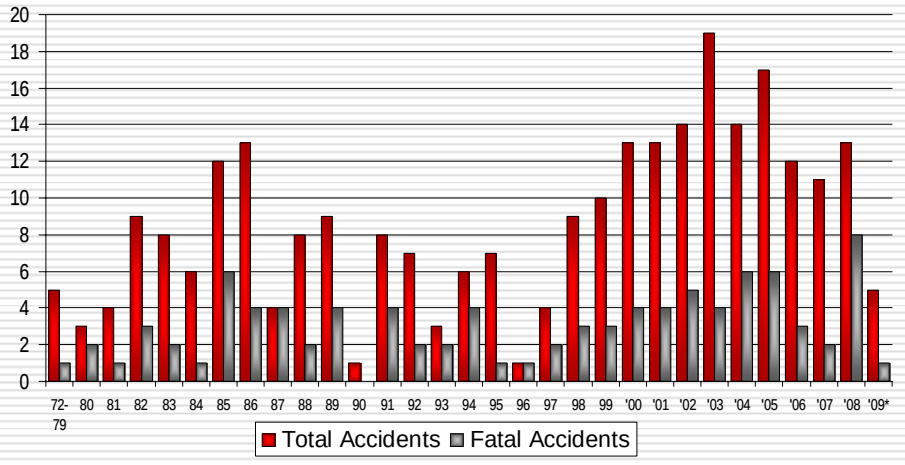
Timeline: 2008-2009

- January 2008: first group meeting
- 2008-2009: 13 meetings (~ every two months)
- September 2009: Initial reviews completed for 140 accidents
- Present initial raw data: IHSS and AMTC
- November 2009: begin weighted analysis and scoring

Accident Analysis

The Process

U.S. HEMS Accidents and Fatal Accidents



**Dedicated and dual-purpose through September 28, 2009*

Focus: 1998-2009

- 150 HEMS accidents
  - 144 dedicated HEMS
  - 6 dual purpose
  - 50 (of 149) fatal
    - 47 HEMS
    - 3 dual purpose

	A	B	C	D	E	F	G	I	K	L	M	N	O	P	Q
1		OSI-HEMS Accident Analysis			utilizing a modified US JHSAT 2008 Format						Confidence Level				
2		NTSB Id# Aircraft Model	Date Time	Event, Action, Conditions	Problem (what)	Contributing Factor (what or why)	SPS Level 1	SPS Level 2	Standard Problem Statement	Look up SPS Code	V	I	P	VI P	VI
3															
4															
5															
6															
7	1	NYC00FA127 BK-117-A4	5/6/2000 23:30L	Depart KLUK Airport enroute base Hospital after		Unknown if pilot reviewed current wind conditions	Ground Duties	Mission Planning	Inadequate consideration of weather/wind	101030	2	2	3	47%	40%
8				Night, VMC high light											
9			23:33L	Approached University Hospital Pad (Base) from	Helipad windsock condition known to be faulty-unreliable	Unknown if mechanical condition of windsock was	Infrastructure	Equipment (Infrastructure)	Failure of non-aircraft based navigation/approach aids	406060	2	2	2	40%	40%
10					Pilot decided to make a downwind approach	Situational Awareness	Pilot situation awareness	External Environment Awareness	Failed to recognize cues to terminate current course of	702060	4	4	4	80%	80%
11							Pilot Judgment & actions	Human Factors - Pilot's Decision	Pilot decision making	501030	4	3	4	73%	70%
12															
13			23:34L	U shaped "open" structure of helipad in situated along	Possible visual situational awareness illusion		Infrastructure	Equipment (Infrastructure)	Infrastructure Equipment – Other	406099	2	2	1	33%	40%
14					Situational awareness	Failed to understand position on helipad	Pilot situation awareness	External Environment Awareness	Aircraft position and hazards	702010	4	5	4	87%	90%
15			23:36L	Positioned over helipad and too close to hangar, pilot initiated right pedal turn	T/R struck roof and wall of hangar	Pilot likely misjudged helicopter position over helipad	Pilot Judgment & actions	Landing Procedures	Misperception of stability and motion cues in hover	504030	4	4	4	80%	80%
16															
17															
18															
19	1	MIA01FA006	######	Eurocopter releases OPTIONAL Service Bulletin AS-355 No 01.04 for installation of main rotor											
20		Twinstar	6/19/1991	Aircraft delivered new.	SB implemented on production line only "at customer request". ASB was not implemented on	Gauge would have confirmed that low pressure was the cause of the low oil pressure light not a failed	Safety Systems and Equipment	Safety Systems and Equipment (level 2)	Safety Systems and Equipment – Other	1401099	3	4	2	60%	70%
21			######	Main Rotor gearbox overhauled by Eurocopter (6870 Hours Since new). Eurocopter installed a											
22			######	Overhauled Main Rotor Gearbox installed on aircraft due to chip light on last	Aircraft flew 4 hours between installation and accident.	No problems noted before day of mishap.	Maintenance	Maintenance Tools	Lack of airborne equipment to detect impending part failure	303010	4	4	4	80%	80%

HEMS Accidents 1998-2008 | Accident Analysis - In Progress | SPS List | Interventions | Accident Analys

Timeline of the Accident

- Events
- Actions
- Conditions
- What happened
- Contributing factors

"Problem Statements"

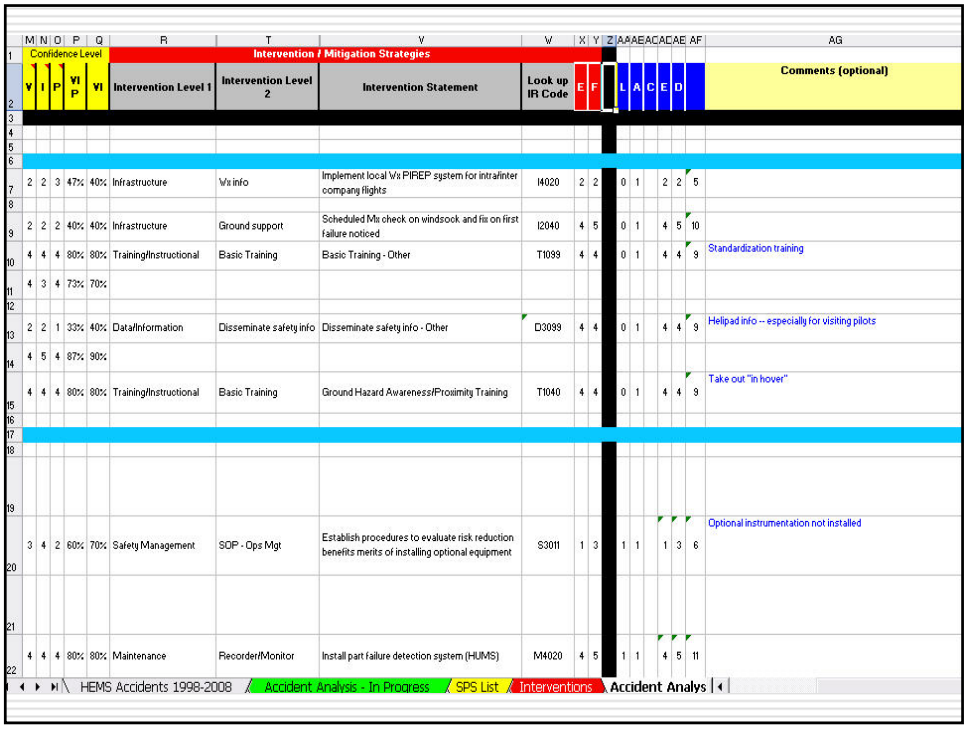
- Standard Problem Statements (SPS)
- Modified and revised US JHSAT format
  - 16 major categories (SPS Level 1)
  - Over 70 sub-categories (SPS Level 2)
  - Over 460 individual SPS
  - Some overlap
- Modified US JHSAT format. . . . .

"Problem Statements"

- Added over 110 new Standard Problem Statements
- New Level 1 categories
  - Medical crew
  - Communications specialists
- Expanded Level 2 Categories (>40% increase)
  - Equipment/safety management
  - Safety program
  - Performance of maintenance duties
  - Inadequate procedures (communications)
  - Mission risk environment
  - Lack of real time data

Confidence Level

- Factors
  - Validity (V)
  - Importance (I)
  - Probability (P)
- Range: 1 to 5
  - 1 = poor (just a guess on our part)
  - 2 = weak
  - 3 = average
  - 4 = good
  - 5 = excellent (absolutely sure)



	M	N	O	P	Q	R	T	V	W	X	Y	Z	AA	AE	AC	AC	AE	AF	AG
1	Confidence Level					Intervention / Mitigation Strategies													
2	V	I	P	VI P	VI	Intervention Level 1	Intervention Level 2	Intervention Statement	Look up IR Code	E	F		L	A	C	E	D		Comments (optional)
3																			
4																			
5																			
6																			
7	2	2	3	47%	40%	Infrastructure	Wx info	Implement local Wx PIREP system for intra/inter company flights	I4020	2	2		0	1		2	2	5	
8																			
9	2	2	2	40%	40%	Infrastructure	Ground support	Scheduled Mx check on windsock and fix on first failure noticed	I2040	4	5		0	1		4	5	10	
10	4	4	4	80%	80%	Training/Instructional	Basic Training	Basic Training - Other	T1099	4	4		0	1		4	4	9	Standardization training
11	4	3	4	73%	70%														
12																			
13	2	2	1	33%	40%	Data/Information	Disseminate safety info	Disseminate safety info - Other	D3099	4	4		0	1		4	4	9	Helipad info -- especially for visiting pilots
14	4	5	4	87%	90%														
15	4	4	4	80%	80%	Training/Instructional	Basic Training	Ground Hazard Awareness/Proximity Training	T1040	4	4		0	1		4	4	9	Take out "in hover"
16																			
17																			
18																			
19																			
20	3	4	2	60%	70%	Safety Management	SOP - Ops Mgt	Establish procedures to evaluate risk reduction benefits merits of installing optional equipment	S3011	1	3		1	1		1	3	6	Optional instrumentation not installed
21																			
22	4	4	4	80%	80%	Maintenance	Recorder/Monitor	Install part failure detection system (HUMS)	M4020	4	5		1	1		4	5	11	

HEMS Accidents 1998-2008 | Accident Analysis - In Progress | SPS List | Interventions | Accident Analys

"Interventions"

- Intervention/Mitigation Strategies (IMS)
- Modified US JHSAT format
  - 8 major categories (IMS Level 1)
  - 42 sub-categories (IMS Level 2)
  - > 425 specific interventions
  - Some overlap
- Modified US JHSAT format. . . . .

"Interventions"

- Added over 150 interventions
- Expanded Level 2 Categories (>40% increase)
  - Investigation
  - Aircraft components
  - Post incident survivability
  - Infrastructure - Communications
  - Infrastructure – Ground support
  - Regulatory – Regulations/standards
  - Safety management – Capital Investment (added)
  - Safety management – Risk Assessment
  - Safety Culture
  - SOP – Mission Specific
  - SOP – Ops Maintenance

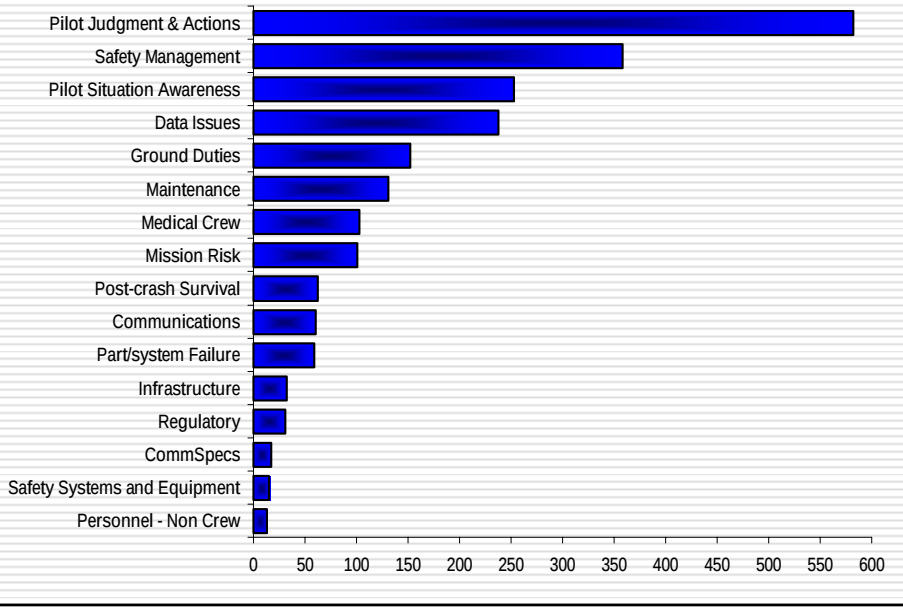
IMS Scoring

- Factors
  - Effectiveness (E)
  - Feasibility (F)
- Range: 1 to 5
  - 1 = poor (poorly effective or utilized)
  - 2 = weak
  - 3 = average
  - 4 = good
  - 5 = excellent (absolutely effective / 100% utilized)

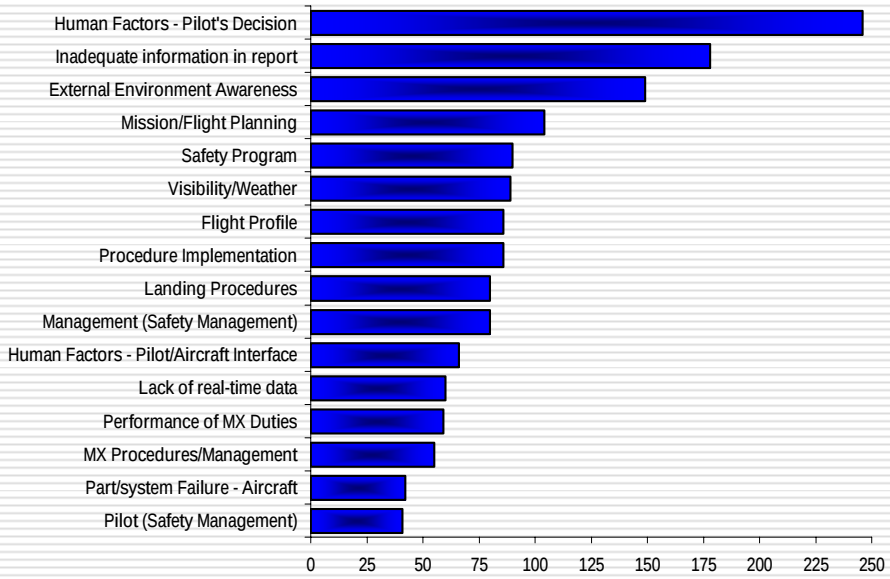
Accident Analysis

Initial Results: Standard Problem Statements (SPS)

Standard Problem Statements: Level 1



Top SPS Level 2s



Top 10 *"Specific"* Standard Problem Statements

- Information missing/incomplete in report (76-100)
- Aircraft position and hazards (51-75)
- Disregarded cues that should have led to termination of current course of action or maneuver [Human Factors – Pilot Decision Making] (51-75)
- Failed to recognize cues to terminate current course of action or maneuver [External Environment Awareness] (51-75)
- Lack of real-time data available (51-75)
- Pilot misjudged own limitations/capabilities (41-50)

Top 10 *"Specific"* Standard Problem Statements

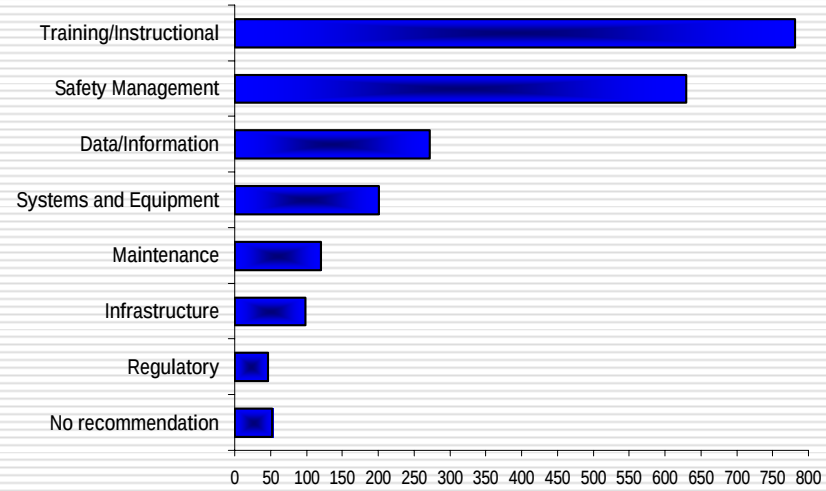
Range: 31-40

- Pilot decision making
- Risk Management inadequate
- Inadequate and/or untimely intervention by medical crew member
- Diverted attention, distraction (tie)
- Management policies/oversight inadequate (tie)

Accident Analysis

Initial Results: Intervention / Mitigation Strategories (IMS)

Intervention Strategy: Level 1



Top 10 IMS: Level 2

Top 10 "*Specific*" Interventions

- AMRM training and utilization (Range: 76-101)
- Improve quality and depth of NTSB investigation and reporting (76-101)
- Install data recording devices (51-75)
- Simulator Training - Advanced Maneuvers (26-50)
- Training emphasis for maintaining awareness of cues critical to safe flight (26-50)
- Install cockpit recording devices (audio) (26-50)

Top 10 "*Specific*" Interventions

- Establish/Comply with programs to encourage culture of conservative safety decisions (26-50)
- Establish/Comply with procedures or risk assessment program to eliminate culture of non-compliance (26-50)
- Ground Hazard Awareness/Proximity Training (26-50)
- Emergency Procedures Training (26-50, tie)
- Establish/Improve Company Risk Management Program (26-50, tie)

The End Product

Recommendations

- Based upon
  - Anticipated benefits
    - Lives that could be saved
    - Accidents that could be prevented
  - Cost
  - Effectiveness
  - Feasibility

LACED Scoring

- *L*ives that may be saved
- *A*ccidents that may be prevented
- *C*ost
- *E*ffectiveness
- *D*oable (Feasibility)

Example: *LACED* Scoring

Factor	Score
*L*ives Saved	1
*A*ccidents Prevented	5
*C*ost	3
*E*ffectiveness	3
*D*oable (feasible)	4
Total	16

LACED Score. . . .

- Determine a LACED Score for the various intervention
- Allow a direct ***quantitative*** comparison between recommended interventions

In conclusion. . . . .

- Evaluate a lot of data
- Identify the problems specific to HEMS
- Identify interventions that will help the HEMS community
- Make recommendations that will make a difference
- Justify our recommendations
- Provide a mechanism for evaluation and comparison

Grant Support and Funding

- MedEvac Foundation International (*formerly Foundation for Air-Medical Research and Education*)
- Flight Safety Foundation
- American Eurocopter Vision Zero Safety Award
- Air Medical Physician Association
- Air Methods Corporation
- PHI Air Medical
- Metro Aviation
- Omniflight Helicopter Corporation
- Turbomeca USA
- Flight Safety International
- Air Medical Memorial Wings
- Sikorsky Aircraft Corporation