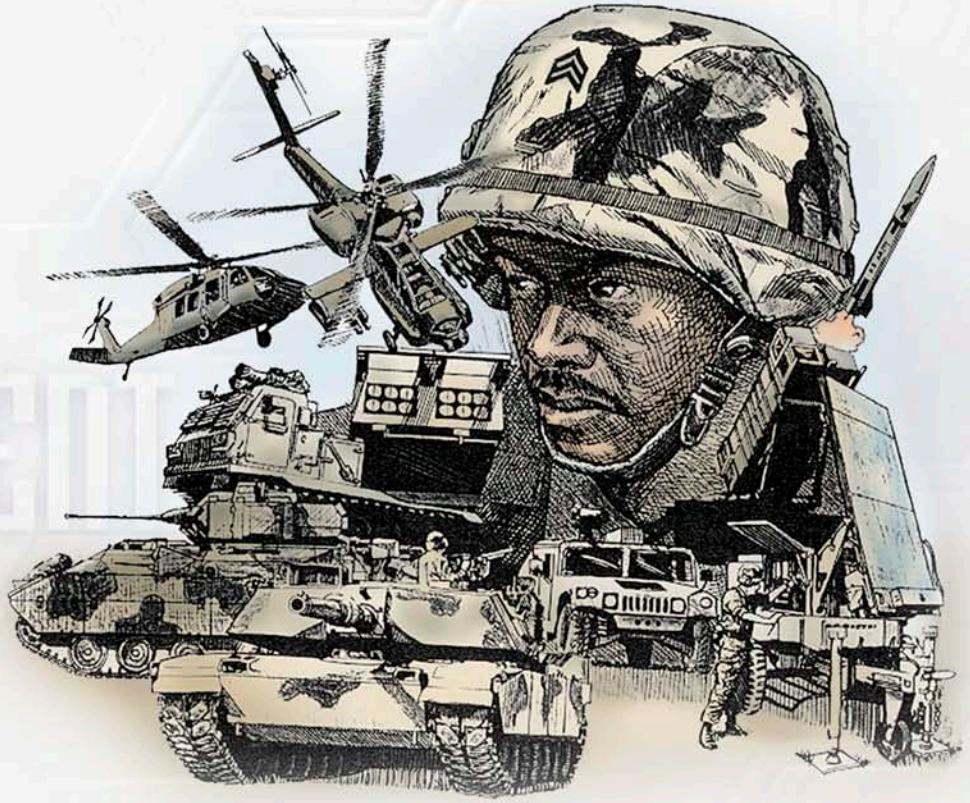
Army Health Hazard Assessment Program:

Medical Cost Avoidance Model



AJ Kluchinsky

Manager, Health Hazard Assessment Program

United States Army Center for Health Promotion and Preventive Medicine

NDIA SE Conference: San Diego, **28 Oct 09**

USACHPPM Readiness thru Health

Manpower and Personnel Integration

Health Hazard Assessment

Training

System Safety Engineering

Human Factors Engineering

Personnel

Manpower

Soldier Survivability

Health Hazard Assessment

PRIMARY OBJECTIVE:

- To identify, assess, and provide recommendations to eliminate or control health hazards associated with:
  - ***weapon platforms***
  - ***munitions***
  - ***equipment***
  - ***clothing***
  - ***training devices***
  - ***other materiel systems***

Health Hazards

SPECIFIC OBJECTIVES:

1. Preserve and protect the health of the SOLDIER.
2. Improve SOLDIER performance and enhance SYSTEM effectiveness.
3. Enhance READINESS - Reduce health hazards causing training/operational restrictions.
4. Reduce SYSTEM design retrofits needed to control or eliminate health hazards.
5. Reduce PERSONNEL COMPENSATION - Eliminate or reduce injury/illness attributable to health hazards from the use of Army materiel.

Proponent & Regulations

- Proponent:
  Army Surgeon General.
- Governing Regulations:
  - DOD 5000 Series.
  - AR 70-1, Army Acquisition Policy.
  - AR 40-10, Health Hazard Assessment Program in Support of the Army Materiel Acquisition Decision Process.
- Lead Agent (1995): USACHPPM.

Health Hazard Categories Addressed by the HHA Program

ACOUSTIC ENERGY

- Impulse Noise
- Blast Overpressure
- Steady-state Noise

BIOLOGICAL SUBSTANCES

- Field Sanitation & Hygiene
- Poisonous Plants & Animals

CHEMICAL SUBSTANCES

RADIATION ENERGY

- Radio Frequency/Ultrasound
- Laser/Optical Radiation
- Ionizing Radiation

SHOCK

- Rapid Acceleration/Deceleration

TRAUMA

- Sharp/Blunt Impact
- Musculoskeletal Trauma

VIBRATION

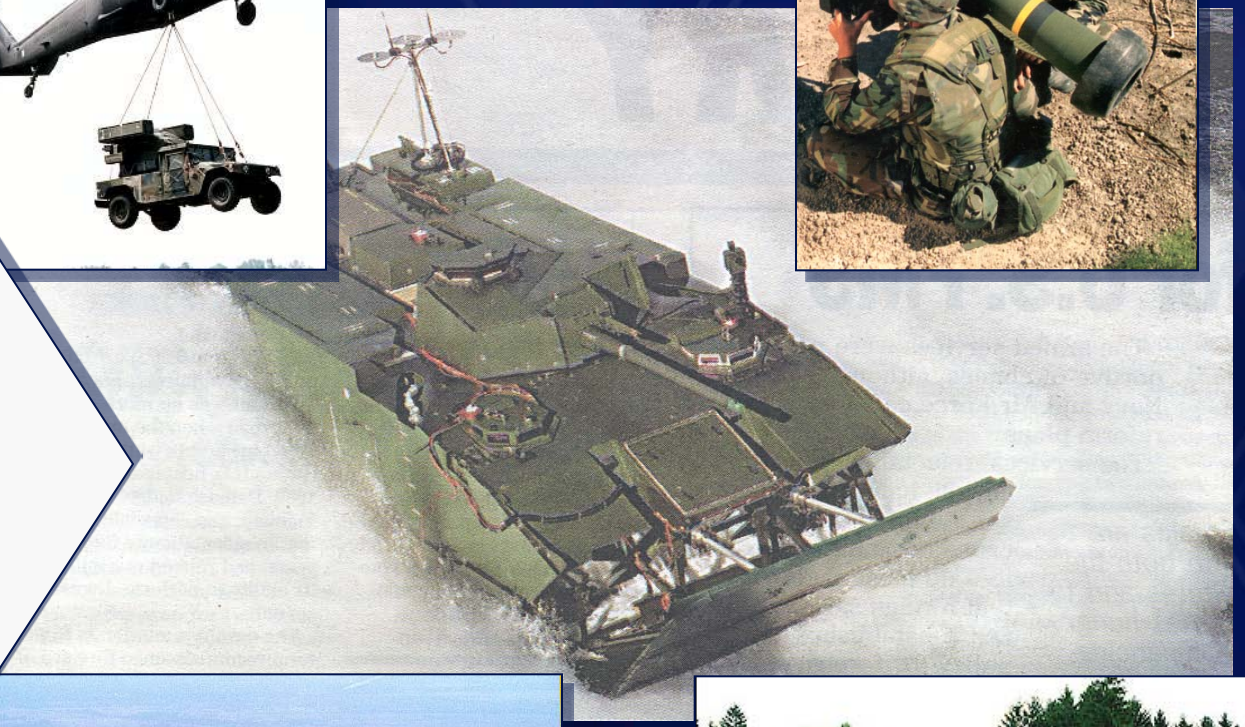
- Whole-body (multiple shock)
- Segmental

TEMPERATURE EXTREMES

- Heat/Cold

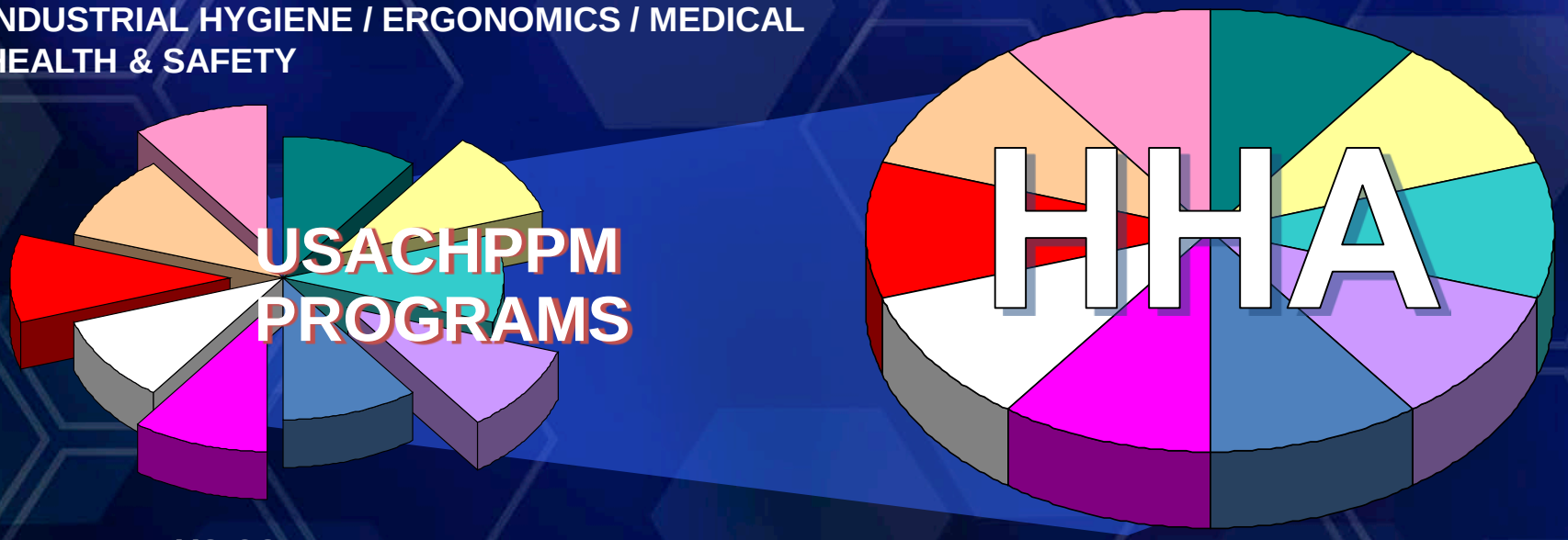
OXYGEN DEFICIENCY

- High Altitude/Confined Spaces
- Ventilation



Matrixed USACHPPM Support

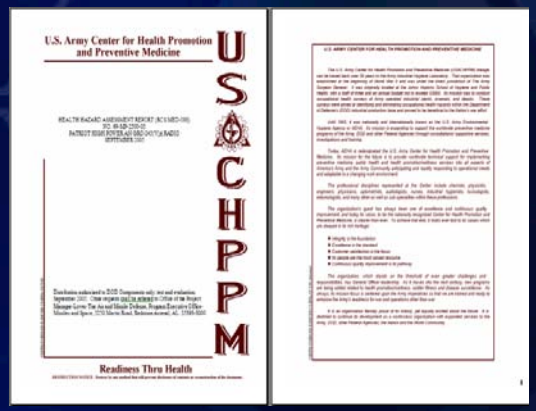
- ENVIRONMENTAL HEALTH ENGINEERING
- HEALTH HAZARD ASSESSMENT
- ARMY HEARING PROGRAM
- ENTOMOLOGICAL SCIENCES
- INDUSTRIAL HYGIENE / ERGONOMICS / MEDICAL HEALTH & SAFETY



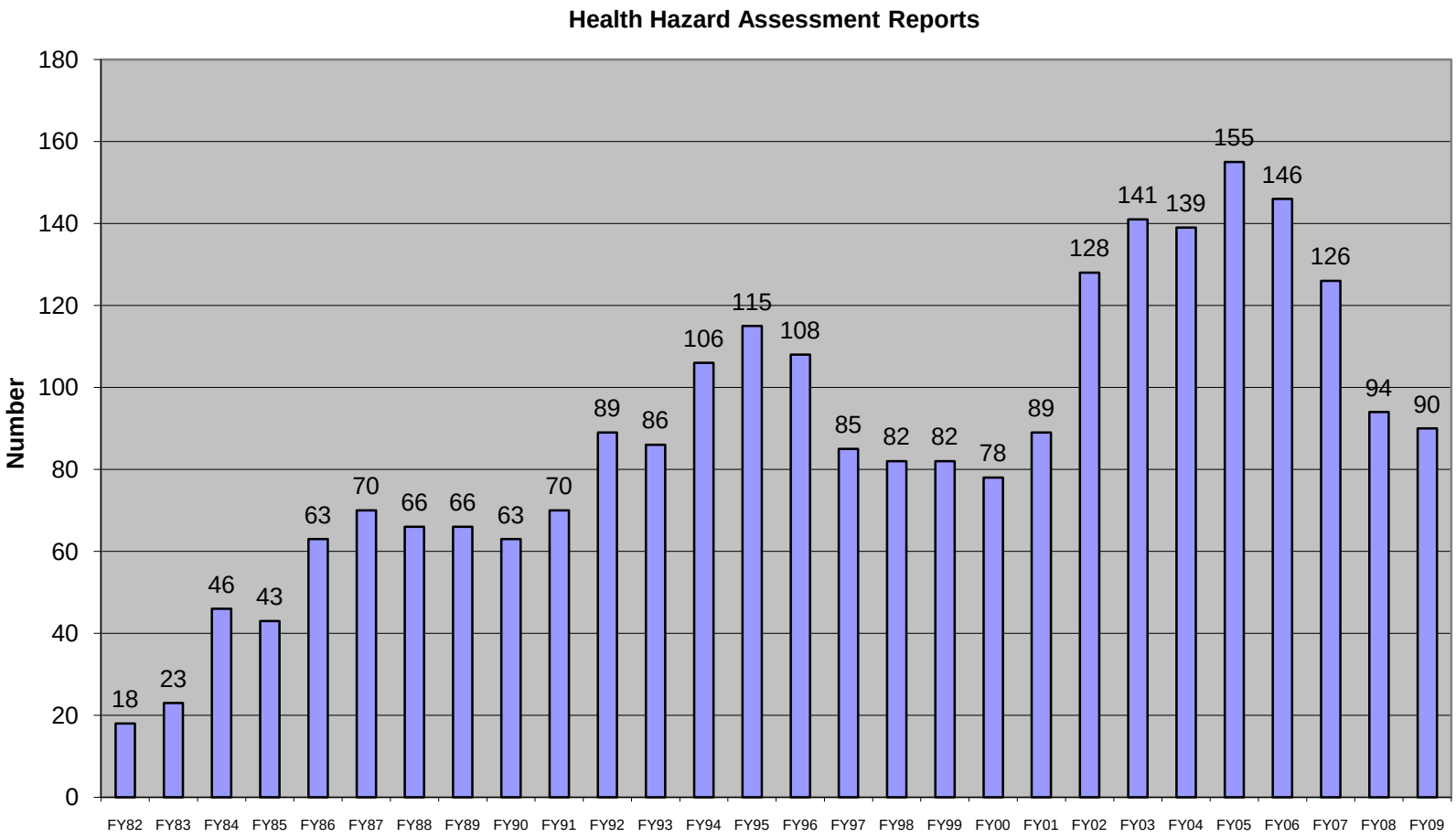
- HEALTH PHYSICS
- TOXICITY EVALUATION
- LASER-OPTICAL RADIATION
- RADIOFREQUENCY/ULTRASOUND
- OCCUPATIONAL MEDICINE

Mission Services

- Health Hazard Assessment Reports
- System Safety IPT Participation
- Manpower and Personnel Integration (MANPRINT) IPT Participation
- Acquisition Document Review
- Weapons Review Board & Committee Membership
- Uniformed Services University Support



Health Hazard Assessment Reports



Health Hazard Assessment Report

- Provides MATDEVs & CBTDEVs an estimate of OH risk associated with “normal use” of items.
- Not intended to provide an all-inclusive medical assessment or USAMEDD approval to use an item.
- Mishaps, accidents, or equipment failures resulting in injuries, although sometimes health-related, do not fall within the scope (Safety).

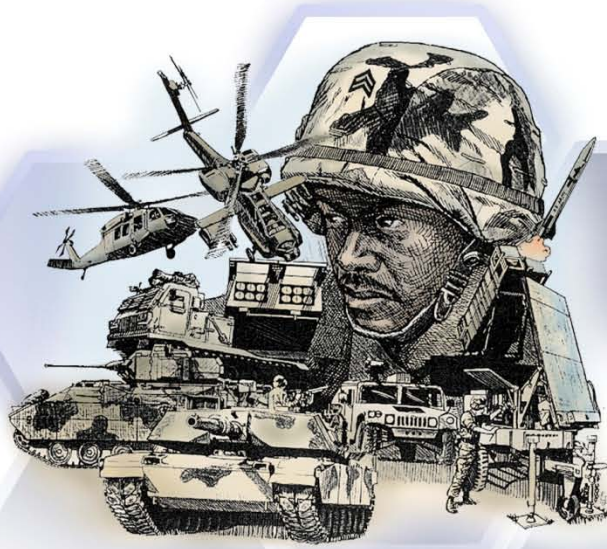
Health Hazard Assessment Report <u>does not</u> address….

- Environmental Quality (EIS)
- Safety (SAR)
- Survivability/lethality (SSV)
- Human Factors Engineering (HFE)
- System performance/effectiveness

Health Hazard Assessment Report Assessment Standards

- Applies OSHA 29 CFR 1910 and other non-DOD regulatory health standards to military-unique equipment, systems, and operations, insofar as practicable.
- OSHA Standards are generally designed for 8-hr exposures and may not be applicable for 24-hr exposures, multiple exposures, or short duration at high level exposures typical of military-unique applications.

Health Hazard Assessment Report

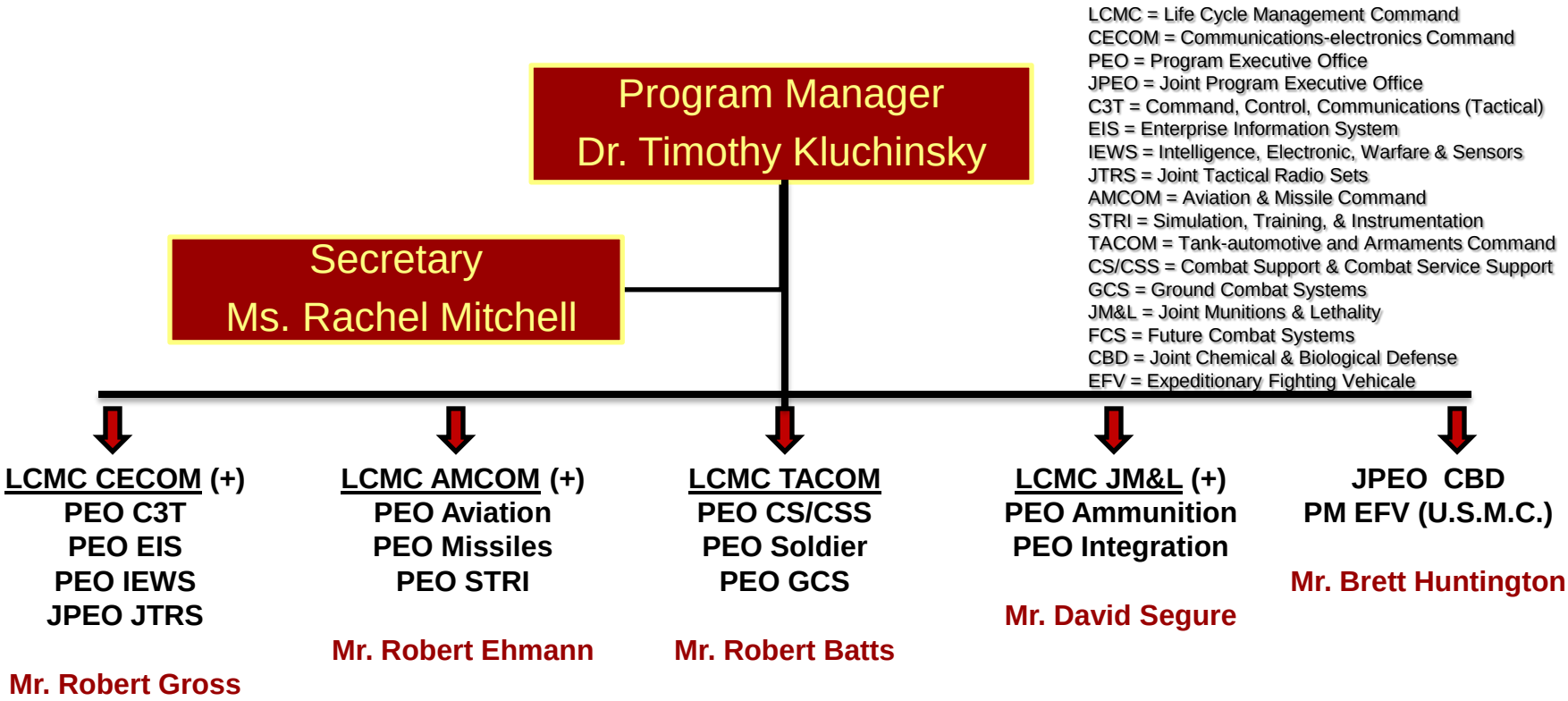


- When military-unique design, specification, or deployment requirements render compliance with existing OH standards infeasible or inappropriate, or when no standard exists for military-unique applications, the Army will use the health risk management process to develop military-unique OH standards.

Requesting a Health Hazard Assessment Report

- http://chppm-www.apgea.army.mil/
- Click on "Request USACHPPM Services"
- Complete the "Request for CHPPM Products and Services" form
- Upload/submit a signed memorandum on letterhead
- Upon acceptance, the HHA-PO:
  - contacts Client
  - develops project plan
  - sends SOW & MIPR Request
  - opens an official HHA project in the OPM Application
- Provide all data/test results and materiel system information relevant to HHA at least 90 working days in advance of the anticipated publication date.

HHA Program TDA



	Total	Civilian	Military	Contractors
REQUIREMENTS	15	11	4	0
AUTHORIZATIONS	5	3	2	0
ON BOARD	7	7	0	0
			Source 0310 Approved TDA	

Health Hazard Assessment Project Officers & SMEs

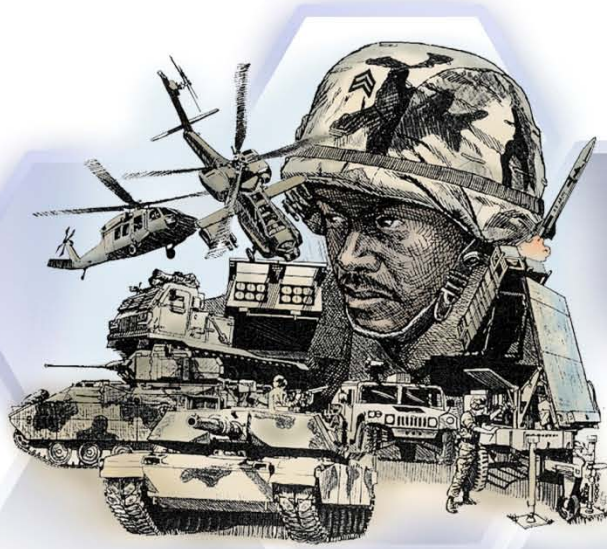
- Review historical HH data on similar items.
- Review health surveillance and safety data.
- Review designs, use scenarios, exposure criteria & data.
- Make recommendations to control or eliminate HH.
- Assign a RAC & residual RAC when applicable.
- Support the PM's risk management decision process.
- Support acquisition Milestone Decision Reviews, safety releases/confirmations, materiel releases, and other events.
- 2010: Will provide an estimate of Medical Cost Avoidance.

HHA and Risk Management Model

Acquisition Program Manager

- Cost
- Performance
- Schedule

Medical Cost Avoidance

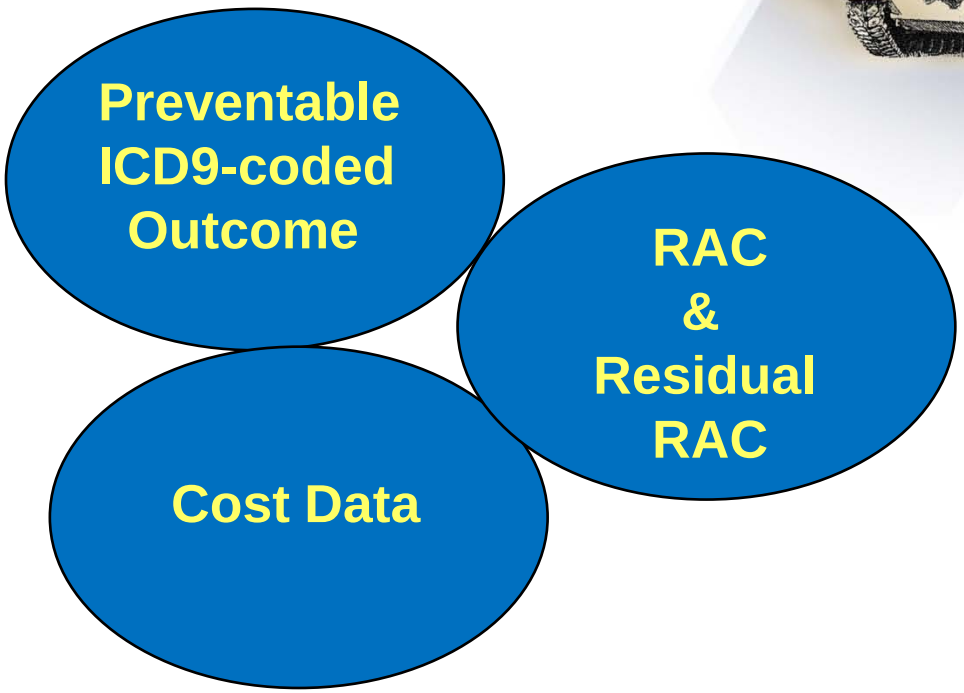


Preventable ICD9-coded Outcome

RAC & Residual RAC

Cost Data

Medical Cost Avoidance



Medical Cost Avoidance

Preventable ICD9-coded Outcome

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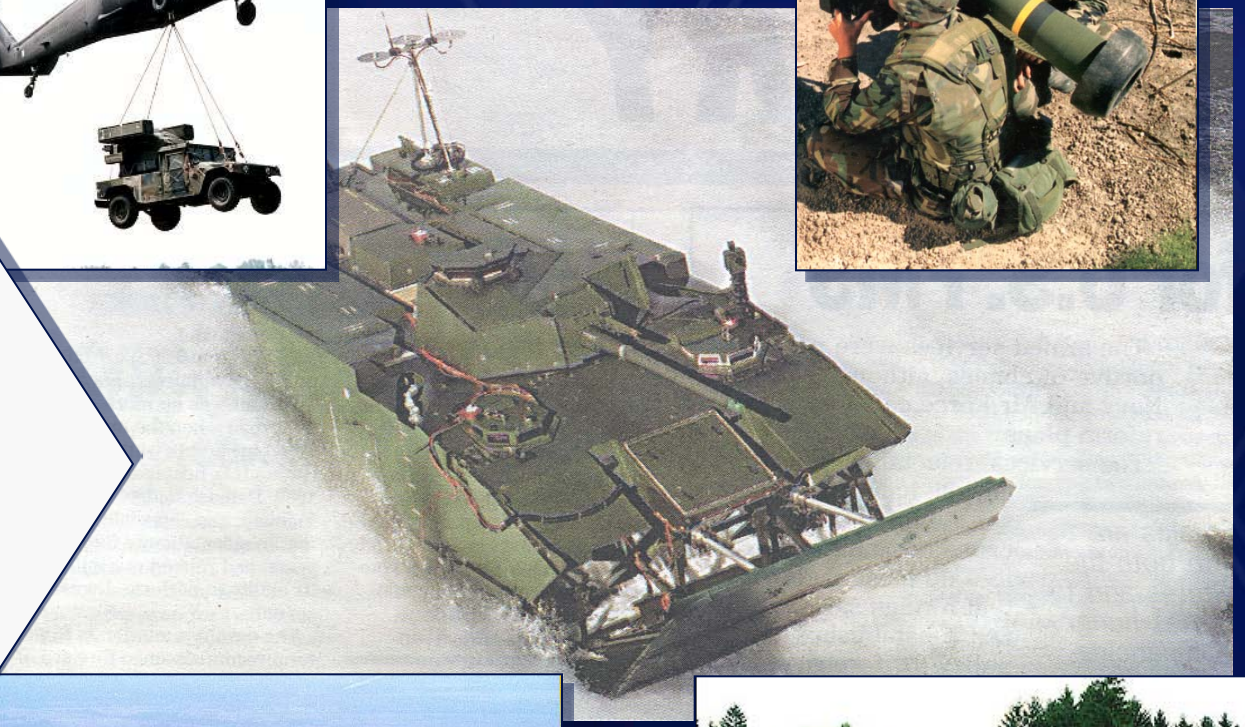

International Classification of Diseases (ICD-9) Categories Used in the Model

ICD-9 Category	ICD-9 Descriptor
001-139	Infectious and Parasitic Diseases
140-239	Neoplasms
240-279	Endocrine, Nutritional, and Metabolic Diseases, and Immunity Disorders
280-289	Diseases of the Blood and Blood-Forming Organs
290-319	Mental Disorders
320-389	Diseases of the Nervous System and Sense Organs
390-459	Diseases of the Circulatory System
460-519	Diseases of the Respiratory System
520-579	Diseases of the Digestive System
580-629	Diseases of the Genitourinary System
630-677	Complications of Pregnancy, Childbirth, and the Puerperium
680-709	Diseases of the Skin and Subcutaneous Tissue
710-739	Diseases of the Musculoskeletal System and Connective Tissue
740-759	Congenital Anomalies
760-779	Certain Conditions Originating in the Perinatal Period
780-799	Symptoms, Signs, and Ill-Defined Conditions
800-999	Injury and Poisoning
V01-V83	Supplementary Classification of Factors Influencing Health Status and Contact with Health Services

Veterans Administration Schedule for Rating Disabilities (VASRD) Codes used in the Model

VASRD Code	VASRD Descriptor
50	Bones and Joints Disease
60	Eye and Visual Acuity
61 & 62	Ear, Smell, and Taste
63	Systemic Disease
65	Nose and Throat
66	Trachea and Bronchi
67	TB, Lungs, and Pleura
68	Non-TB Diseases
70	Heart Diseases
71	Arteries and Veins
72 & 73	Digestive System
75	Genitourinary System
76	Gynecological
77	Hemic and Lymphatic
78	Skin
79	Endocrine System
80 - 87	Organic Disease Central Nervous System
89	Epilepsies
90 & 92	Psychotic Disorders
91 & 93	Organic Brain Disorders
94 & 95	Psychoneurological Disorders
99	Dental and Oral

Medical Cost Avoidance

Preventable ICD9-coded Outcome

Cost Data

RAC & Residual RAC

Risk Assessment Codes

High ⟷ Low

Hazard Severity	Hazard Probability				
	A	B	C	D	E
I	1	1	1	2	3
II	1	1	2	3	4
III	2	3	3	4	5
IV	3	4	5	5	5

High ↕ Low

*AR 40-10

Hazard Severity Categories		
Numerical Designation	**Classification**	**Possible Hazard Outcomes**
I	**Catastrophic**	**May cause death or total loss of a bodily system**
II	**Critical**	**May cause severe bodily injury, severe occupational illness, or major damage to a bodily system**
III	**Marginal**	**May cause minor bodily injury, minor occupational illness, or minor damage to a bodily system**
IV	**Negligible**	**Would cause less than minor bodily injury, minor occupational illness, or minor damage to a bodily system**

Hazard Probability Categories			
Descriptive Word	**Level**	**Specific Individual Item**	**Fleet or Inventory**
Frequent	**A**	**Likely to occur frequently**	**Continuously experience**
Probable	**B**	**Will occur several times in the life of an item**	**Will occur frequently**
Occasional	**C**	**Likely to occur some time in the life of an item**	**Will occur several times**
Remote	**D**	**Unlikely but possible to occur in the life of an item**	**Unlikely but can reasonably be expected to occur**
Improbable	**E**	**So unlikely, it can be assumed occurrence may not be experienced**	**Unlikely to occur, but possible**

Risk Assessment Codes

High ⟷ Low

Hazard Severity	Hazard Probability				
	A	B	C	D	E
I	1	1	1	2	3
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High ↕ Low

*AR 40-10

Risk Assessment Codes

High ⟷ Low

Hazard Severity	Hazard Probability				
	A (0.9)	B (0.5)	C (0.2)	D (0.01)	E (0.001)
I (1)	1	1	1	2	3
II (0.1)	1	1	2	3	4
III (0.01)	2	3	3	4	5
IV (0.001)	3	4	5	5	5

High ↕ Low

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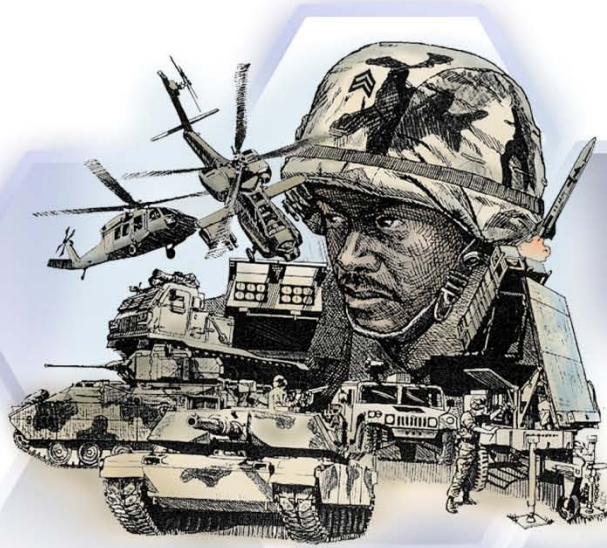
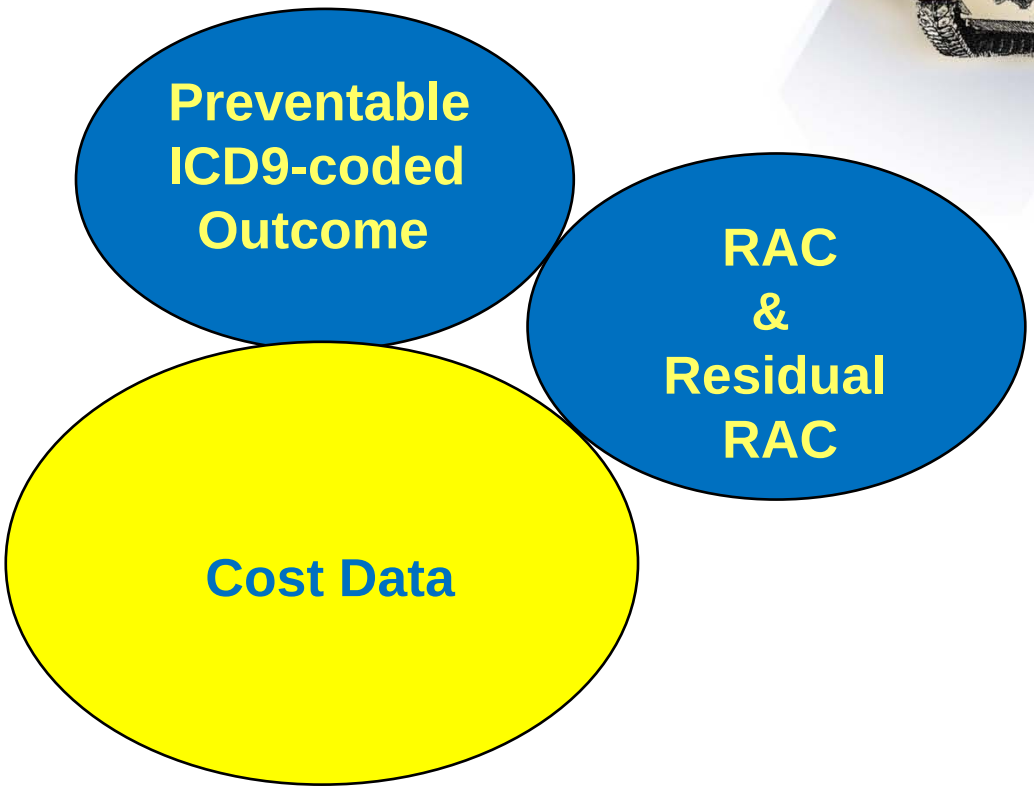
High ↕ Low

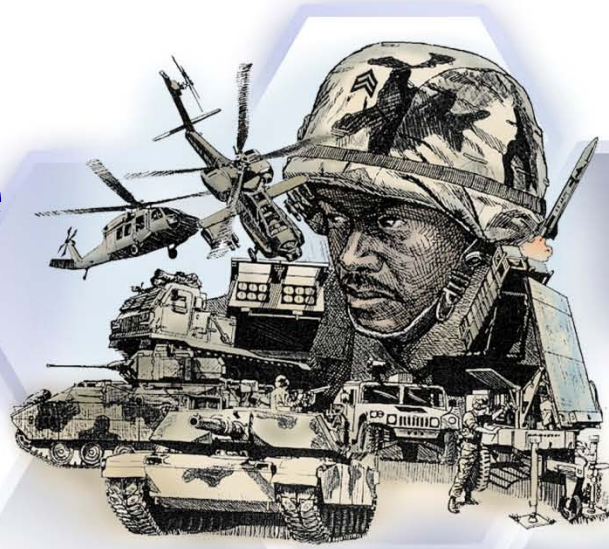
*AR 40-10

Medical Cost Avoidance





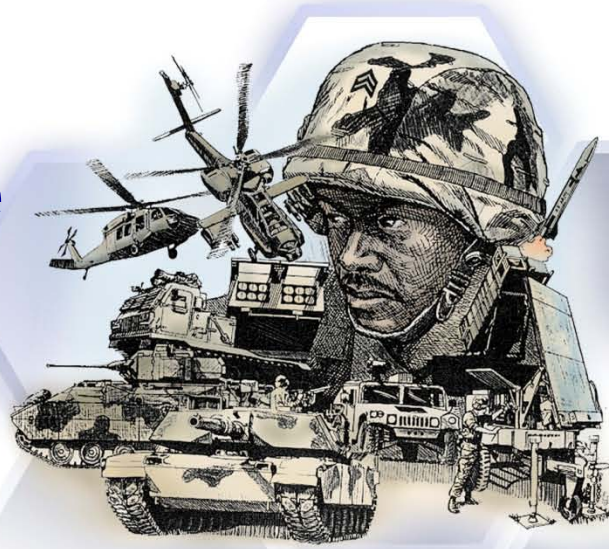
Medical Cost Avoidance Model (MCAM)



Quantifies hazard specific costs by using the following data sources:

- MHS Direct Care and Population Data (M2)
- Army Physical Disability Agency Data
- Military Personnel Cost Data
- VA Disability Compensation Data

Medical Cost Avoidance Model (MCAM)



Quantifies hazard specific costs by using the following data sources:

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M2 Beneficiary Population Data Elements Used in the Model

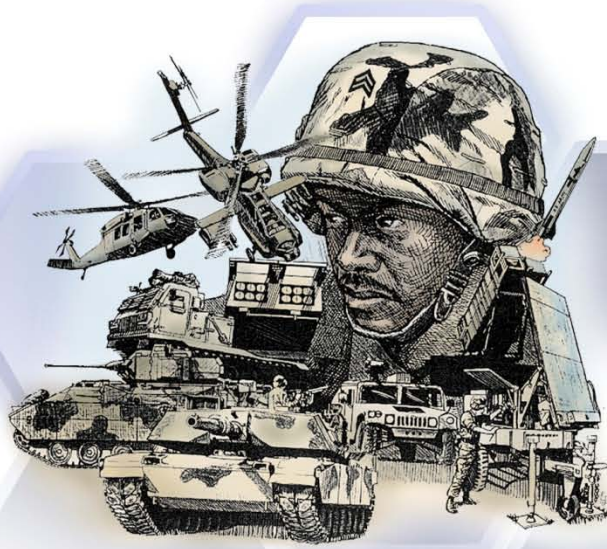
Beneficiary Population—DEERS	Inpatient Beneficiary Population—SIDR	Outpatient Beneficiary Population—SADR
AGE	Pseudo Sponsor ID	Pseudo Sponsor ID
BENCAT	Bed Days Civilian Hospital, Total	Encounters, Total
DODOCC	Bed Days in ICU, Total	Full Cost, Total
FM	Bed Days, Total	Price, Total
FY	Convalescent Leave Days, Total	Variable Cost, Total
GENDER	Cooperative Care Days, Total	Age
MARSTAT	Dispositions, Total	APG, Med
PSUEDOID	Full Cost, Total	APG, Med Desc
FMP	Medical Hold Days, Total	APG, E&M
CTCHDMIS	Price, Total	APG, E&M Desc
CTCHNAME	Quarter Days, Total	APG Proc 1
RACEETH	RWP, Total	APG Proc 2
GRADE	Sick Days this MTF, Total	APG Proc 3
SERVICE	Supplemental Care Days, Total	APG Proc 4
RACE	Variable Cost, Total	Beneficiary Category
	Admission Date	Catchment Area ID
	Beneficiary Category	Catchment Area Name
	Catchment Area ID	Diagnosis 1
	Catchment Area Name	Diagnosis 2
	Diagnosis 1	Diagnosis 3
	Diagnosis 2	Diagnosis 4
	Diagnosis 3	Disposition Code
	Diagnosis 4	E&M Code
	Diagnosis 5	FY
	Diagnosis 6	FM
	Diagnosis 7	FMP
	Diagnosis 8	Gender
	Disposition Status Code	Inpatient Indicator
	FY	Marital Status
	Diagnostic Related Group (DRG)	MEPRS (3) Code
	FM	Patient Category
	Procedure 3	Sponsor Pay Grade
	Procedure 4	Sponsor Service
	Procedure 5	Tmt Parent DMIS ID
	Procedure 6	Tmt Parent DMIS Name
	Procedure 7	Tmt Service Clinic
	Procedure 8	

M2 Beneficiary Population Data Elements[a] Used in the Model

Beneficiary Population—DEERS	Inpatient Beneficiary Population—SIDR	Outpatient Beneficiary Population—SADR
	Pseudo Sponsor ID	
	FMP	
	Race	
	Sponsor Pay Grade	
	Sponsor Service	
	Tmt Parent DMIS ID	
	Tmt Parent DMIS Name	
	Service Date	
	Clinical Service, Admitting	
	Clinical Service, Dispositioning	
	Clinical Service, Second	
	Clinical Service, Third	
	Length Of Stay	Procedure 1
	Age	Procedure 2
	Gender	Procedure 3
	Marital Status	Procedure 4
	Patient Category	Pseudo Sponsor ID
	Procedure 1	Race

Notes:
[a] Data Sources for Beneficiary Population data included Defense Enrollment Eligibility Reporting System (DEERS), Standard Inpatient Data Record (SIDR), and Standard Ambulatory Data Record (SADR)

Medical Cost Avoidance Model (MCAM)



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- VA Disability Compensation Data

Army Physical Disability Agency (APDA) Data

- Obtained from APDA in 2001.
- Contained decisions of 1980-1999.
- Used to determine disability-related percentages for:
  - Degree of Disability
  - Disposition Category
    - Fit for Duty
    - Separation
    - Permanent Disability Retirement
    - Temporary Disability Retirement

Medical Cost Avoidance Model (MCAM)

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Table 6-1-7

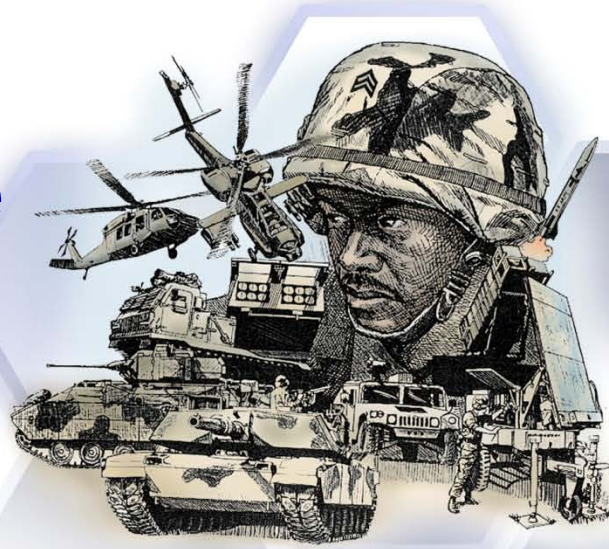
Army Population by Rank and AMCOS Lite Personnel Cost[a]

Military Pay Grade	Population	AMCOS Lite Personnel Cost	Total Personnel Cost for Grade
O-10	10	$229,450	$2,294,500
O-9	40	$207,210	$8,288,400
O-8	103	$192,086	$19,784,858
O-7	147	$234,309	$34,443,423
O-6	3,805	$195,119	$742,427,795
O-5	9,124	$197,795	$1,804,681,580
O-4	14,035	$160,565	$2,253,529,775
O-3	24,264	$118,844	$2,883,630,816
O-2	9,553	$98,082	$936,977,346
O-1	6,704	$81,330	$545,236,320
WO-5	419	$140,503	$58,870,757
WO-4	1,598	$125,569	$200,659,262
WO-3	3,553	$110,467	$392,489,251
WO-2	4,624	$94,659	$437,703,216
WO-1	2,070	$79,841	$165,270,870
E-9	3,439	$143,011	$491,814,829
E-8	11,232	$117,761	$1,322,691,552
E-7	37,573	$106,787	$4,012,307,951
E-6	56,197	$92,299	$5,186,926,903
E-5	74,076	$78,084	$5,784,150,384
E-4	118,874	$62,944	$7,482,405,056
E-3	61,607	$55,054	$3,391,711,778
E-2	31,705	$52,975	$1,679,572,375
E-1	16,521	$50,255	$830,262,855
CADETS	4,101	$18,221	$74,724,321
Total Officer	84,150		$10,561,012,490
Total Enlisted	411,224		$30,181,843,683

Notes:

[a] AMCOS Lite data included major cost categories of Military Personnel-Account (MPA); Operations & Maintenance, Army (OMA); and Other. More specific breakouts within these categories were listed in AMCOS and included under the MPA Category: military compensation, officer acquisition costs, other benefits, permanent change of station costs, retired pay accrual, separation costs, special pays, and training; under the OMA Category: medical support costs, morale, welfare and recreation costs, and officer acquisition costs; and under the Other Category: training.

Medical Cost Avoidance Model (MCAM)



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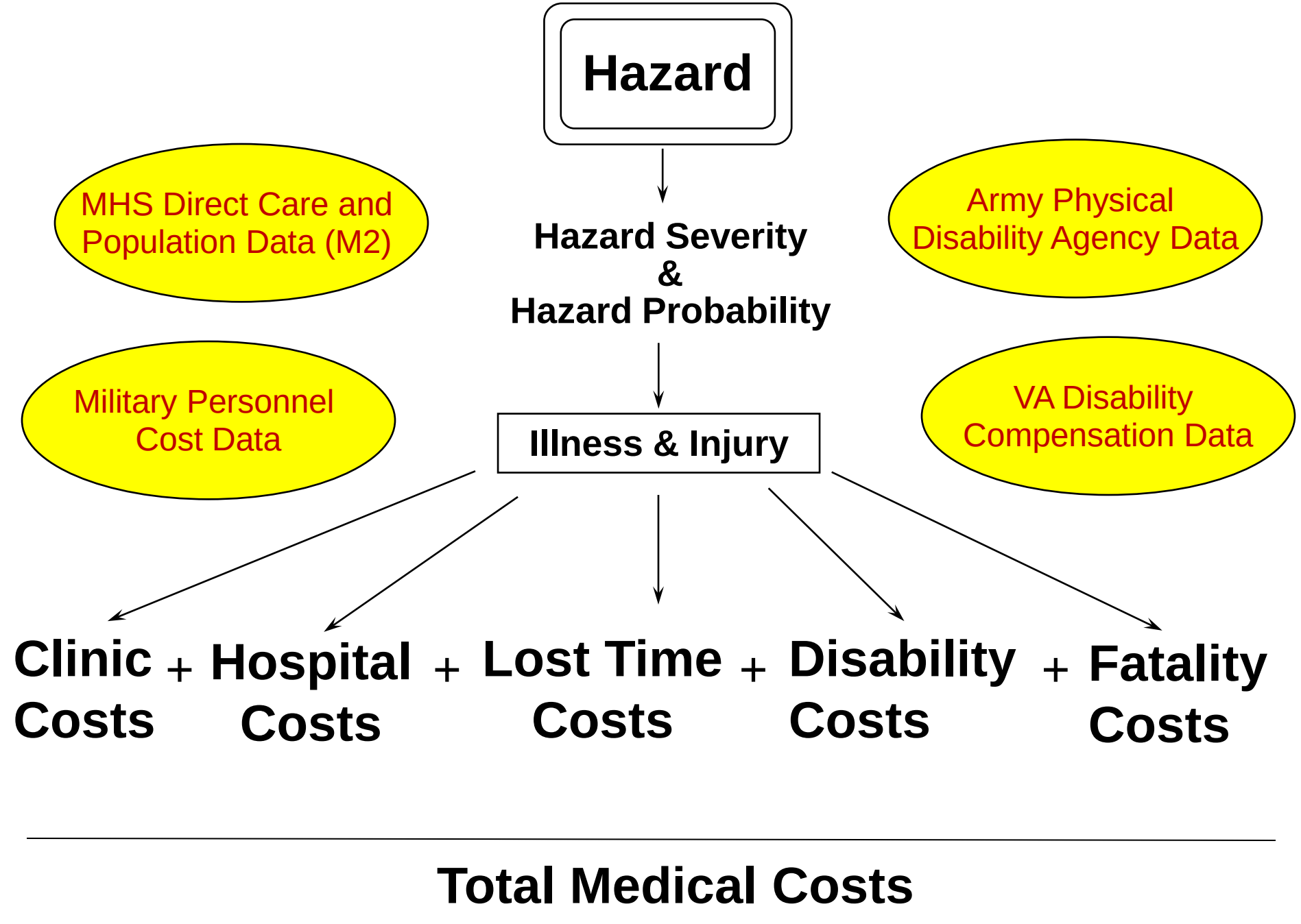
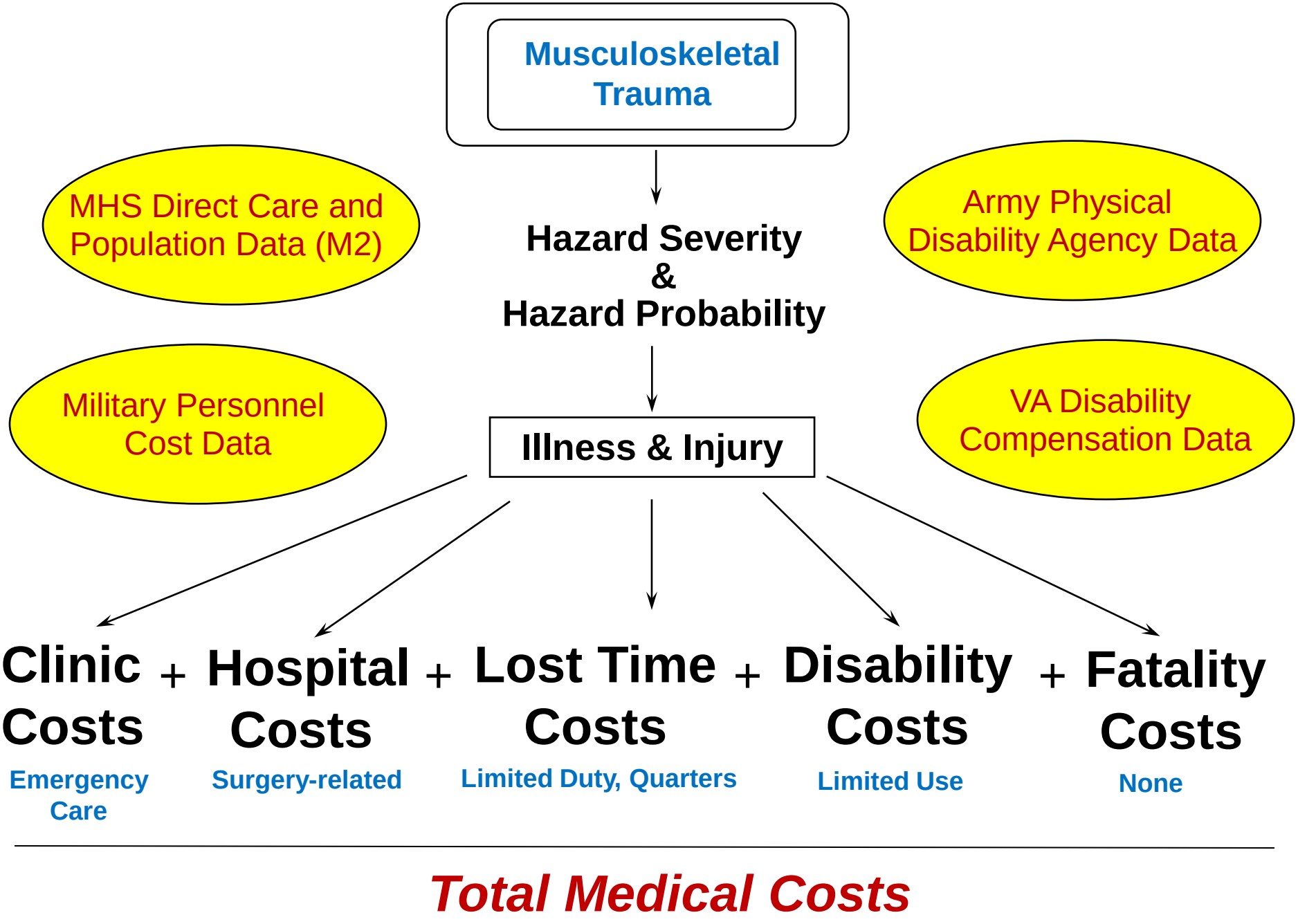
Veterans Affairs
Compensation Rate Table

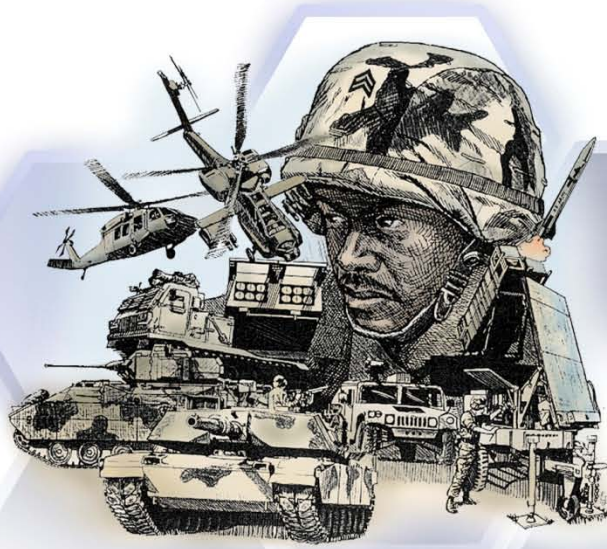
Percentage[a]	Rate[b]
10%	$106
20%	$205
30%	$316
40%	$454
50%	$646
60%	$817
70%	$1,029
80%	$1,195
90%	$1,344
100%	$2,239

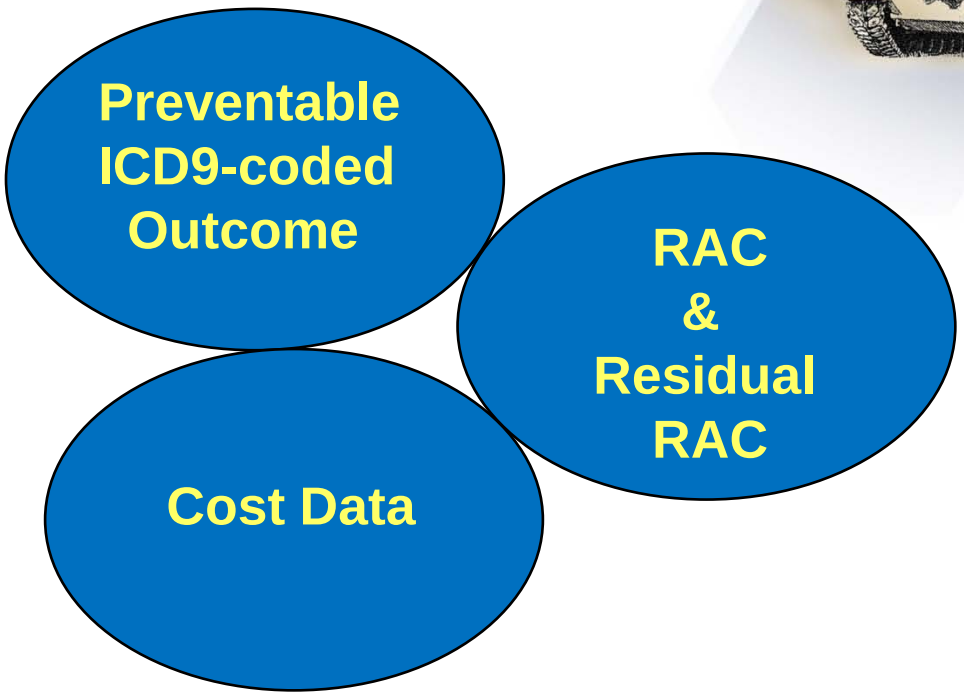
Notes:
[a] Degree of disability
[b] Monthly rate of compensation


Hazard
MHS Direct Care and Population Data (M2)
Army Physical Disability Agency Data
Hazard Severity & Hazard Probability
Military Personnel Cost Data
VA Disability Compensation Data
Illness & Injury
Clinic Costs
+
Hospital Costs
+
Lost Time Costs
+
Disability Costs
+
Fatality Costs
Total Medical Costs


Musculoskeletal Trauma
MHS Direct Care and Population Data (M2)
Army Physical Disability Agency Data
Hazard Severity & Hazard Probability
Military Personnel Cost Data
VA Disability Compensation Data
Illness & Injury
Clinic Costs
Emergency Care
+
Hospital Costs
Surgery-related
+
Lost Time Costs
Limited Duty, Quarters
+
Disability Costs
Limited Use
+
Fatality Costs
None
Total Medical Costs

Medical Cost Avoidance





Overall Cost Elements, Type, Description, and Source

$$C_T = C_c + C_h + C_l + C_d + C_f$$

Cost Element	Type	Description	Source
C_T	Variable	Overall costs related to unabated health hazards	Calculated by model application
C_c	Variable	Cost of clinic visits (includes associated pharmaceutical and laboratory costs)	Calculated by model application
C_h	Variable	Cost of hospitalization (includes associated pharmaceutical and laboratory costs)	Calculated by model application
C_l	Variable	Cost of days of lost time	Calculated by model application
C_d	Variable	Cost of disability	Calculated by model application
C_f	Variable	Cost of fatalities	Calculated by model application

Overall Cost Elements, Type, Description, and Source

$$C_T = C_c + C_h + C_l + C_d + C_f$$

Cost Element	Type	Description	Source
C_T	Variable	Overall costs related to unabated health hazards	Calculated by model application
C_c	Variable	Cost of clinic visits (includes associated pharmaceutical and laboratory costs)	Calculated by model application
C_h	Variable	Cost of hospitalization (includes associated pharmaceutical and laboratory costs)	Calculated by model application
C_l	Variable	Cost of days of lost time	Calculated by model application
C_d	Variable	Cost of disability	Calculated by model application
C_f	Variable	Cost of fatalities	Calculated by model application

Clinic Cost Elements, Type, Description, and Source

$$C_c = P_e \times N_s \times N_{ps} \times S_k \times I_c \times C_a \times N_v$$

Cost Element	Type	Description	Source
C_c	Variable	Cost of clinic visits (includes associated pharmaceutical and laboratory costs)	Calculated by model application
P_e	Variable	Probability of exposure per year, based on the determined HP category	User input
N_s	Variable	Number of systems—the total number of individual items of materiel, equipment, or weapon systems being assessed	User input
N_{ps}	Variable	Number of persons per system being assessed	User input
S_k	Variable	HS factor based on the determined HS category	User input
I_c	Constant (for each hazard)	Clinic visit incidence for injury/illness	Model application (Calculated from M2 clinical data)
C_a	Constant (for each hazard)	Average clinic visit cost (includes associated pharmaceutical and laboratory costs)	Model application (Calculated from M2 clinical data)
N_v	Constant (for each hazard)	Number of clinic visits per injury/illness (includes follow-up visits within 30 day initial visit)	Model application (Calculated from M2 clinical data)

Example

117 Bridge Systems

24 Soldiers/system

N = 2808 Exposures

Health Hazard Categories Addressed by the HHA Program

ACOUSTIC ENERGY
- Impulse Noise
- Blast Overpressure
- Steady-state Noise

BIOLOGICAL SUBSTANCES
- Field Sanitation & Hygiene
- Poisonous Plants & Animals

CHEMICAL SUBSTANCES

RADIATION ENERGY
- Radio Frequency/Ultrasound
- Laser/Optical Radiation
- Ionizing Radiation

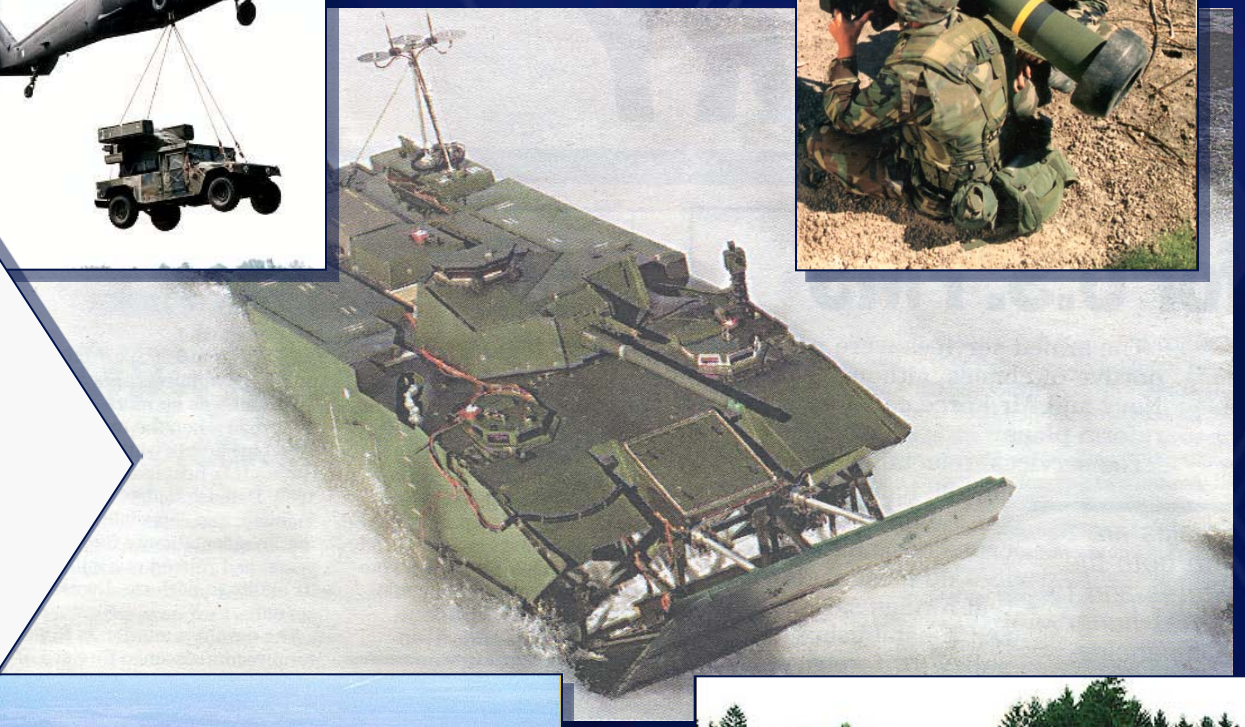
SHOCK
- Rapid Acceleration/Deceleration

TRAUMA
- Sharp/Blunt Impact
- Musculoskeletal Trauma

VIBRATION
- Whole-body (multiple shock)
- Segmental

TEMPERATURE EXTREMES
- Heat/Cold

OXYGEN DEFICIENCY
- High Altitude/Confined Spaces
- Ventilation



*Measuring **Baseline** Costs*: Musculoskeletal Trauma*

High ⟷ Low

Hazard Severity	Hazard Probability				
	A (0.9)	B (0.5)	C (0.2)	D (0.01)	E (0.001)
I (1)	$3,184	$1,769	$708	$35	$4
II (0.1)	$318	$177	$71	$4	$0
III (0.01)	$32	$18	$7	$0	$0
IV (0.001)	$3	$2	$1	$0	$0

High ↕ Low

*Each cell depicts the average medical costs per Soldier exposure

*Measuring **Total Annual** Costs*: Musculoskeletal Trauma*

High ⟷ Low

Hazard Severity	Hazard Probability				
	A (0.9)	B (0.5)	C (0.2)	D (0.01)	E (0.001)
I (1)	$8,904	$4,967	$1,987	$99	$10
II (0.1)	$894	$497	$199	$10	$1
III (0.01)	$89	$50	$20	$1	$0.1
IV (0.001)	$9	$5	$2	$0.1	$0.01

High ↕ Low

*Thousands of dollars: n = (117 Systems) (24 Soldier/system) = 2808 Soldiers

Health Hazards Risks for the Bridge

Worst Case

Health Hazard Category	Hazard Type (n)	Risk Assessment Code (HS, HP)	Residual Risk Assessment Code (HS, HP)	Medical Costs Avoided 1-Year
Trauma	Musculoskeletal (n=24)	2 (II, C)	5 (IV, C)	$196,686
				Total = $196,686

*Measuring **Total Annual** Costs*: Musculoskeletal Trauma*

High ⟷ Low

Hazard Severity	Hazard Probability				
	A (0.9)	B (0.5)	C (0.2)	D (0.01)	E (0.001)
I (1)	$8,904	$4,967	$1,987	$99	$10
II (0.1)	$894	$497	$199	$10	$1
III (0.01)	$89	$50	$20	$1	$0.1
IV (0.001)	$9	$5	$2	$0.1	$0.01

High ↕ Low

*Thousands of dollars: n = (117 Systems) (24 Soldier/system) = 2808 Soldiers

Measuring Total Annual Costs*: Musculoskeletal Trauma

High ⟷ Low

Hazard Severity	Hazard Probability				
	A (0.9)	B (0.5)	C (0.2)	D (0.01)	E (0.001)
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High ↕ Low

*Thousands of dollars: n = (117 Systems) (24 Soldier/system) = 2808 Soldiers

Health Hazards Risks for the Bridge

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				Total = $196,686

Health Hazards Risks for the Bridge
117 Systems

Health Hazard Category	Hazard Type (n)	Risk Assessment Code (HS, HP)	Residual Risk Assessment Code (HS, HP)	Medical Costs Avoided 1-Year
~~Trauma~~	~~Musculoskeletal (n=24)~~	~~2 (II, C)~~	~~5 (IV, C)~~	~~$196,686~~
Trauma	Musculoskeletal (Top Panel, n=5)	2 (II, C)	5 (IV, C)	$40,976
Trauma	Musculoskeletal (Bottom Panel, n=5)	5 (IV, C)	5 (IV, C)	0
Trauma	Musculoskeletal (Deck, n=2)	5 (IV, C)	None	$166
Trauma	Musculoskeletal (Long Ramp, n=7)	5 (IV, C)	5 (IV, C)	0
Trauma	Musculoskeletal (Junction Panel, n=5)	2 (II, C)	3 (III, C)	$37,251
				Total = $78,393

Total 1-year lifecycle costs for the unabated health hazards of the Bridge

Hazard Type	Outpatient	In-Patient	Lost time	Fatality	Disability	Total
WORST CASE						
Musculoskeletal (n=24)	$1,511	$4,285	$133,338	$0	$57,552	**$196,686**
ACTIVITY BASED						
Musculoskeletal (Top Panel, n=5)	$315	$893	$27,779	$0	$11,990	$40,976
Musculoskeletal (Bottom Panel, n=5)	$0	$0	$0	$0	$0	$0
Musculoskeletal (Deck, n=2)	$1	$4	$112	$0	$48	$166
Musculoskeletal (Long Ramp, n=7)	$0	$0	$0	$0	$0	$0
Musculoskeletal (Junction Panel, n=5)	$286	$811	$25,253	$0	$10,900	$37,251
						$78,393

Total 20-year lifecycle costs for the unabated health hazards of System X

Hazard Type	Clinic	Hospital	Lost time	Fatality	Disability	Total
Weapons combustion products	$338,000	$116,700	$44,724,400	$21,600	$3,919,400	$49,120,100
Fire extinguishing agents	$7,500	$2,600	$993,900	$500	$87,000	$1,091,500
Carbon dioxide	$400	$100	$49,700	$0	$4,400	$54,600
Impulse noise	$100	$1,100	$19,400	$0	$1,100	$21,700
Steady-state noise	$100	$1,100	$19,400	$0	$1,100	$21,700
Cold stress	$400	$0	$52,300	$0	$700	$53,400
Heat stress	$400	$0	$47,600	$0	$900	$48,900
Oxygen deficiency (ventilation)	$400	$1,200	$36,500	$0	$500	$38,600
Non-ionizing radiation	$100	$0	$9,700	$0	$200	$10,000
Ionizing radiation	$0	$0	$6,600	$0	$100	$6,700
						$50,467,200

Model Assumptions

- Clinic visit time = 2 hours.
- Limited (temporary restricted) duty duration = 15 days.
- Quarters duration = 3 days.
- Convalescent leave duration = 30 days.
- Limited duty = reduced productivity of 30%.
- Inflation factor = $(1.0204)^{\text{No. Yrs.}}$
- Fatality costs = $674,375.

Model Limitations

- Purchased care (Non-MHS) data is not included.
- Estimates based on worst-case crew position.
- Uses Army-based incidence rates, rather than military occupational specialty (MOS) incidence rates.
- Does not estimate materiel-related pollution prevention costs.
- Does not estimate abatement costs.
- Does not estimate costs to acquire and train replacements.
- Does not estimate family quality of life costs.

MCAM Peer Review

- Textbook of Military Medicine, Chapter X
- Injury Prevention Report No.12-HF-04MT-08
  - Defense Safety Oversight Council
  - *“Preventing Injuries in the U.S. Military: The Process, Priorities, and Epidemiological Evidence”*
- American Journal of Preventive Medicine (Jan 2010)

Questions?