Regional Healthcare Systems Assessment:

A Pilot for Identifying Critical Infrastructure Vulnerabilities and Maximizing Resource Allocations

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Model-Based Risk Analysis Pilot Study
Background / Purpose

- Examine the vulnerability of healthcare systems to critical infrastructure sectors failures due to unforeseen incidents
- Gain insight into how healthcare systems function following critical infrastructure and medical supply-chain interruptions
- Explore the potential for decision-making guidance related to maximizing financial resource investments

Model-Based Risk Analysis Pilot
Methodology

- Apply Model-Based Risk Assessment Methodology[1], modified for use in the healthcare environment, to five pilot sites

- Apply network analysis to critical infrastructure and supply chain disruptions

[1] *Lewis, Ted G. Critical Infrastructure Protection in Homeland Security. Defending a Networked Nation, John Wiley & Sons Inc., 2006, New Jersey.*

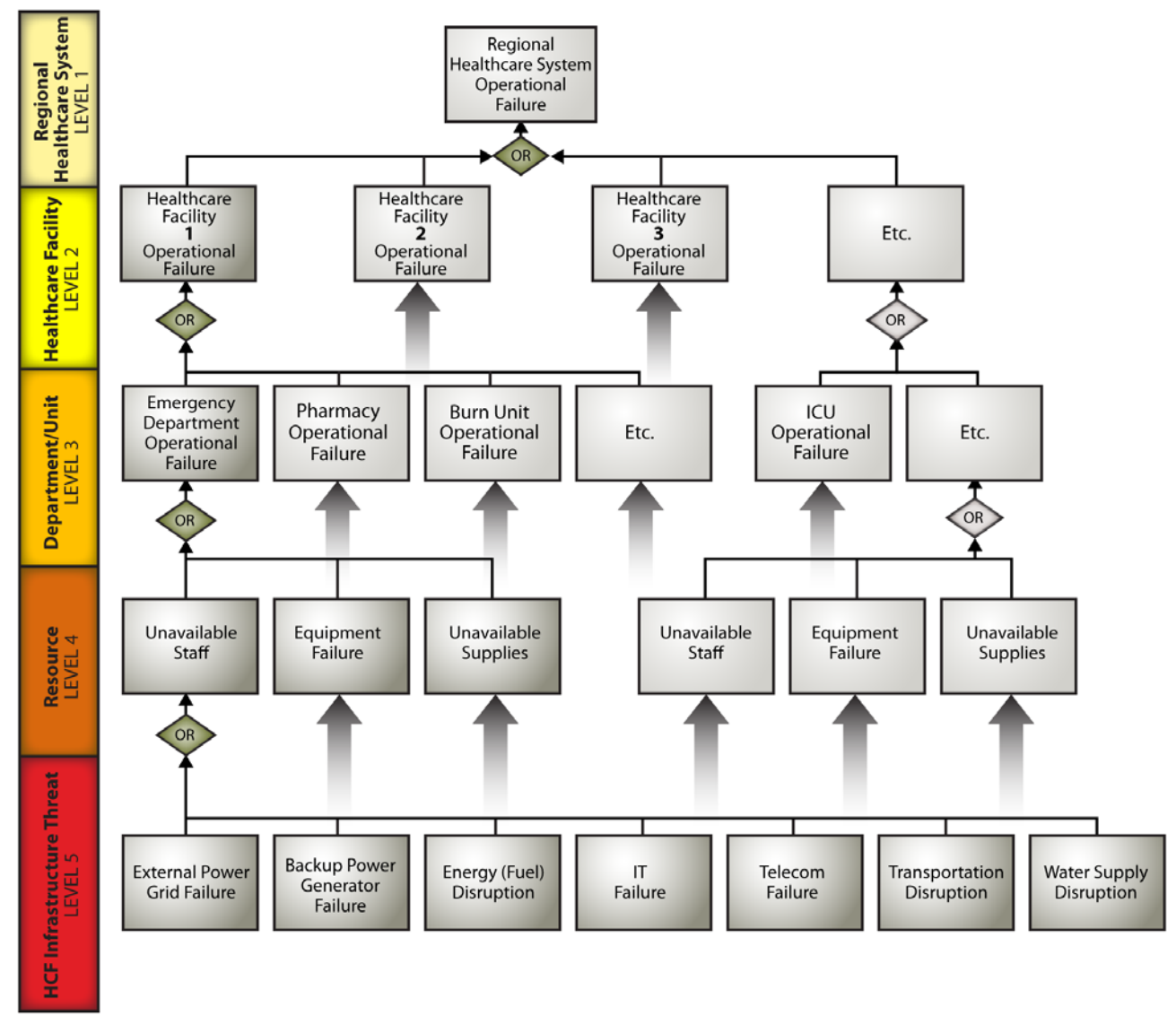
Model-Based Risk Analysis Pilot Methodology

- Uses fault tree analyses
- Defines (i.e. outcome variable) damages as "reduced departmental service capabilities" to "complex care patients"
- Applies a data collection tool specific to collect data to populate the fault tree
- Collects data in a two-phase process[1, 2]
  - Phase I: Electronic distribution of tool
  - Phase II: On-site workshop with completed tool

[1] *Department of Homeland Security's PCII processes apply.*

[2] *Considers parameters set forth by the Paperwork Reduction Act.*

Model-Based Risk Analysis Pilot
Regional Healthcare Fault Tree



Model-Based Risk Analysis Pilot Methodology

- Calculates risk due to major infrastructure disruption at three levels
  - “Regional” healthcare system
  - Healthcare facilities
  - Healthcare departments/units
- Discusses the potential for mitigating vulnerabilities in the context of budget (cost) allocations (range from 0 – 100%)

Model-Based Risk Analysis Pilot Methodology

The model is used to evaluate the risk values for the following budgets:

- $Budget_0 = 0$
- $Budget_5$ = 5% of the maximum budget size
- $Budget_{10}$ = 10% of the maximum budget size
- $Budget_{20}$ = 20% of the maximum budget size
- $Budget_{50}$ = 50% of the maximum budget size
- $Budget_{100}$ = 100% of the maximum budget size

Model-Based Risk Analysis Pilot Preliminary Results

- Each critical infrastructure has a mitigation cost amount that will eliminate most of the associated vulnerabilities.

- The cost to eliminate the vulnerabilities for all critical infrastructures is the sum of these mitigation cost amounts.

Model-Based Risk Analysis Pilot Preliminary Results

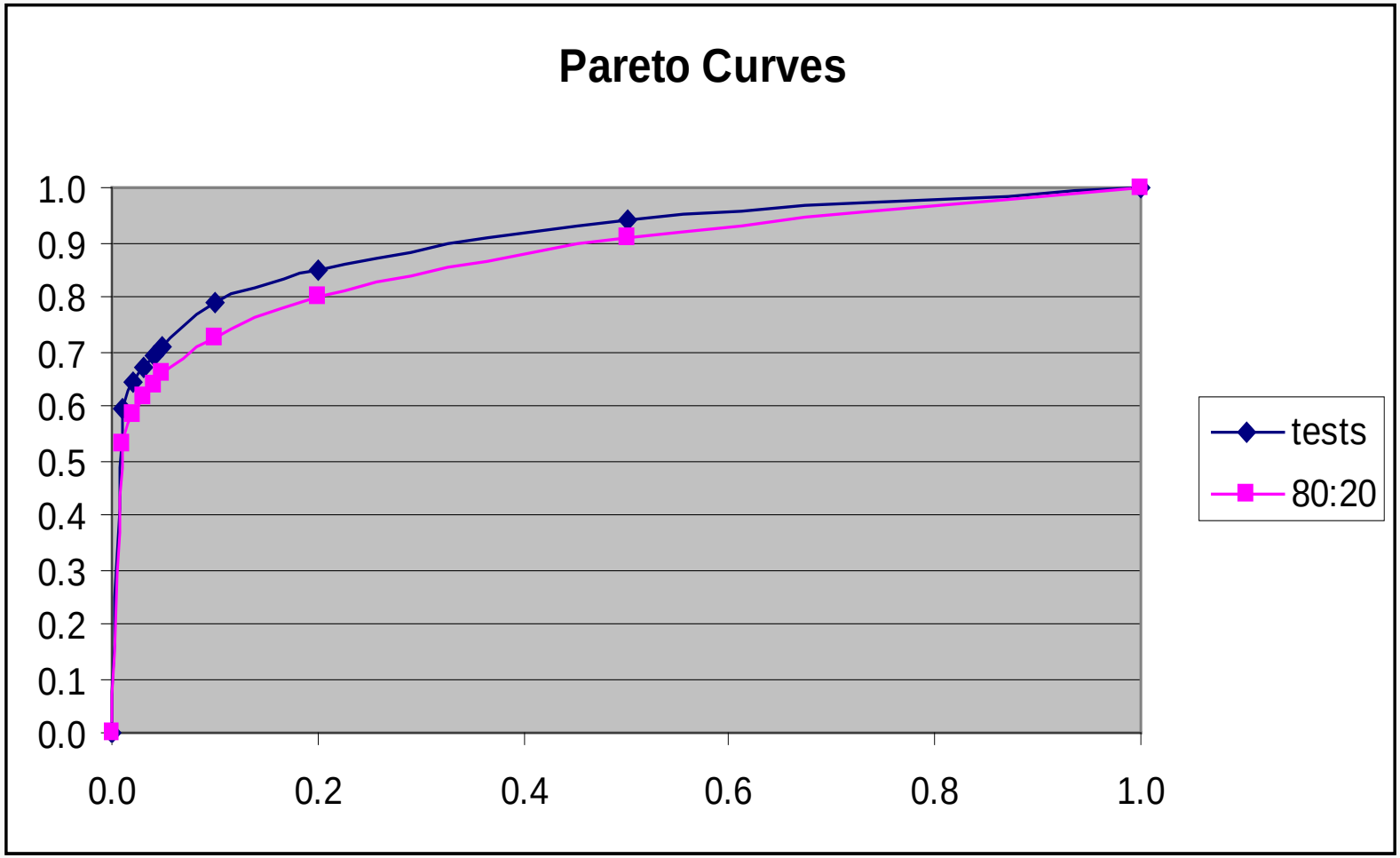
Attribute	Budget Size					
	$Budget_0$	$Budget_5$	$Budget_{10}$	$Budget_{20}$	$Budget_{50}$	$Budget_{100}$
Cost (1,000 $)	$0	$1,725	$3,441	$6,894	$17,231	$34,461
Absolute Risk	140	54	47	42	30	28
Relative Risk	10%	4%	3%	3%	2%	2%
Risk Reduction	0%	77%	83%	88%	99%	100%

Absolute Risk: The annualized number of complex care patients that are potentially affected by critical infrastructure failure due to regional catastrophic events.

Relative Risk: The absolute risk without the healthcare facility specific population component (i.e. number of complex care patients).

Risk Reduction: The percent of the reducible risk that has been eliminated.

Model-Based Risk Analysis Pilot Preliminary Results



Model-Based Risk Analysis Pilot Preliminary Results

Critical Infrastructure	Budget Size				
	$Budget_5$	$Budget_{10}$	$Budget_{20}$	$Budget_{50}$	$Budget_{100}$
Backup power generator	0%	0%	0%	0%	7%
Energy (fuel)	12%	7%	3%	1%	1%
Information technology (IT)	0%	17%	59%	75%	80%
Telecommunication	38%	45%	23%	9%	5%
Transportation	49%	31%	15%	15%	7%
Water supply	2%	1%	0%	0%	0%
All Infrastructure	100%	100%	100%	100%	100%

Model-Based Risk Analysis Pilot Remaining Tasks

- Preliminary Analysis – Final
  - Five Pilot Sites Combined
- User manual completion
- User manual training
- Transfer data to Program Evaluation and Preparedness Interface (PEPI)

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