Peak Oil:
Implications for Disaster Preparedness & Response

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21st Century Public Health Preparedness Challenges

- Pandemic flu
- Severe weather
- Chronic disease
- Terrorism
- Disaster mental health
- Peak Oil
All-Hazards Model

- Current model in U.S.
  - Evolved from terrorism-focused model post-9/11
    - National Incident Management System
    - National Response Framework
    - Pandemic and All Hazards Preparedness Act
- Standardized yet flexible/scalable for broad event spectrum
  - Naturally-occurring (weather, infectious disease)
  - Terrorism (CBRNE)
  - Accidental

Public Health Preparedness System Framework

IOM 2008
All disasters are local events.

- Regardless of type or magnitude
- Necessitates locally-driven response
- Requires at least 72-hour self-sustainability at local level post-onset
  - Longer for pandemic flu scenario
  - These estimates do not factor peak oil

4 Phases of Emergency Management

- Preparedness
- Response
- Prevention/Mitigation
- Recovery
Strategic vs. Operational Plans

- **Strategic Plans**
  - Greatest risks?
  - Capability gaps?
  - How to invest scarce resources to bridge those gaps and reduce risk?

- **Operational Plans**
  - What functions must be performed in emergencies?
  - Who will do what?
  - What strategies will be used to respond and recover?
    - Emergency Operations Plan (EOP)
    - Continuity of Operations Plan (COOP)
Peak Oil and Disaster Response Challenges

Peak Oil and All-Hazards

Peak Oil Challenges:
- Cut across all hazards
- Intensify known hazards
- Create “new” hazards
- Impact entire PH preparedness system
Peak Oil and Local Disaster Impacts

- Impact on emergency response system capacity at all jurisdictional levels
- A Local “Perfect Storm”
  - Local self-sustainability requirements and duration will increase
  - Local infrastructure resources will decrease
  - Physical and psychological vulnerabilities will increase

Peak Oil and Preparedness Phase

- Preparedness phase (“pre-event”)
- Peak Oil disaster preparedness: inadequate to nonexistent
  - Minimal general public awareness
  - Extremely limited local planning/education
  - Inadequately addressed by National Planning Scenarios
Peak Oil and **Response Phase**

- Response (crisis phase – “event”)
  - Increased duration
  - Increased severity
- Example: pandemic flu and transportation

**Peak Oil and Recovery Phase**

- Recovery (consequence phase – “post-event”)
  - Increased duration
  - Increased severity
- Example: weather-related events and infrastructure restoration
### The Haddon Matrix

<table>
<thead>
<tr>
<th></th>
<th>Host</th>
<th>Agent</th>
<th>Physical Environment</th>
<th>Socio-Cultural Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-Event</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Event</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>Post-Event</strong></td>
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<td></td>
</tr>
</tbody>
</table>

### The Haddon Matrix: Example

#### Haddon’s Matrix, Pedestrian Injury Example

<table>
<thead>
<tr>
<th>Event Dimension</th>
<th>Epidemiological Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Human Factors</td>
</tr>
<tr>
<td>Pre-Event</td>
<td>Intoxicated pedestrian</td>
</tr>
<tr>
<td>Event</td>
<td>Osteoporosis in elderly pedestrians</td>
</tr>
<tr>
<td>Post-Event</td>
<td>Elderly pedestrian</td>
</tr>
</tbody>
</table>
Host/Event: Peak Oil Considerations

- Heightened morbidity and mortality
- Pronounced psychological impacts
- Diminished “human” response infrastructure
Host/Event: (Pan Flu – *Current Estimates: US*)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Moderate (1957/68-like)</th>
<th>Severe (1918-like)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illness</td>
<td>90 million</td>
<td>90 million</td>
</tr>
<tr>
<td>Outpatient med care</td>
<td>45 million</td>
<td>45 million</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>865,000</td>
<td>9,900,000</td>
</tr>
<tr>
<td>ICU care</td>
<td>128,750</td>
<td>1,485,000</td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>64,875</td>
<td>745,500</td>
</tr>
<tr>
<td>Deaths</td>
<td>209,000</td>
<td>1,903,000</td>
</tr>
</tbody>
</table>

Current Pandemic Flu Estimates: US

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Host/Event: **Psychological Impacts**

- Patients
  - Mental health surge
    - Psychological : Physical Casualties = 10:1 to 100:1
    - Based on *current* (“non-Peak Oil”) scenarios
- Response personnel
  - Psychosocial vulnerabilities
  - *Willingness* to respond

### LHD Workers’ Willingness to Respond – Pan Flu

- **JH-PHIRST**
- **N = 2264 (84% survey response)**
- **63 LHDs in 3 states (MN, OH, WV)**

<table>
<thead>
<tr>
<th>Reporting to Duty</th>
<th>Weather</th>
<th>Pandemic Influenza</th>
<th>Dirty Bomb</th>
<th>Anthrax</th>
</tr>
</thead>
<tbody>
<tr>
<td>If Required by agency</td>
<td>89%</td>
<td>87%</td>
<td>72%</td>
<td>80%</td>
</tr>
<tr>
<td>If Asked, but not required by agency</td>
<td>83%</td>
<td>79%</td>
<td>61%</td>
<td>70%</td>
</tr>
</tbody>
</table>
The Extended Parallel Process Model (Kim Witte)

- How do you frame messages to get people to take care of themselves?

### Willingness to Report by Scenario/EPPM (if required)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Low threat, Low Efficacy</th>
<th>Low threat, High Efficacy</th>
<th>High threat, Low Efficacy</th>
<th>High threat, High Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
</tr>
<tr>
<td><strong>Weather</strong></td>
<td>1.00 Ref.</td>
<td>12.47 23.91</td>
<td>2.15 3.04</td>
<td>18.86 36.07</td>
</tr>
<tr>
<td><strong>Pan Flu</strong></td>
<td>1.00 Ref.</td>
<td>9.80 17.83</td>
<td>2.23 3.16</td>
<td>20.61 36.53</td>
</tr>
<tr>
<td><strong>Dirty Bomb</strong></td>
<td>1.00 Ref.</td>
<td>7.37 10.26</td>
<td>1.71 2.21</td>
<td>11.22 15.83</td>
</tr>
<tr>
<td><strong>Anthrax</strong></td>
<td>1.00 Ref.</td>
<td>24.06 45.96</td>
<td>1.54 2.03</td>
<td>31.50 54.69</td>
</tr>
</tbody>
</table>

Extended Parallel Processing Model Category

- Low threat, Low Efficacy
- Low threat, High Efficacy
- High threat, Low Efficacy
- High threat, High Efficacy
### Frequencies of Attitudes/Beliefs by Scenario - LHDs

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<tr>
<th>Attitude/Belief Construct</th>
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</thead>
<tbody>
<tr>
<td>Knowledgeable about PH impact</td>
<td>77%</td>
<td>82%</td>
<td>45%</td>
<td>63%</td>
</tr>
<tr>
<td>Awareness of role-specific responsibilities</td>
<td>54%</td>
<td>64%</td>
<td>36%</td>
<td>52%</td>
</tr>
<tr>
<td>Psychologically prepared</td>
<td>77%</td>
<td>76%</td>
<td>45%</td>
<td>62%</td>
</tr>
<tr>
<td>Ability to safely get to work</td>
<td>65%</td>
<td>76%</td>
<td>39%</td>
<td>60%</td>
</tr>
<tr>
<td>Confidence in safety at work</td>
<td>71%</td>
<td>66%</td>
<td>35%</td>
<td>54%</td>
</tr>
<tr>
<td>Family prepared</td>
<td>70%</td>
<td>69%</td>
<td>46%</td>
<td>57%</td>
</tr>
<tr>
<td>Health Department’s perceived ability to provide timely information</td>
<td>74%</td>
<td>81%</td>
<td>58%</td>
<td>71%</td>
</tr>
<tr>
<td>Ability to address public questions</td>
<td>66%</td>
<td>69%</td>
<td>35%</td>
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<tr>
<td>Importance of one’s role in the agency’s overall response</td>
<td>71%</td>
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### The Haddon Matrix: Agent

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Agent/Event: Peak Oil Considerations

- New/emerging pathogens
- Increased virulence in face of weakened immunity
- Increased frequency/intensity of weather-related disasters
- "Psychological contagion"

The Haddon Matrix: Physical Environment

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### Physical Environment/Event: Peak Oil Considerations

- Fossil fuel-dependency of PH preparedness infrastructure
  - Supplies/Equipment
  - Transportation
  - Hospitals / EDs

### Physical Environment/Event: Supplies & Equipment

- **Petrochemical** applications in disasters: a selected list
  - Anesthetics
  - Antihistamines
  - Bandages
  - Heating and Cooling
  - Pharmaceuticals
  - Refrigerators
  - Synthetic rubber
  - Splints
  - Transportation
  - X-ray dyes
## Physical Environment/Event: Stockpiles

- Strategic National Stockpile
  - 12-Hour Push Packs (less than 5% of the SNS inventory)
    - Broad-spectrum oral and intravenous antibiotics
    - Other medicines for emergency conditions
    - IV fluids and fluid administration kits
    - Airway equipment, such as ET tubes, stylettes, oropharyngeal airways, Ambu-Bags, and CO2 detectors
    - Bandages
  - Vendor Managed Inventories
    - Vaccines
    - Antitoxins (e.g., Botulinum)
    - Ventilators
    - Additional quantities of 12-Hour Push Pack items

## Physical Environment/Event: Transportation

- Access to supplies/equipment
  - SNS transport issues
- Ambulance – EMS services
- Access to healthcare settings by patients and providers
  - Rural areas especially (but not exclusively) challenged
Transportation Issues – SNS 12-Hour Push Pack

- The SNS program is committed to having 12-Hour Push Packs delivered anywhere in the United States or its territories within 12 hours of a federal decision to deploy.
- The 12-Hour Push Packs have been configured to be immediately loaded onto either trucks or commercial cargo aircraft for the most rapid transportation.
- At the same time assets from the SNS are deployed, the SNS program will deploy its Technical Advisory Response Unit (TARU) to coordinate with state and local officials so the SNS assets can be efficiently received and distributed on arrival at the site.

HHS

Physical Environment/Event: Case Example

- 1973 Oil Crisis
  - Plastic syringe manufacturers
    - Shortages in ethylene and benzene
    - Increased price
    - Delayed delivery to end-users

Transportation Issues – Ambulance Services

- Ambulances frequently diverted from overcrowded EDs to more distant hospitals (which may have fewer resources)
  - Ambulances diverted 501,000 times in 2003
    - 1 ambulance diverted per minute

IOM: Hospital-Based Emergency Care: At the Breaking Point (2007)

Transportation Issues – Ambulance Services

“[Ambulance] diversion may provide a brief respite for a beleaguered staff, but it prolongs ambulance transport times and disrupts established patterns of care. It also creates ripple effects that can compromise care throughout the community. Because crowding is rarely limited to a single hospital, decisions to divert ambulances can prompt others to do the same. When this happens, a community may experience the health care equivalent of a “rolling blackout”. Everyone’s access to care is affected - insured and uninsured alike.”

Congressional Testimony: Ronald D. Bass, MD, FACEP
(July 26, 2006)
Transportation Issues – LHD Workers

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Transportation Issues – NYC HCWs

  - Most frequently cited barriers to ability to respond in disasters
    - Transportation (33.4%)
    - Child care (29.1%)
    - Personal health concerns (14.9%)
    - Elder care (10.7%)
    - Pet care (7.8%)
    - Second job obligations (2.5%)

Physical Environment/Event: Hospitals / EDs

- Fast-growing demand for emergency care
  - From 1993 – 2003:
    - 26% increase in ED visits
    - # of EDs declined by 425
    - # of hospital beds declined by 198,000
  - A hospital-wide problem
    - Back-up of patients in ED because cannot get admitted to hospital bed
      - Results in patient “boarding” in EDs (can be 48+ hours)
  - **Translation: minimal surge capacity in EDs currently**

IOM: Hospital-Based Emergency Care: At the Breaking Point (2007)

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The Haddon Matrix: Socio-Cultural Environment

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<tbody>
<tr>
<td>PRF-EVENT</td>
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Socio-cultural Environment: Peak Oil Considerations

- Societal expectations toward PH preparedness systems
- Scarce resource allocation: policy and ethics

PH Response Resource Scarcity: Ethics

- Justice
  - Requires equitable distribution of benefits and burdens
  - Example: Allocation of finite petroleum-based healthcare supplies

PH Response Resource Scarcity: Ethics

- How should we allocate?
  - Prevention/public health
  - Scientific/medical functioning
  - Social functioning/critical infrastructure
  - Medical need/vulnerability
  - Intergenerational equity


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PH Response Resource Scarcity: Ethics

- How should we allocate?
  - “Save the most lives.”
  - “Women and children first.”
  - “First come, first serve.”
  - “Save the most quality life years.”
  - “Save the worst off.”

PH Response Resource Scarcity: Ethics

- How should we allocate?
  - “Reciprocity.”
  - “Save the most likely to survive.”
  - Save those “instrumental in making society flourish.”
  - Save those “who contribute to the well-being of others.”

Emanuel EJ, Wertheimer A. Science 2006; 312: 854-855.

Principles, Problems, Prioritization

- Why is prioritization crucial?
  - Massive loss of life
  - Advanced planning should mean that bioethical principles may be considered
  - Peak oil could mean massive political destabilization
  - Failure to plan could lessen trust and adherence to additional governmental policies (e.g. quarantine)
Conclusions

- Impact of peak oil is on entire PH preparedness system
- Haddon matrix can be used to parcel out phases and factors
- Local planning must be a priority
- Must consider psychosocial impacts for general public and responders
  - Resistance, Resilience, Recovery
- Need to explicitly incorporate Peak Oil into current disaster planning scenarios and exercises
- Must address ethical issues as an urgent priority for healthcare system preparedness

Questions?

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