Ultimate Vulnerability: Death and Injury in Tsunamis
Some Observations from 3-11-11

- Per National Police Agency of Japan (July 18, 2012):
  - Deaths: 15,867
  - Missing: 2,906
  - Injuries: 6,109

- Three prefectures accounted for 99.6% of fatalities
  - Miyagi: 9,524
  - Iwate: 4,671
  - Fukushima: 1,606

- Miyagi Prefecture had 68% of the injuries

- Tsunami caused 92% of all fatalities
What factors lead to death and Injury in tsunamis?

- **Being in the inundation zone:**
  - Correlation between maximum run-up height and fatality .72
  - Correlation between housing damage (comp. destroyed) and fatality .92
  - Distance between where in zone one was located and safety

- **Advanced age and mobility impairments**
  - 65% of the fatalities were 60 years or older
  - Demographic trends in region resulted in an older population

- **Warning time and response to warnings**
  - Arrival time of tsunami inundation varied from 30 min to 3 hrs
  - First warning of tsunami was approx 3 minutes after the earthquake
  - Evacuation behavior varied, delays due to many factors including underestimate of risk, desire to assist others, tendency to normalize situation

- **Magnitude of the event/mitigation failures**
  - 1000 year event
  - Over-reliance on sea walls, vertical evacuation and early warning system
Drowning accounted for 92.5% of fatalities

But contributing factors (e.g. trauma) not well known/documented

Injuries included hypothermia, water inhalation, broken bones, cuts and abrasions, exacerbated medical conditions due to lack of medication

Not clear whether injuries, in ambiguous cases, were from earthquake or tsunami.
Deaths and injuries are not the total story

Public health issues in the evacuation centers:
- Hypertension
- Deep Vein Thrombosis
- Respiratory problems
- Mental and Psychosocial health
- Infectious diseases

The many earthquakes experienced by Japan has resulted in well prepared medical response capability-none of the above conditions became severe.
Some research needs and opportunities

- Only a small subset of data collected by Japanese authorities on fatalities are available for research.
- More detailed studies are now becoming available.
- Injury/fatality ratio between earthquake and tsunami requires further investigation.
- NIBS is supervising the development of a HAZUS model for tsunami in US.
## Data Available vs. Data Collected

<table>
<thead>
<tr>
<th>DATA AVAILABLE</th>
<th>DATA COLLECTED</th>
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<tbody>
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<td>Name</td>
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<td>Gender</td>
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<td>Age</td>
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<tr>
<td>Community of Residence</td>
<td>Date of Birth</td>
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<td>Date body recovered</td>
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<td>Location of body</td>
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<td>Date/confirmation of death</td>
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<td>Situation of death (e.g. who found body? In car? In building? In open?)</td>
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Convalescent Facility: Sendai
Exterior View
Questions?

Discussion?