Multi-hazard resilience in the aging era

Prof. Shinichi Egawa, M.D., Ph.D., F.A.C.S

IRIDeS, Tohoku University
Three factors of disaster risk

Vulnerability & Capacity

Hazards

Disaster
- Life, Health
- Properties
- Family
- Community
Disaster Risk Reduction

- Know your risk
- Reduce your risk
- Prepared to act

To reduce the disaster risk,

\[
\text{Hazard x Vulnerability} = \text{Risk} \quad \text{Capacities}
\]
### WHO Classification of hazards in the H-EDRM Framework

<table>
<thead>
<tr>
<th>GENERIC GROUPS</th>
<th>1. NATURAL</th>
<th>1.1 GEOPHYSICAL</th>
<th>1.2 HYDRO-METEOROLOGICAL</th>
<th>1.3 BIOLOGICAL</th>
<th>1.4 EXTRATERRRESTRIAL</th>
<th>2. HUMAN INDUCED</th>
<th>2.1 TECHNOLOGICAL</th>
<th>2.2 SOCIETAL</th>
<th>3. ENVIRONMENTAL DEGRADATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUPS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBGROUPS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAIN TYPES</td>
<td>[SUB-TYPES]</td>
<td>[SUB-SUBTYPES]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earthquake:</td>
<td>- ground-shaking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tsunami</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Movement (Geophysical trigger):</td>
<td>- landslide</td>
<td>- rock fall</td>
<td>- subsidence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquefaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volcanic activity:</td>
<td>- ash fall</td>
<td>- lahar</td>
<td>- pyroclastic flow</td>
<td>- lava flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flood:</td>
<td>- riverine flood</td>
<td>- flash flood</td>
<td>- coastal flood</td>
<td>- ice jam flood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storm:</td>
<td>- extratropical storm</td>
<td>- tropical cyclone [cylonic wind, cylonic rain, cyclone (storm) surge]</td>
<td>- convective storm [tornado, wind, rain, winter storm, blizzard, derecho, lightning thunderstorm, hail, sand/ dust storm]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drought</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wild fire:</td>
<td>- land fire [e.g. brush, bush, pasture]</td>
<td>- forest fire</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glacial lake outburst (flood)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wave action:</td>
<td>- rogue wave</td>
<td>- seiche</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extreme temperature:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airborne diseases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waterborne diseases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vector-borne diseases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foodborne outbreaks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insect infestation:</td>
<td>- grasshopper</td>
<td>- locust</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal diseases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact airburst meteorite</td>
<td>Spaceraider</td>
<td>energetic</td>
<td>particles</td>
<td>geomagnetic</td>
<td>storms</td>
<td>shockwave</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial hazards:</td>
<td>- chemical spill</td>
<td>- gas leak</td>
<td>- radiation [radiological, nuclear]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural collapse:</td>
<td>- building collapse</td>
<td>- dam/bridge failures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupational hazards</td>
<td>- mining</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation:</td>
<td>- air, road, rail, water, space</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explosions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air pollution:</td>
<td>- haze</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrastructure disruption</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acts of violence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Armed conflicts:</td>
<td>- international</td>
<td>- non-international</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Civil unrest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stampede</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terrorism</td>
<td>- chemical, biological, radiological, nuclear and explosives</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial crises:</td>
<td>- hyper-inflation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erosion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deforestation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salinization</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea level rise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desertification</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetland loss/ degradation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glacier retreat/ melting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand encroachment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is impossible to plan for individual hazards. All-hazard approach and disaster risk reduction is practical.

https://www.who.int/hac/techguidance/preparedness/health-emergency-and-disaster-risk-management-framework-eng.pdf?ua=1
* C (chemical): Tokyo Subway Sarin Attack
* B (biological): Ebola Outbreak, **COVID-19**
* RN (radiological and nuclear): Fukushima Nuclear Power Plant Accident

* Mass gathering

* E (explosion): Accident, Terror, Conflict, and War
How can we reduce the risk of SARS-CoV-2 Infection?

Hazard x Vulnerability

\[
\text{Risk} = \text{Capacities}
\]

• Smaller Hazard & Exposure
  – Wearing masks
  – Physical distancing
  – Avoid 3Cs (Closed spaces, Crowded spaces and Close-contact settings)

• Smaller Vulnerability
  – Less co-morbidity
  – Protect vulnerable population (Welfare facility)

• Larger Capacity
  – Government leadership, advocacy, communication capability
  – Individual coping capacity
  – Altruism
  – Medical service coordination
Charter 14 for older people in disaster risk reduction

Three Principles

1. **In need:** Older people have specific requirements which must be understood and responded to within all DRR activities.

2. **Invisible:** Older people’s vulnerabilities and capacities are often overlooked; the collection of data on people’s age and sex is essential to ensure older people and other people at risk are visible and supported in DRR.

3. **Invaluable:** Older people have years of knowledge, skills and wisdom which are invaluable assets in DRR and must be acknowledged, valued and engaged by supporting older people to participate in DRR.

**Minimum Standards in DRR for older people**

<table>
<thead>
<tr>
<th>Easy to win</th>
<th>Good Practice</th>
<th>Best Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Older people are specifically mentioned in national disaster management and climate policies, requiring direct action in planning, budgeting and training.</td>
<td>Sex-, age- and disability-disaggregated data is collected including for the following older age groups: 50-59, 60-69, 70-79, and 80+ years in all disaster management and analysed in regard to the impact of all disaster risk reduction initiatives.</td>
<td>Older people are represented in DRR management and governance from the community to the national level to ensure that their voice is heard.</td>
</tr>
<tr>
<td>Older people have been consulted in the development of national and local disaster and climate risk assessment and their vulnerabilities and capacities included.</td>
<td>Social protection systems such as pensions are available and can be accessed within days of a disaster and utilised as emergency cash transfer mechanisms.</td>
<td>Older people have access to affordable disaster insurance and risk-transfer mechanisms.</td>
</tr>
<tr>
<td>Emergency personnel in health, search and rescue, management, coordination and protection and livelihoods have been trained in working with older people and addressing their specific needs and strengths in emergencies.</td>
<td>Older people have access to cash transfer livelihood recovery initiatives following disasters.</td>
<td>Older people have access to affordable disaster insurance and risk-transfer mechanisms.</td>
</tr>
<tr>
<td>Early warning signals and information are available, accessible, understandable and actionable by older people.</td>
<td>Charter 14 for older people in disaster risk reduction 2014</td>
<td></td>
</tr>
<tr>
<td>Evacuation plans at community level have specific actions to ensure older people can evacuate and are protected during these operations, including actions specific to mobility, sight, hearing and mental impairments and isolation.</td>
<td>Resilient and climate-smart livelihood initiatives are inclusive of people who continue to work into old age.</td>
<td>Emergency personnel in health, search and rescue, management, coordination and protection and livelihoods have been trained in working with older people and addressing their specific needs and strengths in emergencies.</td>
</tr>
<tr>
<td>Evacuation and rest centres are age responsive, with off-floor seating, wheelchair accessible facilities, handrails and privacy for men and women.</td>
<td>Disasters and climate-smart livelihood initiatives are inclusive of people who continue to work into old age.</td>
<td>Emergency personnel in health, search and rescue, management, coordination and protection and livelihoods have been trained in working with older people and addressing their specific needs and strengths in emergencies.</td>
</tr>
</tbody>
</table>
Sendai Framework

Four Priorities
Priority 1: Understanding Disaster Risk
Priority 2: Disaster Risk Governance
Priority 3: Investment in Disaster Risk Reduction
Priority 4: Enhance preparedness for effective response and “Build Back Better” in recovery, rehabilitation and reconstruction

Seven Global Targets

Outcomes

Implementations

- d) infrastructure
- c) direct economic loss
- b) affected
- a) mortality
- e) national and local strategies
- f) International cooperation
- g) multi-hazard EWS

Prof. Kimio Takeya
JICA and TU

Division of International Cooperation for Disaster Medicine
Build back better and disaster risk reduction make the community more resilient

New Stakeholders: women, children and youth, persons with disabilities, poor people, migrants, indigenous peoples, volunteers, the community of practitioners and older persons

Disaster and DRR

Resilience of the community

Division of International Cooperation for Disaster Medicine

IRIDES

IRIDES
Change of Health Risks in disaster
1995 Great Hanshin Awaji Earthquake

January 17, 1995
05:46
M7.3

Cause of Death

- Fire: 13%
- Asphyxia: 83%
- Unknown: 4%

The buildings should be quake-proof
Japanese Association for Disaster Medicine was established
2011 Great East Japan Earthquake

Triple Disaster
• Earthquake
• Tsunami
• Nuclear Accident

Courtesy of Prof. Fumihiko Imamura, IRIDeS, Tohoku University

Division of International Cooperation for Disaster Medicine
Change of health risks in Great East Japan Earthquake

<table>
<thead>
<tr>
<th></th>
<th>Injured</th>
<th>Dead and lost</th>
<th>Displaced</th>
<th>National Disaster Medical System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Great Hanshin-Awaji Earthquake 1995 (M7.3)</td>
<td>43,800</td>
<td>6,433</td>
<td>307,200</td>
<td>No</td>
</tr>
<tr>
<td>Great East Japan Earthquake 2011 (M9.0)</td>
<td>5,942</td>
<td>19,582</td>
<td>488,000</td>
<td>Yes</td>
</tr>
</tbody>
</table>

• Less injuries, but different medical needs lasted longer
• Disruption of traffic and communication made health sector paralyzed
• Complicated radiological disaster
• Mental health of affected people was devastated
• Health facilities were also destroyed by disaster
• Education of disaster medicine was not generalized in health professionals

\[
\begin{align*}
\log E &= 1.5M + 4.8 \\
E(M9.0) &= 10^{1.5 \times (9.0 - 7.3)} = 10^{2.55} = 354.8
\end{align*}
\]
Disaster related deaths

Ministry of Reconstruction, Mar. 31, 2014
Total 3,089

<table>
<thead>
<tr>
<th>Region</th>
<th>Total</th>
<th>Fukushima</th>
<th>Miyagi</th>
<th>Iwate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miyagi</td>
<td>0</td>
<td>200</td>
<td>400</td>
<td>600</td>
</tr>
<tr>
<td>Total</td>
<td>3,089</td>
<td>3,089</td>
<td>3,089</td>
<td>3,089</td>
</tr>
</tbody>
</table>

Division of International Cooperation for Disaster Medicine

International Research Institute of Disaster Science
Cause of disaster related deaths
Ministry of Reconstruction Aug 2012

• 1263 people in the towns and cities of remarkable disaster related death and the areas close to the nuclear power plant.
• More than 90 % are over 70s. Equal gender.
• 60% had some co-morbidity (some disease)
• Cause of death (including 13 suicides)
  – Physical and mental expiration during the evacuation centers.
  – Physical and mental expiration during transportation to the evacuation centers.
  – Latency of primary care because of hospital unavailability.
  – Physical and mental stress from the earthquake and Tsunami.
• Location of death
  – Hospital and health care facilities 30%
  – Home 30%
  – Evacuation shelter 10%
Medical needs after Great East Japan Earthquake

DISASTER MEDICAL RECORD (DMR) ANALYSIS

Division of International Cooperation for Disaster Medicine
The trend of first-visit day and the first day of diagnosis

Suda, Egawa et al. TJEM 2019
Number of diagnoses in each diagnostic group

- **Infectious respiratory disease**
- **Hypertension**
- **Metabolic disease**
- **Pollinosis**
- **Orthopedic disease**
- **Gastrointestinal disease**
- **Gastroenteritis, diarrhea**
- **Skin disease**
- **Cardiovascular disease**
- **Trauma**
- **Sleep deprivation**
- **Prescription**
- **Mental disorder**
- **Ophthalmic disease**
- **Chronic respiratory disease**
- **Dental oral surgical disease**
- **Anemia**
- **Burn/Frostbite**
- **Cognitive impairment**
- **Treatment**
- **Malignant tumor**
- **Chest symptom**
- **Pregnancy/Puerperium**
- **Kidney disease**
- **Bedsore**
- **Benign tumor**

**Suda, Egawa et al. TJEM 2019**

**Division of International Cooperation for Disaster Medicine**
Trend of each module

**NCD**

0 7 14 21 28 35 42 49 56 63

**Infectious disease**

0 7 14 21 28 35 42 49 56 63

**Mental health issue**

0 7 14 21 28 35 42 49 56 63

**Trauma**

0 7 14 21 28 35 42 49 56 63

Suda, Egawa et al. TJEM 2019

Division of International Cooperation for Disaster Medicine
Background demography

Age and sex distribution of disease category

NCD

Infectious disease

Mental health issue

Trauma

Suda, Egawa et al. TJEM 2019

Division of International Cooperation for Disaster Medicine
Japan Rehabilitation Assistance Team (JRAT)

Kumamoto Earthquake
Apr. 14, 2016, M7.3
Dead 50, Related Death 76
Related Death by Rainfall 5
Injured 2,337 as of Sep 30, 2016
Japan Police

JRAT Kumamoto Earthquake Report 2017
Age and vulnerability to COVID-19

Data source as of Feb.2, 2022
Epidemiology in the 5th wave (Delta variant) of COVID-19 pandemic (Jul. 1-Oct. 31) using the data of 28,446 patients in Ibaraki, and Hiroshima prefectures. (https://www.mhlw.go.jp/content/10900000/000892299.pdf)
### Building-Back Better in disaster medicine after 2011 GEJE

<table>
<thead>
<tr>
<th>Before 2011</th>
<th>After 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disaster Base Hospital (DBH)</td>
<td>Disaster Medical Coordinator</td>
</tr>
<tr>
<td>Disaster Medical Assistance Team (DMAT)</td>
<td>Disaster Psychiatric Assistance Team (DPAT)</td>
</tr>
<tr>
<td>Staging Care Unit (SCU) and wide area transportation</td>
<td>Disaster Health Emergency Assistance Team (DHEAT)</td>
</tr>
<tr>
<td>Emergency Medical Information System</td>
<td>Japan Disaster Rehabilitation Assistance Team (JRAT)</td>
</tr>
<tr>
<td>Mother and Child Health Liaison</td>
<td>Hemodialysis Liaison</td>
</tr>
<tr>
<td>Standard Disaster Medical Record/J-SPEED (disease surveillance)</td>
<td></td>
</tr>
</tbody>
</table>

Egawa S, et al. (2020) WHO Guidance on Research Methods for Health and Disaster Risk Management, Chapter 1.3 Historical developments in Health EDRM policy and research: the case study of Japan
Figure 1.3.1 History of earthquake coastal line of Tohoku area, Japan

Key:
- Red: Earthquake with tsunami
- Green: Tsunami without earthquake
- Blue: Earthquake without tsunami

A: 1970 to 2016 (47 years)

B: 1600 to 1969 (370 years)

Figure 1.3.2 Simulated maximum tsunami amplitude (adapted from (15))

Figure 1.3.3 Number of deaths in natural disasters in Japan

Key: Eq: earthquake, Tph: Typhoon.
The number of deaths in the 1995, 2011 and 2016 earthquakes include disaster-related deaths. Adapted from White Paper of Disaster Management (19).
Leave no one behind

From liability to asset
Age distribution in Japan

1950 — 2010

60 years

Male
Female

Statistics Bureau Japan
Age distribution in Japan, Philippines and Nepal

1950 50 years 2000 50 years 2050

Japan

Philippines

Nepal

World Health Rankings
http://www.worldlifeexpectancy.com/country-health-profile/
Division of International Cooperation for Disaster Medicine
Age distribution in USA, Indonesia, and Ghana

1950 → 50 years → 2000 → 50 years → 2050

USA

Indonesia

Ghana

World Health Rankings
http://www.worldlifeexpectancy.com/country-health-profile/
Division of International Cooperation for Disaster Medicine
### Structure of INFORM risk index

**Dimensions**

<table>
<thead>
<tr>
<th>Categories</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>Earthquake</td>
</tr>
<tr>
<td>Human</td>
<td>Current conflict intensity</td>
</tr>
<tr>
<td></td>
<td>Tsunami</td>
</tr>
<tr>
<td></td>
<td>Projected conflict risk</td>
</tr>
<tr>
<td></td>
<td>Drought</td>
</tr>
<tr>
<td></td>
<td>Flood</td>
</tr>
<tr>
<td></td>
<td>Tropical cyclone</td>
</tr>
</tbody>
</table>

**Hazard & Exposure**

- Natural hazards: Earthquake, Tsunami, Drought, Flood, Tropical cyclone
- Human factors:
  - Current conflict intensity
  - Projected conflict risk

**Vulnerability**

- Socio-economic:
  - Development and deprivation (50%)
  - Inequality (50%)
  - Aid dependency (25%)
- Vulnerable groups:
  - Uprooted people
  - Other vulnerable groups

**Lack of Coping Capacity**

- Institutional:
  - DRR
- Infrastructure:
  - Communication
  - Physical infrastructure
- Access to health system

With more than 50 indicators


**Presented in WADEM 2019 Brisbane**
LE negatively correlates with INFORM risk

Presented in WADEM 2019 Brisbane
Natural hazard risk and LE

- **Earthquake**: LE $P=0.005$
- **Tsunami**: LE $P=0.0033$
- **Tropical Cyclone**: LE N.S.
- **Drought**: LE $p<0.0001$
- **Flood**: LE $P=0.0003$

Presented in WADEM 2019 Brisbane
Health related categories of INFORM Risk and LE

- Socio-Economic Vulnerability
- LE
- Japan

CHILDREN U5
- Human Development Index
- Poverty Index
- GINI Index
- Gender Inequality
- Aid Dependency

- Children U5 Mortality
- Children U5 Malnutrition

Lack of ACCESS TO HEALTHCARE
- Physicians density
- Health expenditure per capita
- Measles immunization coverage

Social determinants of health are the determinants of disaster risk

Presented in WADEM 2019 Brisbane
Conclusions

• Make it possible to include older people as a stakeholder in DRR with all-hazard approach.

• Community with high LE has low disaster risk.

• A high hazard & exposure risk country like Japan can reduce total disaster risk by decreasing the vulnerability and lack of coping capacity with improved health related indicators and “Building Back Better” from prior disasters.

• Improving health indicators is an effective and important strategy of disaster risk reduction making a healthy society resilient against disaster.
POST-DISASTER HOUSING RECONSTRUCTION IN JAPAN AFTER 3.11

2022 APRU Multi-Hazards Webinar: Looking ahead to the 2nd decade of recovery after the Great East Japan Earthquake and Tsunami

Liz Maly
Associate Professor, IRIDeS, Tohoku University

March 15, 2022
THE GREAT EAST JAPAN EARTHQUAKE: A MASSIVE, WIDE-AREA, COMPLEX DISASTER

2:46 PM, MARCH 11, 2011

- 9.0 magnitude earthquake
- tsunami-40 meters run up
- fires
- nuclear meltdown accident
MASSIVE DAMAGE, VAST/VARIED AFFECTED AREA

- 20,000 deaths
- 561 square kilometers inundated by tsunami
- 129,000 houses totally damaged
- 470,000 evacuees at peak, over 350,000 evacuees (in March 2011)
- as of Feb. 2022, more than 38,000 people still living in temporary housing/displacement

(Reconstruction Agency, March, 2022)
SOCIAL CONTEXT OF 3.11: AGING SOCIETY

National Institute of Population and Social Security Research

Figure 1.3 Proportion of the aged
65 years and over, municipality level, 2010

Source: Population Census of Japan

GEOGRAPHIC CONTEXT OF TOHOKU, AREA AFFECTED BY 3.11

Rias Coast: lack of buildable land
Source: The Association of Japanese Geographers

Sendai Plain: lack of high land

Source: Mainichi Shinbun, http://mainichi.jp/graphs/20160311/hpj/00m/040/002000g/12
Relocation after 1896 Meiji Tsunami
Relocation after 1933 Showa Tsunami
Relocation after 2011 GEJE

Multiple relocations, repeated disaster loss

map of past high ground relocation areas, and their situation after the GEJE in 2011
TOHOKU—HISTORIC EXAMPLES OF RELOCATION
NEW LOGIC OF DISASTER MITIGATION BEHIND LAND USE PLANNING AND RELOCATION AFTER THE GEJE

<table>
<thead>
<tr>
<th>Level</th>
<th>Design tsunami</th>
<th>Required performance</th>
</tr>
</thead>
</table>
| Level 1| Largest tsunami in modern times (return period: around 100 years) | • To protect human lives  
• To protect properties  
• To protect economic activities |
| Level 2| One of the largest tsunamis in history (return period: around 1000 years) | • To protect human lives  
• To reduce economic loss, especially by preventing the occurrence of severe secondary disasters and by enabling prompt recovery |
HISTORY OF HOUSING RECONSTRUCTION/RELOCATION PROGRAMS

Tsunamis affecting the Tohoku area

- **1896 Meiji Sanriku Tsunami**
  → Reconstruction of Tokyo

- **1923 Great Kanto Earthquake (fires)**
  → Reconstruction of Tokyo

- **1933 Showa Sanriku Tsunami**
  → Reconstruction of Tokyo

- **1945 WWII Firebombing**
  → Reconstruction of Tokyo

- **1959 Ise Bay Typhoon (Nagoya)**
  → 1961 Disaster Countermeasures Basic Act

1971 Collective Relocation and Cliffside Relocation Programs

- **1995 Great Hanshin Awaji Earthquake (Kobe)**
  → Large scale reconstruction of urban areas
  → 1998 Act Concerning Support for Reconstructing Livelihood of Disaster Victims (can't use for housing)

- **2004 Chuetsu Earthquake in Niigata Prefecture**
  → Residential relocation in rural, mountainous areas (population decline)
  → 2008 Amendment of Act Concerning Support for Reconstructing Livelihood of Disaster Victims (can't use for housing)

- **2011 Great East Japan Earthquake**
  → Massive, complex disaster, various local conditions.
  → Population decreasing and aging society, rural fishing villages;
  → New recovery policies to address unprecedented scale including establishment of National Reconstruction Agency and kofukin subsidy from national gov't for reconstruction projects; and a menu of 40 projects including types used before

After GEJE, existing housing recovery programs applied at an unprecedented/massive scale Used differently than stated purpose of policies

- **Collective Relocation for Disaster Mitigation**
- (individual) Relocation from Cliff Area
- Land Readjustment (including land raising)
- Construction of Public Housing

Recovery included some residential relocation projects of affected areas

Recovery used **Land Readjustment** projects;
Main support for housing recovery= **Public Housing** (reconstruction of private residences not supported)

Recovery used **Collective Relocation for Disaster Mitigation** projects;
Main support for housing recovery= **Public Housing**
EXAMPLE FROM MINAMI SANRIKU TOWN, MIYAGI PREFECTURE

photos from Kahoku Shinpo Newspaper Archive
http://kahoku-archive.shinrokuden.irdes.tohoku.ac.jp/kahokuweb/
Residential areas moved away from coast to high land areas (residential zone: yellow)
HIGH LAND RELOCATION: 2 MAIN STRATEGIES

- Cut the mountain
- Fill
ONGOING TOWN AND HOUSING RECOVERY

Created by cutting mountains, or building up land
including lots for private rebuilding or public housing

89% of 18,000 planned residential lots completed by May 2018 (Reconstruction Agency)
various types—prefabricated, wooden, private apartments
PRIVATE HOUSING RECONSTRUCTION IN RELOCATION AREAS

More than 18,000 new residential lots in 400+ project areas

Higashi Matsushima, Oct 2017
Multifamily public housing in Koriyama City, Fukushima

More than 30,000 Disaster Recovery Public Housing units
# FUKUSHIMA: MORE COMPLICATED SITUATION

## Damages from the Great East Japan Earthquake

<table>
<thead>
<tr>
<th></th>
<th>Casualties</th>
<th>Evacuees (as of 7/29/2016)</th>
<th>Damaged houses (as of 9/12/2016)</th>
<th>Inundated area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Iwate</strong></td>
<td>4,673</td>
<td>1,123</td>
<td>470/459</td>
<td>771/18,788</td>
</tr>
<tr>
<td><strong>Miyagi</strong></td>
<td>9,540</td>
<td>920</td>
<td>929</td>
<td>1,273/33,970</td>
</tr>
<tr>
<td><strong>Fukushima</strong></td>
<td>1,613</td>
<td>197</td>
<td>2,329/2038</td>
<td>6,710/47,850</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>15,893</td>
<td>2,556</td>
<td>3,472/147,772</td>
<td>121,739</td>
</tr>
</tbody>
</table>

**Inundated area:**
- Iwate: 58 km²
- Miyagi: 327 km
- Fukushima: 112 km²
- Total: 561 km²

**Original data sources:** Reconstruction Agency (2016b, 2016c), National Police Agency of Japan (2017), Fire and Disaster Management Agency (2017)

**Updates:** From Dec. 2021 and Feb. 2022, Reconstruction Agency

---

**Feb. 2022:**
38,000 evacuees total (source: Reconstruction Agency)
26,692 from Fukushima evacuated outside Prefecture
(sources: Reconstruction Agency and Fukushima Pref.)
EVACUATION INFORMATION AND ZONES

Legend
- Air dose rates at the height of one meter from the ground [μSv per hour], as of April 29, 2011
- Restricted zone, 20 km from NPP
- Deliberate evacuation zone
- Evacuation preparation zone
- Location of Daiichi NPP

Source: Ministry of Education, Culture, Sports, Science and Technology
EVACUATION ZONES

➤ Basis for not only evacuation
➤ Also for compensation
➤ Double standard for so-called “voluntary evacuees”
➤ Monthly payment for “official evacuees”
➤ One time payment for “voluntary” evacuees

Minami Soma City
Iidate Town
Katsurao Town
Kawauchi Town
Tomioka Town
Kawamata Town
Kawaura Town
Tamura Town
Namie Town
Okuma Town
Naraha Town
Hirono Town

Preparing to lift evacuation
Difficult to return zone
Evacuation order lifted
Date order lifted
THE UNSOLVABLE PROBLEMS OF FUKUSHIMA

➤ Long term-time scale, uncertain future—When/if areas can fit for habitation? This is not knowable.

➤ Government approach to recovery is based on finite timelines, ultimate decontamination and repopulation (officially). However, now, some areas re-open without decontamination

➤ Recovery planning and programs based on the principles of hometown recovery

➤ Relocation projects carried out within individual towns, support for housing and life in the interim/temporary phase before returning to former towns. This logic does not support the situation of long-term, scattered, distant, uncertain displacement of nuclear evacuees.
AFTER 11 YEARS...

➤ Planning for town reconstruction is complete
  ➤ New roads and sea walls are built
  ➤ New shopping centers, commercial areas are created
  ➤ New housing areas have been created
  ➤ Many people have moved into new housing, many people moved to different places...communities changed a lot

➤ Many remaining challenges:
  ➤ Long-term sustainability of affected communities?
    ➤ Aging, depopulation, post-relocation, economic issues (including Covid)
  ➤ Rebuilding communities, and placemaking in empty areas
RECOVERY IS LONG-TERM

➤ “Recovery” issues are “sustainable community” issues

➤ Need to shift focus from recovery to community-building, place-making (good examples of people already doing this)

➤ Using history, tradition, memories, documentation and storytelling, to connect to the future