Alaska’s High Magnitude Earthquakes
Past Impact and Lessons Learned
1964 Earthquake Mortality in Alaska

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Department of Health and Social Services
Outline

I. Background & Study Purpose
II. Methodology
III. Results
IV. Discussion
V. Questions/Comments
Background & Study Purpose

The 1964 Earthquake
Background

1964 Earthquake

- Occurred on March 27th 1964
- Magnitude 9.2 – largest in US history
- Soil liquefaction occurred in the Anchorage, Valdez, etc.
- Tidal Wave (Tsunami) measured over 200 feet near the Valdez Inlet.
- Aftershocks continued for weeks (up to 6.2 magnitude)
- Estimated damages totaled $300 million in 1964
# Background

The 2nd largest earthquake in recorded history

<table>
<thead>
<tr>
<th>Rank</th>
<th>Event</th>
<th>Magnitude</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1960 Valdivia, Chile Earthquake</td>
<td>9.4 - 9.6</td>
<td>1,000 to 7,000</td>
</tr>
<tr>
<td>2</td>
<td>1964 Alaska Earthquake</td>
<td>9.2</td>
<td>131</td>
</tr>
<tr>
<td>3</td>
<td>2004 Indian Ocean Earthquake</td>
<td>9.1 - 9.3</td>
<td>227,898</td>
</tr>
<tr>
<td>4</td>
<td>2011 Tōhoku earthquake</td>
<td>9.1</td>
<td>22,131</td>
</tr>
<tr>
<td>5</td>
<td>1952 Kamchatka Earthquakes</td>
<td>9.0</td>
<td>2,336</td>
</tr>
</tbody>
</table>
To evaluate the impact of the 1964 Earthquake in Alaska using historical death records
Methodology
Study Methods and Analytic Plan
Methods

Data Source

Alaska Vital Statistics, Mortality

- Registering births, deaths, and marriages was first required under Alaskan territorial law in 1913
- Death certificates were entered (backlogged) into the Electronic Vital Records System (EVRS)
- Includes all deaths from March 22, 1964 to May 31, 1964
Methods

Analytic Plan

- Identified earthquake-related deaths using the literal text for both underlying and contributory cause of death
  - Terms included “earthquake”, “tidal wave”, and other spelling variations
- Described demographic characteristics of decedents
- Evaluated location of death classified by Census Area/Borough
- Projected current day impact for a similar event in Alaska
Methods

Analytic Plan

Estimated Regional & Statewide Crude Rates

- \((\text{Deaths} \div \text{Population size}) \times 100,000\)
Calculate Population Size

Determine Population Size by All Years

Averaged the 1963 and 1964 mid-year statewide population sizes to approximate the March 1964 population size.
Determine Population Size by All Years

Statewide population size (denominator) used for this analysis

- July 1963: 249,904
- March 1964: 251,554
- July 1964: 253,204
Calculate Population Size

Determine Population Size by All Years

Statewide

- July 1963: 249,904
- March 1964: 251,554
- July 1964: 253,204

Used same method to determine population size for census/borough areas.
Methods

Analytic Plan

Estimated Statewide Age-Adjusted (AA) Rates

- Age group proportions used from the 1960 census and applied to the 1963/’64 average population, then adjusted to the 2000 US standard population.

- For the earthquake affected area, AA rates were applied to the 2018 Alaska population to project impact.
Results

Historical Death Records
# Earthquake-Related Deaths

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>86</td>
<td>75%</td>
</tr>
<tr>
<td>Female</td>
<td>29</td>
<td>25%</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-14 years</td>
<td>34</td>
<td>30%</td>
</tr>
<tr>
<td>15-34 years</td>
<td>27</td>
<td>23%</td>
</tr>
<tr>
<td>35-54 years</td>
<td>18</td>
<td>16%</td>
</tr>
<tr>
<td>55+ years</td>
<td>15</td>
<td>13%</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>77</td>
<td>67%</td>
</tr>
<tr>
<td>Alaska Native</td>
<td>37</td>
<td>32%</td>
</tr>
</tbody>
</table>

115 1964 Earthquake-Related Deaths in AK
## Deaths by Location

### Census Area/Borough

1. Valdez-Cordova Census Area 74
2. Kodiak Island Borough 19
3. Kenai Peninsula Borough 13
4. Municipality of Anchorage 9
Deaths by Location

Census Area/Borough

1. Valdez-Cordova Census Area 74
2. Kodiak Island Borough 19
3. Kenai Peninsula Borough 13
4. Municipality of Anchorage 9

64% Earthquake-related deaths in 1964
Deaths by Location

Census Area/Borough

1. Valdez-Cordova Census Area  74
2. Kodiak Island Borough  19  17%
3. Kenai Peninsula Borough  13
4. Municipality of Anchorage  9

Earthquake-related deaths in 1964
Deaths by Location

Census Area/Borough

1. Valdez-Cordova Census Area 74
2. Kodiak Island Borough 19
3. Kenai Peninsula Borough 13
4. Municipality of Anchorage 9

12 of 13 Earthquake-related deaths occurred in Seward-Hope Subarea
Cause of Deaths

Literal Text of Underlying Cause

1. Drowning/trauma from tidal wave 101
2. Trauma, not tidal wave related 8
3. Other 5
   - Lost in ground movement 2
Death Impact

Timeline

- 111 earthquake-related deaths occurred on March 27\textsuperscript{th}
- 4 occurred after (March 28\textsuperscript{th} – 31\textsuperscript{st})
Death Impact

Timeline
- 111 earthquake-related deaths occurred on March 27th
- 4 occurred after (March 28th – 31st)

Earthquake-Related Death Rates in Affected Areas
- Age-Adjusted (AA) Rate = 158.9 deaths per 100,000
- Crude Rate = 97.2 deaths per 100,000
Death Impact

Timeline

- 111 earthquake-related deaths occurred on March 27th
- 4 occurred after (March 28th – 31st)

Earthquake-Related Death Rates in Affected Areas

- Age-Adjusted (AA) Rate = 158.9 deaths per 100,000
- Crude Rate = 97.2 deaths per 100,000

2018 AA Rates For Comparison
- Cancer = 141.6 per 100,000
- Heart = 130.4 per 100,000
- Injury = 56.3 per 100,000
Death Impact

Timeline

- 111 earthquake-related deaths occurred on March 27th
- 4 occurred after (March 28th – 31st)

Earthquake-Related Death Rates in Affected Areas

- Age-Adjusted (AA) Rate = 158.9 deaths per 100,000
- Crude Rate = 97.2 deaths per 100,000

Present Impact

- Age-adjusted rates applied to the 2018 population represents 598 earthquake-related deaths.
All-Cause Death Crude Rates

1964 = 568.7 per 100,000

1963 = 517.8 per 100,000

50.9 Excess Deaths per 100,000
Discussion

What have we learned?
Outcomes

- Led to significant scientific breakthroughs in subduction earthquakes.
- Earthquake-monitoring system were created.
- Engineers developed earthquake-resistant structures and new building codes were put in place.
- Health and medical disaster response systems and capabilities.
Limitations & Other Considerations

- Some deaths may have been misclassified as not-related to the 1964 earthquake
- The recording precinct may have been listed as location of death
- 2018 projected death does not take into account advances in building codes, warning systems, and emergency responses.
- This study only looked at deaths in Alaska. It’s important to note that 15 deaths occurred in Oregon and California due to tidal waves.
- We could not evaluate morbidity
Takeaway

- Most deaths occurred from the tidal wave in the Valdez-Cordova Census Area, many of which were children and young adults.
- Compared to earthquakes of this magnitude, loss of life was small.
- The total number of deaths from Alaska’s Vital Statistics were consistent with other historical accounts. However, locations of death differ (i.e. Chenega).
Contacts and Links

Health Analytics & Vital Records (HAVRS)
http://dhss.alaska.gov/dph/VitalStats/Pages/default.aspx

HAVRS Data and Statistics (to access data brief)
http://dhss.alaska.gov/dph/VitalStats/Pages/data/default.aspx

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healthanalytics@alaska.gov
Questions/Comments
Syndromic Surveillance Following the 2018 Alaska Earthquake

Anna Frick, MPH
Alaska Section of Epidemiology
Syndromic surveillance in Alaska

- Began in 2014 with BioSense
- Transitioned to NSSP ESSENCE in 2016
- 16 of 22 emergency departments onboarded (at the time)
  - 2 of 3 largest hospitals
  - Not currently onboarding urgent cares, other practice types
- One HIE in AK serves as routing point for all hospitals
Nov 30, 2018

7.2 magnitude earthquake hits ~14 miles north of Anchorage at 8:29 AM

Aftershocks started quickly, with a 5.7 about 10 minutes later
Statewide and Anc overall visits
Earthquake-related visits
What did we look for?

- Volume
  - Any particular groups of people?
- Injuries
- GI illness- there was concern about damage to the water system
- Mental health
- Cardiac events- question from cardiologists
Data analysis

- Looked at visits flagged as quake-related for day of earthquake and 10 days after
  - 361 total visits
  - ~60% of visits on the day of the earthquake

- Local hospital not participating in syndromic did a one-time data pull for this report
  - All visits hand-coded for syndromes
Who was in the ED?

<table>
<thead>
<tr>
<th></th>
<th>Patient Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>00-04</td>
</tr>
<tr>
<td>Quake-Related Visits</td>
<td>5%</td>
</tr>
<tr>
<td>Baseline</td>
<td>8%</td>
</tr>
</tbody>
</table>

Quake-related: 63% female
Baseline: 54%
**What were quake visits for?**

<table>
<thead>
<tr>
<th>Reason for Earthquake-associated ED Visit</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest Pain</td>
<td>9%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastro-intestinal</td>
<td>7%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Care Services</td>
<td>14%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental Health</td>
<td>14%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neurologic</td>
<td>10%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Reason for Earthquake-associated ED Visit**

<table>
<thead>
<tr>
<th>Chest Pain</th>
<th>Gastro-intestinal</th>
<th>Health Care Services</th>
<th>Injury</th>
<th>Mental Health</th>
<th>Neurologic</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>9%</td>
<td>7%</td>
<td>14%</td>
<td>45%</td>
<td>14%</td>
<td>10%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Totals >100% as people may have had multiple complaints
Medication Refill CCDD Category
Mental health

- Mostly anxiety
  - 73% (37/51) of quake-related mental health visits

- Aftershocks...
  - 500+ above magnitude 2.5 in ~4 days afterwards
  - 5 at or above magnitude 5

- Also used WA’s dashboard
Mood and Depressive disorders

- Terms: ICD-10 F30-F39, depressive disorder, bipolar, mood disorder, depression, manic episode, psychotic
Mood and Depressive disorders
Schizophrenic disorders

- Terms: ICD10 F20-29, psychosis, psychotic, schizo, delusional, paranoid, auditory hallucinations, hearing voices
Schizophrenic disorders

Age Stratification of Schizophrenic Disorder Visits

Percent of Visits

0 1 2 3 4


- 05-17
- 18-44
- 45-64
- 65+
Anxiety disorders

Terms: ICD10 F40-48, anxiety+spellings, phobia, panic attack
Anxiety disorders

Age Stratification of Anxiety Disorder Visits

- Percent of Visits
- Age Stratification: 00-04, 05-17, 18-44, 45-64, 65+
- Year: 2018-44 to 2019-08
Using the data

- Identification of non-issues
  - NOT seeing GI issues
  - Hospital volume NOT insane

- Interest in the number/level of injuries → moving state resources

- Concerns about mental health → social media posts

- Rumor mill management
  - Numbers/trends/information for communicating with the public
Thanks to NSSP community!

- Offered assistance right away
- Shared queries and dashboards
Ongoing work

In Alaska:

- Developed and monitoring chest pain/cardiac event queries
- More involved with EOC
- Trying to be more forward-thinking with building dashboards
Read More

- Syndromic bulletin: 

- Survey bulletin: 
Thanks!

Anna Frick
Anna.frick@Alaska.gov
Overdose

CDC All Drug
Alaska Earthquake Response
November 2018

Sondra LeClair, Section Chief
Rural and Community Health Systems
Alaska Department of Health and Social Services (DHSS)
Agenda

• Earthquake
  – Infrastructure impacts
  – State health response activities
  – EMS impacts
  – Hospital impacts

• Overall health system lessons learned
Alaska Health Response Structure

• One statewide health care coalition
• One local health department with emergency response staff—located in Anchorage
• Health and medical coordination and response quickly escalates to the state
  – Department of Health and Social Services Emergency Operations Center (DHSS EOC)
Earthquake Infrastructure Damage
Immediate Impacts

• Most communication technology remained operational (radios, landlines, cell phones)
• Airports quickly re-opened
• Port quickly re-opened
• Gas and Electric generally available—impacted by power outages and some building damage
• Water—precautionary boil water notice
Road Damage

• Extensive road damage throughout Anchorage and Mat-Su

• Temporary shutdown of Glenn Highway one way
  – Opened one way in the evening
  – Impacted hospital staffing
    • Incoming hospital staff from Mat-Su unable to get to work in Anchorage
    • Hospitals notified DHSS EOC and Municipality of Anchorage
      – Began working to establish quick process for allowing passage of hospital staff
      – Road re-opened early, prior to implementation of process
Impact of School Closures

• School Districts
  – Released all students to maintain safety
  – Roads congested and nearly impassable in some areas
  – All employees with school-aged children had to respond
  – All schools in Anchorage, most in Mat-Su, remained closed for one week
State Health Response
DHSS EOC Initial Actions

• Information gathering/sharing
  – Critical infrastructure
  – Rumor Control
    • Hospital on fire (false)
    • Hospital structure collapse (false)

• Statewide hospitals calling for awareness
  – Patients ready for transfer to Anchorage
  – Hospitals around the state needed updated info asap
Statewide Teleconferences

- DHSS EOC distributed first situation report to hospitals and health care partners at 11:17am
- First statewide health teleconference occurred at 11:30am
- Updates from multiple health system entities
- Gathered informal injury reports
- Fielded questions from hospitals
- Provided State DHSS and Muni 24/7 contact information
Other Health Care Response Coordination

- 1135 Waiver requested by Division of Health Care Services and granted – December 3, 2018
- Medicaid pre-approvals for travel
- Request for quick nursing staff licensure process
- Integration of State Pharmacist
  - Update on open pharmacies
- Integration of Behavioral Health
- Dialysis Center updates
  - Worked with regional network for ongoing situation reports
- Air medical update
  - Flooding temporarily impacted one provider, quickly restored services
  - Other air medical operational
State Health Response: Public Health Laboratory

• Damage to several areas of Anchorage Public Health Laboratory
  – 13 rooms affected
  – Cracks in walls rendered areas unusable
  – Sprinkler break resulted in water, minor flooding

• Only one other state laboratory
  – Fairbanks, different capabilities

• Impacted in-state testing of tuberculosis, botulism, other testing
  – Delays of up to one week in receiving results

• Decontamination, specialized equipment, training needed to repair

• No changes to hospital processes
EMS Impacts
Anchorage Fire Dept. (AFD)

- AFD Buildings were largely intact and functional after the earthquake
- Old fire station used for warm storage in Eagle River condemned for occupancy
  - Will be demolished
- AFD Chugiak VFD, Girdwood FD facilities had minimal to no damage and/or service disruptions
AFD Impact to Facilities/Services

- Most issues occurred at Fire Station #12
- Earthquake took many systems offline, including backup systems and multiple redundant power sources
- Power returned quickly but backup systems remained offline
- AFD Dispatch moved to its secondary center in the Anchorage EOC
- AFD Dispatch returned to St. #12 on December 11, 2018
AFD Call Volume

911 Calls, 11/30/2018

Auxiliary Calls, 11/30/2018
Hospital Impacts
Mat-Su Regional Medical Center

• Facility Assessment
  – Minor structural damage
  – Utilities- Electricity and Natural Gas off
  – Boilers converted to diesel but both off due to broken boiler line with Glycol spills; initially no heat
  – Air handlers turned off to reserve internal heat
  – 3rd floor sprinkler line rupture, repaired with no impact to patient care
  – All elevators inoperable but cleared
  – Attached Medical Office Building had natural gas leak and water-main break on 4th floor with flooding all the way down to the 1st floor surgery center
    • Building evacuated

• Summary
  – 200 patients in the first 24hrs. (120 disaster related and 80 deemed regular ER patients)
  – All systems and utilities restored within 12 hours
  – Returned to normal hospital operations on Monday, December 3, 2018
Mat-Su Regional Medical Center
Alaska Regional Hospital

- No major structural damage—cracks, damaged ceiling tiles, sprinkler heads, carpet, expansion joints
- Water damage to multiple areas: Central Sterile Processing, Peri-operative area, supply storage
- Medical Office Building—Water and Glycol Damage
- Elevator went to the basement and stayed there
Alaska Regional Hospital

- Water main fracture in parking lot
Lessons Learned
Overall Health Care System
Lessons Learned

An Incomplete List...

• Maintain consistent engagement between health care emergency managers
• Underscores the value of planning, exercises and health care investment in preparedness
• Ongoing training for health care facilities in incident command structure
• Review prioritization of health care facilities for infrastructure restoration (example: elevators, water supply)
• Impact of schools on road congestion/staff availability
• Opioid/Addiction Treatment Centers – important elements of patient care
• Assisted Living Homes—ongoing communication and response mechanisms
• Other health care provider types
  – Need non-hospital providers to consider themselves essential and remain open
Planning Continues...