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

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ALPHA 2020 Health Summit

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Division of Public Health
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

Statewide

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

Averaged the 1963 and 1964 mid-year statewide population sizes to approximate the March 1964 population size.
Calculate Population Size

Statewide population size (denominator) used for this analysis
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>
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
3. Kenai Peninsula Borough 13
4. Municipality of Anchorage 9

Earthquake-related deaths in 1964
## Deaths by Location

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</tr>
<tr>
<td>2. Kodiak Island Borough</td>
<td>19</td>
</tr>
<tr>
<td>3. Kenai Peninsula Borough</td>
<td>13</td>
</tr>
<tr>
<td>4. Municipality of Anchorage</td>
<td>9</td>
</tr>
</tbody>
</table>

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 27th
- 4 occurred after (March 28th – 31st)
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 = \textbf{158.9} deaths per 100,000
- Crude Rate = \textbf{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 Mortality Impact

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 magnitude earthquake 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>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>00-04</td>
<td>05-17</td>
<td>18-44</td>
<td>45-64</td>
<td>65+</td>
<td>Unknown</td>
</tr>
<tr>
<td>Quake-Related Visits</td>
<td>5%</td>
<td>6%</td>
<td>44%</td>
<td>30%</td>
<td>16%</td>
<td>0%</td>
</tr>
<tr>
<td>Baseline</td>
<td>8%</td>
<td>10%</td>
<td>40%</td>
<td>25%</td>
<td>16%</td>
<td>0%</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>Chest Pain</th>
<th>Gastrointestinal</th>
<th>Health Care Services</th>
<th>Injury</th>
<th>Mental Health</th>
<th>Neurologic</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<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
Cuts/Lacerations

Other or Unknown 32%

Hit by/hitting something 18%

Falls

Injury Mechanism
Injury Type

- Cuts/Lacerations: 21%
- Sprain/Strain: 19%
- Fractures: 11%
- Bruising: 17%
- Head injury: 13%
- Other/Unknown: 27%
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

Age Stratification

[Graph showing trends by age groups from 2018-44 to 2019-08]
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

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

Year:
- 2018-44
- 2018-45
- 2018-46
- 2018-47
- 2018-48
- 2018-49
- 2018-50
- 2018-51
- 2018-52
- 2019-01
- 2019-02
- 2019-03
- 2019-04
- 2019-05
- 2019-06
- 2019-07
- 2019-08

Age Groups:
- 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
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
Syndromic bulletin: 

Survey bulletin: 
Thanks!

Anna Frick
Anna.frick@Alaska.gov
Overdose

Overdoses Anchorage Hospitals

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

Photos from Anchorage Daily News and KTVA
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

“Caution!!
Load Bearing
IV Pole
Do Not Disturb”
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...