What is the Amazon Echo?

What can this device do?
Aging Population

- Each day more than 10,000 Americans turn 65\(^2\)
- As the aging population rises, so do fall-related injuries and deaths\(^2\)
  - Secondary effect: increased healthcare costs\(^2\)
Healthcare Costs in an Aging Population

- In 2016 Medicare spending rose 3.9% to $672.1 billion\(^3\)
  - Projected to increase by 5.6% each year\(^3\)

**EXHIBIT 1**
Relative Per Capita Health Spending, By Age Cohort (Age 35-44 Equals 1), 1999

Using Technology to Reduce Healthcare Costs

- Telecare Development Programme in Scotland created the largest telecare service\textsuperscript{7}
- Smart home technology reduces frequency of visits and length of stay\textsuperscript{7, 30}
Voice-activated Intelligent Assistants

- Reis et al compared features of voice-activated devices
  - Amazon Echo
    - Built-in applications
    - Smart home devices
    - Customized third-party skills
## Smart Home Technology and Elderly

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skeptical of technology(^{32})</td>
<td>Sense of security and confidence(^{7})</td>
</tr>
<tr>
<td>Cost(^{32})</td>
<td>Independence(^{15})</td>
</tr>
<tr>
<td>User Friendliness(^{18})</td>
<td>Social interaction(^{29})</td>
</tr>
</tbody>
</table>
Objectives & Purpose

- Mimic scenarios that individuals can possibly find themselves inside the home
- Investigate at what decibel level and how far away the Amazon Echo can hear the user
- Utilize Amazon Echo skills that would benefit a person who may be home-bound

The purpose of this study was to measure the efficacy of using Amazon Echo voice activated applications to assist patients in a home health setting.
Materials/Methods

- Utilized 23 Doctor of Physical Therapy Students (13 males, 10 females)
- Predetermined Scenarios (each question to be performed in each scenario):
  1. In bed, same room
  2. Behind closed door
  3. At a distance from the device, not in the same room, open door
Pass/Fail Criteria by Task

Task 1: “Alexa, turn on the lights”
- Pass: Alexa turned lights on
- Fail: Alexa did not turn lights on

Task 2: “Alexa, set an alarm”
- Pass: Alexa set an alarm
- Fail: Alexa did not set alarm, or set incorrect time

Task 3: “Alexa, translate ‘How are you feeling?’ to Spanish”
- Pass: Alexa translated “How are you feeling?” to Spanish
- Fail: Alexa did not translate the sentence correctly, or at all
Pass/Fail Criteria by Task (cont.)

Task 4: “Alexa, open Notion”
  ● Pass: Alexa opened Notion app
  ● Fail: Alexa did not open Notion app

Task 5: “Alexa, set a metronome”
  ● Pass: Alexa set metronome at tempo selected by participant
  ● Fail: Alexa did not set metronome or set metronome at incorrect beats per minute

Task 6: “Alexa, trigger emergency”
  ● Pass: Alexa called researcher phone
  ● Fail: Alexa did not call researcher phone
# Results: First Attempt Pass Rates

<table>
<thead>
<tr>
<th>Result</th>
<th>Location 1</th>
<th>Location 2</th>
<th>Location 3</th>
<th>Total Attempts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>123</td>
<td>96</td>
<td>122</td>
<td>341</td>
</tr>
<tr>
<td>Fail</td>
<td>15</td>
<td>42</td>
<td>16</td>
<td>73</td>
</tr>
</tbody>
</table>

- Location 1: 89.1%
- Location 2: 69.57%
- Location 3: 88.41%
- Overall: 82.37%
Results: Decibel Levels

- No significance in decibel levels for success/failure

<table>
<thead>
<tr>
<th>Result</th>
<th>Location 1</th>
<th>Location 2</th>
<th>Location 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Pass Decibel Level</td>
<td>71.50 ± 4.96 dB</td>
<td>48.50 ± 3.89 dB</td>
<td>58.34 ± 5.14 dB</td>
</tr>
<tr>
<td>Average Fail Decibel Level</td>
<td>71.00 ± 4.54 dB</td>
<td>47.73 ± 3.76 dB</td>
<td>57.13 ± 6.90 dB</td>
</tr>
</tbody>
</table>
# Results: Male vs Female

<table>
<thead>
<tr>
<th>Result</th>
<th>Location 1</th>
<th>Location 2</th>
<th>Location 3</th>
<th>Total Attempts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Pass</td>
<td>75</td>
<td>72</td>
<td>74</td>
<td>221</td>
</tr>
<tr>
<td>Male Fail</td>
<td>8</td>
<td>19</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>Female Pass</td>
<td>57</td>
<td>51</td>
<td>58</td>
<td>166</td>
</tr>
<tr>
<td>Female Fail</td>
<td>6</td>
<td>26</td>
<td>6</td>
<td>38</td>
</tr>
</tbody>
</table>
What does this mean?

- Failures mainly due to enunciation
- Only one significant value comparing male to female decibel level
- Decibel levels consistent with an elderly population\textsuperscript{14}
Limitations To Our Study

- Small sample size
- Convenience sample
- Self-selection of time for alarm and BPM for metronome
- Voice enunciation was not accounted for
Limitations To Using Alexa in the Home

- Skills have been developed since trials were run
- Lack of security
- Set-up of device
- Cost of add-ons
Conclusions

- Overall Amazon Echo performed well in all tasks (82.37% pass rate)
- Most difficulty was seen with Task 5 (metronome) across all locations
- Most difficulty was seen in Location 2 (behind a door)
- No significance found in decibel level and Amazon Echo response
- Vast majority of gender comparisons were insignificant
- Useful as an adjunct to Physical Therapy
Clinical Relevance

Clinicians treating patients in a home health care setting, should consider the use of smart home devices like the Amazon Echo.

- Monitor compliance with HEP
- Initiate emergency services
- Assist with ADLs
Acknowledgements

- Dr. Donald Shaw
- Joe Burgess & Lynelle Decker
- FPU Student Volunteers
- FPU Faculty & Staff
References


24. CDC. Algorithm for Fall Risk Screening, Assessment, and Intervention. STEADI.
Why should clinicians care about the Amazon Echo?

Facing a progressing problem:
● Each day more than 10,000 Americans turn 65\(^2\)
● As the aging population rises, so too does fall-related injuries and deaths\(^2\)
  ○ Secondary effect being increased healthcare costs\(^2\)
● In 2016 Medicare spending rose 3.9% to $672.1 billion, accounting for 20% of the National Health Expenditure\(^3\)
  ○ National health spending is projected to increase by 5.6% each year for 2016-25\(^3\)
  ○ Medicare is the largest single payer of home health care services\(^6\), with services including physical therapy\(^9\)
What can we do about this observation?

**Preventive action** through physical therapy intervention can decrease incidence of falls, increase elderly quality of life, and in turn decrease healthcare costs.²

- Address malleable risk factors of falls (reduced muscle strength, increased inactivity, severe chronic health conditions)² via in home physical therapy interventions
  - CDC statement supports the use of evidence based fall prevention programs (Tai Chi, Otago Program)²,⁸

Again, where does the Amazon Echo come in?
Pietrzak et al found that smart home technology can help aging adults feel an increased sense of security and confidence in the home.

Telecare Development Programme in Scotland created the largest telecare service to decrease healthcare costs and improve quality of life.

Majumder et al established smart home technology allows for in-home monitoring which lead to a decrease in frequency of medical visits and length of stay.

Living independently has been shown to be important to older adults’ well-being.
Smart Home Technology and the Elderly

- Portet et al found that elderly were afraid to adopt smart home technology because they would be considered dependent.
- A retirement community in San Diego, CA is using Amazon Echo to assist residents with everyday tasks as well as update family\(^\text{17}\).
- Callari et al investigated the accessibility and acceptability of technology that promoted motor and cognitive training in people over the age of 70.
- Most help received in the home in people over the age of 70 was from a person’s social network of friends and family\(^\text{21}\).
# Results: Male vs Female at Location 1 (Next to Device)

<table>
<thead>
<tr>
<th></th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
<th>Task 5</th>
<th>Task 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>71.20 ± 4.23</td>
<td>71.92 ± 4.63</td>
<td>70.64 ± 5.37</td>
<td>73.43 ± 3.82</td>
<td>71.86 ± 4.83</td>
<td>69.38 ± 5.27</td>
</tr>
<tr>
<td>Average Decibel Level ± SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P-value</td>
<td>0.948</td>
<td>0.956</td>
<td>0.551</td>
<td>0.351</td>
<td>0.613</td>
<td>0.389</td>
</tr>
<tr>
<td>Female</td>
<td>71.33 ± 5.93</td>
<td>71.80 ± 5.57</td>
<td>72.10 ± 6.08</td>
<td>71.73 ± 4.84</td>
<td>70.80 ± 5.05</td>
<td>71.20 ± 4.61</td>
</tr>
<tr>
<td>Average Decibel Level ± SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Franklin Pierce University
## Results: Male vs Female at Location 2 (Behind Closed Door)

<table>
<thead>
<tr>
<th></th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
<th>Task 5</th>
<th>Task 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decibel Level ± SD</td>
<td>49.35 ± 5.06</td>
<td>49.54 ± 5.29</td>
<td>47.19 ± 4.35</td>
<td>47.47 ± 3.95</td>
<td>46.87 ± 2.92</td>
<td>47.00 ± 4.04</td>
</tr>
<tr>
<td>P-value</td>
<td>0.469</td>
<td>0.761</td>
<td>0.248</td>
<td>0.313</td>
<td>0.042*</td>
<td>0.357</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decibel Level ± SD</td>
<td>48.25 ± 3.47</td>
<td>49.00 ± 3.28</td>
<td>48.71 ± 2.58</td>
<td>48.77 ± 2.98</td>
<td>49.45 ± 3.08</td>
<td>48.55 ± 3.98</td>
</tr>
</tbody>
</table>
### Results: Male vs Female at Location 3 (Down the Hall)

<table>
<thead>
<tr>
<th></th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
<th>Task 5</th>
<th>Task 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>57.87 ± 5.73</td>
<td>59.00 ± 5.99</td>
<td>56.67 ± 5.64</td>
<td>58.00 ± 4.83</td>
<td>55.23 ± 4.51</td>
<td>57.21 ± 4.68</td>
</tr>
<tr>
<td>Decibel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level ± SD</td>
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</tr>
<tr>
<td>P-value</td>
<td>0.134</td>
<td>0.275</td>
<td>0.185</td>
<td>1.000</td>
<td>0.067</td>
<td>0.828</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>61.25 ± 5.55</td>
<td>61.60 ± 5.13</td>
<td>59.55 ± 5.05</td>
<td>58.00 ± 6.36</td>
<td>58.73 ± 4.36</td>
<td>56.80 ± 4.44</td>
</tr>
<tr>
<td>Decibel</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Level ± SD</td>
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