Barriers and Enablers of Hearing Aid Wireless Technology Adoption

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Barriers and Enablers of Hearing Aid Wireless Technology Adoption

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ZPower LLC
Camarillo, California
“What or Who is ZPower?”

A new sports drink?

Special formula for calculating acoustic impedance?

Automatic transmission system from BMW?

What you need to turn on ZLight!

The better battery.
“Yes, it’s the smallest, slimmest watch in the world. The only downside is the battery!”
Hearing aid wireless features and functions

ZPower survey regarding wireless usage

Recent advances in wireless accessories

The Future
Hearing aid wireless features and functions

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Recent advances in wireless accessories

The Future
Overview of Five Common Wireless Functions/Accessories

- Bilateral Commands
- Remote controls
- Audio/TV streaming
- Bluetooth phone
- Remote microphone

The better battery.
Bilateral Commands

• Hearing aids exchange codes to sync volume, programs, activate special features (e.g. directional), etc.

• Integral feature in hearing aid, doesn’t require a device

• Can be configured so one aid controls programs, the other volume, etc.
Overview of Five Common Wireless Functions/Accessories

- Bilateral Commands
- Remote controls
- Audio/TV streaming
- Bluetooth phone
- Remote microphone

The better battery.
Remote Controls

• Wirelessly change volume & programs
Remote Controls

- Higher end devices have more functionality
- From push buttons to touch screens
Overview of Five Common Wireless Functions/Accessories

- Bilateral Commands
- Remote controls
- Audio/TV streaming
- Bluetooth phone
- Remote microphone
Audio/TV Streaming

• Audio from entertainment system to hearing aid
• Cables connect streaming device to TV/Receiver
Audio/TV Streaming

- Lanyard & RF designs
- ~30 feet maximum distance between streaming device & hearing aids
Overview of Five Common Wireless Functions/Accessories

- Bilateral Commands
- Remote controls
- Audio/TV streaming
- Bluetooth phone
- Remote microphone
Bluetooth Phone

- Communication between hearing aid and phone
- Audio from call streams directly into hearing aid
- Microphone in relay device or in hearing aids
Bluetooth Phone

- NFMI (near field magnetic induction)
  - Worn around neck
  - Shorter transmission distance
  - Lower current drain

- RF (radio frequency)
  - Carry in pocket, clip-on, etc.
  - Longer transmission distance
  - Higher current drains
Overview of Five Common Wireless Functions/Accessories

- Bilateral Commands
- Remote controls
- Audio/TV streaming
- Bluetooth phone
- Remote microphone
Remote Microphone

• External microphone sends sound to hearing aids
Remote Microphone

- Relay connection
  - Hearing aids receive audio through a separate device

- Direct connection
  - Hearing aids receive audio directly from microphone
Hearing aid wireless features and functions

ZPower survey regarding wireless usage

Recent advances in wireless accessories

The Future

The better battery.
ZPower Wireless Accessory Survey

• Why did ZPower do this?
  – Wireless enabled hearing aids becoming standard
  – Attachment rate of wireless accessories was quite low

• Given to HISs & audiologists in 2013
  – Over 100 respondents
  – International Hearing Society (IHS)
  – Academy of Doctors of Audiology (ADA)
  – California Academy of Audiology (CAA)

• Focus on experience with wireless accessories
  – Which accessories are most popular?
  – What impacts dispenser’s wireless accessory decision?
ZPower Wireless Accessory Survey

Wireless Accessory Popularity

Respondents that provide wireless features for at least 60% of their patients

- Bilateral commands: 80%
- Remote control: 47%
- Bluetooth phone: 38%
- Audio/TV streaming: 20%
- Remote microphone: 13%
ZPower Wireless Accessory Survey
What Limits Use of Wireless Features?

Respondents that provide wireless features for at least 60% of their patients
Combined percent of “strong” and “moderate” ratings
ZPower Wireless Accessory Survey
What Limits Use of Wireless Features?

Respondents that provide wireless features for at least 60% of their patients
Combined percent of “strong” and “moderate” ratings
ZPower Wireless Accessory Survey

How Easy are Wireless Accessories to Set Up?

<table>
<thead>
<tr>
<th>Feature</th>
<th>Percent of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral commands</td>
<td>100%</td>
</tr>
<tr>
<td>Remote control</td>
<td>83%</td>
</tr>
<tr>
<td>Remote microphone</td>
<td>70%</td>
</tr>
<tr>
<td>Bluetooth phone</td>
<td>42%</td>
</tr>
<tr>
<td>Audio/TV streaming</td>
<td>29%</td>
</tr>
</tbody>
</table>

Percent of “very easy” and “easy” ratings for set-up of wireless features
ZPower Wireless Accessory Survey

How Easy are Wireless Accessories to Set Up?

Percent of “very easy” and “easy” ratings for set-up of wireless features

- Bilateral commands: 100%
- Remote control: 83%
- Remote microphone: 70%
- Bluetooth phone: 42%
- Audio/TV streaming: 29%

The better battery.
Are Wireless Accessories Too Complicated?

Audio/TV Streaming

- TV or satellite receiver or cable box?
- Speakers muted when “Audio Out” is connected
Are Wireless Accessories Too Complicated?  
Audio/TV Streaming

- Converters/adapters sometimes required
- Connection ports difficult to access
Are Wireless Accessories Too Complicated? Bluetooth Phone

- **Pairing process**
  - Press button(s) on device to start pairing
  - Open smartphone Bluetooth settings
  - Enter pairing code
  - Connected!

The better battery.
Impact of Complicated Wireless Accessories

- How is patient affected?
  - Possible return of accessory and/or hearing aids
  - Dissatisfaction with hearing aids

- How is dispenser affected?
  - Set-up and configuration of devices takes time
  - Must be familiar with different consumer devices
  - More follow-up questions
ZPower Wireless Accessory Survey
What Limits Use of Wireless Features?

Respondents that provide wireless features for at least 60% of their patients
Combined percent of “strong” and “moderate” ratings
ZPower Wireless Accessory Survey
Which Wireless Features are Most Beneficial?

Respondents that provide wireless features for at least 60% of their patients and identify given feature above as “Very Beneficial”
ZPower Wireless Accessory Survey
Popularity vs. Benefits

• Why doesn’t popularity match patient benefit?
  – Remote control is simple to explain to patients?
  – Don’t have Bluetooth phone?
  – Too complicated to use?

Popular with Dispensers

Patient Benefit

Percent of Respondents

<table>
<thead>
<tr>
<th>Feature</th>
<th>Popular with Dispensers</th>
<th>Patient Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral commands</td>
<td>80%</td>
<td>81%</td>
</tr>
<tr>
<td>Remote control</td>
<td>47%</td>
<td>56%</td>
</tr>
<tr>
<td>Bluetooth phone</td>
<td>38%</td>
<td>56%</td>
</tr>
<tr>
<td>Audio/TV streaming</td>
<td>20%</td>
<td>50%</td>
</tr>
<tr>
<td>Remote microphone</td>
<td>13%</td>
<td>38%</td>
</tr>
</tbody>
</table>
ZPower Wireless Accessory Survey
Popularity vs. Benefits

• Why is Bluetooth benefit so high?
  – Headset difficulty with hearing aids
  – Need hands-free capability when driving in many states
ZPower Wireless Accessory Survey
Popularity vs. Benefits

- Remote microphone had one of the largest gaps
  - Remote microphone was rated as very easy to use
  - Do dispensers recommend or promote this technology?
  - How many patients are willing to use this technology?

**Popular with Dispensers**

- 80% Bilateral commands
- 47% Remote control
- 38% Bluetooth phone
- 20% Audio/TV streaming
- 13% Remote microphone

**Patient Benefit**

- 81% Bluetooth phone
- 56% Bilateral commands
- 56% Audio/TV streaming
- 50% Remote microphone
- 38% Remote control

Percent of Respondents

ZPower Wireless Accessory

81%

56%

56%

50%

38%

80%

47%

38%

20%

13%
Remote Microphone Benefits

- Background noise is a problem for many patients.
- Intelligibility diminishes with distance.
- Room reverberation affects feedback cancellation.

![Diagram showing Noise, Distance, and Reverberation with Signal to Noise Ratio at the center.]
Remote Microphone Benefits

- Remote microphone increases SNR which helps with background noise, distance and reverberation
- Directionality is less effective when signal isn’t in front

SNR-50 (dB)

<table>
<thead>
<tr>
<th></th>
<th>Adaptive Directional</th>
<th>FM/HA Mic</th>
<th>Mini-Mic/HA Mic</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNR-50 (dB)</td>
<td>-5</td>
<td>-15</td>
<td>-15</td>
</tr>
</tbody>
</table>

DOWN IS GOOD!
ZPower Wireless Accessory Survey
What Limits Use of Wireless Features?

Respondents that provide wireless features for at least 60% of their patients
Combined percent of “strong” and “moderate” ratings

- Too complicated: 50%
- Higher battery drain: 38%
- Limited benefit: 38%
- Return visits: 31%
- Fitting time: 25%
Wireless Streaming Design Approaches

NFMI Design

“Near Field” Magnetic Induction

- Lanyard acts like inductive loop
- Device must be relatively close to hearing aids
- Orientation sensitivity of lanyard to hearing aids
- Minimal increase in hearing aid current drain
Wireless Streaming Design Approaches

RF Design

“Far Field” Radio Frequency

- Device uses radio communication
- Longer distance communication possible
- May be placed in pocket, worn on clothing, etc.
- Noticeable increase in hearing aid current drain
Wireless Streaming Effect on Battery Life?

Source: Audiology Online, June 3, 2013; Battery Consumption in Wireless Hearing Aid Products; Joergensen, Baekgaard, Bendtsen
Battery life (hours of use) of six hearing aids during simulated everyday use and streaming based on measured current consumption. The calculations are based on an expected battery capacity of 130 mAh.

Source: Audiology Online, June 3, 2013; Battery Consumption in Wireless Hearing Aid Products; Joergensen, Baekgaard, Bendtsen
ZPower Wireless Accessory Survey
How Do Patients Handle Higher Current Drain?

Respondents that provide wireless accessories to at least 60% of patients; respondents observations of patient behavior
Frequent RF streaming users consume 2.3x more batteries than NFMI
Source: Oticon

Respondents that provide wireless accessories to at least 60% of patients; respondents observations of patient behavior
Hearing aid wireless features and functions

ZPower survey regarding wireless usage

Recent advances in wireless accessories

The Future
Advances in Wireless Accessories
What’s Happened Since 2013 Survey?

• Made for iPhone (MFi)

Compatible devices

Audibel
A3i
Beltone
Beltone First
NuEar
iSDS
Starkey
Halo
Audigy
AGXsp
MicroTech
Kinnect
ReSound
ReSound LiNX

www.apple.com/accessibility/ios/hearing-aids/
Advances in Wireless Accessories
What’s Happened Since 2013 Survey?

- Made for iPhone (MFi)
- Integrate wireless features in smartphone
Advances in Wireless Accessories
What’s Happened Since 2013 Survey?

- Made for iPhone (MFi)
- Integrate wireless features in smartphone
- iPhone & Android Apps
Advances in Wireless Accessories
Making Wireless Accessories Easier to Use

• Smartphone as device platform
  – Remote control, audio streaming, remote microphone, Bluetooth
  – Don’t need extra device
  – Charge only one device

• Smartphone apps
  – User friendly interface
  – Easy to update with new features
Advances in Wireless Accessories
Making Wireless Accessories Easier to Use

• Wired connections to avoid device pairing
Advances in Wireless Accessories
Making Wireless Accessories Easier to Use

- Wired connections to avoid device pairing
- Use smartphone for remote microphone for Audio/TV streaming
Advances in Wireless Accessories
Making Wireless Accessories Easier to Use

• Bluetooth vs. Bluetooth Smart on iPhone
  – Hearing aids not shown in standard screen
Advances in Wireless Accessories
Making Wireless Accessories Easier to Use

- Bluetooth vs. Bluetooth Smart on iPhone
  - Hearing aids not shown in standard screen
  - Settings: Bluetooth vs. triple click Home button
Advances in Wireless Accessories
Making Wireless Accessories Easier to Use

• Bluetooth Smart set up is different
  – Follow instructions to the letter...or else!

• Bluetooth Smart pairing
  – Open/close battery door and/or turn Bluetooth on/off
Advances in Wireless Accessories
Increasing Benefits with Smartphone Apps

- Finding lost hearing aids
Advances in Wireless Accessories
Increasing Benefits with Smartphone Apps

- Finding lost hearing aids
- Geo-tagging programs
- Customized programs
- Stereo streaming
- Bass/treble adjustment
- Online user manual
- Online how to guide
Advances in Wireless Accessories
Improving Battery Life in Wireless Streaming

• Battery life getting shorter due to wireless streaming & other features
• Shorter battery life affects patients
  – More frequent battery changes
  – Less predictable battery life
Rechargeable Batteries
What is Needed?

• Hearing aid performance
  – Identical acoustic performance
  – All day run time (16+ hours)
  – Predictable battery life

• Charging
  – Reliable, easy to use charger
  – Charges overnight (within 7 hours)

• Interchangeable with zinc-air
  – Forget to charge
  – Go on vacation

• Environment benefit = less waste

All manufacturers offer rechargeable batteries in their wireless accessories
Hearing aid wireless features and functions

ZPower survey regarding wireless usage

Recent advances in wireless accessories

The Future
Solutions for the Future

Expanded smartphone compatibility

“Killer” apps

Better battery solutions

Communication standards
Wireless Technology Adoption Summary

• The 3 most important factors enabling the adoption of wireless accessories: **patient benefit, ease of use & batteries**

• Patient benefit
  – Bluetooth phone offers biggest benefit to patient
  – Remote microphone may be most underutilized benefit

• Ease of use
  – More features are being incorporated into smartphones
  – User interface is significantly improving with apps

• Batteries
  – RF streaming consumes more batteries
  – Rechargeable battery technologies are gaining attention to improve the patient’s experience
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