MISSED OPPORTUNITIES

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UNIVERSITY OF NORTH TEXAS
MARKET LANDSCAPE

ADOPTER CHARACTERISTICS

Kochkin (2009)
ADOPTER CHARACTERISTICS

![Median United States Income Graph](image1)

**US Census**

ADOPTER CHARACTERISTICS – FIRST-TIME USERS

![Percent of Sales Graph](image2)
ECONOMIC LANDSCAPE
DEMAND AND HEARING AID MARKET

• Demand function ($\varepsilon$) within the hearing aid market is inelastic (Aaron, 1987; Lee & Lotz, 1998; Amlani & De Silva, 2005; Amlani, 2010)
  • An inelastic market means that consumers are **not** price sensitive (i.e., $\varepsilon < |1|$)
    • No depreciable decline in quantity sold when price is increased
    • No appreciable increase in quantity sold when price is decreased

![Graph showing demand function (ε) vs. price and quantity]

Figure 1. A rough schematic of hearing aid technologies (blue) and styles (green) during the last 30 years, as well as unit volume (magenta).

http://hearinghealthmatters.org/hearingeconomics/2013/hearing-aid-prices-going-up-going-down/
As market demand increases by 44%, price decreases by 100%.

Est H'd Population (millions) - 2012

- Conventional\(^1\): 26.27 mil, 24.60%
- Practical\(^2\): 8.14 mil, 8.57 mil, 51.28%
- Potential\(^2\): 8.57 mil

Adoption Rate - 2013

2. Amlani (Unpublished)

Growth in Private Sector is Stagnate (5-8% annual growth); Growth of VA has Doubled/Tripled (23-31% annual growth)

QUESTION 1

• Who is the bigger threat to the demand of hearing aids?

A. “Big-box” retail chains (e.g., Costco)
B. Hearing aid manufacturer-owned practices
This image is a poll’s place holder. Enter slide show mode (F5) to view your live poll.

You can resize this image to resize where your poll will load in slide show mode.

Make sure you’ve installed the PollEv Presenter app (poll-ev.com/app) and are connected to the internet!

If you need to duplicate this poll make sure to copy/paste the entire slide (not just the place holder image).

RETAIL CHAINS
AUDIOLOGY RELINQUISHING ITS AUTONOMY?

<table>
<thead>
<tr>
<th>Vestibular Assessment</th>
<th>1992*</th>
<th>1998*</th>
<th>2008**</th>
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<tbody>
<tr>
<td></td>
<td>51%</td>
<td>47%</td>
<td>37%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vestibular Diagnosis/Interpretation</th>
<th>1992*</th>
<th>1998*</th>
<th>2008**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>---</td>
<td>80%</td>
<td>56%</td>
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</table>

<table>
<thead>
<tr>
<th>CAP Assessment</th>
<th>1992*</th>
<th>1998*</th>
<th>2009***</th>
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<tbody>
<tr>
<td></td>
<td>64%</td>
<td>---</td>
<td>37%</td>
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</tbody>
</table>

* Martin et al (1998); **ASHA (2012); Emmanuel (2009)
WHAT OPPORTUNITIES ARE AVAILABLE FOR... GROWTH? SUSTAINABILITY? AUTONOMY?

Facility - Value Chain - Access - Appeal - Comfort - Staff - Privacy

Demeanor - Competency - Attentiveness - Empathy - Informative - Unbiased - Accessibility

Provider

Referrals - Loyalty - Satisfaction - Perceived Value

Patient - Emotional Value - Social Value - Quality Value - Value Chain

Utilization - Compliance - Loyalty - Perceived Value - Satisfaction

Family/Friends - Referrals - Loyalty - Satisfaction - Perceived Value - Utilization - Compliance

Amlani (2013)
(MIS)UNDERSTANDING THE PATIENT

MISSED OPPORTUNITY - 1
PATIENT EXPECTATIONS
(AMLANI & D’ABREO, UNPUBLISHED)

• Pilot study (23 DFW Practices; 54 Patients)
  • Dispensers (AuD, HIS) expectations of hearing healthcare differ from those of patients

• Dispensers
  • Product-driven
    • Unwilling to assist if product is not purchased from that dispenser
  • Price
  • Physician Referrals
  • Advertising/Marketing
  • Device Brand

• Patients
  • Service-driven (Counseling, Rehab)
  • Practice Reputation
  • Lack Knowledge of Degree Differences of Providers
  • Family/Friend Recomm.
  • Dispenser Competency
  • Payment Options

PATIENT EXPECTATIONS
(AMLANI & D’ABREO, UNPUBLISHED)

• Pilot study (23 DFW Practices; 54 Patients)
  • Dispensers (AuD, HIS) expectations of hearing healthcare differ from those of patients

• Dispensers
  • Assume that aided audibility benefits listening in all situations
  • Assume that experienced and inexperienced listeners have the same needs

• Patients
  • Experience “significant” problems in at least >3 environments using the device
  • Experienced and inexperienced listeners have different needs
INTERNET PRESENCE

MISSED OPPORTUNITY - 2

Provider
- Facility
  - Value Chain
  - Access
  - Appeal
  - Comfort
  - Staff
  - Privacy
- Demeanor
  - Competence
  - Attentiveness
  - Empathy
  - Informative
  - Unbiased
  - Accessibility

Patient
- Emotional Value
- Social Value
- Quality Value
- Value Chain

Perceived Value

Satisfaction

Loyalty

Compliance

Utilization

Total Utility: High

Family/Friends

Referrals
Pew Institute
June, 2013

Mean Percentage

Age Groups

E-mail Use
Internet Use

18-29 30-49 50-64 65+

0 10 20 30 40 50 60 70 80 90 100
SOCIAL MEDIA EXPOSURE

http://bloom.bg/16jCCK#ooid=dhc2NkYzl0bNRyAJsmOb4aGFj0aq0
HEARING SCREENINGS

MISSED OPPORTUNITY - 3

HEARING SCREENING

• ~18% of face-to-face adult hearing screenings result in provider compliance and recommendations
  • Increase in denial for hearing loss
  • Increase in perceived pressure for hearing aids, **NOT** audiological services
IMPROVING REFERRALS THROUGH SMARTPHONE HEARING SCREENINGS
(AMLANI & RUSSO, UNPUBLISHED)

• Group 1 (n = 104)
  • Traditional hearing screening
    • Otoscopy, tympanometry
    • 20 dB at 1000, 2000, 4000 Hz
    • 30 dB at 500 Hz (based on behavioral testing)
    • Traditional counseling

• Group 2 (n = 104)
  • Smartphone Application on iPad 2 with Standard Apple Earbud Headphones
  • No counseling
  • Provided e-mail account for folks who wanted additional testing/counseling
IMPROVING REFERRALS THROUGH SMARTPHONE HEARING SCREENINGS
(AMLANI & RUSSO, UNPUBLISHED)

• Results
  • Group 1
    • 16 listeners, out of 104, made appointments for diagnostic testing (i.e., 15.4%)
    • 11 had sufficient hearing loss that required amplification
  • Group 2
    • 31 listeners, out of 104, e-mailed their results and made appointments for diagnostic (i.e., 29.8%)
    • 21 listeners had sufficient hearing loss that required amplification
      • False positives in 6 listeners
      • Not a bad thing – opportunity to build relationship for the future

Odds of referral increase by 1.94 (i.e., 16/31) times using a smartphone compared to traditional methods
IMPROVING REFERRALS THROUGH SMARTPHONE HEARING SCREENINGS  
(AMLANI & RUSSO, UNPUBLISHED)

• Results  
  • Group 1  
    • 11 candidates for amplification  
    • 4 listeners underwent trial periods with amplification  
      Closure Rate = 36%
  • Group 2  
    • 21 candidates for amplification  
    • 15 listeners underwent trial periods with amplification  
      Closure Rate = 71%

Is it possible that smartphone applications increases self-acceptance of hearing loss and need for amplification?

MILD HEARING LOSSES  
MISSED OPPORTUNITY - 4
11/9/2013

Amlani (Unpublished)

 Adoption Window for First-Time Users

REDUCE COGNITIVE DECLINE

Listen up: Dementia linked to hearing loss

Janice Lloyd, USA TODAY  6:00 p.m. EST January 21, 2013

Millions of hearing-impaired older adults are more likely to suffer early memory and thinking problems than adults without hearing loss, a study out Monday finds.

Cognitive problems developed 30% to 40% faster when hearing declined to 25 decibels — mild hearing loss, according to the research online in the JAMA Internal Medicine. “That’s when you begin noticing trouble hearing and understanding in settings like a busy restaurant,” says lead author Frank Lin.
Waiting time and “price elasticity”

A multiple regression study of the demand for gasoline at individual Boston-area service stations found that the elasticity of demand with respect to the price of gasoline was \(-3.3\). Customers of service stations, however, pay two prices: one in money to the seller and another in the form of waiting time. Estimates of demand must take into account the customers’ sensitivity to waiting. If a station raises its price by 1\%, its customers must pay 1\% more in money. But this tends to reduce customer purchases. Given the station’s fueling capacity, the reduction in purchases will reduce waiting times, which tends to increase the quantity demanded.

Accordingly, the estimated “price elasticity” of \(-3.3\) combines the responsiveness to an increase in price alone together with the responsiveness to a reduction in waiting time. After adjusting for the effect on waiting time, Png and Reitman estimated that the pure own-price elasticity ranged between \(-6.3\) and \(-8.4\).

Other businesses that serve randomly arriving customers from a fixed capacity include Internet service providers, banks, hospitals, and supermarkets. In estimating the own-price elasticity of demand at any such business, an analyst must take care to adjust for the effect of price changes on waiting times.


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**SUBSTITUTE PRODUCT**

(AMLANI ET AL, IN REVIEW)
QUESTION 2

• Are smartphone hearing aid applications a threat to your business?

A. Yes
B. No
3. Personal Sound Amplification Products (PSAPs)

PSAPs are intended to amplify environmental sound for non-hearing impaired consumers. They are not intended to compensate for hearing impairment. Examples of situations in which PSAPs typically are used include hunting (listening for prey), bird watching, listening to lectures with a distant speaker, and listening to soft sounds that would be difficult for normal hearing individuals to hear (e.g., distant conversations). Because PSAPs are not intended to diagnose, treat, cure or mitigate disease and do not alter the structure or function of the body, they are not devices as defined in the Food, Drug and Cosmetic Act. As such, there is no regulatory classification, product code, or definition for these products. Furthermore, there are no requirements for registration of manufacturers and listing of these products with FDA.

However, PSAPs are subject to applicable provisions of the Radiation Control for Health and Safety Act of 1968, under which FDA regulates electronic products that emit sonic vibrations, such as sound amplification equipment. (See also 21 CFR 1000.15.) Manufacturers of PSAPs must report defects and adverse events and take other measures described in 21 CFR Part 1003. Manufacturers of PSAPs must also comply with the requirements to repurchase, repair, or replace electronic products required under 21 CFR Part 1004.

For questions regarding the requirements for PSAPs, please contact the Branch Chief for the Electronic Products Branch at 240-276-3291.

http://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/GuidanceDocuments/ucm127086.htm
Amlani et al. (In Review)
Klipsch S4i insert earphones and Apple iPod Touch (5th Gen)

Mean Rau Score

UA  HA  Ears  Mic

Amlani et al. (In Review)
Amlani et al (In Review)
ADVANTAGES OF SMARTPHONE HEARING AID APPLICATIONS

- Allow relationship to be built between patient and practitioner
- Increase revenue stream by providing out-of-pocket services
  - These services separate audiology from
    - Dispensers/Otolaryngologists
    - "Big-Box" Retailers
- Improve acclimatization
- Reduce cognitive decline
- And…

Improve \( \varepsilon = \text{Increase Adoption Rates} \)

Est. Hi'd Population (millions) - 2012

Adoption Rate - 2013

Conventional¹

Practical²

Potential²

HA Adopted

Untapped

Decline HA

Increase of 1.12 mil HA users

2. Amlani (Unpublished)

QUALITY OF DEVICE

MISSED OPPORTUNITY – 5
Assistive Technology Experiences of Californians with Disabilities (2011)

Satisfaction with commonly used AT devices

- scooter: 78.5%
- ventilator: 78.3%
- adapted telephone: 77.4%
- oxygen: 72.4%
- cane, walker, crutches: 72.4%
- adapted vehicle: 70.0%
- manual wheelchair: 69.7%
- reacher / grabber: 68.9%
- electric wheelchair: 67.8%
- books on tape: 66.7%
- magnifiers: 66.3%
- specialized software: 64.7%
- computer: 61.2%

Hearing aid: 59.8%

Hearing aids are <= 4 years old

- one-on-one: 36%
- small groups: 24%
- t.v.: 25%
- outdoors: 19%
- leisure activities: 18%
- listening to music: 20%
- car: 20%
- while shopping: 17%
- restaurant: 18%
- place of worship: 23%

Positive and Negative satisfaction levels

Kochkin, MarkeTrack VIII
http://electronicdesign.com/dsp/sound-development-hearing-aid-chip

Amlani et al (In Press)
QUALITY OF DEVICE AND COGNITION

Galster & Galster (2011)
RETAIL PRICING DEPENDENT ON CHANNELS

<table>
<thead>
<tr>
<th>Channels</th>
<th>Audeo Q (Q90)</th>
<th>Audeo Q (Q70)</th>
<th>Audeo Q (Q50)</th>
<th>Audeo Q (Q30)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
<td>16</td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>

www.hearingplanet.com
• Commercially available MCWDRC devices are often designed with fast-acting compression

• Some manufacturers’ design hearing aids such that the attack ($T_a$) and release ($T_r$) times in all channels are symmetrical

\[
\begin{align*}
\text{Linear} & : T_a = T_r = T_s \\
\text{Slow} & : T_a = T_r = 10T_s \\
\text{Medium} & : T_a = T_r = T_s \\
\text{Fast} & : T_a = 0.1T_s \\
& T_r = 0.3T_s
\end{align*}
\]

Dillon (2001)

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**INCREASE PERCEPTIONS BY PERFORMING...**

• **Verification measures**
  • Real-ear
  • Speech Mapping

• **Validation measures**
  • Count-the-Dot Audiogram
  • Handicap/disability scales
  • Follow-up telephone call

• **Counseling/Rehabilitation**
  • Communication Strategies
Facility - Value Chain - Access - Appeal - Comfort - Staff - Privacy

Provider

Family/Friends → Referrals → Loyalty → Satisfaction → Perceived Value

Patient

- Emotional Value
- Social Value
- Quality Value
- Value Chain

Demeanor - Competency - Alertiveness - Empathy - Informative - Unbiased - Accessibility

Utilization

Compliance

Satisfaction

Loyalty

Perceived Value

Family/Friends

Referrals

PRICING

MISSED OPPORTUNITY – 6
QUESTION 3

• Select a product below that you would purchase for the retail price of $1.00.

A. Pencil
B. Thee-course meal at a five star restaurant
C. Computer tablet
ELASTICITY AND HEARING AID MARKET

At high prices, demand function is elastic

$1645

At low prices, demand function is inelastic

RELATIONSHIP – E AND TOTAL REVENUE

Total Revenue = \sum (Price_i \times Quantity_i)

<table>
<thead>
<tr>
<th>Demand</th>
<th>Raise Prices</th>
<th>Reduce Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elastic</td>
<td>Total Revenue Decreases</td>
<td>Total Revenue Increases</td>
</tr>
<tr>
<td>Inelastic</td>
<td>Total Revenue Increases</td>
<td>Total Revenue Decreases</td>
</tr>
</tbody>
</table>

Amlani (2008)

Caveat: Over-charging is not being advocated. Over-charging for a product or service can result in no gain or a loss in revenue.
### Hypothetical Data – ABC Audiology, LLC
Data from Fiscal Year 2012-2013

<table>
<thead>
<tr>
<th>Q</th>
<th>%ΔQ</th>
<th>P</th>
<th>%ΔP</th>
<th>ε</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td></td>
<td>$1,000.00</td>
<td></td>
<td></td>
<td>$20,000.00</td>
</tr>
<tr>
<td>17</td>
<td>-0.16</td>
<td>$1,700.00</td>
<td>0.52</td>
<td>-0.31</td>
<td>$28,900.00</td>
</tr>
<tr>
<td>14</td>
<td>-0.19</td>
<td>$2,500.00</td>
<td>0.38</td>
<td>-0.51</td>
<td>$35,000.00</td>
</tr>
<tr>
<td>11</td>
<td>-0.24</td>
<td>$3,300.00</td>
<td>0.28</td>
<td>-0.87</td>
<td>$36,300.00</td>
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<tr>
<td>8</td>
<td>-0.32</td>
<td>$4,000.00</td>
<td>0.19</td>
<td>-1.65</td>
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<tr>
<td>5</td>
<td>-0.46</td>
<td>$4,800.00</td>
<td>0.18</td>
<td>-2.54</td>
<td>$24,000.00</td>
</tr>
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</table>

| 75 |     |       |     |   | $176,200.00 |

### Forecast Scenario #1 – ABC Audiology, LLC
Reducing Price (-$200) Across the Board

<table>
<thead>
<tr>
<th>Q</th>
<th>%ΔQ</th>
<th>P</th>
<th>%ΔP</th>
<th>ε</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 (+1)</td>
<td></td>
<td>$800.00</td>
<td></td>
<td></td>
<td>$16,800.00</td>
</tr>
<tr>
<td>18 (+1)</td>
<td>-0.15</td>
<td>$1,500.00</td>
<td>0.61</td>
<td>-0.25</td>
<td>$27,000.00</td>
</tr>
<tr>
<td>15 (+1)</td>
<td>-0.18</td>
<td>$2,300.00</td>
<td>0.42</td>
<td>-0.43</td>
<td>$34,500.00</td>
</tr>
<tr>
<td>12 (+1)</td>
<td>-0.22</td>
<td>$3,100.00</td>
<td>0.30</td>
<td>-0.75</td>
<td>$37,200.00</td>
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<tr>
<td>9 (+1)</td>
<td>-0.29</td>
<td>$3,800.00</td>
<td>0.20</td>
<td>-1.41</td>
<td>$34,200.00</td>
</tr>
<tr>
<td>6 (+1)</td>
<td>-0.40</td>
<td>$4,600.00</td>
<td>0.19</td>
<td>-2.10</td>
<td>$27,600.00</td>
</tr>
</tbody>
</table>

| 81 |     |       |     |   | $177,300.00 |

+$1100.00
## Forecast Scenario #2 – ABC Audiology, LLC
### Increasing Price (+$200) Across the Board

<table>
<thead>
<tr>
<th>Q</th>
<th>%ΔQ</th>
<th>P</th>
<th>%ΔP</th>
<th>ε</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 (-1)</td>
<td>-0.17</td>
<td>$1,200.00</td>
<td>0.45</td>
<td>-0.38</td>
<td>$22,800.00</td>
</tr>
<tr>
<td>16 (-1)</td>
<td>-0.21</td>
<td>$1,900.00</td>
<td>0.35</td>
<td>-0.59</td>
<td>$30,400.00</td>
</tr>
<tr>
<td>13 (-1)</td>
<td>-0.26</td>
<td>$2,700.00</td>
<td>0.26</td>
<td>-1.01</td>
<td>$35,100.00</td>
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<tr>
<td>11 (-1)</td>
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<td>$3,500.00</td>
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<td>0.17</td>
<td>3.14</td>
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</table>

**69**

**$172,700.00**

- **-$3500.00**

## Forecast Scenario #3 – ABC Audiology, LLC
### Following Revenue Table

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<thead>
<tr>
<th>Q</th>
<th>%ΔQ</th>
<th>P</th>
<th>%ΔP</th>
<th>ε</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 (-1)</td>
<td>-0.17</td>
<td>$1,200.00</td>
<td>0.45</td>
<td>-0.38</td>
<td>$22,800.00</td>
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<tr>
<td>16 (-1)</td>
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<td>0.35</td>
<td>-0.59</td>
<td>$30,400.00</td>
</tr>
<tr>
<td>13 (-1)</td>
<td>-0.26</td>
<td>$2,700.00</td>
<td>0.26</td>
<td>-1.01</td>
<td>$35,100.00</td>
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<tr>
<td>10 (-1)</td>
<td>-0.25</td>
<td>$3,500.00</td>
<td>0.26</td>
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<tr>
<td>9 (+1)</td>
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<td>$3,800.00</td>
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<tr>
<td>6 (+1)</td>
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<td>$4,600.00</td>
<td>0.19</td>
<td>-2.10</td>
<td>$27,600.00</td>
</tr>
</tbody>
</table>

**73**

**$185,100.00**

- **+$8900.00**

* = Increase Price (+$200) • = Decrease Price (-$200)
Increasing Hearing Aid Adoption Rates Through Value-based Advertising and Price Unbundling

Explaining the benefits of our products and services is the key to future market growth

By Amy M. Amlani, Ph.D., Brian Taylor, Au.D., and Tara Wenzberg

<table>
<thead>
<tr>
<th>Feature</th>
<th>Pure Price Bundling</th>
<th>Partial Price Bundling</th>
<th>Price Unbundling</th>
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<tbody>
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<td>$2200.00</td>
<td>$2000.00</td>
<td>$500.00</td>
</tr>
<tr>
<td>3 Memories</td>
<td>Included</td>
<td>Included</td>
<td>$200.00</td>
</tr>
<tr>
<td>12 Channels, 8 Bands</td>
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<td>Included</td>
<td>$200.00</td>
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<tr>
<td>Independent WDRC</td>
<td>Included</td>
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<td>$200.00</td>
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<td>Adaptive Noise Reduction</td>
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<td>Included</td>
<td>$250.00</td>
</tr>
<tr>
<td>Adaptive Feedback Control</td>
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<td>Included</td>
<td>$250.00</td>
</tr>
<tr>
<td>Professional Fee</td>
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<td>$200.00</td>
<td>$200.00</td>
</tr>
<tr>
<td>2-Year Mfr Warranty</td>
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<td>Included</td>
<td>$150.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$2200.00</strong></td>
<td><strong>$2200.00</strong></td>
<td><strong>$2200.00</strong></td>
</tr>
</tbody>
</table>

Amlani et al (2011)
QUESTION 4

• Which pricing strategy is employed in your practice?

A. Price Bundling  
B. Partial Price Unbundling  
C. Price Unbundling
BUNDLED VS. UNBUNDLED PRICING

Amlani et al (2011)
INFLUENCE OF ADVERTISING FRAMING

Amlani et al (2011)

INFLUENCE OF PRICING STRATEGY

Amlani et al (2011)
Amlani (2013)

SUBSTITUTE TO PRICE UNBUNDLING
SUMMARY
Facility - Value Chain - Access - Appeal - Comfort - Staff - Privacy

Provider

Demeanor
- Competence
- Attentiveness
- Empathy
- Informative
- Unbiased
- Accessibility

Patient

Emotional Value
Social Value
Quality Value
Value Chain

Family/Friends

Referrals

Loyalty

Satisfaction

Perceived Value

Utilization

Compliance

Total Utility

High

Low

Amlani (2013)

amlaniam@unt.edu