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Rethinking Your Diagnostic Audiology Battery: Part 1. Using Value Added Tests

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Rethinking Your Diagnostic Audiology Battery: Part 1. Using Value Added Tests

- Learner Outcomes
  1. Describe evolution of the audiological test battery
  2. Define what is meant by “standard of care”, “evidence based practice” and “value added test”
  3. List advantages of specific test procedures in assessing auditory functions
Rethinking Your Diagnostic Audiology Battery:

- Historical Perspective on Diagnostic Audiology  (0—5 min)
- Standard of Care in Audiology  (6—10 min)
- Concept of Value Added Tests  (11—15 min)
- Guidelines for Efficient and Effective Diagnostic Test Batteries (41—55 min)
- Summary, Questions and Answers (55—60 min)

Scientific Foundation of Audiology
Psychoacoustics Laboratory (PAL)
Harvard University (1940s and 1950s)

SS Stevens
(1906-1973)
Scientific Foundations of Audiology
Audiology Grandparents

Georg von Bekesy (1899 - 1972)
Nobel Prize for Physiology or Medicine 1961
GSI E800 Bekesy Audiometer

PhD from University of Chicago under Nobel Prize Winner Robert Miliken
Illustrious Career at Bell Telephone Laboratories
Seminal Publications, e.g.

Harvey Fletcher (1884-1981)
Hallowell Davis
(1896 - 1992)

Ira Hirsh
(1922 - 2010)
Scientific Foundations of Audiology
Audiology Grandparents
*The Hearing Journal, 64 (8), 2011*

Robert Galambos, PhD, MD
(1914 - 2010)

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Origins of Audiology in the USA
*Demand for Hearing Services During and After WW II*
Raymond Carhart: Father of Audiology

*Developed Audiology Test Battery 70 Years Ago*

*(Audiology Father of James Jerger)*

- Test battery at the beginning of our profession, in order of test administration
  - Air-conduction pure tone audiometry
  - Bone-conduction pure tone audiometry
  - Speech reception thresholds
  - Word recognition (PB word lists)
  - Uncomfortable loudness level (UCL), i.e., loudness discomfort level (LDL)


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Scientific Foundation of Audiology

James Jerger, PhD ... My Audiology Father

*Father of Diagnostic Audiology; Founder of American Academy of Audiology*
### Rethinking Your Diagnostic Audiology Battery: An Update or “Makeover” is Long Overdue

<table>
<thead>
<tr>
<th>Procedure</th>
<th>% Performing Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure tone audiometry: air conduction</td>
<td>100%</td>
</tr>
<tr>
<td>Pure tone audiometry: bone conduction</td>
<td>100%</td>
</tr>
<tr>
<td>Word recognition</td>
<td>95%</td>
</tr>
<tr>
<td>Speech reception threshold</td>
<td>91%</td>
</tr>
<tr>
<td>UCL (LDL) for speech</td>
<td>83%</td>
</tr>
<tr>
<td>Tympanometry</td>
<td>45%</td>
</tr>
<tr>
<td>UCL (LDL) for tones</td>
<td>45%</td>
</tr>
<tr>
<td>Acoustic reflexes</td>
<td>20%</td>
</tr>
<tr>
<td>Otoacoustic emissions (OAEs)</td>
<td>4%</td>
</tr>
</tbody>
</table>

Source: The Hearing Journal, December, 2002

### Rethinking Your Diagnostic Audiology Battery: Part 1. Using Value Added Tests

- Historical Perspective on Diagnostic Audiology *(0—5 min)*
- Standard of Care in Audiology *(6—10 min)*
- Concept of Value Added Tests *(11—15 min)*
- Guidelines for Efficient and Effective Diagnostic Test Batteries *(41—55 min)*
- Summary, Questions and Answers *(55—60 min)*
Standard of Care in Audiology:  
*Best Practice is Research Based Practice*

"Those who fall in love with practice without science are like a sailor who steers a ship without a rudder or compass, and who can never be certain whither he is going."

Leonardo Da Vinci (1452-1519)

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Evidence-Based Practice:  
Categories of Research Evidence (ASHA, 2004)

- 1a: Well-designed meta-analysis of randomized controlled trials
- 1b: Well-designed randomized controlled trials
- 2a: Well-designed controlled studies without randomization
- 2b: Well-designed quasi-experimental studies
- 3: Well-designed non-experimental studies, i.e., correlational and case studies
- 4: Expert committee reports, consensus conferences and clinical experience
Rethinking Your Diagnostic Audiology Battery: Part 1. Using Value Added Tests

*Standard of Care*

- The degree of caution that a reasonable person should exercise in a given situation so as to avoid causing injury ... try to help but do not harm
- Consistent with local, regional or national clinical practice
- Follows guidelines on clinical practice approved by
  - Multi-disciplinary professional committees or panels, e.g., Joint Committee on Infant Hearing
  - National professional organizations
- Is consistent with statements of
  - Scope of Practice
  - Code of Ethics
- In compliance with Federal guidelines for clinical practice

<table>
<thead>
<tr>
<th>Rethinking Your Diagnostic Audiology Battery: Part 1. Using Value Added Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>❑ Historical Perspective on Diagnostic Audiology (0—5 min)</td>
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<tr>
<td>❑ Summary, Questions and Answers (55—60 min)</td>
</tr>
</tbody>
</table>
The Concept of Value Added Tests (VATs):
Rationale for Inclusion in a Test Battery

- Procedure adds value to the description of auditory status for the patient, including information that is:
  - Not available from other procedures and/or
  - Obtained quicker than with another procedure and/or
  - Poses less risk than an alternative procedure and/or
  - Costs less than a comparable procedure
  - Findings are more reliable or valid than an alternative test
  - Highly sensitive to auditory dysfunction
  - Provides site-specific information on auditory dysfunction
  - Contributes to more accurate diagnosis
  - Useful in managing the patient and/or
  - Information leads to better outcome for the patient

The Concept of Value Added Tests (VATs):
Old versus New Procedures

- Some old procedures almost always add value, e.g.,
  - Tympanometry
  - Acoustic reflexes
- Some more recent procedures almost always add value, e.g.,
  - Otoacoustic emissions
- Some traditional test procedures do not invariably add value, e.g.,
  - Speech recognition threshold (SRT)
  - Bone conduction pure tone audiometry
  - Word recognition in quiet at 40 dB SL
The Concept of Value Added Tests (VATs): A Critical Look at Three Traditional Procedures

Speech Recognition Threshold (SRT)

- Study of 1000 pediatric and adult patients (Roscher & Hall, 2005)
- SRT rarely contributed to diagnosis of hearing loss
- Factors in significant differences between PTA vs. SRT
  - Age
    - Children (< 20 years)
    - Older adults (> 66 years)
  - Hearing loss
    - No value in persons with normal hearing thresholds
    - Greater PTA-SRT difference for SNHL
    - Greater PTA-SRT difference for sloping hearing loss

<table>
<thead>
<tr>
<th>TABLE 2. Age distribution for all complete records and for patients with repeat tests excluded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
</tr>
<tr>
<td>&lt;10 10s 20s 30s 40s 50s 60s 70s 80s 90s No age</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>%</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>%</td>
</tr>
</tbody>
</table>


For 53% of 16,818 patients, age was between 20 to 70 years.
The Concept of Value Added Tests: 
Selective Use of Speech Reception Threshold

- Little or no value for
  - Adult patients age 20 to 65 years
  - Patients with normal hearing thresholds
  - Consistent findings available before pure tone audiometry
    - Normal tympanograms bilaterally
    - Acoustic reflex thresholds at expected normal levels
    - Otoacoustic emission amplitudes within normal limits
- Speech reception threshold measurement in such patients will
  - Waste valuable test time
  - Not add value to the diagnosis
  - Not add value to referral or management decisions
  - Not lead to improved patient outcome

The Concept of Value Added Tests (VATs):
A Critical Look at Three Traditional Procedures
Bone Conduction Pure Tone Audiometry

The Concept of Value Added Tests: Selective Use of Bone Conduction Pure Tone Audiometry

- No value in many patients, e.g., an adult with
  - No history of middle ear disease
  - Pattern of findings available before pure tone audiometry
    - Normal tympanograms bilaterally
    - Acoustic reflex thresholds at expected normal levels
    - Otoacoustic emission amplitudes within normal limits
  - Air conduction pure tone audiometry showing sloping high frequency hearing loss
- Bone conduction pure tone audiometry in such patients will
  - Waste valuable test time
  - Not add value to the diagnosis
  - Not add value to referral or management decisions
  - Not lead to improved patient outcome

The Concept of Value Added Tests (VATs): Selective Use of Word Recognition in Quiet

- Patient is an adult with the chief complaint of difficulty hearing in noisy settings
- Patient converses easily in the clinic without visual cues
- Pure tone audiometry findings are entirely normal
- Word recognition in quiet will ...
  - Waste valuable test time
  - Not add value to the diagnosis
  - Not add value to management
  - Not lead to improved patient outcome
- Instead
  - Perform a test of speech perception in noise
  - Consider other tests of auditory processing
Rethinking Your Diagnostic Audiology Battery:  

☐ Historical Perspective on Diagnostic Audiology  (0—5 min)  
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Rethinking Your Diagnostic Audiology Battery:  
Comparative Times for Different Tests

“Remember that time is money”

Benjamin Franklin

Advice to a Young Tradesman  
1748
American Academy of Audiology  
Clinical Guidelines Development

Published on Audiology (http://www.audology.org)
Home / Clinical Practice Guidelines

The Clinical Practice Guidelines Development Process

The Clinical Practice Guidelines Development Process
July 2006

Clinical practice guidelines (CPG) advance the mission of the American Academy of Audiology (Academy) by providing a framework of clinical recommendations to audiologists for the express purpose of providing state-of-the-art care for individuals with hearing and balance disorders. CPGs have been defined as “systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances” (Committee to Advise the Public. Health Impact on Clinical Practice Guidelines, Institute of Medicine, 1990). More specifically, well-developed guidelines have the potential to: (1) enhance current, appropriate clinical practice; (2) improve the quality of audiology diagnostic assessment and treatment; (3) result in better patient outcomes; (4) improve cost-effectiveness of the care; and (5) identify areas requiring further investigation. These recommendations should be provided in a manner that affords the practitioner a more complete understanding of the topical evidence available for each condition, procedure, and treatment option presented.

Examples of Current AAA Practice Guidelines in Audiology (More are Coming)

- 2007 Joint Committee on Infant Hearing (JCIH) Position Statement
- 2008 Guidelines on Identification, Diagnosis, and Management of Auditory Neuropathy Spectrum Disorder in Infants and Young Children
- 2009 Clinical Guidelines for Ototoxicity Assessment and Monitoring
- 2010 American Academy of Audiology Clinical Practice Guidelines: Diagnosis, Treatment, and Management of Children and Adults with Central Auditory Processing Disorders
Examples of Current AAA Practice Guidelines in Audiology *(More are Coming)*

- 2010 American Academy of Audiology Clinical Practice Guidelines: Childhood Hearing Screening
- 2012 American Academy of Audiology: Audiologic Guidelines for the Assessment of Hearing in Infants and Young Children
- 2013 American Academy of Audiology Clinical Practice Guidelines: Pediatric Amplification
- American Academy of Audiology Clinical Practice Guidelines: Otoacoustic Emissions (in progress)

Examples of Some of the ASHA Audiology Guidelines *(www.asha.org)*

- Audiologic Screening (1997)
- Audiology Service Delivery in Nursing Homes (1997)
- Audiology Service Provision in and for Schools (2002)
- Clinical Practice Guidelines: Cerumen Impaction (2008)
- Audiologists Providing Informational and Adjustment Counseling (2008)
Examples of Current Practice Guidelines in Audiology: UK

Recommended Procedure
Tympanometry
Date: August 2013

Recommended Procedure
Pure-tone air-conduction and bone-conduction threshold audiometry with and without masking
Date: September 2011 (minor amendments: February 2012, and December 2013)

Position Statement
Auditory Processing Disorder (APD)
Date of this version: March 2011

Examples of Current Practice Guidelines in Audiology: UK

NEWBORN HEARING SCREENING AND ASSESSMENT
Guidance for Auditory Brainstem Response testing in babies
Version 2.1
March 2013

NHSP Clinical Group
Graham Sutton², Guy Lightboll (Co-editor)
Contributors: John Stevens¹, Rachel Bouch¹, Sobhan Brennan¹, Rachel Fein¹, Ethan Meredith¹

NEWBORN HEARING SCREENING AND ASSESSMENT
Guidelines for the Assessment and Management of Auditory Neuropathy Spectrum Disorder in Young Infants
Version 2.2
August 2013

NHSP Clinical Group
Rachel Fein¹ (Editor), Graham Sutton², Glynnis Packer³, Tony Sirimanna⁴, Guy Lightboll¹, Sally Wood²
Examples of Current Practice Guidelines in Audiology:

**UK**

**Recommended Procedure**

Taking an aural impression

Date: February 2011

**Recommended Procedure (Supplement)**

Taking an aural impression: children under 5 years of age

Date: February 2018

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**Examples of Current Practice Guidelines in Audiology:**

**UK**

**Tinnitus in Children**

Practice Guidance

**Recommended Procedure**

Cortical Auditory Evoked Potential (CAEP) Testing

Date: May 2016
Canadian Clinical Guidelines on Auditory Processing Disorder in Children and Adults
(www.sac-oac.ca)

Clinical Guidelines:
Auditory Neuropathy Spectrum Disorder (2010)

- In June 2008, at the invitation of Deborah Hayes, a panel of experts met in Comon, Italy at the NHS 2008 Conference to develop Guidelines for the Identification and Management of Infants and Young Children with Auditory Neuropathy.
- The panel consisted of:
  - Yvonne Sininger, Ph.D.
  - Arnold Starr, M.D.
  - Christine Petit, M.D., Ph.D.
  - Gary Rance, Ph.D.
  - Barbara Cone, Ph.D.
  - Kai Uus, M.D., Ph.D.
  - Patricia Roush, Au.D.
  - Jon Shallop, Ph.D.
  - Charles Berlin, Ph.D.
### A Modern Diagnostic Audiologic Test Battery
**In the Order of Testing for New Patients.**

*Total Test Time ~ 30 - 45 minutes.*

- **Otoscopy**
- **Objective measures**
  - Otoacoustic emissions (OAEs)
    - DPOAEs 500 to 8000 Hz
    - Normal versus present but abnormal versus absent
  - Aural immittance measures
    - Tympanometry
    - Acoustic reflexes (*crossed vs. uncrossed conditions*)

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### Behavioral measures

- Pure tone audiometry (*automated technique as appropriate*)
  - Inter-octave frequencies (e.g., 3000 and 6000 Hz)
  - High frequency (> 8000 Hz) audiometry *as indicated*
  - Bone conduction measurement *only as indicated*

- Speech audiometry
  - SRT *only as indicated*
  - Word recognition (recorded material) with 10 most difficult words first
  - Speech-in-noise test
  - Screen auditory processing as indicated
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Rethinking Your Diagnostic Audiology Battery:

- Summary
  - Audiology patient care should be in compliance with clinical practice guidelines
  - Efficiency and effectiveness should also be considered in the diagnostic audiology test battery … the most clinical information in the least test time
  - The test battery should consist of value added tests … how will the findings contribute to diagnosis or management of the patient

- Questions and Answers