Alaska Native
Tribal Health Consortium

Technology Assessment 101

Selecting the Right Equipment for your Program

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The Problem(s)

- New telemedicine specialties, which require …
  - New hardware to enable it, which requires …
  - New software to integrate it, all of which …
  - Must be developed with the following limitations in mind …
    - Conflicts of usage style (specialist vs. generalist)
    - Conflicts of cost
    - Installation, Training, Maintenance and support

Technology is a "Limiter" for Telehealth

- Successful selection of technology does not guarantee a successful telehealth program.

- But a failed technology selection will likely lead to a failed telehealth program.

  - "The equipment is too difficult to use"
  - "Nobody showed me how to use the …"
  - "The audio/video quality made a diagnosis impossible"
  - Equipment is not calibrated
  - Equipment fails repeatedly

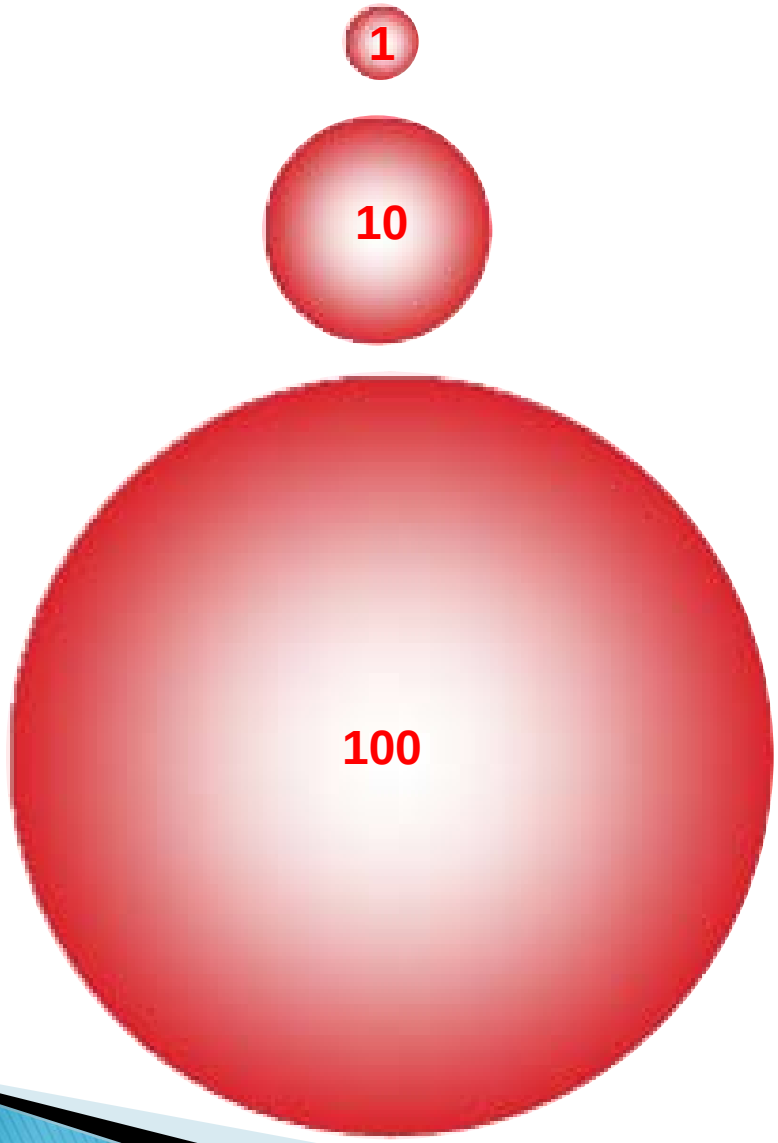
GIGO Rules

Technological tools are the eyes and ears of the physician.

Physicians are limited by the information provided by the technology.

- Live Audio/Video
- General Purpose Video & Still Cameras
- Scope Technology: Dental/Retinal Cameras
- Stethoscope
- ECG
- Vital Signs
- Ultrasound

Assessment Saves Time and Effort

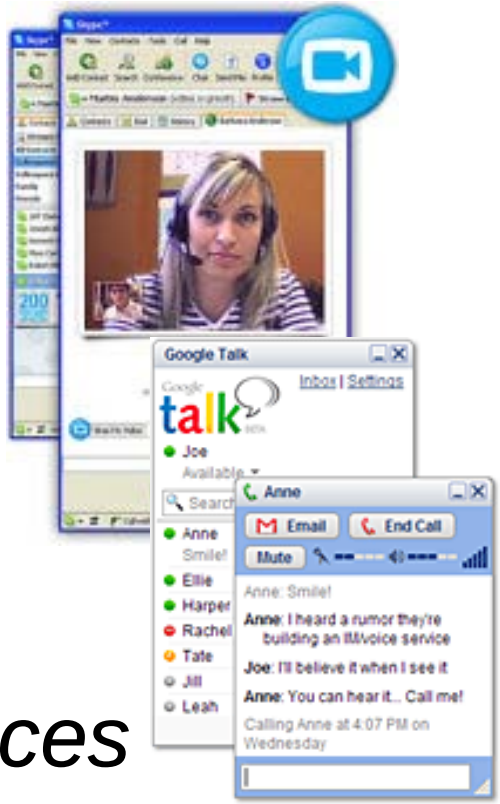


Cost of catching a problem before a final purchase

Cost of catching a problem before deploying equipment

Cost of catching a problem after deploying equipment

A Changing Landscape



Traditional Devices

+ New Connectivity

+ New Messaging

= NEW SOLUTIONS

A NEW TECHNOLOGY PARADIGM

It is becoming less relevant to simply assess component technologies without understanding the system design and device context.

OLD PARADIGM	Videoconferencing with “inband” serial devices … OR … Store and Forward … OR … Home Health
NEW PARADIGM	Synchronous or asynchronous data feeds from multiple devices, integrated into the patient health record, and available on a multitude of display platforms

What is Technology "Assessment"?

Technology Assessment is …

Technology assessment is critical to allow providers and programs to keep up with needs, expectations, and the market.

- Finding the "Right" technology
  - Define "Right"?
  - Where do you "Find" answers?
  - What level of risk are you willing to accept?

- **How do you define your questions?**
- **How do you learn about your options?**
- **How can you differentiate between the options?**

Solution "Lifecycle"

Technology is not a solution, but a portion (or investment) in many facets of the solution design

- Needs Assessment & Functional Requirements
- Hardware Integration
- Software Integration
- Procurement / Inventory Management
- Manufacturing
- Deployment / Installation
- Workflow Integration
- Production Support
- Training
- Customer Support
- Decommissioning
- Security
- Quality Assurance
- Reimbursement / Billing
- Evaluation

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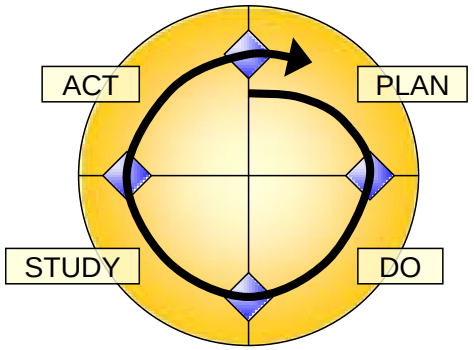
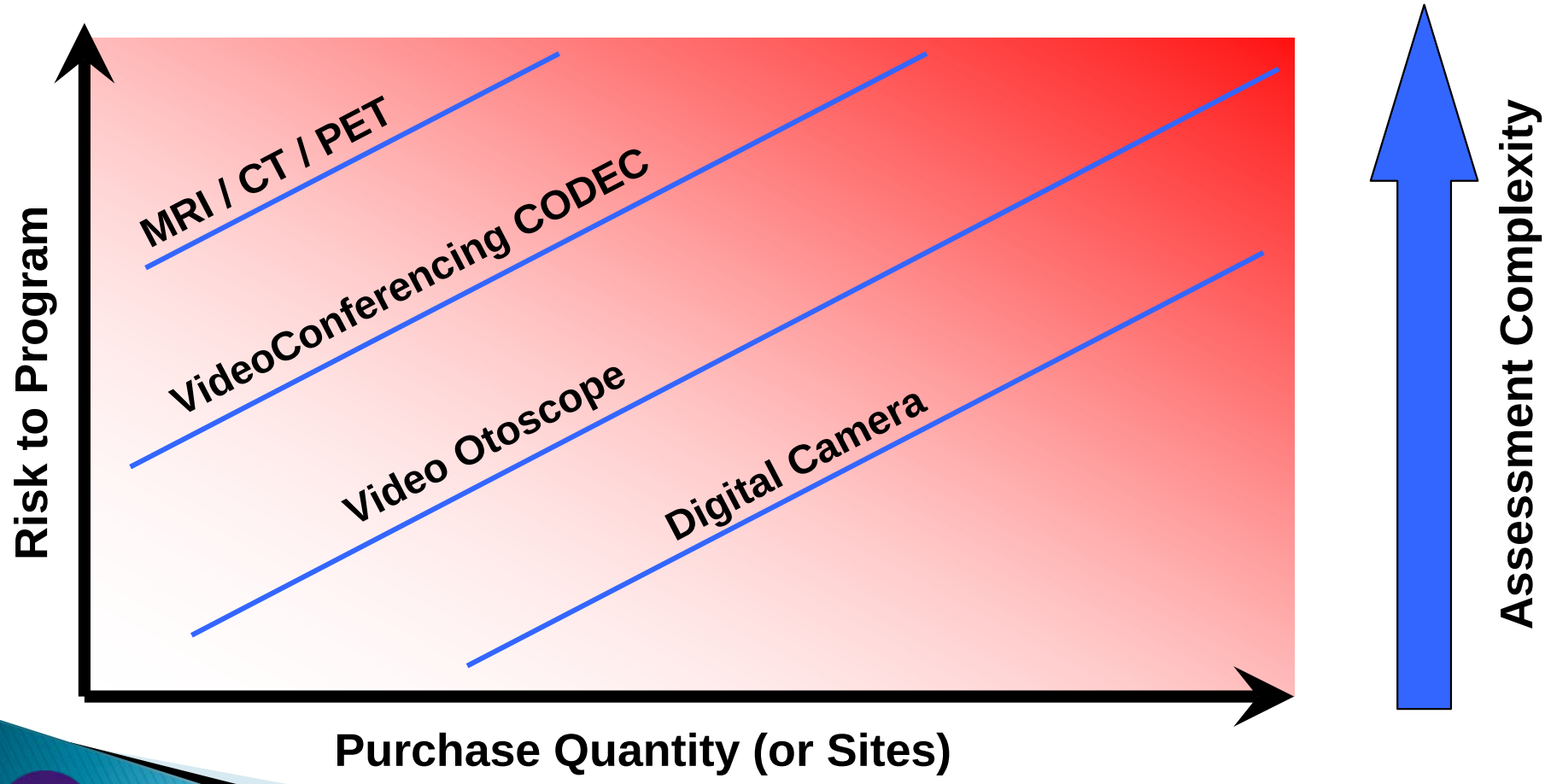
Telehealth Technologies

- The Goal is to *design-build* appropriate solutions as part of the solution lifecycle.
  - Review / Design / Build / Test
    - Requirements Analysis → Product Solution
    - Usability, Verification
  - Refine / Improve
  - Integrate
  - Review / Refine / Refresh
    - Performance, Validation



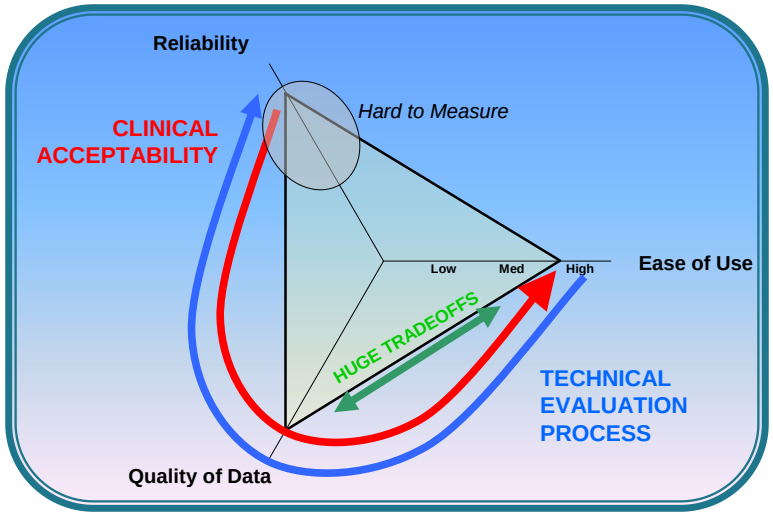
It is about building solutions.

Risk Analysis



Testing to Assure Usage

- "Providers want to use it"
  - Meets a critical health need
  - Improve the quality of care
  - Improve efficiency
  - Reduce workload
- "Providers use it correctly"
  - Regular use -- not intermittent!
  - Ongoing training and Quality Control
- "Providers continue to use it"
  - Broad Customer Support services (technical, clinical, …)
  - Non-obsolescence – New products, Features, Peripherals
  - User involvement in Product Improvement
- "Providers can interact as needed"
  - Inter-operability with other systems – telehealth, PACS, HIS, Billing, …
  - Technical Standards
  - Active involvement/recruitment of receivers



A Structured Process for Telehealth Assessment

- Introduction
  - Clinical Need
  - Design Goals
    - Mandatory
    - Value Added
- Market Review
  - Manufacturers
  - Available Products
  - First Cut
  - Description of the Units
  - Expert Interviews and reviews
  - Scientific Papers
  - Specifications Research
  - Costs (consumables, calibration etc.)
  - Functional Requirements
  - Second Cut
  - Summary
- Testing and Review
  - Methods
    - Evaluations by Users: Long & Short Forms
    - Formal Testing
  - Results
    - Evaluations
    - Formal Testing
  - Features
    - Physical Design Features
    - Functional Design Features
  - Analysis of Results
    - Data Quality
    - Evaluation Ratings
    - Features
- Final Selection
  - Units and Reasons
- Project Goals and Choice
  - How the unit meets the original design goals
    - Mandatory Design Goals
    - Value Added Design Goals

Follow a Well Formed Process

Technology/Device Evaluation

- **Introduction**
  - Clinical Need
  - Design Goals
    - Mandatory
    - Value Added
- *Market Review*
  - *Manufacturers*
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  - *Summary*
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  - *Methods*
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Know your USER(S)

To thine own self be true

- User Volume
  - How many users?
- Frequency of Use
  - How often will user(s) touch the equipment?
- Setting
  - Clinical environment and “remoteness”
- Interface
  - How will user(s) download data?
- Skill Level
  - How adept with technology and relevant techniques (e.g. imaging)?

Know your APPLICATIONS(s)

What are we trying to do?

- Dermatology
  - Skin and associated lesions
- Primary care
  - Skin, wound, burns and x-ray imaging
- Dental and ENT
  - Intra – oral imaging of moist mucous membranes and teeth
- Surgery
  - Skin, blood, and moist anatomical landmarks such as vessels, nerves, organs, etc.
- Pathology
  - Adaptation to a microscope and imaging of slides with specific color and lighting needs
- While the purpose of the application is usually for diagnosis and treatment, there may be another purpose that guides your selection, such as quality assurance or documentation.

Technology/Device Evaluation

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"Choice Overload"

- Identified 90 Digital Cameras on the Market

Canon	Casio	Fuji	Kodak	Nikon	Olympus	Panasonic	Pentax	Samsung	Sony
A490	EX-Z2000	JV100	M575	L110	9010	DMC-ZR3	H90	HZ30W	DSC-HX5V
A495	EX-Z550	F80EXR	M550	L22	7040	DMC-FX66	I-10	HZ35W	DSC-W330
A3000 IS	EX-H15	Z700EXR	M530	L21	7030	DMC-FT2	M90	TL240	DSC-W320
A3100 IS	EX-FH100	Z70	SLICE	S8000	5010	DMC-ZS7		TL210	DSC-W310
SD1400	EX-S7	S1800	M580	S6000	FE-4040	DMC-ZS5		TL205	DSC-W380
SD1300	EX-Z35	S1600	M590	S4000	FE-4030	DMC-TS10		SL600	DSC-TX7
SX210	EX-H5	JZ500		S3000	FE-47	DMC-FH1		SL605	DSC-W370
SD3500	EX-Z800	JZ300		P100		DMC-FH3		CL80	DSC-W350
SD4000IS		JV150				DMC-FP3		ST80	DSC-S2100
		Z800EXR				DMC-FP2		TL500	DSC-S2000
						DMC-FP1		TL350	DSC-TX5
						DMC-FH22		HZ50W	DSC-H55
						DMC-FH20			DSC-TX9
						DMC-FX75			

amazon.com®

allheart™ America's Medical Superstore™

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Marketing Strategies

- Cut through the noise
  - Cut sheets, product announcements and press releases can be biased, but may provide useful information
- Does it to what you need?
- Does it do something you don't need?

Note…

The needs for telehealth may be different than needs for "traditional" clinical care

- Does the device need to record data?
- Does the device need to transmit data?
- How will the device be used?

Narrow the Field
… or WHY we need requirements

- Determine if the products meet your minimum requirements and design goals
  - Rule out products that don't meet your needs.
  - Decide if you will evaluate multiple products from the same manufacturer.

Technology/Device Evaluation

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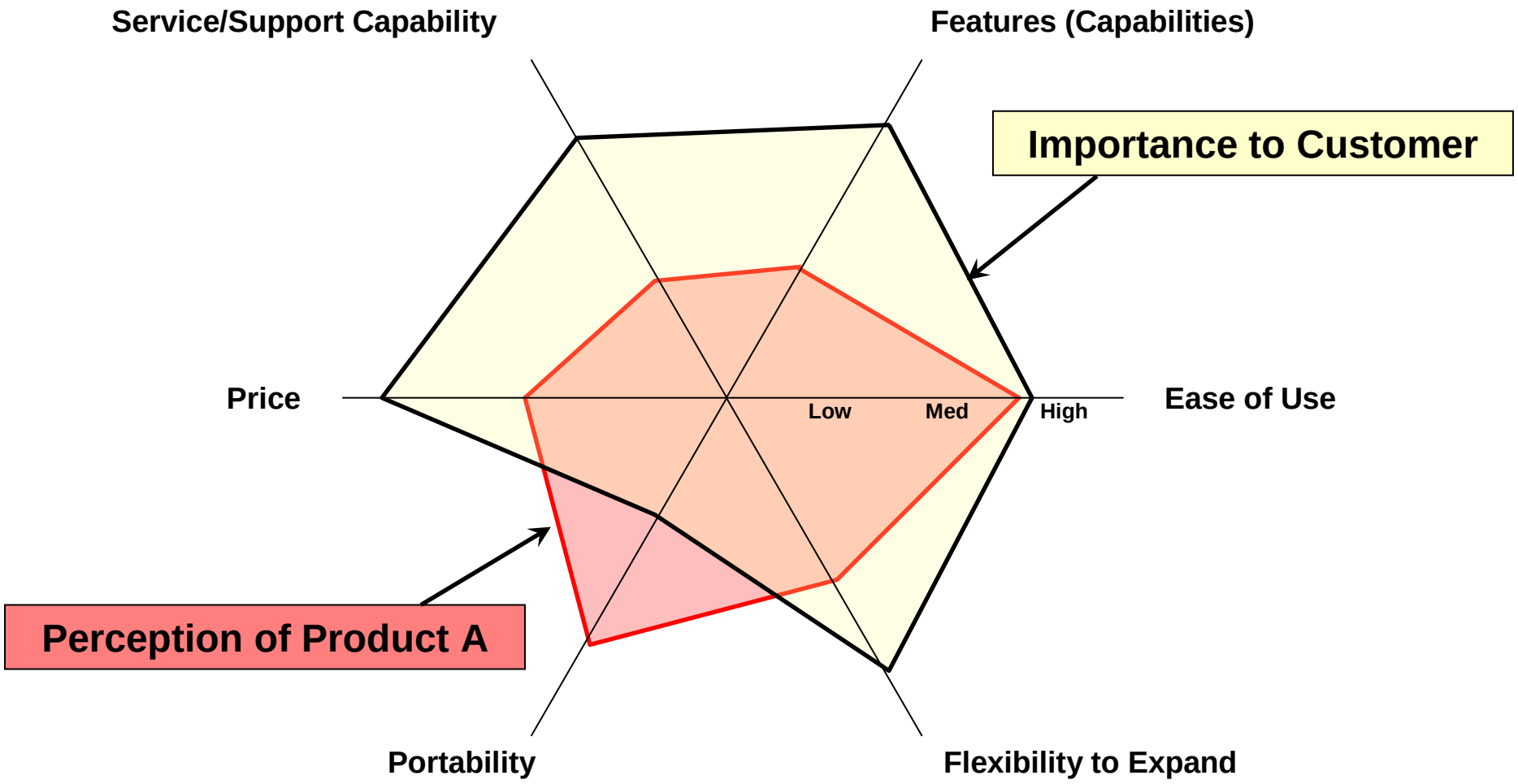
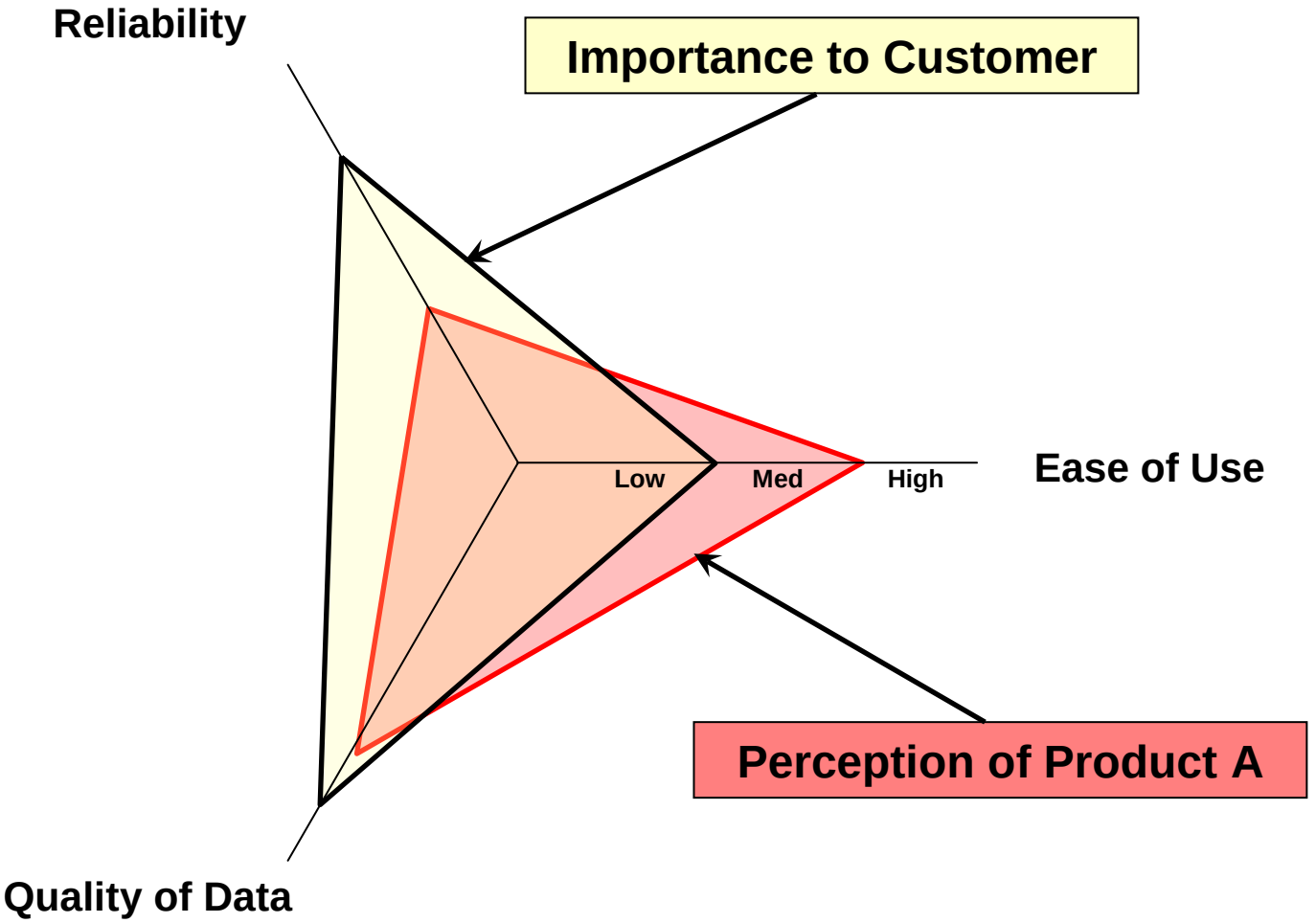
What are you evaluating, and why?

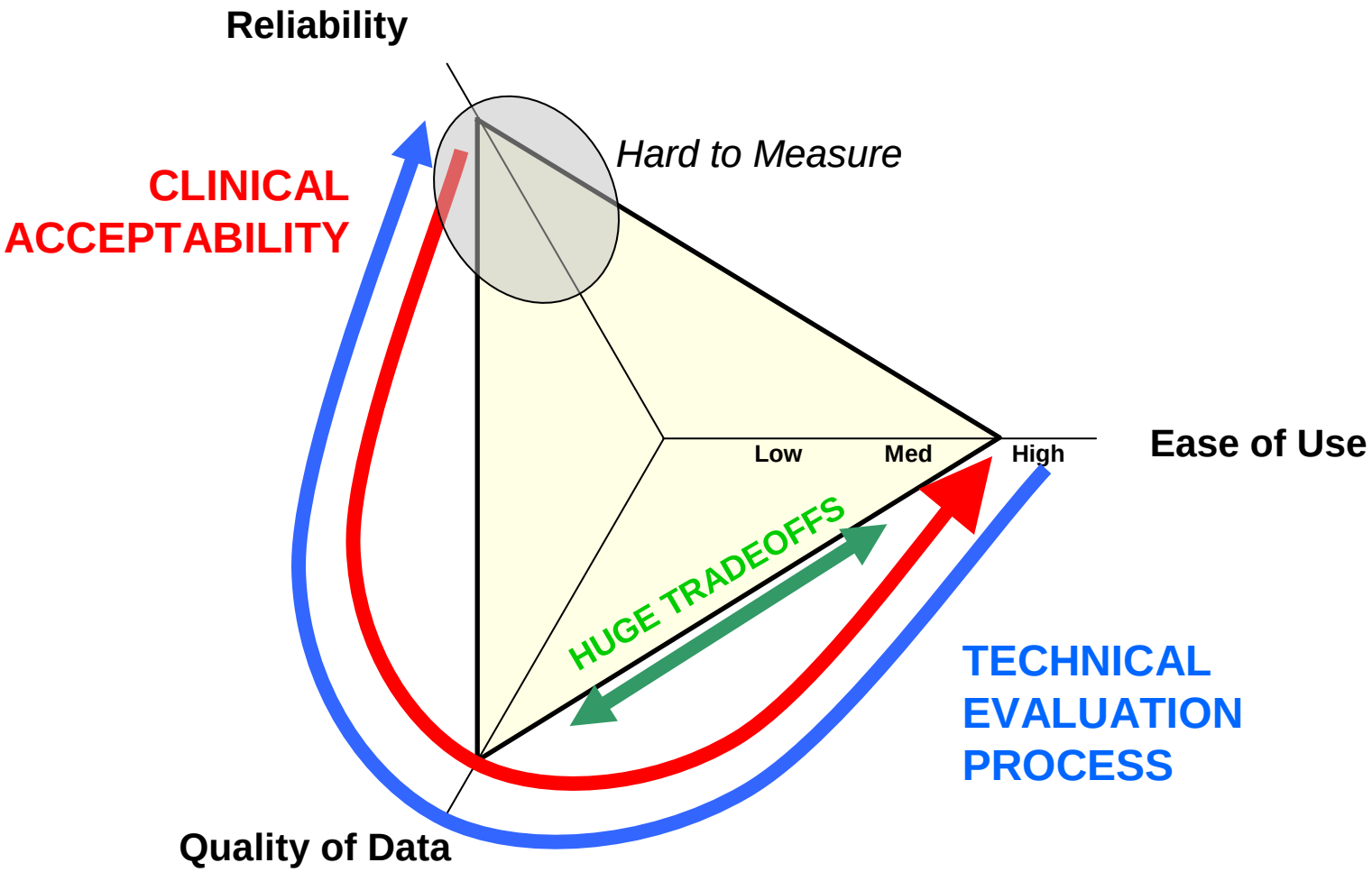
Criteria need to be determined – e.g. from interviews



Key Technical Assessment Criteria



Key Technical Assessment Criteria



RELIABILITY

- From a clinician's perspective:
  - The equipment selected must meet some minimum standard of **Reliability.**
    - Clinicians will be frustrated with your program and opt out if technology fails once (or more?)

- Are you and your technical staff confident in this device?
- Will it keep functioning properly?
- Can you promise support?

DATA QUALITY

- The equipment needs to provide **High Quality** data.
  - Even if it is easy to use, and reliable, you can't really live with poor data.

- ***Quality does not mean "perfect."***
  - You often need to sacrifice some aspects of quality for reliability and ease of use.

- How do you measure quality?
  - Bench tests, Subject Matter Experts, Product Comparison.

EASE OF USE

Average Sum of Ranks of Criteria for Purchasing Telehealth Equipment

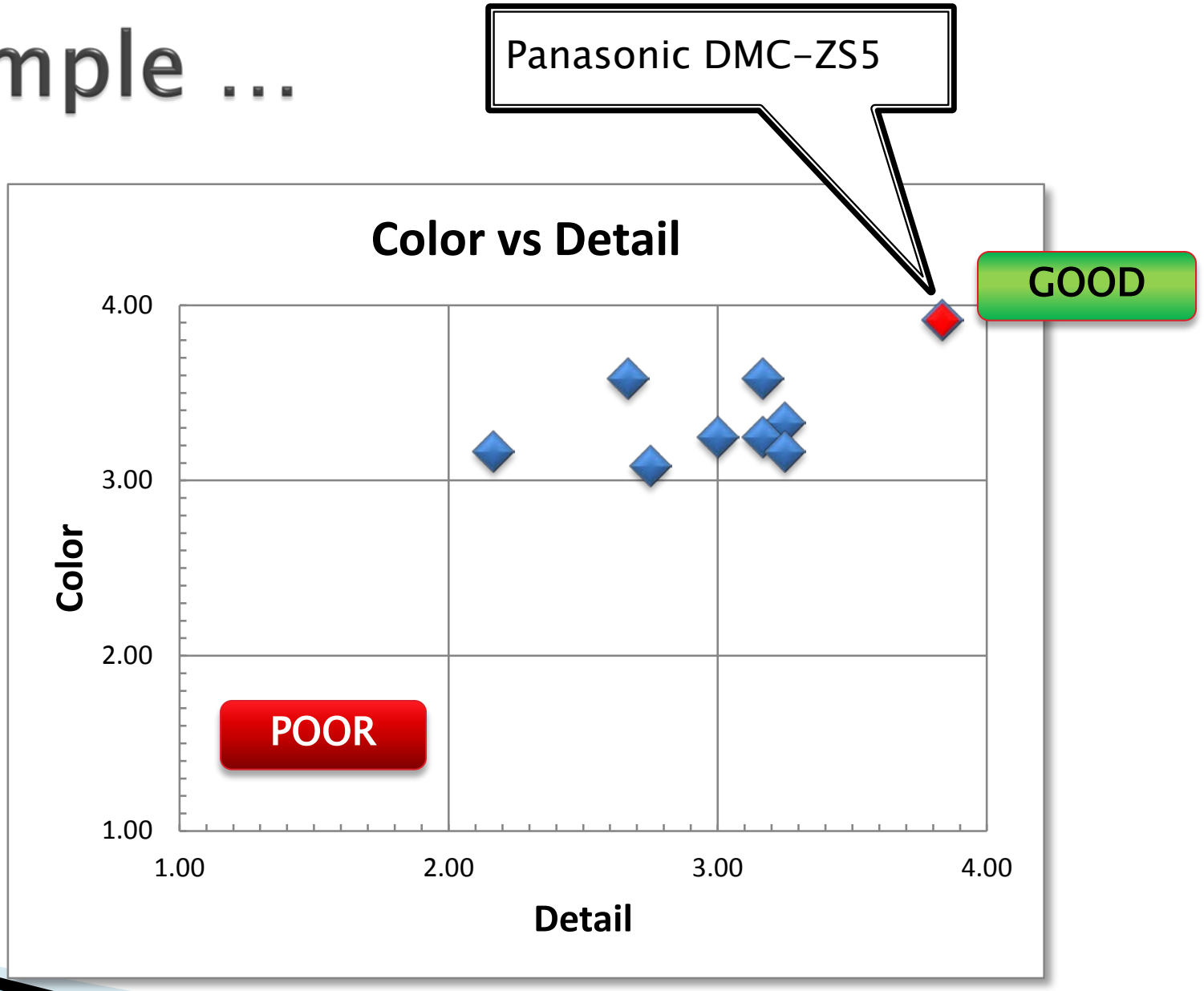
Criteria	*Sum of Rank*	*Average Sum of Rank*
Ease of Use	**194**	**3.4**
Price	**260**	**4.5**
Conformance to standards	**314**	**5.5**
Performance of Equipment during Demonstration	**329**	**5.8**
Ability to Interface with Peripherals	**352**	**6.2**
Service/Support	**365**	**6.4**
Speed	**398**	**7.0**
Mode	**417**	**7.3**
Conformance to Requirements	**419**	**7.4**
Acceptability to Patients	**467**	**8.2**
Financial Stability of Vendor	**484**	**8.5**
Vendor Relationship	**726**	**12.7**
Interoperability	**756**	**13.3**
Meeting Business Requirements	**756**	**13.3**
Reliability	**756**	**13.3**
Acceptability to Providers	**756**	**13.3**
n=57		

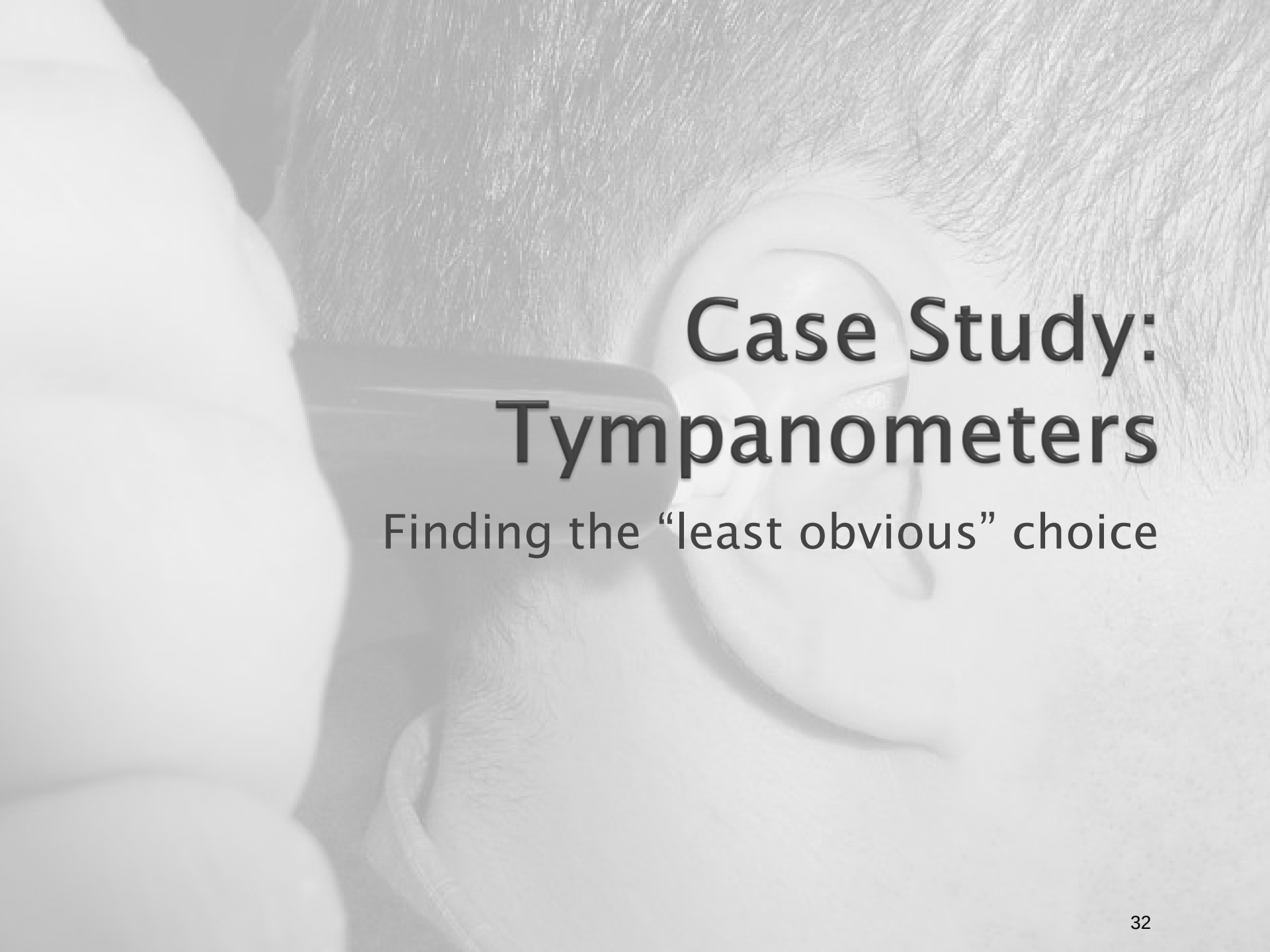
Source: National Initiative for Telehealth Guidelines (NIFTE) , April 2003, Canada. *Survey of 230 stakeholders in the Telehealth Stakeholders Database.*

Analysis …

	Canon SD3500	Casio FH100	Fuji F80EXR	Kodak M580	Nikon S8000	Olympus 7040	Panasonic DMC-ZS5	Pentax H90	Samsung HZ35W
MECHANICAL	3.78	3.74	**4.46**	3.61	***4.12***	3.60	**4.27**	3.75	**4.31**
IMAGE QUALITY	**3.21**	**3.21**	3.13	**3.34**	3.13	2.92	**3.88**	2.67	**3.38**
COMBINED	3.50	3.48	**3.80**	3.48	**3.63**	3.26	**4.08**	3.21	**3.85**

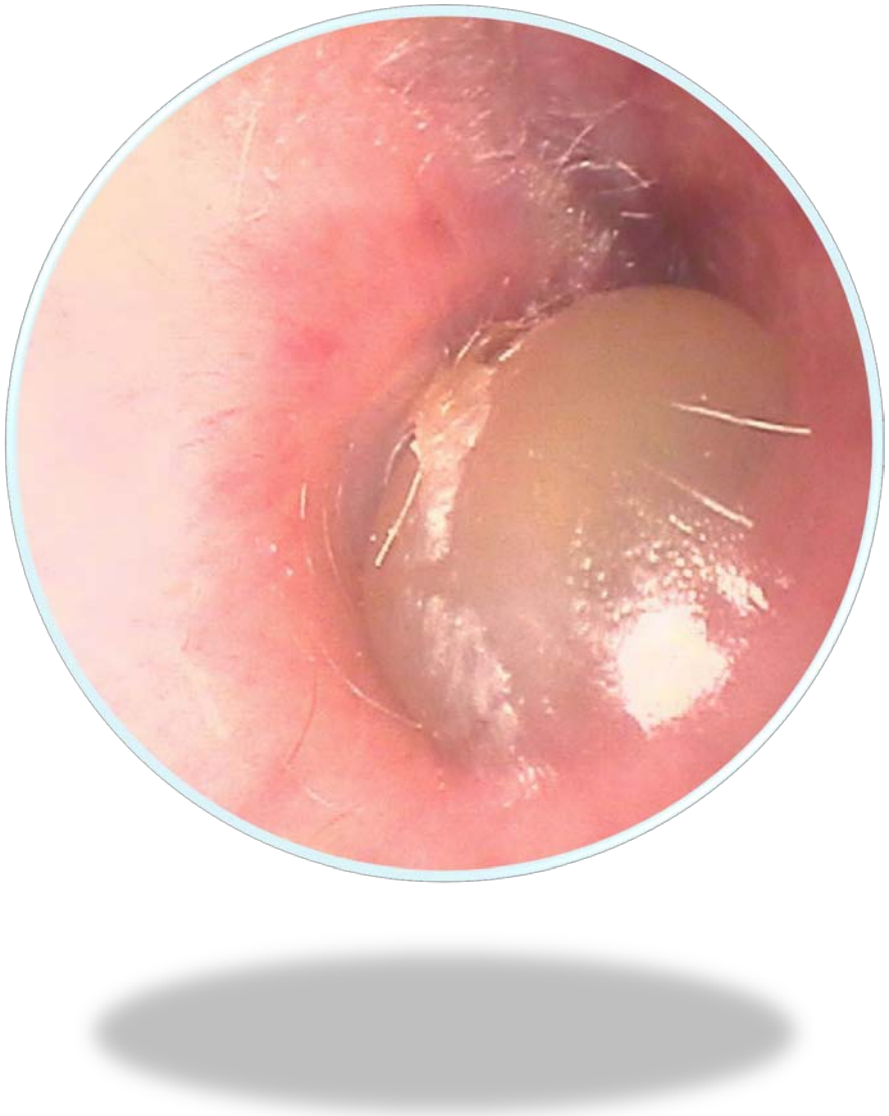
Example …


Panasonic DMC-ZS5
Color vs Detail
GOOD
POOR
4.00
3.00
2.00
1.00
Color
1.00
2.00
3.00
4.00
Detail



Case Study: Tympanometers

Finding the “least obvious” choice



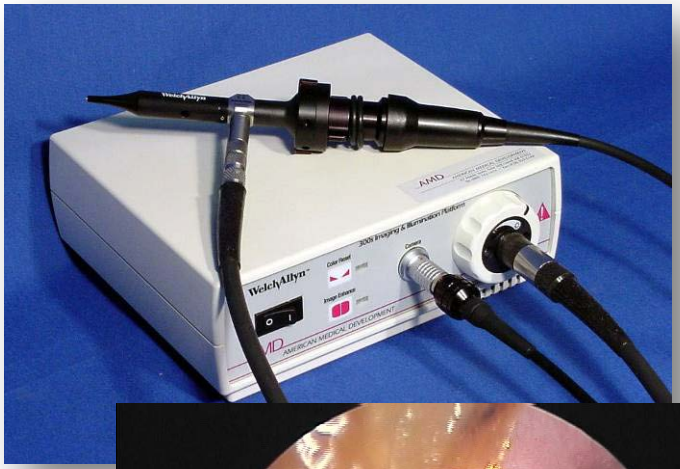
Case Study – Tympanometer

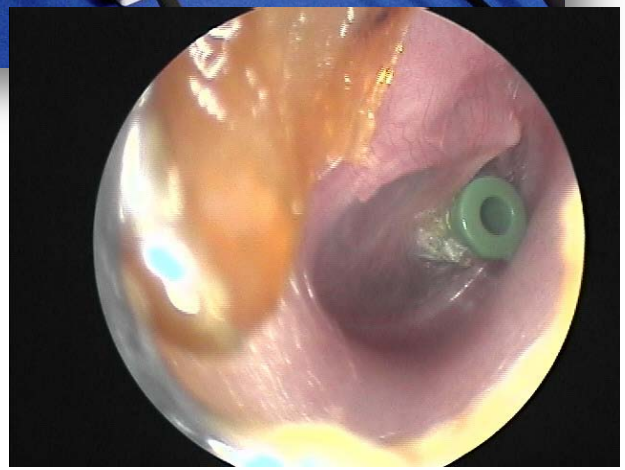
Adjunct to visual and pneumatic otoscopy

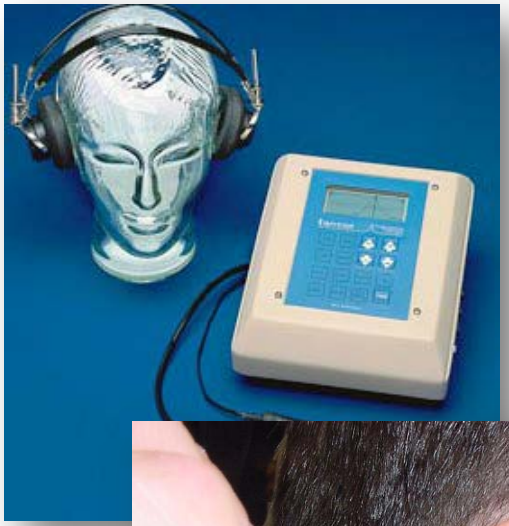
Total national expenditure for otitis media is $5.3 Billion

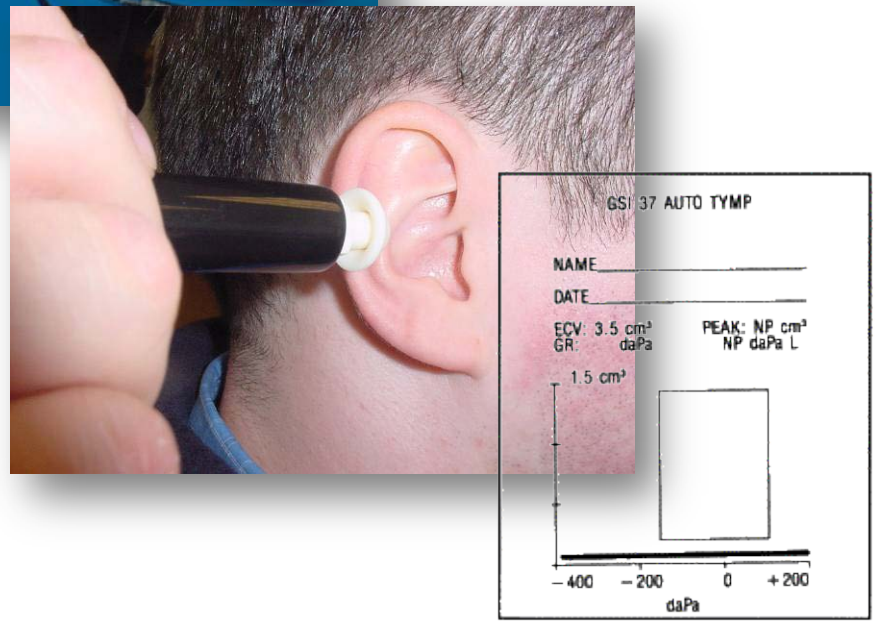
Ear Tubes is the most common pediatric surgical procedure

Ear Tubes and Tympanometry









Mandatory Design Goals

- Deliver quality data
- Be easy to use
- Be designed ergonomically
- Fit on the standard cart design with minimal changes (i.e. do not require major modifications to the cart frame)
- Be economical

Design Goals – Value Added

- Be readily available in bulk purchasing
- Be expected to be available for the next 1-2 years
- Meets or exceeds all regulatory issues
- Seamlessly integrate with the software model (touchscreen based, easy to use). Note – it is not acceptable to merely interface through scanning of printed output.
- Be rugged/ sturdy and have an lengthy MTBF (3+ years)
- Require minimal calibration and annual maintenance
- Have a professional appearance
- Be able to be supported by AFHCAN
- Require a minimal (reasonable) amount of technical and clinical training
- Provide options for both US and international market (e.g. 220v, 50HZ, NTSC vs. PAL))

Market Survey

- Fourteen tympanometers identified
- First cut based on obvious realities
  - Size, weight, dimensions
  - Cost
  - Calibration Cost
- Those 6 systems passing the first cut were then further researched
  - Descriptions
  - Expert Interviews
  - Publications
  - Specifications
  - Costs
- Second cut was made based on ability to integrate with system
- Final 4 systems submitted to full evaluation

Testing

- Long Form Evaluation
  - Appearance
  - Size
  - Safety
  - Durability
  - Capabilities
  - Ergonomics of Physical Design
  - Ease of Use: Overall Operations
  - Ease of Use: Specific Control Features
  - Screen: Information Layout
  - LCD Screen/Monitor
  - Printing Capabilities
  - Maintenance
  - Software Interface
  - Data Quality and Reliability
  - Accessories
- Short Form Evaluation
  - Appearance
  - Ease of Use: Overall Operations
  - LCD Screen/Monitor

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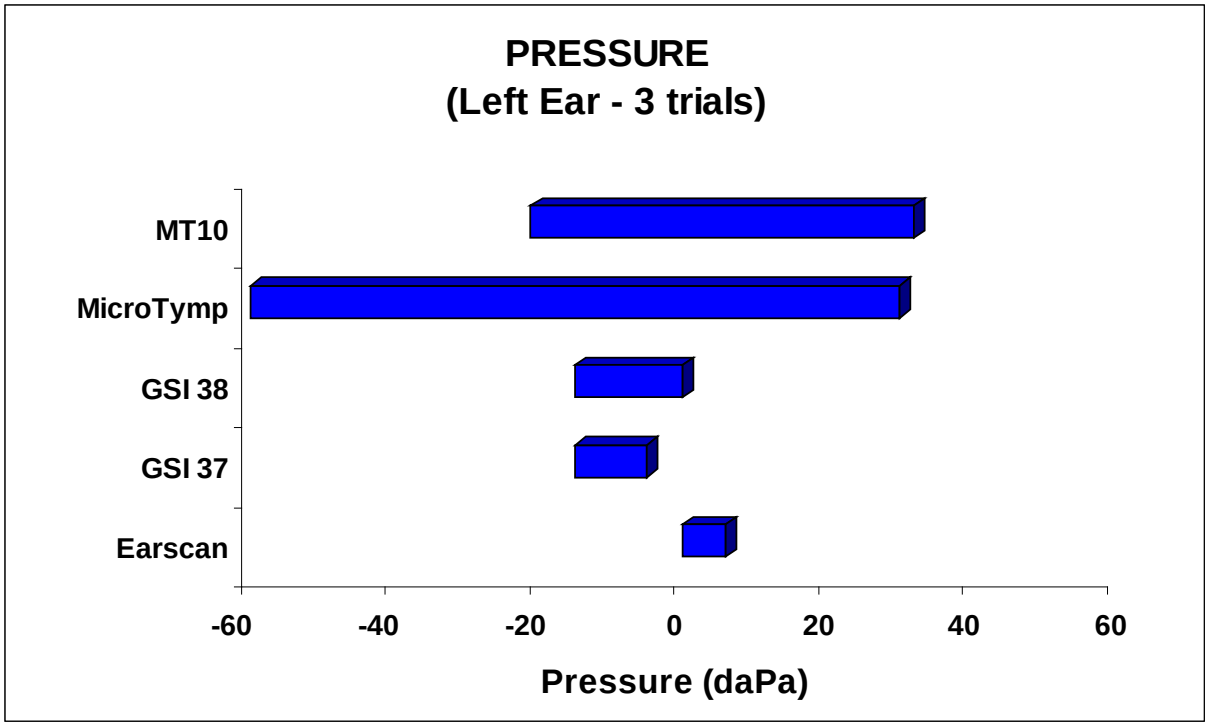
Clinical Tests



Final reviewers

- Physicians
- Community Health Aide
- Audiologist
- Staff RN
- Staff Nurse Practitioner
- Non-clinical Staff

Case Study: Tympanometers
Lessons Learned

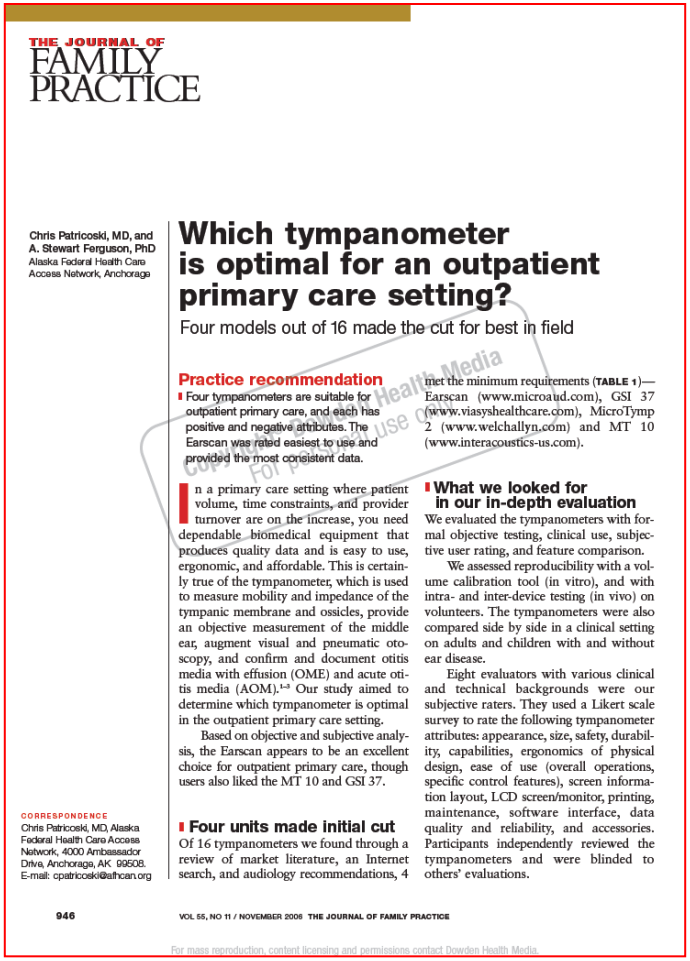
- Establish "Must Haves" and "Like to Haves"
- Market Leader
  - Certainly not the "easiest to use"
  - Concerns about the data produced / repeatability
- Major manufacturer
  - Well liked equipment
  - Completely uninterested in computer interface
- Small company
  - Same product for 20 years – reliable
  - Willing to change printer interface – create partnership

"Which Tympanometer is Optimal for an Outpatient Primary Care Setting?"
Chris Patricoski MD & A. Stewart Ferguson PhD
Journal of Family Practice, 2006
Vol. 55 No. 11 Pages 946-952.

Tympanometers – Lessons Learned

- Look beyond market leaders
- Find a partner
- Work with partners on product development

- Publication available – C. Patricoski



THE JOURNAL OF FAMILY PRACTICE

Chris Patricoski, MD, and
A. Stewart Ferguson, PhD
Alaska Federal Health Care Access Network, Anchorage

Which tympanometer is optimal for an outpatient primary care setting?

Four models out of 16 made the cut for best in field

Practice recommendation

- Four tympanometers are suitable for outpatient primary care, and each has positive and negative attributes. The Earscan was rated easiest to use and provided the most consistent data.

In a primary care setting where patient volume, time constraints, and provider turnover are on the increase, you need dependable biomedical equipment that produces quality data and is easy to use, ergonomic, and affordable. This is certainly true of the tympanometer, which is used to measure mobility and impedance of the tympanic membrane and ossicles, provide an objective measurement of the middle ear, augment visual and pneumatic otoscopy, and confirm and document otitis media with effusion (OME) and acute otitis media (AOM).[1-3] Our study aimed to determine which tympanometer is optimal in the outpatient primary care setting.

Based on objective and subjective analysis, the Earscan appears to be an excellent choice for outpatient primary care, though users also liked the MT 10 and GSI 37.

Four units made initial cut

Of 16 tympanometers we found through a review of market literature, an Internet search, and audiology recommendations, 4 met the minimum requirements (TABLE 1)—Earscan (www.microaud.com), GSI 37 (www.viasyshealthcare.com), MicroTymp 2 (www.welchallyn.com) and MT 10 (www.interacoustics-us.com).

What we looked for in our in-depth evaluation

We evaluated the tympanometers with formal objective testing, clinical use, subjective user rating, and feature comparison.

We assessed reproducibility with a volume calibration tool (in vitro), and with intra- and inter-device testing (in vivo) on volunteers. The tympanometers were also compared side by side in a clinical setting on adults and children with and without ear disease.

Eight evaluators with various clinical and technical backgrounds were our subjective raters. They used a Likert scale survey to rate the following tympanometer attributes: appearance, size, safety, durability, capabilities, ergonomics of physical design, ease of use (overall operations, specific control features), screen information layout, LCD screen/monitor, printing, maintenance, software interface, data quality and reliability, and accessories. Participants independently reviewed the tympanometers and were blinded to others' evaluations.

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Case Study: Video Otoscopes

Non-obvious issues





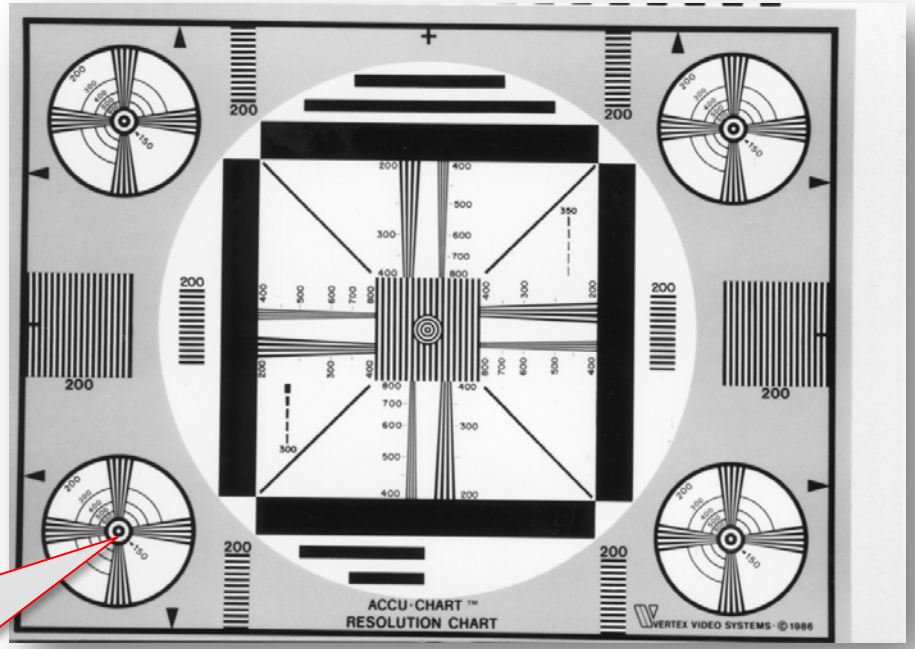
Video Otoscope: Obvious Mandatory Requirements

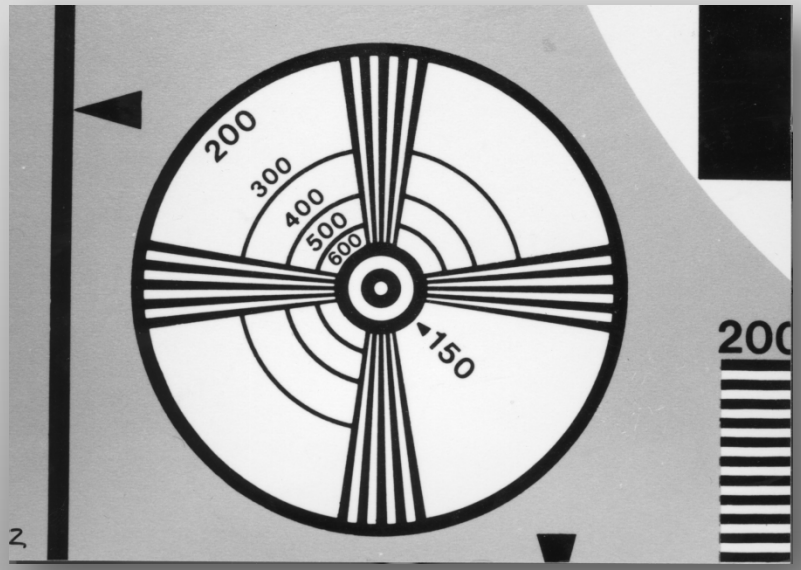
- High quality video and still images of tympanic membrane.
  - Depth of field, Color accuracy, high resolution, auto gain control.
- Ergonomics
  - Easy to use and maintain
- Rugged and reliable
- Support for pneuomo-otoscopy

Video Otoscope: "After the fact" Mandatory Requirements

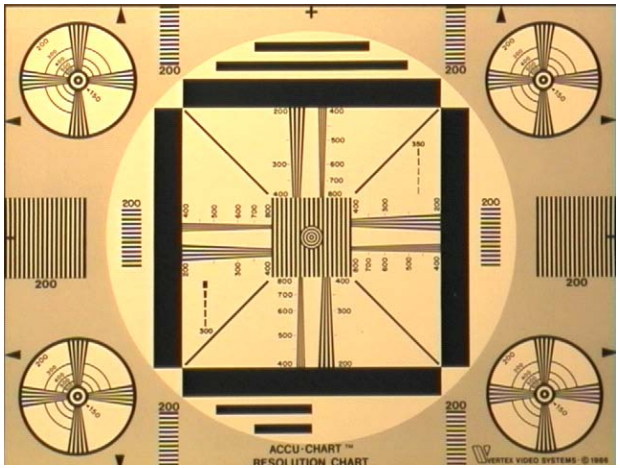
- Must be able to image entire TM
  - One picture is sufficient.
  - Require wide angle view
- Uses widely available speculum
- Steer-able past obstruction
  - Esp. in children
- Pneumo-otoscopy not critical
- Cable management must be addressed
- High quality white light source
  - Bulb life and cost are factors

Resolution Test Images

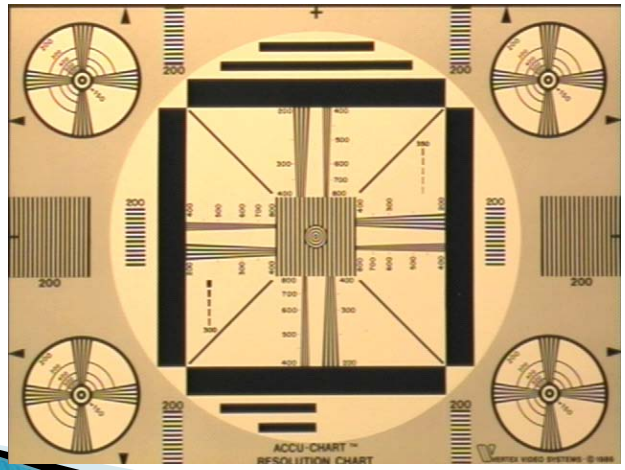




Resolution: S-Video / Composite

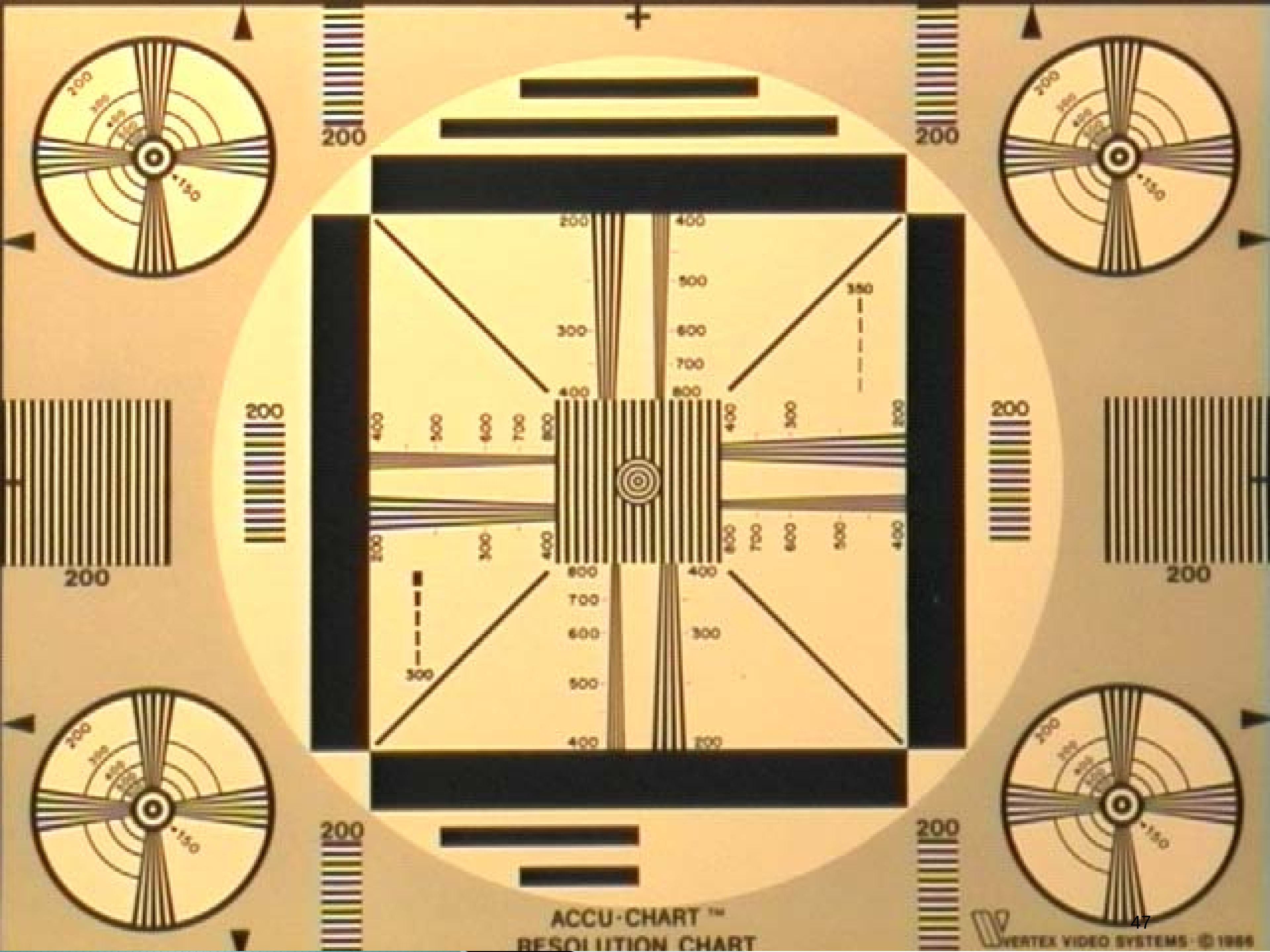


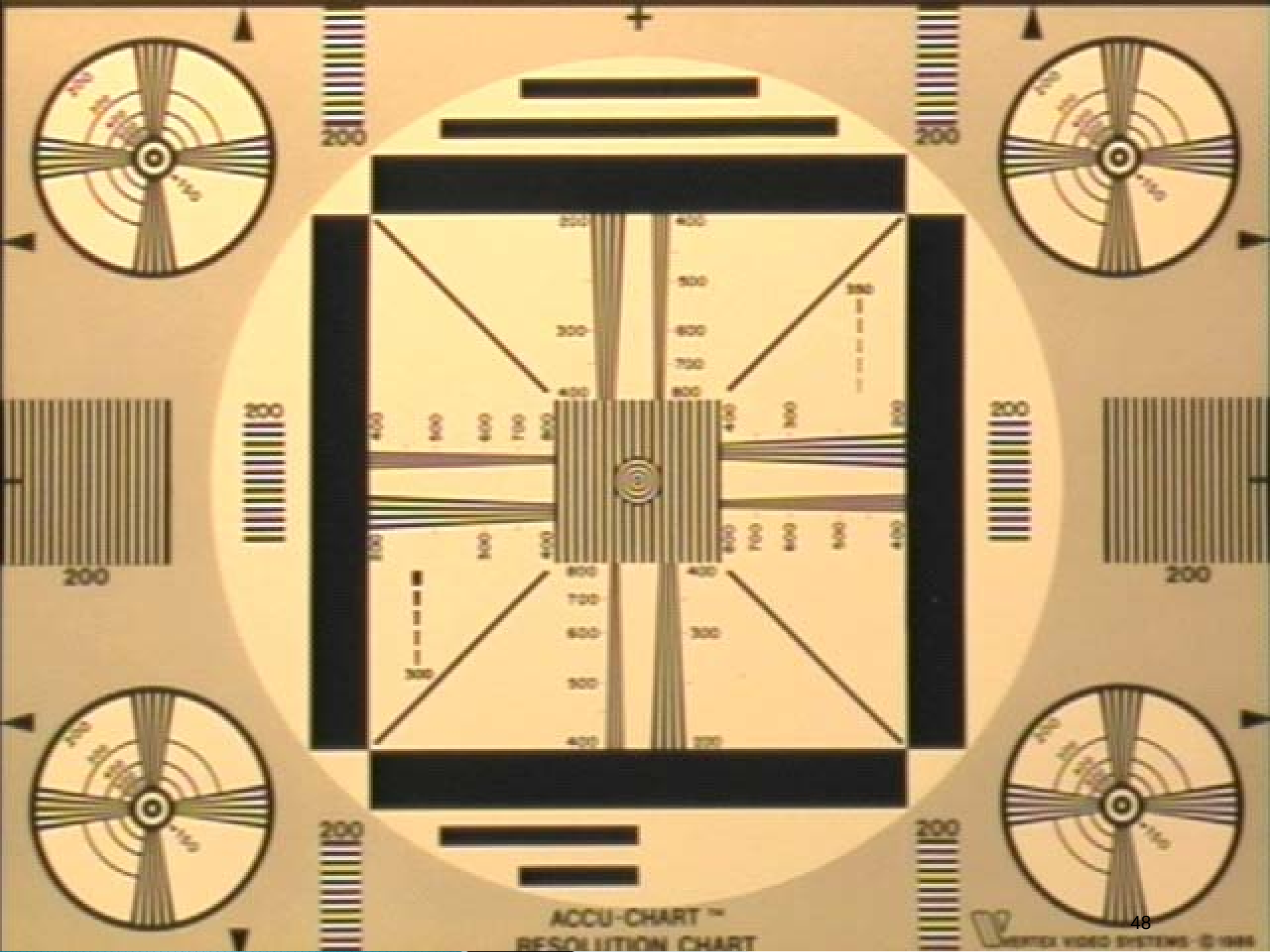
- Welch Allyn (AMD) S-Video



- Welch Allyn (AMD) Composite Video

AFHCAN


ACCU·CHART ™
RESOLUTION CHART
VERTEX VIDEO SYSTEMS


ACCU-CHART ™
RESOLUTION CHART

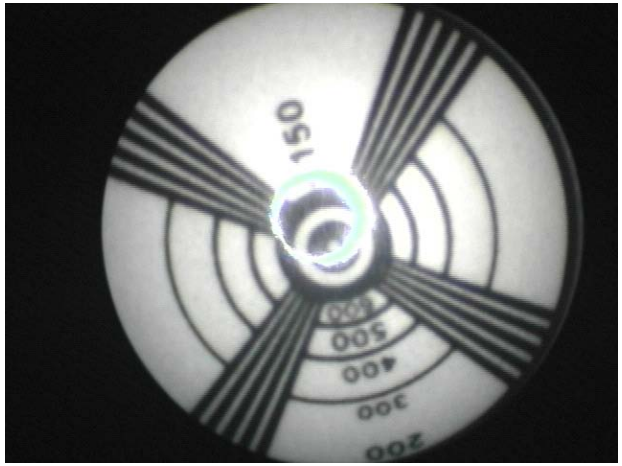
Gain Control

Vendor A

Distant Image

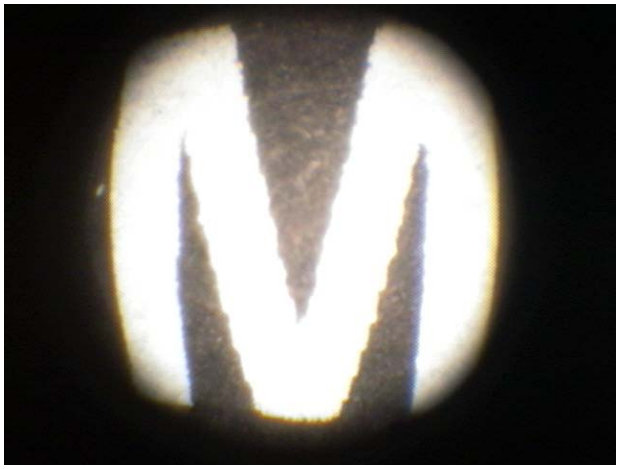
Closer Image

Vendor B

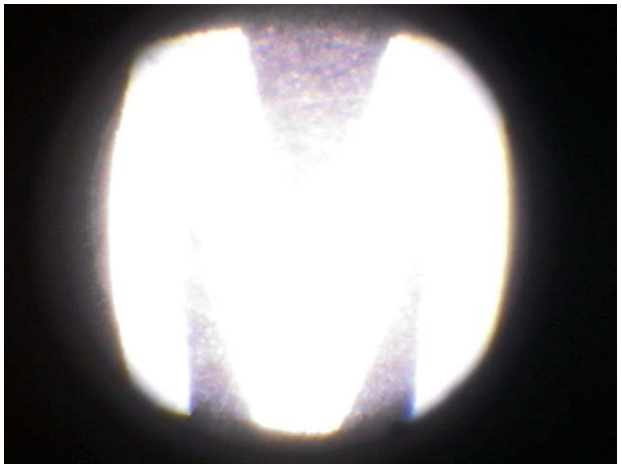


Blooming

Vendor A

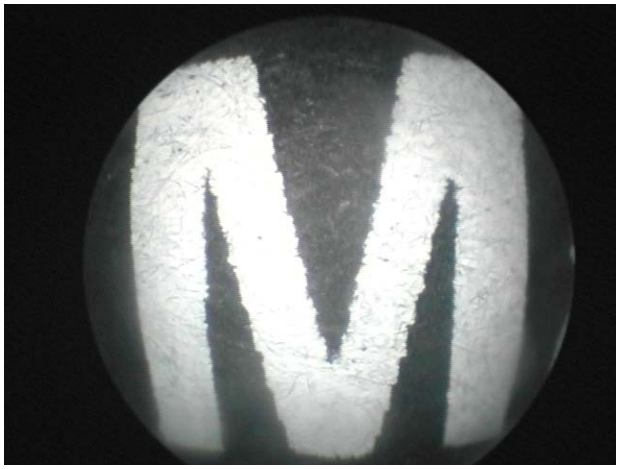


Half Light

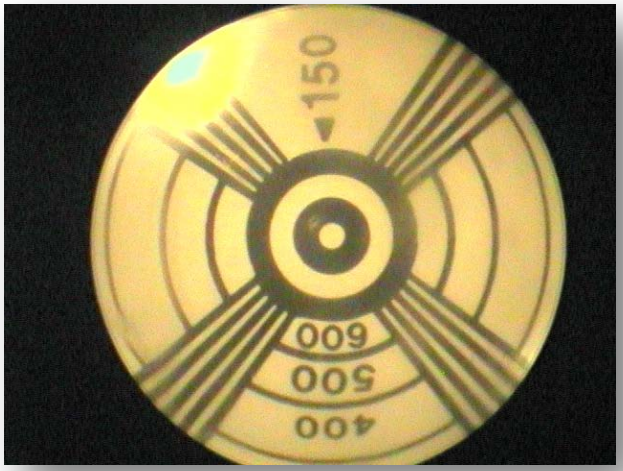


Full Light

Vendor B



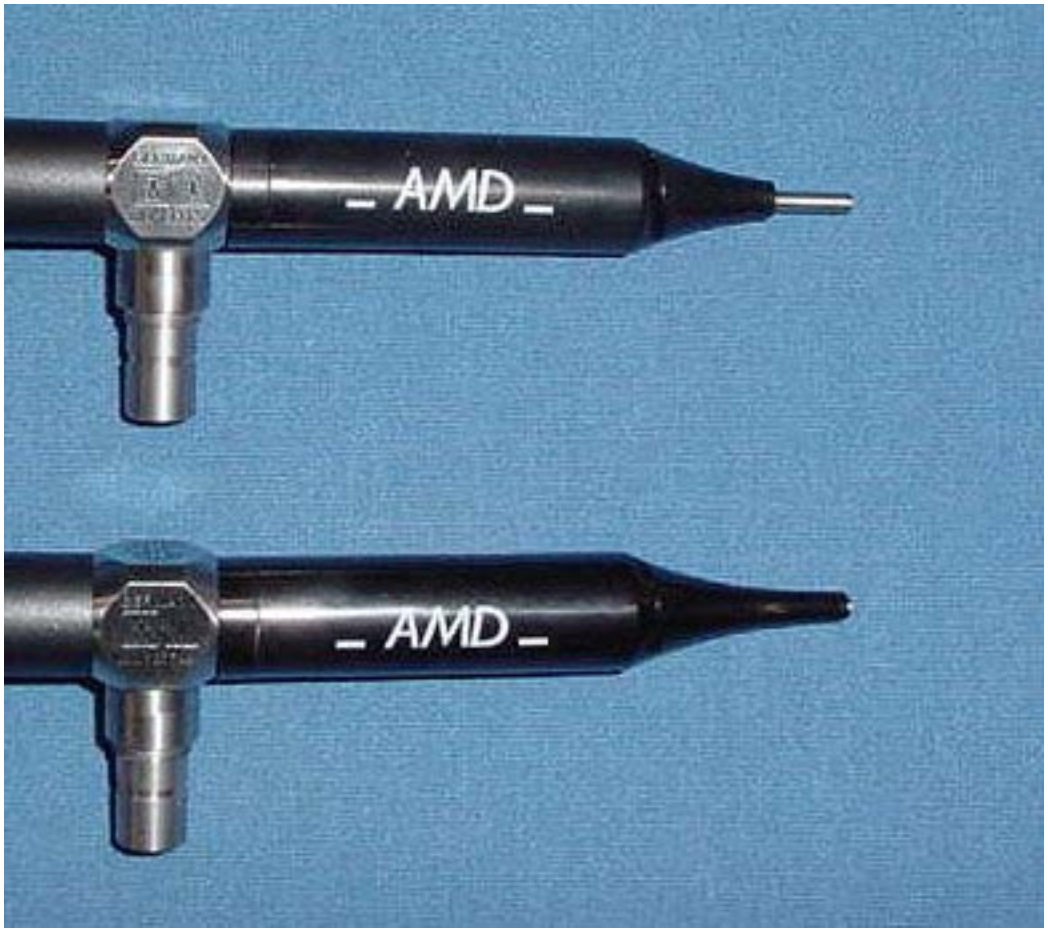
Field of View: Test Environment



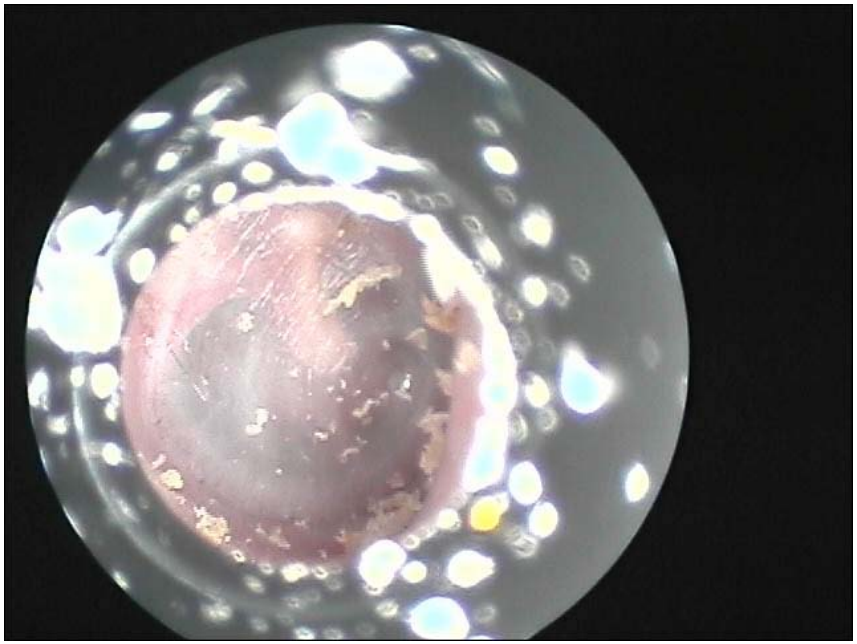
Field of View: Clinical Environment

Video Otoscope: Modification

Video Otoscope: Modification



Video Otoscope: Modification



Blooming

No blooming

Blooming

Trigger Switches

- Learning from the Providers
  - Foot pedal versus hand trigger

Video Otoscope: Lessons

- Expect your requirements to clarify during all phases – esp. the research and testing phase.
- Make your own judgment and ask for changes to the product
- Vendors are interested in improving their product with your feedback.
- Periodically you need to start the entire process over.

Case Study: Video Otoscopes
Lessons Learned

- Prepare for a steep learning curve on technology, or find a good technical partner.

- Expect the unexpected.

VIDEO OTOSCOPE TESTING Final Report
A. Stewart Ferguson, Ph.D., The Alaska Native Health Board

Case Study: Oral Cameras

Learning what's "right"

Oral Camera – Dental Application

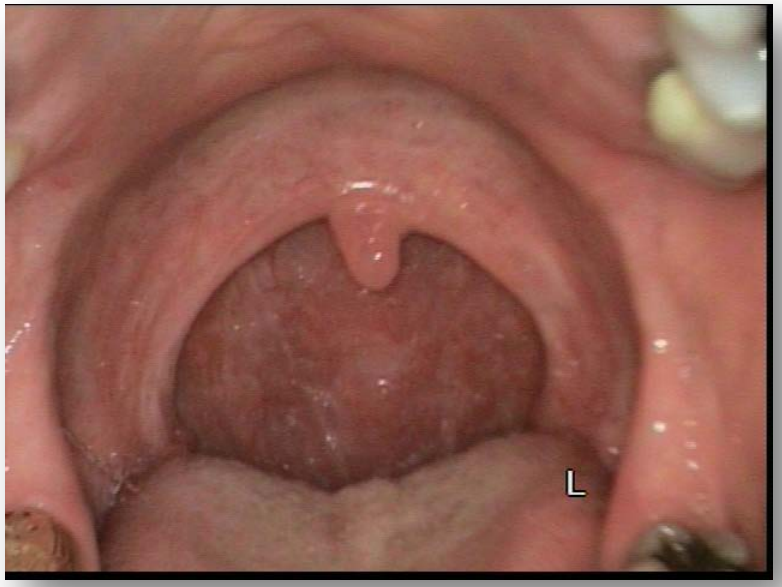
Vendor #1

Vendor #2

Light Source

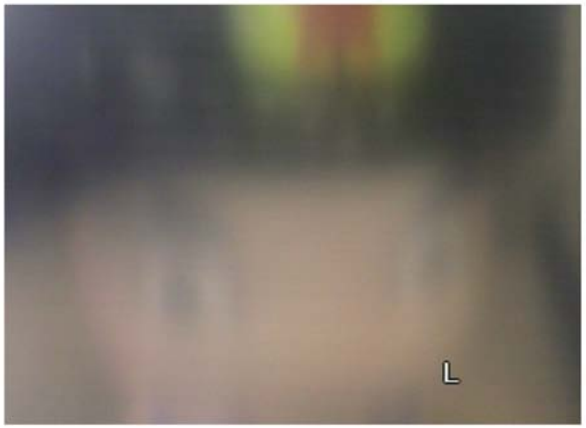
- Halogen
- Light Emitting Diode (LED)

Oral Camera – Lighting



Oral Camera – Features
Focusing, Image Mode

Oral Camera – Sheath



Case Study: Oral Cameras
Lessons Learned

- Light sources and lighting technology play a crucial role in the image quality.
- Design issues greatly affect user experience and image quality, which can only be discovered through real world testing
  - E.g. Focus mechanism, sheathing
- In some cases, it may not be possible to determine what is the “correct” feature
  - E.g. revered vs non-reversed images

In Summary …

Learning from these case studies

A Simple Framework

- **How do you define your questions?**
  - Develop clear and simple requirements appropriate to the clinical specialty, and link to standards.
- **How do you learn about your options?**
  - Centralized and Distributed Knowledge Resources
  - Lends itself to partnerships, collaboratives, and networks (of networks).
- **How can you differentiate between the options?**
  - Self-Assessment tools
- **Advocate for change**

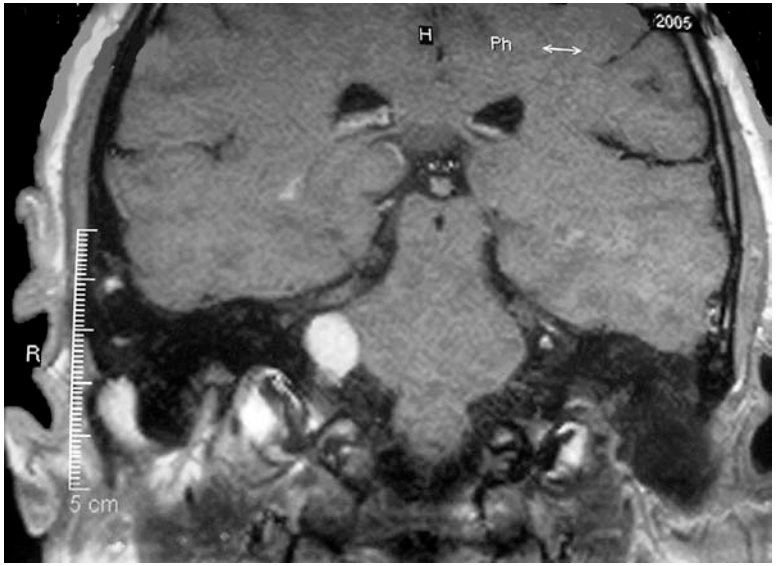
"Good" Assessment

- Need to understand and explain the technology
- Follow clear & well documented methodology
- Produce repeatable results
- Focus on appropriateness for the end-user
- Apply to "real" world needs and settings
- Differentiate options
- Generalize results for multiple programs
- Make your product work for the decision makers

Mistakes in Technology Assessment

- We all have the same requirements
- Treat vendors as vendors
- Product cannot be changed by little old me
- You can't go wrong with a major company or market leader
- We're a small project – so the technology is not a big issue
- Technology is too complicated for me to understand it
- My users just want me to pick something for them
- I'm sure it will work right out of the box

Interesting Dilemmas



- Is this research?
  - Equipment Evaluation
  - Institutional Review Board
- Documentation?
  - Hey Joe!
- Vendor relationship?
  - Equipment procurement (Beg, Buy, Borrow, Steal)
  - Critique & Feedback
- What if you find something?
  - Screening vs. Treatment vs. Informal Testing

Resources

- Colleagues
  - Telehealth Technology Assessment Center
  - Telehealth Resource Centers
  - Telehealth Community
  - OAT Listserve
  - Others
- Internet searches
- Vendors
- Telehealth Resource Center
- Journals …

Questions?

- sferguson@anthc.org
- gspargo@anthc.org

- www.telehealthtac.org

Toolkits

- Technology Assessment 101 will be posted to the TTAC website in mid-November
  - Looks at the process in greater depth
  - Provides some sample evaluation guides

- Two existing toolkits
  - Point-and-Shoot Digital Cameras
  - Desktop Videoconferencing Software

- Upcoming Toolkits
  - Electronic Stethoscopes
  - General Exam Cameras

Webinars

- A recording of this webinar will be posted to the TTAC website
- Additional webinars will occur in November and December
- Email info@telehealthtac.org if you would like to be notified of future webinars.