Technology Assessment 101
Selecting the Right Equipment for your Program

Stewart Ferguson Ph.D., Director of Telehealth, ANTHC/AFHCAN
Garret Spargo, TTAC Director, ANTHC
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: 1
- Cost of catching a problem before deploying equipment: 10
- Cost of catching a problem after deploying equipment: 100
Traditional Devices
+ New Connectivity
+ New Messaging
= NEW SOLUTIONS
A NEW TECHNOLOGY PARADIGM

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

It is becoming less relevant to simply assess component technologies without understanding the system design and device context.
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?
Technology is not a solution, but a portion (or investment) in many facets of the solution design.
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

- MRI / CT / PET
- Video Conferencing CODEC
- Video Otoscope
- Digital Camera

Axes:
- Risk to Program
- Purchase Quantity (or Sites)
- Assessment Complexity
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
Technology/Device Evaluation

- **Introduction**
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- **AFHCAN Testing and Review**
  - 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

<table>
<thead>
<tr>
<th>Canon</th>
<th>Casio</th>
<th>Fuji</th>
<th>Kodak</th>
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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?
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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- **Final Selection**
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What are you evaluating, and why?

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

Service/Support Capability

Features (Capabilities)

Importance to Customer

Price

Ease of Use

Portability

Flexibility to Expand

Perception of Product A
Key Technical Assessment Criteria

- Reliability
- Quality of Data
- Importance to Customer
- Ease of Use
- Perception of Product A
Key Technical Assessment Criteria

- Reliability
- Quality of Data
- CLINICAL ACCEPTABILITY

Hard to Measure

HUGE TRADEOFFS

TECHNICAL EVALUATION PROCESS

Ease of Use
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

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Sum of Rank</th>
<th>Average Sum of Rank</th>
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<td>Ease of Use</td>
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<tr>
<td>Price</td>
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<td>Conformance to standards</td>
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<tr>
<td>Performance of Equipment during Demonstration</td>
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<tr>
<td>Ability to Interface with Peripherals</td>
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<td>Service/Support</td>
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n=57

## Analysis

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</table>
Example ...

Panasonic DMC-ZS5
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
Clinical Tests

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

![Graph showing pressure (daPa) for different tests](image-url)
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.
Look beyond market leaders
Find a partner
Work with partners on product development
Publication available – C. Patricoski
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
Gain Control

Vendor A

Distant Image

Vendor B

Closer Image
Blooming

Vendor A

Half Light

Vendor B

Full Light
Field of View:
Test Environment
Field of View: Clinical Environment
Video Otoscope: Modification
Video Otoscope: Modification
Video Otoscope: Modification
Blooming

No blooming

Blooming
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.
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
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.