Why do we need to conduct evidence-based treatment?

What is evidence based practice?
- “The conscientious, explicit, and judicious use about the care of individual patients…..[by] integrating individual clinical expertise with the best available external clinical evidence from systematic research.”

What’s missing?
External versus internal evidence
- External – in the literature
- Internal – patient centered

Useful framework when conducting EBP
- PICO

Example PICO question
- To improve intelligibility, would a person with severe flaccid dysarthria benefit more from pacing and speech supplementation with an alphabet board or from oral motor exercises?

What we’re trying to avoid....

Some terminology found in evidence based practice literature
Treatment outcome
- A natural result
- Change, or lack of it, that may occur as a result of time, treatment, or both

Treatment efficacy
- Probability of benefit to individuals in a defined population

Ideal conditions

Treatment Effectiveness
- Probability of benefit to individuals in a defined population under average conditions of use

Treatment efficiency
- First, treatment must be efficacious and effective
- Then, can it be performed with a minimum of expense or unnecessary effort?

Progression from treatment outcome to treatment efficiency
- Ramig references

What is credible evidence?
Independent confirmation and converging evidence
Experimental control
Avoidance of subjectivity and bias
Effect sizes
Relevance and feasibility
What are levels of evidence?
Gold standard – Class I evidence
  • Randomized control trials
Class 1a
  • Meta-analysis of RCTs
Two key features of RCTs
  • Random
  • Controlled
Why are RCTs rare in SLP research?

Most common in SLP research
  • Class II studies
  • Well-designed observational clinical studies with concurrent controls

Why concurrent controls?
  • Avoid threats to internal validity
  • Always want to be able to say it was your treatment that made the difference

Biggest threat to internal validity in neurological studies?
Class III evidence
  • Case studies
  • Expert opinion

What do we really want as clinicians?
  • Ideally, evidence
  • Probably, confirmation that what we do is good…..
  • Must have adequate evidence to support what we do

How does evidence-based practice differ from the treatment we typically conduct?
Evidence-based treatment for dysarthria
Assumptions in this presentation
  • Moderate dysarthria
  • Any type
  • Some speech to work with
Treatment Biases
  • Always work within the context of speech
  • Always work at the highest level of the patient’s ability
Approaches to dysarthria treatment
  • Whole body
  • System by system

Advantage to whole body approach
  • Always ideal to try to make the biggest change with the simplest intervention
**Whole Body Approaches**
- Increase Vocal Effort
- Reduce speaking rate

*Patient appropriate for increased vocal effort intervention – “talk loud”*
- video

*Plausible physiological rationale for increased vocal effort*
- Maximizes motor unit recruitment across all physiological systems

*What happens across systems?*
- Respiration – take bigger breaths
- Laryngeal – increased vocal fold adduction
- Velopharyngeal – more complete closure
- Articulatory – increased precision

*Biggest advantage*
- All this happens with a single cue of “Talk loud”

*Efficacy data to support increased vocal effort*
- All of Ramig’s work cited in references based on Lee Silverman Voice Treatment
- Typically used for individuals with Parkinson’s Disease (hypokinetic dysarthria)

*Key concepts of LSVT*
- Exclusive voice focus
- Multiple repetitions of high effort productions
- Intensive treatment
- Enhance sensory awareness of increased vocal loudness
- Quantification of behavior

*Most recent version of LSVT*

*Variation*
- Twice a week, one hour sessions
- Over 8 weeks

*Results for 12 participants*
- Increased vocal SPL by 8 dB
- Maintained increased vocal SPL by 7.2 dB at 6 months post end of tx

*Additional support for increased loudness*
- D’Innocenzo et al., 2006
- Effects of listener familiarity and speaking condition

*Speaking Conditions – using CAIDS*
- Habitual rate
- Fast rate
- Loud
- Slow rate
Familiarization
- Listeners followed along with paragraph or with word lists
- Previous results regarding effect of familiarization
  - Increases comprehension of segmentals
  - i.e., understand person’s sound substitutions
Results
**Another alternative to increase vocal effort**
- Pharmacological intervention
- Work with good neurologists

**Efficacy of pharmacological intervention**
- McHenry – case study – dopamine agonist
**Example of pharmacological intervention – pre therapy**
- Video – pre Permax
**Example of pharmacological intervention – post therapy**
**Example of pharmacological intervention – Post Permax**

**Pharmacological intervention in advanced Parkinson’s disease**
- Limitation of LSVT – best with mild PD
**Effect of levadopa on respiration and word intelligibility – severe PD**
- DeLetter et al., 2007
  - 25 participants
**Compared measures with and without levadopa**
- VC
- Sustained vowel phonation
- Phonation quotient
- Word intelligibility test

**Results**
- No correlation between respiratory measures and intelligibility
- Intelligibility
  - Off – 64%
  - On – 73%

**Pharmacological intervention for different type of problem**

**Intrathecal Baclofen**
- To reduce spasticity
- Two case studies
- Both from same hospital in London
- Neither detailed nor rigorous
- Functionally oriented

**Evidence**
- Leary et al., 2006 –
  - Single subject
  - Sentence intelligibility increased from 9 – 41%
- Mason et al., 1998
Single subject
Sentence intelligibility increased from 18 – 51%

Rate Control Strategies
Intelligibility vs. Comprehensibility

Comprehensibility goal
- Dynamic process by which individuals share meaning
- Use ANY AND ALL INFO AVAILABLE

Communication in Natural Settings
- Acoustic signal
- Context

Why rate control?
Physiologic and linguistic justification for rate reduction strategies
- Gives articulators more time to reach targets
- Lets listener know breaks between words
- Gives listener more processing time
- If using alphabet board, gives contextual cues, i.e., narrows the range of possible words

Patient appropriate for rate control videos

Speech production does change
- Beukelman and Yorkston (1977) – intelligibility improved even when alphabet board was concealed from the listener.

Effect of alphabet supplementation
- Sentence intelligibility improved an average of 26%
- Word intelligibility improved an average of 11%
Hustad and Garcia, 2005
- 3 adults with CP and dysarthria
- Hand gestures and alphabet cues increased intelligibility

Hustad and Garcia, 2005
- Effect on speech
  - Reduced speech rate
  - Reduced articulation rate
  - Increased frequency and duration of pauses
Hustad, 2007
- Effect of alphabet cues and/or semantic predictability
- 8 speakers with CP and dysarthria
- 128 listeners (16/speaker)

Concluded
Both alphabet cues and semantic predictability contributed to intelligibility
Alphabet cues contributed more

Illustration of making a case for semantic predictability
Candidate for speech supplementation?
Severity more important than dysarthria type
Speakers with severe dysarthria
Can handle cognitive demands
Can access letters

Caveat
People HATE speaking slowly
Often prefer to repeat several times rather than saying it slowly once
Unnatural interaction – listener must look at board to follow conversation
Requires external device
Naturalness versus intelligibility trade-off

Influence of Visual Information on intelligibility of dysarthric speech
Keintz, Bunton, & Hoit, 2007

Participants
8 speakers with PD and dysarthria
10 experienced, 10 experienced listeners

Tasks
Listeners transcribed sentences in two conditions
Auditory only
Auditory plus visual (videotapes)

Results
NSD between two listener groups
Auditory-visual scores were significantly higher than auditory only scores for the three speakers with the lowest intelligibility scores.

Conclusion for whole body strategies
Increasing vocal effort improves physiology across all systems.
Reducing rate with alphabet board supplementation can increase intelligibility by roughly 25%.
More severe the problem, the more signal independent information is needed.

System specific strategies
When changing one system will make a difference in intelligibility
Typically used for speakers with mild or moderate dysarthria
More severe dysarthrias typically require a more global approach

Respiratory system
Often difficult to separate respiration and phonation

Ideal speech breathing
Quick inhalation and prolonged expiration
● Breathe to appropriate lung volume
● Initiate speech at normal point
● Absence of exaggerated movements

Clinical observations - speech
● Only a few words per breath
● Inability to increase loudness
● Overall reduced loudness

Appropriate candidate
● video

Is respiratory pattern adequate for speech?

Two Issues re: Respiration
● Adequate subglottal pressure?
● Adequate vital capacity?

How to estimate
ability to generate subglottal pressure

Candidates for respiratory intervention
● < 5 cm H₂O estimated subglottal pressure
● Sustains 5 cm H₂O < 5 seconds
● Inadequate subglottal pressure for phonation
● Says one word at a time

Strategies with supporting evidence

Nonspeech tasks
● Prior to recent research, considered appropriate only for individuals who can’t generate adequate Psg for speech
● View may be changing

Expiratory muscle conditioning in hypotonic children with low vocal intensity levels
● Cerny, Panzarella, & Stathopoulos (1997)

Purpose
● Determine if expiratory muscle conditioning in children with low muscle tone and reduced vocal intensity would be reflected in increased vocal SPL

Participants
● 10 children, ages 8 – 14
● No neurological or muscular diseases (no CP or muscular dystrophy)
● Considered hypotonic – reduced muscle tone

Pre-tx measures
● Max expiratory pressure
● Expiratory muscle endurance
● Subglottal pressure estimate
● SPL during syllable trains

Muscle conditioning program
Wore a mask
15 minutes/day, 5 days/week for 6 weeks
Mask had valve – to exhale, they had to generate a specific pressure (2.5, 5.0, 7.5)
To induce strength-related muscle adaptation

Method, cont.
Masks worn 3 weeks with no resistance
Worn during school day
Dummy masks worn by other classmates

Results
No change in spirometry values
Expiratory muscle strength significantly increased by a mean of 69%
No change in expiratory muscle endurance
Subglottal pressure increased by about 40% in both comfortable and loud conditions
SPL increased about 20%

Results 3 weeks post conditioning
Continued significant increase in SPL in both conditions
Even though training tasks were during non-speech, subglottal pressures and SPL improved during syllable production
Implication – both tasks required the expiratory muscles to provide enough force to build sufficient subglottal pressure to exceed a downstream resistance (mask during conditioning, vocal fold closure during speech)

Abdominal trussing
For patients who don’t have upper torso motor control to use expiratory board
Fixes abdomen inward relative to rest position

Effects of abdominal trussing on breathing and speech in men with cervical spinal cord injury
Watson and Hixon, 2001

Participants
3 men with spinal cord injury

Method
Compared measures in trussed/untrussed condition

Results in trussed condition
Increased vital capacity via increased inspiratory capacity
Longer utterance duration in oral reading
More syllables per utterance
More appropriate pause placement
Likely could generalize for individuals with other neurological disorders

Speech Tasks
Ideal intervention
Modification of inhalatory/exhalatory pattern
Biofeedback
Supported by expert opinion and case studies

*Teach inspiratory checking*
- Take a big breath
- Let the air out slowly

*3-way stop cock valve*

*Biofeedback strategies*

*Incentive spirometer*

*Respitrace*

*Real time continuous visual biofeedback in the treatment of speech breathing disorders....* 


*Participant*

- 12 year old male
- Severe TBI
- Mixed dysarthria with components of spastic, ataxic, flaccid

*A-B-A-B*

- A = baseline
- B1 = traditional tx
- A 2 = withdrawal
- B2 = physiological biofeedback tx

*Traditional tx*

- 8, 30 – 45 minute sessions
- Establish controlled inhalation and steady exhalation
- Improve posture
- Deep inhalation
- U – tube manometer to regulate subglottal pressure

*Biofeedback tx*

- Task hierarchy from vowel prolongation to syllable repetition to rote tasks
- Criterion for syllable reps not met.
- Most sessions focused on non-speech tasks and vowel prolongation

*After 10 week withdrawal*
- 8 sessions of biofeedback for 2 weeks
- Respitrace
- Target matching
- Task hierarchy from quiet breathing, deep breathing, prolonged Vs, syllable reps, serial speech, phrases of increasing length
- Didn’t get past syllable reps.
- Focused on deep breathing and vowel prolongation

**Murdoch’s conclusion**

“Biofeedback techniques were superior to traditional therapy techniques in establishing the required physiological changes for the subject in the present study”

**Caveat to Murdoch’s conclusion**

No information provided on transfer of skills outside of clinic

- Did not get beyond syllable repetition
- Unlikely to have induced functional changes

**Evaluation of a treatment program to “normalize” speech breathing dysfunction**

- Hodge, M., ASHA presentation, 1993

**Effects of syllable characteristics and training on speaking rate in a child with dysarthria secondary to near-drowning**


**Participant**

- 11 year old boy
- Hypoxic encephalopathy
- Extremely slow speaking rate (<1 syl/s.)
- Limited self-monitoring abilities
- Interfered with social interactions
- Speech characterized by regularity in syllable durations

**Intelligibility**

- 95% to familiar listeners
- 50% in single words to unfamiliar listeners

**Speech breathing**

- Very short breath groups
- Inappropriate placement of inspirations (within vowels, words, and phrases)
- Unusual stress patterns

**Treatment**

- Establish consistent pre-utterance inspirations
- Match “target” inspiratory and expiratory lung volumes
- Eliminate within word inspirations

**Pre-training**
inspiratory checking” using imagery and U-tube manometer)
Inspired and maintained “target” expiratory pressure for at least 4 seconds.

Lung volume target training
Visual feedback of estimated lung volumes (Respitrace)
Inspiratory and expiratory target regions marked
Self-evaluation after each trial
Parent observation and data recording in all sessions

Results
Subject able to meet criterion to move to next level
At beginning of each higher level, performance decreased, then improved
Increase of mean of 7.5 syl/breath compared to 3 syl/breath pre-tx

Conclusions
Subject demonstrated slow but significant progress in using appropriate inspiratory and end-expiratory volumes during speaking tasks WITH feedback
Had ability to control speech breathing WITHIN training context.

Conclusions
Outside training contexts, dysfunctional behaviors remained
Brain injury appeared to limit spontaneous generalization

Single case study supporting biofeedback
Yorkston, Beukelman, Strand & Bell, 1999)

Participant
Adult female
Mixed ataxic/flaccid dysarthria

Method
Monitored lung volumes with output of Respitrace
Trained to breathe in higher in VC curve
Began with non-speech tasks and moved to speech tasks

Result
Shift to higher lung volumes improved voice quality
Generalized away from biofeedback to all communicative situations (except laughter)

Respiratory Management Summary
Few need it
Small percentage of VC used for speech
Key features
Adequate pre-phonatory inspiration
Controlled expiration
Biofeedback useful in establishment, but evidence is mixed re: generalization

Questions re: any aspect of managing respiration?

Phonatory Intervention
Distinguish hypoadduction from hyperadduction
**Hypoadduction**
- Incomplete adduction of vocal folds
- Acoustic result? Breathiness
- Associated with – Flaccid or hypokinetic dysarthrias

**Hyperadduction**
- Excessive adduction of vocal folds
- Acoustic result? Tight, pressed, strained-strangled quality
- Associated with spastic and hyperkinetic dysarthrias

**Hypoadduction treatment – appropriate candidate**
- Previously seen for low effort

**What adduction enhancing strategies have evidence-based support?**

**Increased vocal effort**
- Will improve vocal fold adduction
- All of Ramig and colleagues’ work

**Effort closure techniques**
- Pushing and pulling
  - Can be done in the context of speech

**Evidence-based techniques to reduce hyperadduction**
- Extremely difficult to modify
- Unlikely to impact intelligibility

**No evidence to support**
- Non-speech tasks
- Traditional voice treatment techniques used to treat muscle tension dysphonia
- Biofeedback

**Why not?**
Relaxation does not generalize to speech

**Example**
- EMG biofeedback
- Client able to reduce extrinsic laryngeal muscle tension in non-speech tasks
- Unable to maintain relaxation in speech tasks even with biofeedback

**No evidence to support**
- Biofeedback during speech tasks
- Traditional tension-reducing strategies during speech tasks

**Single case study to support**
- Botox injection to reduce laryngeal hyperadduction associated with spastic dysarthria

**Subject characteristics**
- Primary symptom of laryngeal hyperadduction – excessive loudness
- TBI
- Reduced vocal effort strategies did not work (i.e., able to reduce loudness in the clinic but not outside)
- Very bothered by excessive loudness
Pre-Botox video
Post-Botox Video
Rationale for Botox injections
- Partially paralyzes thyroarytenoid muscle
- Reduces intrinsic laryngeal muscle tension
- Results in incomplete adduction

Need more research
- Little evidence-based data on strategies to reduce hyperadduction

Questions on laryngeal management?
Velopharyngeal system
Likely candidates for intervention?
- Hypernasality impacts intelligibility
Modifying the pattern of speaking
- Increasing effort
- Decrease rate
- Overarticulation

The Impact of Stimulated Vocal Loudness on Nasalance in Dysarthria
- McHenry & Liss (2006)

Participants
- 22 males, 8 females
- 24 with severe TBI, others with CVA, anoxia, angioma

Method
- Nasometer
- 3 conditions – habitual, soft, loud
- SPL measured
- Differential dx performed by consensus

Audiotape judgments
- Played tapes to naïve listeners
- Paired with habitual production and least nasal
- Listener said which one was more nasal

Results by dysarthria type
- Spastic
- Flaccid
- Hypokinetic
- Ataxic

Spastic
- Increased loudness increased nasality in 7 of 13
- Decreased loudness reduced nasality in 9 of 13, but not by much

Flaccid
- Increased loudness decreased nasality in 7 of 9
Reduced loudness (soft condition) increased nasality in 6 of 9

**Ataxic**
- Inconsistent effect
- Increased loudness increased nasalance in 4 of 5
- Decreased SPL made a noticeable difference in 2 of 5

**Hypokinetic**
- For 2 of 3, no change either way
- For 1, relatively small changes in SPL in either direction markedly improved nasalance.

**Conclusions**
- Loudness is worth manipulating to see if it affects nasalance
- Flaccid most likely to benefit from increased loudness
- Spastic most likely to benefit from decreased loudness

**Rate reduction – expert opinion**

**Exaggerate articulation – expert opinion**

**Effect of increased mandibular excursion?**

**Resistance treatment during speech**
- Some evidence-based support
- CPAP

**Development of a new technique for treating hypernasality: CPAP**
- Kuehn, 1996

**CPAP**
- Continuous positive airway pressure

**Speech drills**
- VNCV
- V – vowel
- N – nasal consonant
- C – any pressure consonant
- Stress on second syllable

**Word lists**
- Available from Dave Kuehn, University of Illinois – Champagne-Urbana (UICU)

**Rationale**
- Velum lowered for nasal
- Then needs to lift vigorously and quickly for the pressure consonant

**CPAP therapy program**
- Speech drills with CPAP
Rationale – muscles involved in VP closure become stronger because of working against resistance

*Evaluation of CPAP therapy in the treatment of hypernasality following TBI*

*Cahill et al., 2004* Journal of Head Trauma Rehabilitation

**Participants**
- 3 adults with dysarthria
- Moderate to severe hypernasality
- At least 7 months post injury

**Method**
- ABA
- 4 week treatment

**Assessments**
- Perceptual judgment
- Intelligibility
- Nasalance with nasometer

**Subject 1**
- Nasalance
  - Baseline - 33
  - Midway - 36
  - Post - 32
  - 1 month - 25
- Intelligibility (sent.)
  - Baseline - 0
  - Midway - 0
  - Post - 1.4
  - 1 month - 0

**Subject 2**
- Nasalance
  - Baseline - 47
  - Midway - 27
  - Post - 12
  - 1 month - 14
- Intelligibility (sent.)
  - Baseline - 12
  - Midway - 18
  - Post - 16
  - 1 month - 28

**Subject 3**
- Nasalance
  - Baseline - 37
  - Midway - 24
  - Post - 33
  - 1 month - 33
- Intelligibility (sent.)
  - Baseline - 69
  - Midway - 73
  - Post - 68
  - 1 month - 81

**Conclusion?**
- May help some people
- Seems to have more impact on individuals with less severe nasalance and intelligibility

**Biofeedback – expert opinion only**

**Techniques focusing on non-speech movements**
- NOT ENDORSED

**Why not?**
- Speech and nonspeech vp closures involve different underlying mechanisms
- No evidence exists that increasing soft palate strength improves speech performance
Most of the methods do not provide the patient with information on the timing of articulatory gestures during speech.

**NO evidence available for the following**
- Pushing techniques
- Strengthening exercises such as blowing and sucking
- Tasks that encourage patients to control and modify the airstream using whistles, candles, straws, etc.
- Inhibition techniques such as icing, brushing, desensitization

**Prosthetic Methods**

**Palatal Lift Prosthesis**
- Props up velum

**Obturator vs. Palatal Lift**

*Do palatal lifts stimulate VP activity?*  
- **NO!**

**Palatal lift candidate** (Netsell and Rosenbek, 1985)
- Large and constant VPI
- Fair to good articulation
- Able to generate adequate Psg for speech

**Nasalance measurements as outcome indices for palatal lift management: lift in versus lift out**
- Karnell et al., 2004

**Participants**
- 19 patients – varied etiologies
- 8 with neurogenic disorder
- 3 with head injury

**Results**
- Mean nasalance life out – 37.5
- Lift in – 17.1
- Statistically significant difference
- With lift, adequate oral/nasal resonance

**Use of palatal lift and palatal augmentation prostheses to improve dysarthria in patients with ALS: a case series**
- Esposito, Mitsumoto, & Shanks, 2000

**Participants**
- 25 patients with ALS

**Method**
- Retrospective study

**Results**
- 84% demonstrated reduced hypernasality, with 76% benefiting at least moderately for at least 6 months
- Patients reported easier to speak with less effort with prosthesis

**Management note**
- May need to modify lift/augmentation every month to compensate for degenerative nature of disease
Rationale

Some people don’t tolerate lifts well.

Participant 1
- 21 year old male
- 14 month TBI
- Profound flaccid dysarthria
- 25% intelligible for Cs, 10% for Vs
- VP moved during swallowing, but not speech
- Intraoral air pressure /p/ < .5 cm H20

VP intervention
- Tried lift first
- Insufficient soft palate (had been compensating with pharyngeal wall mvt.)

Speech outcomes

- Nasal airflow from 622/s. to < 200 cc/s.
- Plosives improved from 22 to 50%
- Fricatives improved from 0 – 76%

Participant 2
- 12 year old
- Cranial nerves damaged during surgery to remove benign brainstem tumor
- Profound flaccid dysarthria

VP intervention
- Palatal lift

Results

- With lift – Po increased from 7 to 9.7 cm H20, nasal airflow dropped from 408 cc/s to 27 cc/s.
- With nasal obturator – Po increased to 8.5 cm H20, nasal airflow dropped to 180 cc/s.

Conclusions

- Pt. 1 – nasal obturator improved speech more than palatal lift
- Pt. 2 – palatal lift improved speech more than nasal obturator

Conclusion

- Worth considering for persons who can’t tolerate lift
- May work best with custom fitting of obturator (under development)

Appropriate Candidate #1?
Appropriate Candidate #2?

Articulatory System

- Rarely effective to treat in isolation

What to do?

- Return to global strategies
- Rate and loudness manipulation
Another option - Speech Enhancer
● Potentially useful for both articulation and reduced loudness

Speech Enhancer
Function
● Compares incoming speech signal to normalized model of speech
● Alters signal in real time to a best-fit approximation of the model

Cariski and Rosenbek, 1999
● 2 individuals with PD
● 3 speaking conditions

Campbell, 1999
● Paper presented at the 4th Australian Conference on Technology for people with disabilities

Participants
● 9 dysarthric and dysphonic individuals
● Wide range of etiologies

Method
● Intelligibility rated in background noise
● 4 judges for each subject
◆ Trained listener
◆ Familiar listener
◆ Unfamiliar listener
◆ Individual user

Results
● Most judges found it improved intelligibility to some degree
● Degree of improvement varied greatly among individuals

Speech intelligibility in quiet and noise environments with the Speech Enhancer amplification and natural speech
● Weiss (2002)

Participants
● Two speakers with severe hypokinetic dysarthria

Method
● Compared intelligibility scores with SE and voice amplifier

Results
● In noise, SE intelligibility scores were significantly higher than unaided and voice amplifier conditions

Design problem
● Judges were familiar with the subjects

Effectiveness of the speech enhancer on intelligibility: a case study
● Bain, Ferguson, Mathison (2005)

Participant
Female with hyperkinetic dysarthria from CP

*Method*
- Intelligibility rated by a range of experienced and naïve judges
  - 2 experienced judges
  - 1 less experienced judge
  - 10 inexperienced judges

*Results*
- Degree of improvement in intelligibility varied among judges and speaking conditions
- Inconclusive results
- Unaided condition produced highest intelligibility scores with naïve listeners

*Summary*
- Optimize the physical system
- Try global strategies first
  - Rate reduction
  - Increased or decreased vocal effort
- Always work within the context of speech

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*Speech Enhancer*

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**Questions?**