Using telehealth in research to improve behavioral assessment and treatment for children with autism

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As things improve, Izzy is able to find more moments of calm.
(KC McGinnis / Spectrum)
1. Introduction to telehealth and its scope of usage
2. Brief history of telehealth research at Ulowa
4. Case study
5. Utility of telehealth for behavioral assessment and treatment for ASD
Telehealth: The provision of health care remotely by means of...technology, including telephones, smartphones, and mobile wireless devices (Dorsey & Topol, 2016)
**Telehealth Terminology**

Broad and specialty specific terminology:
- **General:** *Telehealth > telemedicine*
- **Specifics:** *Telepsychology, teleradiology, and telepsychiatry*

**Sites:**
- *Originating or Remote Site* = Patient site
- *Distant or Host Site* = Provider site

**Timing of interaction:**
- *Synchronous* = Real-time audio/video feed
- *Asynchronous* = Storage and forwarding of clinical data (ex: teledermatology)
Usage:
- 2006 = 26,000 visits;
- 2012 = 10 million users;
- 2013 = 15 million + users
  (Gilman & Stensland, 2013; Modahl, 2015)
- Telehealth soon to overtake in-person visits at some hospitals (Dorsey & Topol, 2016)

Acceptance:
- 64% of consumers are willing to use telehealth for physical and/or mental health care (Modahl, 2015)
UIOWA’S HISTORY OF
TELEHEALTH RESEARCH
UW’s ABA Telehealth Journey

Type I: Feasibility Studies of Telehealth

Type II: Comparative Studies (Telehealth vs. In Vivo)

Type III: Telehealth as the Modality
UIowa’s ABA Telehealth Journey: Grant Support

**Type I: Feasibility Studies of Telehealth**


**Type II: Comparative Studies (Telehealth vs. In-Vivo)**


**Type III: Telehealth as the Modality**


Type I: Feasibility Studies of Telehealth

- Clinic to school/clinic BFA: Baretto et al. (2006). *JABA*
- Clinic to clinic extended FAs with parents: Wacker et al. (2013) *JABA*
- Clinic to clinic FCT with parents: Wacker et al. (2013) *J Dev Phys Disabil*
- Clinic to home fidelity of treatment with parents: Suess et al. (2014) *J Behav Educ*
- Clinic to clinic brief assessment and treatment model: Suess et al. (2016) *JABA*
UIowa’s ABA Telehealth Journey: Type II Studies

Type II: Comparative Studies (Telehealth vs. In-Vivo)

# Behavioral Outcomes Achieved by Parents of FA+FCT Treatment Using Different Service Delivery Models

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group 1 In-Home Therapy (n=44)</th>
<th>Group 2 Clinic Telehealth (n=20)</th>
<th>Group 3 Home Telehealth (n=30)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Reduction in Problem Behavior:</td>
<td></td>
<td></td>
<td></td>
<td>.074</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>95.76% (8.91)</td>
<td>91.00% (13.66)</td>
<td>97.27% (6.00)</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>59.07 - 100%</td>
<td>47.40 - 100%</td>
<td>77.01 - 100%</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 3 Costs of Treatment With FA and FCT When Delivered via Different Service Models

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group 1: In-Home Therapy (n = 44)</th>
<th>Group 2: Clinic (n = 20)</th>
<th>Group 3: Home Telehealth (n = 30)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff costs</td>
<td>Mean $4687.86&lt;sup&gt;a&lt;/sup&gt; (1799.51)</td>
<td>$1693.30&lt;sup&gt;b&lt;/sup&gt; (371.72)</td>
<td>$1190.00&lt;sup&gt;b&lt;/sup&gt; (519.20)</td>
<td>&lt;.001&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Facility costs</td>
<td>Mean $99.04&lt;sup&gt;a&lt;/sup&gt; (38.02)</td>
<td>$172.20&lt;sup&gt;b&lt;/sup&gt; (37.80)</td>
<td>$97.44&lt;sup&gt;a&lt;/sup&gt; (42.51)</td>
<td>&lt;.001&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Family costs</td>
<td>Mean $1163.06&lt;sup&gt;a&lt;/sup&gt; (446.46)</td>
<td>$1202.96&lt;sup&gt;a&lt;/sup&gt; (264.08)</td>
<td>$858.20&lt;sup&gt;b&lt;/sup&gt; (374.43)</td>
<td>.002&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total cost</td>
<td>Mean total cost per child to complete treatment $5949.97&lt;sup&gt;a&lt;/sup&gt; (2283.99)</td>
<td>$3068.46&lt;sup&gt;a&lt;/sup&gt; (673.60)</td>
<td>$2145.64&lt;sup&gt;a&lt;/sup&gt; (936.15)</td>
<td>&lt;.001&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Sensitivity analyses based on 25%-50% higher or lower estimates of staff, facility, and family costs produced changes in total costs for each treatment, but the pattern of relative costs between groups remained similar.

<sup>a</sup> When there were significant between-group differences, groups with the same superscript in the same row did not differ from each other.

<sup>b</sup> When there were significant between-group differences, groups with the same superscript in the same row did not differ from each other.

<sup>c</sup> Significant differences were based on ANOVA.

From: Lindgren, S. et al. (2016). *Pediatrics*
UIowa’s ABA Telehealth Journey:
Type III Studies

- Clinic to clinic: Functional vs. arbitrary reinforcers in FCT: Fewell et al. (2016) *J Dev Phys Disabil*
- Recently completed: RCT of FCT
- Study in progress: RCT of FA

**Type III: Telehealth as the Modality**
CURRENT RESEARCH AT UIOWA: ASSESSMENT AND TREATMENT OF CHALLENGING BEHAVIOR IN CHILDREN WITH ASD
Purpose: Conduct randomized controlled trials of common ABA procedures (FA+FCT) for severe and challenging behavior in children with autism

• Large-N designs may increase acceptance of ABA (Smith, 2012) & allows for greater dissemination

• The “Gold Standard” for “evidence-based” medicine = randomized controlled trial (RCT; Guyatt et al., 2008)
Treating Challenging Behavior

Two-Step Package:

1. Functional Analysis
   - “gold standard” of behavioral assessment

2. Functional Communication Training
   - Most studied behavioral treatment for S&C behavior
What is it?

Systematic manipulation of antecedents and consequences to determine their effect(s) on occasioning and maintaining behavior.

The Goal:
Identify:

A. What evokes problem behavior?
B. What maintains problem behavior?
Functional Analysis  

(Alvarez et al., 1982/1994)

- Randomized 5-min sessions
- Multi-element design
- Assessment length: once a stable pattern of responding with separation across conditions
- Criteria developed by Roane et al., (2013) for determinations of function
## Step 1: Functional Analysis

(Iwata et al., 1982/1994)

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>ANTECEDENT (E.O.)</th>
<th>BEHAVIOR</th>
<th>CONSEQUENCE/PUTATIVE REINFORCER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free Play (control)</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Attention</td>
<td>divert/divide attention</td>
<td>target</td>
<td>brief statement of disapproval</td>
</tr>
<tr>
<td>Escape</td>
<td>demand</td>
<td>target</td>
<td>break from demand for 30 sec</td>
</tr>
<tr>
<td>Tangible</td>
<td>remove tangible</td>
<td>target</td>
<td>return tangible for 30 sec</td>
</tr>
</tbody>
</table>
Standard Functional Analysis
Total Problem Behavior (Dest + Agg + SIB)

Responses per Min

Sessions

- Free Play
- Tangible
- Demand
- Attention
Standard Functional Analysis
Total Problem Behavior (Dest + Agg + SIB)

Responses per Min

Sessions

- Free Play
- Tangible
- Demand
- Attention
Standard Functional Analysis
Total Problem Behavior (Dest + Agg + SIB)

Responses per Min

Sessions

ESCAPE

- Free Play
- Tangible
- Demand
- Attention
Most published function-based treatment (Tiger et al., 2008)

*Differential reinforcement* (teach child recognizable movements or sounds to produce a specific outcome)

+ 

*Extinction* (withhold reinforcement for problem behavior)

Carr & Durand (1985)
FCT (with Demand Fading)
FCT with Izzy
STUDY 1: RANDOMIZED CONTROLLED TRIAL OF FUNCTIONAL COMMUNICATION TRAINING

- N=56
  - Dx: autism
  - 18 mo. to 83 mo. (6 yr., 11 mo.)
  - Exhibit destructive or disruptive behavior (score of 12+ on ABC Irritability subscale)

- Two step-procedure for all participants
  - FA to identify function
  - FCT tailored to function
RCT OF FCT

- Non-inferiority (intent to treat) design structured with single-case design
- Randomized to *Immediate FCT* or *Delayed FCT* (delay = 3 months)
- Statistical analysis: Repeated measures ANOVA

Clinic-to-home

- All sessions conducted in participant home (e.g., bedroom, living room)
  - Families provided webcam, laptop, and Ethernet cable
- Remote coaching from telehealth center
  - Equipped with PC, video monitor, webcam, and headset
RCT of FCT: Results

Mean Percentage of Intervals with Problem Behavior

- Immediate Treatment Group
- Delayed Treatment Group

Time:
- Time 1: Extinction baseline (I)
- Time 2: First month of extinction baseline (D)
- Time 3
- Time 4

Values:
- 0
- 5
- 10
- 15
- 20
- 25
- 30
Results

<table>
<thead>
<tr>
<th>Time</th>
<th>Mean Percentage of Intervals with Problem Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
</tr>
</tbody>
</table>

**Delayed Treatment Group**

**Immediate Treatment Group**

Extinction baseline (I)
First month of extinction baseline (D)
Third month of FCT (I)
Third month of extinction baseline (D)
Results

- Mean Percentage of Intervals with Problem Behavior

- Delayed Treatment Group
- Immediate Treatment Group

- Extinction baseline (I)
- First month of extinction baseline (D)
- Third month of FCT (I)
- Third month of extinction baseline (D)
- End of FCT (I)
- End of FCT (D)
Results

Time 1: Extinction baseline (I), First month of extinction baseline (D)
Time 2: Third month of FCT (I), Third month of extinction baseline (D)
Time 3: End of FCT (I), End of FCT (D)
Time 4: 6-month follow-up (I), 6-month follow-up (D)
STUDY 2: RANDOMIZED CONTROLLED TRIAL OF FUNCTIONAL ANALYSIS PROCEDURES
Purpose:
To evaluate the effects of functional analysis (FA) procedures on treatment outcomes.

Primary Research Question:
Are treatment outcomes (i.e., reduction in problem behavior; time to reduction criterion) similar for children who receive a more rigorous FA than those who do not?
RCT of FA

**Funding:**
NIMH – 4 yr project (2015-2019)
(PIs: Lindgren & Wacker; now: Berg & O’Brien)

**Research Sites:**
Marcus Autism Center – Atlanta, GA
  (Investigator: Nate Call)
University of Houston (Clear Lake) – Houston, TX
  (Investigator: Dorothea Lerman)
University of Iowa – Iowa City, IA
Participants:
114 families with a child meeting the following:
• Diagnosed with autism (DSM-5 criteria)
• 18 mo. to 83 mo. (6 yr., 11 mo.)
• Exhibit destructive or disruptive behavior (score of 12+ on ABC Irritability subscale)
• Live or receive services in Iowa, Georgia, or Texas

Setting:
Clinic-to-home
• All sessions conducted in participant home (e.g., bedroom, living room)
  • Families provided webcam, laptop, and Ethernet cable
• Remote coaching from telehealth center at each site
  • Equipped with PC, video monitor, webcam, and headset
Design:
Randomized controlled trial using a non-inferiority (intent to treat) design.

Stratification across site, gender, age, and intellectual ability.

Single case design to structure assessments and interventions.
Study Procedures:

Pre:
Autism evaluation; functional behavioral assessment interview

I. Assessment Phase (Randomly Assigned):
A. Brief Assessment of Motivation (BAM) only (see Call et al., 2013)
or
B. BAM + Standard Functional Analysis (SFA)

II. Extinction Baseline:
Matched to function

III. Treatment Phase:
FCT is customized to match the results of the BAM or the SFA:
Treatment goal is established based upon baseline data

IV. Follow-up:
Maintenance probes at 6 mo. post treatment completion
Criteria for Completion:
Three consecutive sessions with:
1. Reduction of problem behavior by 90% over baseline
2. Compliance with 90% of task requests (for escape)
3. Independent and appropriate manding

Follow-up:
Maintenance probes at 6 mo. post treatment completion
Case Study: Akiva

6 yr., 0 mo., biracial male

- **Family:**
  - divorced parents
  - 5 children; 3 with developmental disabilities

- **DXs:** autism, moderate ID

- **Target BXs:** self-injury (hand to head, head to ground), aggression (hitting, biting, kicking), destruction, and noncompliance

- **Meds:** Seroquel, fluoxetine, and guanfacine

- **Communication:** nonvocal; no AAC

- **Distance to teleconsultation center:** 259 mi. (~4 hr. 20 min.); very rural location

- **Total travel without telehealth:** 7252 mi. (14 visits)
Akiva: Location
Phase I: BAM

Total Problem Behavior

Sessions

Rate Per Minute
Phase II: Extinction Baseline
Treatment goal:

- Reduction of problem behavior by 90% (from BL)
- Compliance with 90% of tasks
- Independent manding for break
Phase III: Treatment (FCT)
Phase IV: Follow-up
Nearing treatment completion
Lessons Learned: Benefits of Telehealth ABA

1. Increased access & reduction in travel and wait time
   - See Wacker et al. (2013): 222mi from clinic
   - 20 min appt = 2hours (15% direct care time)

2. Results consistent with in-vivo service delivery
   - See Lindgren et al. (2016)

3. Comfort and flexibility of remote in-home consultation
   - Wacker et al. (N.d.): comparable to in-vivo

4. Reduced costs
   - See Lindgren et al. (2016)

5. Increased access for research
Challenges to Successful Telehealth ABA

1. Technology
   - Adequate equipment and internet connections needed on both ends
   - HIPAA compliance (need a BAA)

2. State laws and regulations
   - Originating and home site laws/policies

3. Insurance and Reimbursement Limitations
   - Medicaid-only reimbursement in many states
   - 33 states have parity laws

4. Challenging Patients
   - Safety risks
   - Limited ability to model and intervene

5. Reduced environmental control
References


