Direct Observation of Respiratory Treatments in Cystic Fibrosis: Parent–Child Interactions Relate to Medical Regimen Adherence

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Objective  Use a standardized system to code parent–child interactions during respiratory treatments for cystic fibrosis (CF) and analyze relations between behaviors during treatments and medical regimen adherence. Methods  A total of 15 families (53% girls; M age = 8.9 years; SD = 1.8) had three respiratory treatments recorded in the home environment and coded. Families provided six 24-hr recalls of child medical regimen activities, and electronic airway clearance time was recorded over 3 months to measure medical regimen adherence. Results  Parent positive attention, instructions, and avoidance of negative statements were significantly related to child cooperation during respiratory treatments. Parental presence, positive attention, instructions, and child cooperation during treatments were related to higher respiratory adherence rates. Conclusions  Direct observation methodology has led to effective nutritional adherence intervention for children with CF. These preliminary data demonstrate that an observational method could also be used to develop interventions to promote respiratory medication adherence.

Key words  adherence; behavior problems; children; chronic illness; cystic fibrosis; family functioning; parenting.

Cystic fibrosis (CF) is a genetically transmitted chronic illness affecting approximately 30,000 children and adults in the United States (CF Foundation, 2013). The disease primarily impacts the respiratory, digestive, and reproductive organ systems. Although therapies have significantly improved the life expectancy and quality of life of individuals with CF, they continue to have a shortened life expectancy with the majority of the morbidity and mortality in CF accounted for by chronic lung infections (Montgomery & Howenstine, 2009).

Owing to the importance of lung health, intense and time-consuming respiratory treatments are an essential component of the CF medical regimen. This includes multiple inhaled medications designed to open airways, thin mucus, prevent/treat infection, draw water into the airways, and reduce inflammation. These medications are typically delivered using a nebulizer and/or metered dose or dry powder inhaler. Respiratory treatment also involves airway clearance techniques designed to remove mucus from the airways. This can include wearing an oscillating vest connected to an air compressor. Twice daily treatments lasting between 15 and 30 min are typically recommended. Treatments are increased during periods of illness (Montgomery & Howenstine, 2009).

Completing respiratory treatments as recommended is burdensome, and adherence to respiratory treatments in CF is suboptimal with rates ranging from 40% to 90% depending on the measurement (DeLambo, Ievers-Landis, Drotar, & Quittner, 2004; Eakin & Riekert, 2013; Ievers et al., 1999; Modi et al., 2006; Zindani, Streetman, & Nasr, 2006). Using a cued recall procedure, Modi and colleagues (2006) found that rates of adherence to nebulized medications were 48% and rates for airway clearance techniques were 51%. Research examining barriers to adherence suggests that families find adherence to nutrition and airway clearance recommendations to be the most challenging...
ents are unsure of how to effectively implement behavioral interactions, it may be that in this stressful situation, parents examination (Modi & Quittner, 2006). Similar to mealtime child oppositional behavior is a significant concern for parents with CF, so a direct comparison with children without CF cannot be made. However, prior research suggests that parents of children with CF have been found to have poorer overall family functioning at mealtimes including having less behavioral control (Janicke, Mitchell, & Stark, 2005). Results of these studies have been used in the development of effective behavioral interventions to improve adherence to nutrition in CF (Powers et al., 2005; Stark, Opipari-Arrigan, Quittner, Bean, & Powers, 2011; Stark et al., 1993, 1996).

To date, no studies have used direct observation to examine other aspects of the CF medical regimen including respiratory treatments. Unlike mealtimes, engaging in respiratory treatments is a daily activity unique to children with CF, so a direct comparison with children without CF cannot be made. However, prior research suggests that child oppositional behavior is a significant concern for parents during respiratory treatments, so it is worth further examination (Modi & Quittner, 2006). Similar to mealtimes, it may be that in this stressful situation, parents are unsure of how to effectively implement behavioral strategies to improve child cooperation, and thus may unintentionally engage in ineffective strategies.

An abundance of research exists supporting the role of parent behavior in changing child behavior (Eyberg, Nelson, & Boggs, 2008). Specifically, parental attending to child behaviors typically results in an increase in those behaviors while removing attention decreases behaviors. Parental attention can be categorized into positive (child praise, describing the child’s appropriate behaviors, repeating the child’s appropriate statements) or negative (sarcasm, criticism, yelling) behaviors. Similarly, child responses can be categorized as positive (behavioral compliance/cooperation) or negative (behavioral non compliance/opposition). Another way that parents impact child behavior is through providing behavioral commands, and children can respond through compliance (cooperating with command) or noncompliance (opposition to command). Research suggests that children are more likely to cooperate when parents provide direct commands, which are clearly stated statements telling the child to change his/her behavior (Please hand me that toy.) versus indirect commands, which are vague and often asked as a question (Why don’t you stop whining?). For children diagnosed with CF, Stark and colleagues (2005) found that school-aged children displayed greater oppositional behavior during mealtimes despite the fact that their parents provided more indirect and direct commands than parents of children without CF. They hypothesized that this was due to parents providing either type of command when children engaged in behaviors incompatible with eating, thereby, providing attention for negative child behaviors.

The Dyadic Parent–Child Interaction Coding System (DPICS; Eyberg, Nelson, Duke, & Boggs, 2005) was designed to assess the quality of parent–child social interactions and quantify parent and child behaviors. It specifically measures parental reciprocality, nurturance, and control and child cooperation and opposition. The DPICS was designed for children aged 3–6 years seen in a laboratory setting following a set of standardized instructions, but is flexible, permitting the selection of categories based on the user’s needs. It has been adapted to record parent interactions with children aged 7–12 years, to use in the home environment, and to be administered using a variety of formats, so strict adherence to the instructions is not necessary for use (Coursen et al., 2009; Eyberg et al., 2005).

The aims of this study were to measure the feasibility and reliability of the DPICS for quantifying parent–child behavior during respiratory treatments, if prosocial parent behaviors relate to child cooperation during respiratory
treatments, and if there is a relation between parent–child interactions during respiratory treatments and 3-month medical regimen adherence. We hypothesized that (1) three observations would be collected from >75% of families, parents would report that the observations were typical >90% of the time, and inter-rater reliability would exceed 80%; (2) positive parent attending would relate to child cooperation, while negative parent attending would relate to child opposition; and (3) positive parent and child behavior and greater parental presence and interaction during treatments would relate to higher 3-month respiratory treatment adherence rates. Parent commands and questions were examined in an exploratory manner, as they have been associated with both child cooperation and opposition (Eyberg et al., 2005; Stark et al., 2005).

**Methods**

**Participants**

Children diagnosed with CF and their families were recruited from a CF center at a Midwestern academic medical setting. Participants ranged in age from 6 to 12 years, which is consistent with the age range used to observe mealtime behaviors of children with CF (Stark et al., 2005). Children were eligible if they had been diagnosed with CF for >1 year, were prescribed inhaled medications, used a high-frequency chest wall oscillating (HFCWO) vest for airway clearance, and lived within approximately 60 miles of the medical center. Children experiencing an exacerbation of pulmonary symptoms at enrollment, who had a known developmental delay, and children with non–English-speaking parents were excluded. Only one child per family participated.

This study was approved by the institutional review board of the medical center. Individual informed consent was obtained from each family, including written consent from a parent/legal guardian and written assent from children. Families were approached for recruitment during an outpatient pediatric pulmonary clinic appointment. In total, 27 families were approached, and 16 consented to the study (59% recruitment rate). Of the 11 families that declined, 5 children reported discomfort with being recorded, 2 parents reported discomfort with having a stranger in their home, 2 parents reported being too busy, 1 child was discontinued from daily airway clearance by his pulmonologist after being approached, and 1 parent reported lack of interest in research.

**Procedure**

Participating families received three home visits and three telephone calls during the course of this study. They were provided with financial compensation for their time and effort.

Home visits were targeted to occur within a 3-month time window and were scheduled at the family’s convenience to coincide with the usual timing of children’s respiratory treatments with no more than one per week. Video recording started on arrival. Twenty-four-hour recalls were conducted and HFCWO vest use time was collected before children began respiratory treatments to allow children and families time to become accustomed to the camera before the observation began. Families were then asked to proceed with respiratory treatments as typical. Coding began when parents announced the start of treatments and ended when parents endorsed that the treatment was complete. All verbalizations were coded whether they were directly related to the medical treatment (Put on your mask) or unrelated to the treatment (Change the television channel). During the observation, the research assistant sat in another room or in the corner and did not interact with the parent or child.

As recommended by Quittner, Modi, Lemanek, Ievers-Landis, and Rapoff (2007), two methods of measuring respiratory adherence were used, daily diary through 24-hr recall and electronic measurement through recording HFCWO vest use time. Twenty-four-hour recalls were collected during each of the three home visits, and parents were contacted by telephone three times over the same 3-month time to collect additional recalls. During home visits, HFCWO vest use time was recorded.

**Measures**

**DPICS**

The DPICS was used to code parent and child behaviors during respiratory treatments (Table I) (Eyberg et al., 2005). This coding system is well established (Eyberg et al., 2005). Observations are broken into four classes of behaviors, Verbalizations, Vocalizations, Physical Behaviors, and Response Behaviors, and two categories, Child and Parent. Owing to low instances of Vocalizations (yelling) and Physical Behaviors (hitting) observed during coded interactions, these classes were not analyzed. Parent categories included Positive Attention, which is a combination of Behavioral Descriptions, Reflective Statements, and Praises (Labeled and Unlabeled); Negative Talk; Direct Commands; Indirect Commands; and Questions, which is a combination of Information Questions and Behavioral Questions. Child categories included Prosocial Talk and Negative Talk, and Child Response Behaviors included behavioral Compliance (with commands) and behavioral Noncompliance (with commands). Behaviors were coded according to the frequency of their occurrence during
the interaction. Observations were coded by one of four research assistants who were individually trained in the DPICS by the first author who was trained to research reliability. Training used the DPICS coder training manual including a final quiz requiring a score of 90% (Eyberg et al., 2005).

### Twenty-Four-Hour Recall

This cued recall method was used to assess children’s medical regimen adherence six times over a 3-month time by asking parents to recall all activities completed by the child over the past 24 hours (Johnson, Silverstein, Rosenbloom, Carter, & Cunningham, 1986). Consistent with previous research, all child behaviors were reviewed to avoid social desirability responding. Recalls were timed to collect information about both weekdays and weekends to improve generalizability. After recalling the child’s day, the research assistant reviewed the parent’s report and asked questions to elicit more detailed information. For instance, if the parent said that the child “took pills,” the research assistant asked for specific medication names. This method is considered to be a “well established” measure of medical regimen adherence by the American Psychological Association Society of Pediatric Psychology. It has been found to be reliable, relate to electronic adherence measures, reduce social desirability responding, and it is listed as an efficacious method of adherence assessment (Quittner et al., 2007). Recalled medical regimen activities were compared to the child’s prescribed medical regimen determined through medical record review from their last pediatric pulmonary clinic appointment. Adherence was summarized as a percentage.

### Electronic Measure

HFCWO vests prescribed for airway clearance include an electronic device tracking time used. Time use was recorded during each of the three home visits. Adherence was measured by comparing time use over that period to the prescribed time use determined through medical record review from the child’s last pediatric pulmonary clinic appointment. Adherence was summarized as a percentage.

### Data Analyses

Feasibility was examined by the proportion of families that had three coded observations. Reliability was measured by

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**Table I. DPICS Definitions**

<table>
<thead>
<tr>
<th>Parent categories</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>Positive attending</td>
<td>Combination of Behavioral Descriptions, Reflective Statements, and Praises</td>
</tr>
<tr>
<td>Behavioral descriptions</td>
<td>Non-evaluative sentences or phrases where the subject is the other person and the verb describes ongoing or immediately completed observable behavior (“You put your Vest on.”)</td>
</tr>
<tr>
<td>Reflective statements</td>
<td>Declarative phrase or statement that has the same meaning as a child verbalization (Child: “I’m gonna sit on the couch.” Parent: “You’re going to sit on the couch right by your nebulizer.”)</td>
</tr>
<tr>
<td>Praises</td>
<td>Verbalization expressing a favorable judgment of the child. Two types: 1) Labeled-teaches the child how to receive further parent approval (“Great job starting your machine right after I asked.”), and 2) Unlabeled-does not necessarily reinforce behavior, but may enhance self-esteem (“Great job!”)</td>
</tr>
<tr>
<td>Negative talk</td>
<td>Verbal disapproval of the child or the child’s attributes, activities, or choices (“Why are you just lying there?”)</td>
</tr>
<tr>
<td>Direct commands</td>
<td>Declarative statements that contain an order or direction for a behavior to be performed and indicate that the child is to perform this behavior (“Please put on your Vest now.”)</td>
</tr>
<tr>
<td>Indirect commands</td>
<td>Suggestion for a behavior to be performed that is implied or stated in question form (“Do you want to start treatments now?”)</td>
</tr>
<tr>
<td>Questions</td>
<td>Have a rising inflection and/or have a question sentence structure. Two types: 1) Descriptive/reflective-do not request a response (Child: “I’m done now.” Parent: “Are you sure?”) and 2) Information-request a response (“Where is your inhaler?”)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Child categories</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prosocial talk</td>
<td>Verbalizations which contribute positively to the parent-child interaction (“This is fun mom!”)</td>
</tr>
<tr>
<td>Negative talk</td>
<td>Comment that contains a negatively evaluative word(s) referring to the parent or an action, product, attribute, or choice of the parent (“You never help me!”)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response behavior categories</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance</td>
<td>Coded when the command is obeyed or beginning to be obeyed within 5-seconds.</td>
</tr>
<tr>
<td>Noncompliance</td>
<td>Coded when the command is not obeyed or attempted within 5-seconds.</td>
</tr>
</tbody>
</table>

Note: *Definitions from Eyberg, Nelson, Duke, and Bogg (2005).*
parent rating of how typical the observed respiratory treatments were compared with usual treatments. Inter-rater reliability was assessed through intraclass correlation coefficients (ICC) after double coding 33% of the observations.

Observations were coded based on the frequency of child and parent vocalizations and were averaged across the three observations. Since observation time varied between participants and observation time correlated with vocalizations (r = .50, p < .05), partial correlations, controlling for total observation time, were used to examine relations between parent behaviors, child behaviors, and respiratory adherence rates.

HFCWO vest use time was calculated by dividing the time use during study participation by the time use prescribed over that period and multiplying by 100. Respiratory adherence based on 24-hr recall was obtained by identifying the frequency of respiratory medications and airway clearance activities listed on the recall, dividing by the number of respiratory medications and airway clearance activities prescribed, and multiplying by 100. Twenty-four-hour recalls of respiratory adherence were averaged across the six recalls.

Examination of the two measures of respiratory adherence found that there was no significant difference between the two measures (F(1, 14) = 46.41, p = .11), and that they were significantly correlated (r = .58, p = .03). When multiple methods of adherence are used that include an electronic measure, Quittner and colleagues (2007) recommended the use of regression to correct inflation caused by use of subjective data. However, examination of our data indicated that for 33% of the children, adherence percentages from electronic data were higher than recall data, suggesting that use of this type of correction may overly reduce adherence rates. Quittner and colleagues (2007) also suggested using hierarchical linear modeling to create an underlying adherence construct; however, the small sample size of this project precludes use of this statistical method. Given the concern with overly inflating the error rate through multiple comparisons with a small sample size, and the fact that there was a significant correlation between the two adherence measurements, HFCWO vest use and 24-hr recall data were averaged together to obtain an overall respiratory adherence rate percentage. Rates of adherence were capped at 100% to decrease artificial inflation of adherence scores. Partial correlations, controlling for total coding time, were used to examine relations between behaviors during respiratory treatments and respiratory adherence rates over 3 months. Partial correlations between behaviors during respiratory treatments and HFCWO vest use and 24-hr recall rates were also analyzed individually to allow for examination of relations between behaviors and each type of adherence measurement.

The percentage of time that parents were present during child treatments, and the percentage of verbal exchanges per minute of coding time were also calculated. Although the correlations between parent presence and respiratory adherence (r = .37) and percentage of verbal exchanges and respiratory adherence (r = .42) were moderate, they were not significant. Further analysis of these variables found that there was large variability in the data and that the data had a bimodal distribution. As such, these data were reexamined using the mean as a cut point. High parent presence was defined as parents who were present for ≥76.42% of the observation, and low parent presence was defined as parents who were present for <76.42% of the observation. High frequency of verbal exchanges was defined as utterances occurring at a frequency of ≥0.53 per minute, and low frequency of verbal exchanges was defined as utterances occurring at a frequency of <0.53 per minute. Child age was also examined as a potential covariate with parental presence and verbal exchanges. Child age was not significantly correlated with parental presence but was significantly correlated with percentage of verbal exchanges (r = −.71, p = .003). An independent samples t-test was used to examine differences in respiratory adherence based on parental presence, and analysis of covariance was used to examine differences in respiratory adherence based on percentage of verbal exchanges after controlling for child age.

Results

Participants

Sixteen children were diagnosed with CF and a parent consented. After one home visit and two 24-hr recalls, one family withdrew citing difficulty scheduling as the reason. Due to the missing data, this participant was not included in analyses. The final sample included 15 children (53% girls; M age = 8.9; SD = 1.8). Table II summarizes demographic information, child health information, and child medical regimen adherence rates.

Feasibility and Reliability

Duration of study participation ranged from 2.5 to 5.5 months, with an average of 3.17 months (SD = 1.11). Sixty percent of families completed the study within 2 weeks of the targeted study interval of 3 months. Three recorded observations were obtained from 15 of 16 families (94%), and parents reported that the observations captured typical family interactions 100% of the time. Ninety-eight percent of the observations occurred during children’s
afternoon/evening respiratory treatment, with only one family choosing to have one visit in the morning. Observation time ranged between 8:00 a.m. and 9:00 p.m., with 84% of observations occurring between 3:00 p.m. and 7:00 p.m. ICCs (two-way mixed model, absolute agreement type) were calculated based on the total frequency of the individual behaviors observed during the videos. ICCs ranged between .93 and .99, suggesting acceptable inter-rater agreement.

Relation Between Parent and Child Behaviors During Respiratory Treatments

Average coding time ranged between 18 and 45 min ($M = 33.78$, $SD = 8.08$). Table III summarizes the average frequency of parent and child behaviors during the observations. Parental Positive Attending was related to Child (behavioral) Compliance ($r = .60$, $p = .02$) and Parental Negative Talk was inversely related with Child (behavioral) Compliance ($r = -.58$, $p = .03$). Parental Positive Attending and Parental Negative Talk were not significantly related to Child (behavioral) Noncompliance. Direct Commands were positively correlated with both Child (behavioral) Compliance ($r = .70$, $p < .001$) and Child (behavioral) Noncompliance ($r = .86$, $p < .001$). Indirect Commands were positive correlated with Child (behavioral) Compliance ($r = .70$, $p = .006$), but not Child (behavioral) Noncompliance. Parental Questions were significantly correlated with Child (behavioral) Compliance ($r = .58$, $p = .03$) and were unrelated with Child (behavioral) Noncompliance. Table IV summarizes correlations between the parent and child behavior ratings.

Relation Between Behaviors During Individual Respiratory Treatments and 3-Month Respiratory Adherence Rates

Three-month respiratory adherence rates ranged between 26% and 96% ($M = 70.17$, $SD = 21.90$). Parent Positive Attending and Child (behavioral) Compliance were both significantly correlated with respiratory adherence ($r = .57$, $p = .03$; $r = .62$, $p = .02$, respectively). Parent Negative Talk and Child (behavioral) Noncompliance were not significantly associated with respiratory adherence. Table IV summarizes correlations between all of the coded behaviors and respiratory adherence rates and also includes correlations between coded behaviors and the two separate measures of respiratory adherence (i.e., HFCWO vest adherence rates and 24-hr recall adherence rates).

Percentage of time that parents were present during respiratory treatments ranged from 10% to 100% ($M = 76.42$, $SD = 0.29$). Number of utterances per minute ranged from 0.03 to 1.83 ($M = 0.53$, $SD = 0.55$).
Children with high parent presence had higher respiratory adherence rates ($M = 83.05$, $SD = 13.75$) than children with low parent presence ($M = 55.45$, $SD = 20.60$, $t(13) = 3.09$, $p = .009$). Similarly, children in families with a high frequency of verbal exchanges had higher respiratory adherence rates ($M = 84.53$, $SD = 12.56$) than children in families with a low frequency of verbal exchanges ($M = 64.00$, $SD = 22.46$, $F(2) = 5.9$, $p = .02$) after controlling for child age.

### Exploratory Analyses of Aspects of the Treatment Environment

Exploratory analyses were conducted to examine aspects of the treatment environment and whether they related to medical regimen adherence. Length of respiratory treatment completion time ranged between 17 and 41 min ($M = 29.16$, $SD = 7.16$) and all children were observed while simultaneously inhaling nebulized medications and using their HFCWO vest. Multiple family members were present with the child during 64% of observations, mothers only were present for 20%, fathers only were present for 13%, and another caregiver only was present for 3%. Treatments were most likely to occur in the family’s living room (56%). Other locations included the child’s bedroom (29%), the child’s playroom (7%), and the family’s kitchen (7%). The most common child activities during treatments involved electronics (watching television = 37%, playing videogames = 20%, using a computer/tablet = 18%). Other activities included reading (11%), playing with toys or art activities (9%), and playing a board game (7%). Treatment duration, location, activity, and who was present during treatments were not significantly related to respiratory adherence rates.

### Discussion

The objectives of this study were to measure the feasibility and reliability of the DPICS for quantifying parent–child behavior during respiratory treatments in CF, measure if prosocial parent behaviors relate to child cooperation during respiratory treatments, and study the relation between parent–child interactions during respiratory treatments and 3-month medical regimen adherence rates.

Results support the feasibility and reliability of using a direct observation method to capture parent–child interactions during respiratory treatments. The flexibility of the DPICS allowed this coding method to move outside of a standardized laboratory environment focused on young child and parent social interactions to a naturalistic home environment focused on medical treatments of school-aged children that are unique to individuals with lung disease. Although the DPICS is highly flexible, there are aspects of this coding system that limited its applicability to analyzing behaviors during respiratory treatments. Specifically, children are using a mask or a breathing tube during treatments, and are advised to limit talking to allow the medications to be appropriately inhaled. This was likely one reason why the overall amount of talking during coded observations was low.

Feasibility of this method was supported through obtaining three home observations from greater than 75% of families (94% obtained). Reliability was supported through 100% of families reporting that observations reflected typical child behavior and inter-rater reliability exceeding 80% (range = .93-.99). Feasibility of completing home visits and obtaining observations was supported, but the time and cost associated with completing home visits is a barrier.

### Table IV. Partial Correlations Between Observed Parent and Child Behaviors and 3-Month Respiratory Adherence Controlling for Observation Time

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
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<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
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<tbody>
<tr>
<td>1. Parent positive attending</td>
<td>–</td>
<td>2</td>
<td>–</td>
<td>–</td>
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<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>–</td>
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<tr>
<td>2. Parent negative talk</td>
<td>0.31</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>–</td>
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<tr>
<td>3. Parent direct commands</td>
<td>0.45</td>
<td>–</td>
<td>0.47</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>–</td>
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<tr>
<td>4. Parent indirect commands</td>
<td>0.60*</td>
<td>–</td>
<td>0.52</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>–</td>
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<tr>
<td>5. Parent questions</td>
<td>0.29</td>
<td>–</td>
<td>0.27</td>
<td>0.55*</td>
<td>–</td>
<td>–</td>
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<td>–</td>
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<td>–</td>
</tr>
<tr>
<td>6. Child compliance</td>
<td>0.60*</td>
<td>–</td>
<td>0.58*</td>
<td>–</td>
<td>0.70**</td>
<td>–</td>
<td>0.58*</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>7. Child noncompliance</td>
<td>0.25</td>
<td>0.17</td>
<td>0.86**</td>
<td>–</td>
<td>0.82</td>
<td>–</td>
<td>0.73**</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>8. Child prosocial talk</td>
<td>0.24</td>
<td>–</td>
<td>0.54*</td>
<td>0.73**</td>
<td>–</td>
<td>0.43</td>
<td>0.78**</td>
<td>0.71**</td>
<td>0.55*</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>9. Child negative talk</td>
<td>0.10</td>
<td>0.24</td>
<td>0.29</td>
<td>–</td>
<td>0.15</td>
<td>0.16</td>
<td>0.16</td>
<td>0.23</td>
<td>0.38</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>10. Respiratory adhere rate</td>
<td>0.57*</td>
<td>–</td>
<td>0.38</td>
<td>0.54*</td>
<td>0.67*</td>
<td>0.30</td>
<td>0.62*</td>
<td>0.53</td>
<td>0.38</td>
<td>–</td>
<td>0.18</td>
<td>–</td>
</tr>
<tr>
<td>11. 24-hr recall resp adhere</td>
<td>0.66*</td>
<td>0.11</td>
<td>0.45</td>
<td>0.54*</td>
<td>0.01</td>
<td>0.50</td>
<td>0.49</td>
<td>0.03</td>
<td>0.19</td>
<td>0.83**</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>12. HFCWO vest adherence</td>
<td>0.43</td>
<td>–</td>
<td>0.49</td>
<td>0.51</td>
<td>0.64*</td>
<td>0.43</td>
<td>0.59*</td>
<td>0.47</td>
<td>0.53</td>
<td>0.15</td>
<td>0.94**</td>
<td>0.58*</td>
</tr>
</tbody>
</table>

Note. *Average of 24-hr recall respiratory adherence rate and vest adherence rate.

\*p < .05; \**p < .01
Additionally, although parent and child comfort with having a researcher visit their home was not specifically measured, the recruitment rate for this study was only 59%, and 7 of 11 (64%) families that declined enrollment cited discomfort with aspects of the home visit as the reason for declining. Previous research in CF using a direct observation methodology reported similar recruitment rates, 44% (Stark et al., 2005) and 45% (DeLambo et al., 2004). To obtain larger sample sizes of 28 and 96 participants, these studies recruited participants from three to six different medical centers. Although a direct observation method appears to be a feasible and reliable data collection method, there are a number barriers associated with time and cost, and there is likely a need to recruit from a large pool of participants to obtain a representative sample.

As expected, we found that positive parental attention in the form of praise, reflective statements, and behavioral descriptions was associated with higher levels of child cooperation during respiratory treatments and that negative parent statements were related to lower levels of cooperation. This finding is consistent with child behavioral theory, as parental positive attention is the hallmark of parent training intervention methods for child oppositional behavior problems (Eyberg et al., 2008). Although children diagnosed with CF do not have higher rates of externalizing behavior disorders than children without CF (Bregnballe, Thastum, & Schiotz, 2007), they are asked to complete uncomfortable and restrictive medical treatments multiple times per day, which likely causes stress and may lead to opposition. Furthermore, Modi and Quitner (2006) found that child opposition was the most frequent barrier identified by parents as impacting respiratory treatment adherence. In addition to stressing children, respiratory treatment completion is likely stressful for parents. Similar to Stark and colleagues’ (2005) findings from mealtime observations of children with CF, parental stress during respiratory treatments may lead to engagement in ineffective parenting strategies.

Child behavioral research demonstrates that parent direct commands lead to higher levels of child cooperation than vague instructions and that questions do not increase child prosocial behaviors (Eyberg et al., 2005). However, Stark and colleagues (2005) found that during mealtimes for school-aged children with CF, any type of commands were ineffective. They hypothesized that this was because parents often provided commands after children stopped eating, thereby, providing child attention for noneating behaviors. We found that both direct and indirect commands were associated with child compliance and that direct commands were also associated with child noncompliance. Unlike mealtimes, respiratory treatments likely require some type of parental instructions at the beginning, whether direct (Start your treatment now) or indirect (Why don’t you put on your vest?). However, similar to mealtimes, it may be that additional instructions are typically provided when children oppose the initial command, or when children begin demonstrating opposition, which is why direct commands may have also been related to child opposition.

We also found that questions were associated with child compliance, which is contradictory to child behavioral theory. However, while the overall rates of positive parental attending were low (M = 0.44, SD = 0.44), rates of questions were much higher (M = 5.89, SD = 4.77). Because total verbalizations were positively related to respiratory adherence, it may be that question-asking is acting as a proxy for overall interaction intensity, as adults use a high rate of question-asking when talking with children.

Our hypothesis that positive parent and child behavior and greater parental presence and interaction during treatments would relate to higher 3-month respiratory treatment adherence rates was supported, as Positive Parental Attending and Child (behavioral) compliance were both significantly related to 3-month respiratory adherence rates. Parent Negative Talk and Child (behavioral) Noncompliance were not related to medical regimen adherence rates. This finding is consistent with DeLambo and colleagues’ (2004) observation that positive family relationships were related to greater adherence to respiratory treatments.

There was a significant variability in the amount of parental presence during respiratory treatments (10%–100%). Whether parents were present are not, the overall level of speaking was low, likely related to the fact that while children are completing nebulized treatments, they are instructed to avoid talking to allow for better medication inhalation. Both parental presence and utterances per minute were associated with higher 3-month adherence rates. This suggests that for school-aged children, there is value in parents being present throughout children’s medical treatments even if they are not directly interacting. This is supported by adherence literature that suggests that higher parental involvement relates to improved child medical regimen adherence into adolescence (King, Berg, Butner, Butler, & Wiebe, 2013). Exploratory analyses found that the location and activity completed during respiratory treatments were not related to 3-month respiratory adherence rates. This further supports the value of parental presence over other aspects of the treatment environment.

This study contains a number of limitations. First, the sample size was low and was from a single CF center,
which reduces the generalizability of results. Second, the majority of the families were from married households with an upper middle-class background. This is likely an artifact of the constraint that participants had to reside within driving distance of the academic medical center, which is surrounded mainly by upper middle-class communities. The absence of a more diverse sample further limits the generalizability of this study. Third, the frequency of interactions during the recorded respiratory treatments was low, so it was less likely that significant correlations would be found. Fourth, both medical treatment-related utterance and nonmedical utterances were coded in the same manner, making it difficult to determine whether parent behaviors specific to the medical regimen were playing a key role. However, because overall utterances were low, it appears that the majority of the talking occurred at the beginning and end of treatments, as breathing in nebulized medications should reduce children’s speaking. Finally, the use of correlational statistics does not allow us to infer causality of the direction of relationships. It could be that parents provided more instructions to children who were oppositional or that children who received more parental instructions have more opportunities to either cooperate or disobey.

Further research using a larger sample size and statistical methods allowing for identification of causality is needed. Because respiratory treatments are unique to children with lung disease, a control group without lung disease cannot be used. However, grouping children with high and low respiratory adherence rates may be a way to make a comparison because findings suggest that behaviors during individual treatments are correlated with overall adherence rates. Additionally, the DPICS coding system could be further modified to distinguish between medical-related and -unrelated verbalizations and to examine patterns to the command and response behaviors. Further research could lead to the development of interventions to improve child respiratory adherence similar to those developed to improve CF nutritional adherence.

Despite its limitations, this study is the first to use a direct observational method to assess parent and child behaviors during respiratory treatments for CF. Unlike taking pills, the time required to complete nebulized respiratory and airway clearance treatments makes daily completion burdensome for families. Similar to interventions developed to promote nutritional adherence in CF, teaching parents how to target positive attention during child prosocial and cooperative behaviors and to avoid negative/sarcastic remarks may result in improved child cooperation during individual treatments and improvements in overall respiratory adherence. Based on these findings, it appears that just encouraging parents to be present during respiratory treatments may positively impact children’s medical regimen adherence.

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References


