Empirically Supported Treatments in Pediatric Psychology: Regimen Adherence

Kathleen L. Lemanek,1 PhD, Jodi Kamps,2 MA, and Natasha Brown Chung,3 PhD
1Ohio State University College of Medicine, 2University of Kansas, and 3University of Washington School of Medicine

Objective: To review empirical studies of psychological interventions for nonadherence to medical regimens for three chronic illnesses: asthma, juvenile rheumatoid arthritis (JRA), and type 1 diabetes.

Methods: The Chambless criteria for “promising,” “probably efficacious,” or “well-established” were applied to 8 intervention studies on asthma, 4 on JRA, and 11 on type 1 diabetes.

Results: For asthma, organizational strategies appear probably efficacious in promoting adherence, whereas educational and behavioral strategies appear promising. For JRA, behavioral strategies appear probably efficacious in improving adherence. For type 1 diabetes, multicomponent packages and operant learning procedures appear probably efficacious, whereas cognitive-behavioral strategies appear promising. No interventions were identified as “well-established.”

Conclusions: Future studies will need to develop adequate definitions of adherence, accurate methods of assessing adherence, and appropriate designs to evaluate multicomponent treatment programs to advance interventions to the “well-established” category.

Key words: intervention; nonadherence; asthma; JRA; type 1 diabetes; review.

The literature is replete with reviews, chapters, and empirical studies on nonadherence to long-term medical regimens for chronic illnesses. These reports focus on identifying factors associated with nonadherence (e.g., negative side effects of the regimen) and describing various methods of assessing adherence (e.g., pill counts). Many papers also describe intervention strategies to promote adherence, but few empirical studies address the actual implementation and evaluation of these strategies. This article will review available intervention studies targeting nonadherence to regimens for three pediatric chronic illnesses: asthma, juvenile rheumatoid arthritis (JRA), and type 1 diabetes. These three illnesses were chosen because of their frequency of occurrence in children and adolescents, the range of adherent behaviors involved in the respective medical regimens, and the need to follow these regimens over an extended period of time. We summarize the prevalence of nonadherence, correlates of nonadherence, and possible intervention strategies, and we present an overview of the medical characteristics and treatments for these illnesses. The intervention studies for each illness will then be examined using a set of criteria developed by the American Psychological Association Task Force on Promotion and Dissemination of Psychological Procedures, headed by Diane Chambless (Task Force, 1995).
Definition/Prevalence of Nonadherence

In most investigations, adherence is defined as “the extent to which a person’s behavior (in terms of medications, following diets, or executing lifestyle changes) coincides with medical or health advice” (Haynes, 1979, pp. 2–3). This definition not only delineates a range of adherent behaviors (e.g., taking medications, following diets) but also suggests whether adherence agrees with medical recommendations (Rapoff & Barnard, 1991). On average, the prevalence of nonadherence with medical regimens for chronic illnesses is approximately 50% (Rapoff & Christophersen, 1982; Litt & Cuskey, 1980). With respect to specific chronic illnesses, prevalence rates differ according to the method of assessment, the criteria used to interpret adequate adherence, the recommended regimen components, and the setting where adherence is assessed (Rapoff & Barnard, 1991).

Consequences of Nonadherence

Negative consequences of nonadherence to medical regimens may include increased morbidity, such as exacerbation of symptoms, medical complications, and school absences, as well as greater mortality (Lemanek, 1990; Rapoff & Barnard, 1991). Nonadherence is also related to escalated health care utilization rates (e.g., physician visits, hospitalizations) and expenses from unused medications and unnecessary laboratory tests (Lemanek, 1990; Rapoff & Barnard, 1991). In addition, these expenses may subsequently raise insurance premiums and taxes to families of youths with chronic illnesses and to society at large (Rapoff & Barnard, 1991). Finally, nonadherence may negatively influence decisions regarding clinical drug trials in terms of the adequacy of specific medications to manage illnesses (Rapoff & Barnard, 1991).

Correlates of Nonadherence

Identified factors related to nonadherence to medical regimens can be placed into one of three categories: (1) regimen characteristics, (2) disease characteristics, and (3) patient/family variables (Creer & Levstek, 1996; La Greca & Schuman, 1995; Rapoff & Barnard, 1991).

Regimen Characteristics

Examples of regimen characteristics correlated with nonadherence include longer duration of the regimen, complexity of the medical regimen (e.g., taking multiple medications at different times throughout the day, changes in lifestyle), presence of negative side effects of the medication or the regimen (e.g., weight gain with corticosteroids, pain with range of motion exercises), and unstable efficacy of the regimen. Inconsistent supervision by physicians and parents is also related to nonadherence in youths with chronic illnesses.

Disease Characteristics

Disease characteristics associated with nonadherence consist of asymptomatic periods, younger age at illness onset, and illness severity as perceived by the family. This final characteristic may be related to the degree of parental supervision and vigilance about following the regimen components (Rapoff & Barnard, 1991).

Patient/Family Variables

Patient and family variables involve youths’ characteristics and family interaction patterns rather than demographic variables such as gender and ethnicity. Premorbid behavioral and emotional problems (e.g., oppositional behaviors), family dysfunction (e.g., disharmony, poor problem solving), and lack of social support are related to nonadherence to medical regimens. These characteristics are based on correlational analyses or between-group differences in adherent versus nonadherent youths and families and, therefore, cannot be considered causative.

Intervention Strategies

Intervention strategies to improve adherence stem from clinical experience and research. These strategies can be grouped into one of three categories: (1) educational, (2) organizational, and (3) behavioral (La Greca & Schuman, 1995; Lemanek, 1990; Rapoff & Barnard, 1990).

Educational Strategies

Educational strategies focus on providing verbal and written instructions to inform youths and their
parents about the nature of the illness and its management. Instructions center on giving families factual information about the illness and the regimen requirements, explaining the importance of adherence, and advising families in advance about potential negative side effects of prescribed recommendations.

Organizational Strategies

Organizational strategies emphasize changing clinic and regimen characteristics as a means of promoting adherence. These strategies include, for example, simplifying regimens, increasing supervision by health care providers, improving clinic convenience (e.g., short waiting times, follow-up visits with the same provider), and boosting accessibility to health care services.

Behavioral Strategies

Behavioral strategies target specific adherent behaviors by incorporating visual reminders (e.g., medication calendars, exercise charts) and self-monitoring (e.g., daily logs) into the youth’s daily schedule. Encouraging parental support and dispensing incentives for adherence are also examples of behavioral strategies. Finally, clinical interventions directed toward modifying behavioral and emotional difficulties displayed by youths (e.g., noncompliance, short attention span, depression) and psychopathology or dysfunction evidenced by families (e.g., substance abuse, coercive patterns of interaction, enmeshment) are provided on a more limited basis.

Medical Characteristics and Treatments

Asthma

Asthma is a common childhood chronic illness, occurring in approximately 6% of children younger than 18 years old (Taggart & Fulwood, 1993). The prevalence of asthma is higher in minority populations, low-income groups, and those living in poverty areas (Litonjua, Carey, Weiss, & Gold, 1999; Miller, 2000). For instance, morbidity and mortality rates due to asthma are greater among African American and Hispanic children, especially those of Puerto Rican descent, compared to European American children (Homa, Mannino, & Lara, 2000; Joseph, Ownby, Peterson, & Johnson, 2000). However, the confounding influence of economic status on biological predisposition in these groups is not clear (Litonjua et al., 1999; Miller, 2000).

Asthma is defined as a chronic inflammation disorder that causes airflow obstruction, which is often reversible either spontaneously or with treatment, and bronchial hyperresponsiveness (National Institutes of Health, 1997). The first component of the definition entails the hallmark characteristics of asthma: (1) intermittent occurrence of attacks within and across youths, (2) variable severity of attacks within and across youths, and (3) reversibility of acute airway obstruction (Creer & Bender, 1995). The other two components of the definition—hyperresponsivity and airway inflammation—are more recent defining characteristics.

Airway hyperresponsiveness or “bronchoconstriction” involves narrowing of the small airways due to muscle spasm, mucosal edema, mucosal inflammation, and excessive mucus secretion (Creer & Bender, 1995). Inflammation produces further obstruction as the airway membranes swell and secrete excess mucus. Hyperresponsiveness and inflammation may occur in response to a variety of environmental and internal stimuli, such as allergens (e.g., dust mites, animal dander), irritants (e.g., cigarette smoke, perfumes), drugs (e.g., aspirin), respiratory infections, exercise, changes in air temperature, and emotional reactions (e.g., laughing, crying) (Creer & Bender, 1995; Young, 1994).

Hyperresponsiveness seems to be attributable to the following factors: airway inflammation, deficiencies in bronchial epithelial integrity, changes in autonomic neural control of airways, modifications in intrinsic smooth muscle function, and baseline airway obstruction (Creer & Bender, 1995). Inflammation in the airways also appears to be related to an interplay among inflammatory cells, mediators (e.g., mast cells, macrophages, histamines, platelet-activating factors), and airway cells and tissues; a more detailed explanation of factors influencing hyperresponsiveness and inflammation can be found in a report by the National Institutes of Health (1997). In general, both genetics (the strongest identified factor) and the environment are predisposing factors for the development of asthma (Report, 1997).

The goals of management of asthma are to (1) control symptoms and exacerbations with minimal medication and the need for emergency care, (2) maintain “normal” pulmonary function, (3) optimize functional status (e.g., ability to attend school,
participate in activities), and (4) educate children and their families in early intervention and self-management of asthma (Cockcroft & Hargreave, 1990; Lemanek, 1990). To achieve these goals, regimen requirements for asthma consist of medications, lifestyle changes emphasizing environmental control, and management of crisis (National Institutes of Health, 1997; Young, 1994).

Medications are prescribed to both manage and to prevent asthma attacks, whether these attacks are episodic, recurrent, or exercise-induced. The medications most often administered consist of bronchodilators, anti-inflammatory medicines, and steroids given on an intermittent or daily basis and are taken orally or inhaled. Bronchodilators (e.g., albuterol, metaproterenol) are adrenaline-like drugs that relax the constriction of smooth muscle surrounding the airways. Anti-inflammatory medicines (e.g., cromolyn, nedocromil) lessen airway hyperactivity and the swelling and mucous secretions of airway membranes. Inhaled steroids (e.g., beclomethasone, triamcinolone), given at low doses daily and increased for periods of time, can lessen airway inflammation. Oral steroids (e.g., prednisone, prednisolone) may be necessary during exacerbations of asthma that do not adequately resolve with inhaled medications (e.g., chest colds causing increased airway inflammation).

In terms of environmental control, youths and their families are instructed on how to reduce exposure to known triggers of asthma attacks, such as by avoiding animals, eliminating tobacco smoke and bedroom carpeting, and using air-conditioners and dehumidifiers. Immunotherapy (allergy shots) is also recommended if allergens are constant or cannot be avoided, as with perennial indoor allergens. Management of a crisis or status asthmaticus usually requires administration of oxygen and varying combinations of medications, including injections of epinephrine or terbutaline, inhaled B-2 adrenergic agonists, theophylline IV, and methylprednisolone IV.

Nonadherence usually involves failure to avoid allergens or irritants, underuse daily, or intermittent medications. In addition, appointments may be missed for scheduled allergy shots. Nonadherence rates for pediatric asthma have ranged from 34% (Wood, Casey, Kolski, & McCormick, 1985) to 98% (Sublett, Pollard, Kadlec, & Karibo, 1979) when examining serum assays for therapeutic levels of theophylline. With respect to medications administered through metered-dose inhalers, nonadherence rates ranged from 40% to 55%, based on either canister weights (Zora, Lutz, & Tinkelman, 1989) or a Nebulizer chronolog (Coutts, Gibson, & Paton, 1992).

**JRA**

JRA is one of a group of heterogeneous disorders classified as pediatric rheumatic diseases. The incidence of JRA ranges from approximately 9 to 19 per 100,000 per year (Cassidy & Petty, 1995). The overall gender ratio for JRA is 2:1, female to male. JRA is characterized by muscle and joint pain, swelling, stiffness, and possible impaired functioning or deformity in one or more joints (Cassidy & Petty, 1995; Rennebohm 1994). Related medical complications that typically occur include ocular difficulties, abnormalities of growth and development, and infections (Woo, 1990). In general, the pathophysiologic hallmark of arthritis is inflammation of the synovium, or the spongy lining of the joint (Cassidy & Petty, 1995; Rennebohm, 1994). A malfunction in the immune system is implicated in which the white blood cells “attack” the joints to fight a nonexistent infection (Fantini, 1993; Rennenbohm, 1994). In addition, the disease may be activated and/or sustained in genetically vulnerable youths by environmental factors, such as viruses, nutrition, and trauma (Kewman, Warschausky, & Engel, 1995).

JRA is divided into three basic types: systemic, polyarticular, and pauciarticular onset (Ansell, 1990; Cassidy & Petty, 1995; Rennebohm, 1994). Systemic onset JRA occurs in approximately 10% of those with JRA and equally affects males and females. It involves periodic fever spikes that appear over several days at a time, fatigue, minimal appetite, and anemia. The number of joints involved, and the severity of this involvement, varies widely among youths. Polyarticular onset JRA is characterized by the involvement of five or more joints, prolonged tiredness, minimal appetite, and low-grade fevers. Approximately 40% of cases are classified as polyarticular JRA, with a higher ratio of females to males (3:1). In pauciarticular onset JRA, four or fewer joints are involved, with the knees and ankles the most common joints affected. However, spontaneous remission of pauciarticular JRA is rather standard. This type of JRA occurs in at least 50% of the cases and more often in females than males, with a ratio of 5:1.

The goals of medical treatment are to restrict inflammation and control pain; optimize range of
Type 1 Diabetes

Type 1 diabetes occurs in 1.6 per 1,000 school-age youths (Silverstein, 1994). Type 1 diabetes is characterized by an absence of insulin due to pancreatic failure (Johnson, 1995). This insulin deficiency produces high blood glucose levels (hyperglycemia), which cannot be used by cells for energy or fat and protein synthesis. As insulin levels fall, glycerol and free fatty acids are converted to ketones, which collect in the bloodstream along with glucose. Associated symptoms include extreme fatigue, weight loss with adequate consumption of food, and frequent urination (polyuria) and drinking (polydipsia). In addition, chronic complications may consist of retinopathy, renal failure, heart disease, gastroparesis, and limited joint mobility (Dorman & LaPorte, 1985; Silverstein, 1994).

Genetic factors are implicated in the development of type 1 diabetes, specifically the immune response genes HLA-DR3 and -DR4 (Wolf, Spencer, & Cudworth, 1983). In general, eradication of insulin-producing islet cells within the pancreas is an autoimmune process (Eisenbarth, 1986; Johnson, 1995). However, the mechanism that activates this autoimmune process is not known at this time (Thai & Eisenbarth, 1993). Daily injections of exogenous insulin are required to treat the hyperglycemia. A “honeymoon” period develops at the start of treatment in which youths are able to produce their own insulin, necessitating only small doses of exogenous insulin (Silverstein, 1994). The duration of this period seems related to age at diagnosis in that the destruction of islet cells has occurred for a shorter time in older patients.

The goals of treatment for type 1 diabetes are to support youths’ blood sugar levels within normal ranges, to promote normal growth and activities, and to prevent complications (Silverstein, 1994; Johnson, 1995). Regimen requirements consist of multicomponents including medications, lifestyle changes, such as dietary adherence and exercise prescriptions, and management of crisis of insulin reactions.

Subcutaneous injections of insulin are used to regulate blood glucose levels. Insulin can be either of animal or human origin, short-acting (Regular® or Semilente®) or intermediate-acting (NPH® or Lente®), and administered in single or multiple doses. Blood glucose levels should be monitored at least twice a day because of fluctuations over the course of a day. Acceptable blood glucose levels are in the range of 80 to 180 mg/dl before meals and at bedtime, and 60 to 150 mg/dl when fasting. As such, monitoring typically occurs before all meals and bedtime using commonly available reagent strips and meters. In addition, urine should be checked for ketones using Acetate tablets or urine testing strips, especially if blood glucose levels rise above 240 mg/dl or vomiting develops.

Dietary guidelines are prescribed, including eating at least three meals and three snacks per day and avoiding or limiting sweets, whole milk, and fried or salty foods. Finally, regular aerobic activity is recommended so that glucose can be used for energy and to increase the efficiency of insulin receptors. Careful monitoring of blood glucose levels is mandatory due to the need for adjusting insulin doses based on the interaction among diet, exercise, illness, and stress (Johnson, 1995). Nonadherence with respect to blood glucose monitoring and urine
testing ranges from 30% to 80% (e.g., Johnson et al., 1982; Kovacs, Goldston, Obrosky, & Iyengar, 1992).

**Intervention Studies**

The studies in this review were selected following literature searches using Psych Lit (1974–1999) and Medlines (1983–1999). Articles were included if they met the following criteria: (1) included samples of children and adolescents younger than 18 years old; (2) focused on a diagnosis of asthma, JRA, or type 1 diabetes; (3) directly measured adherence to some component of a medical regimen rather than a collateral measure of disease outcome; (4) reported on an intervention that targeted nonadherence to the medical regimen; and (5) obtained significant results in terms of improved adherence rates. Information from 8 articles on asthma, 4 on JRA, and 11 on diabetes was obtained that met these criteria. Outcome studies on asthma education programs were not included in this review because they were not designed to specifically target nonadherence and were not selective in recruiting children based on their level of adherence. In addition, studies that focused specifically on teaching regimen requirements (e.g., urine testing) to groups of children regardless of level of adherence were excluded from this review. Appendices I, II, and III describe relevant characteristics of these studies.

The effectiveness of the interventions described in these studies was examined according to criteria proposed by the Chambless Task Force and modified by the Society of Pediatric Psychology Task Force (SPP) (Spirito, 1999). To be considered a well-established treatment, an intervention must have been tested in at least two randomized group designs that showed superiority over a psychological placebo or alternative treatment with adequate statistical power (about 30 per group). A large series of well-designed single-case experiments that compared the intervention to another treatment would also be acceptable. Further criteria for well-established treatments were that treatments must be manualized, samples must be adequately described, and effects must demonstrated by at least two independent research groups. Probably efficacious treatments require (1) two or more group intervention studies displaying superiority over a waiting list control group or (2) one study meeting criteria for a well-established intervention. A third category was added by the SPP Task Force, promising interventions, with the following criteria: (1) positive support from one well-controlled study and at least one other less well-controlled study, or (2) a small number of single-case design experiments, or (3) two or more well-controlled studies by the same investigator. Additional modifications to the Chambless criteria included (1) a specified treatment protocol could replace a manual, (2) the number for chronic illness groups could be smaller than 30, and (3) two multiple baseline designs by independent investigators would be evidence for a well-established treatment.

**Chambless Criteria**

**Asthma**

Appendix I presents the sample characteristics, the diagnostic criteria, experimental design, assessment measures, treatment protocols, and outcomes of eight studies examining adherence to medical regimens for pediatric asthma. These eight studies are diverse in terms of methodology, including a single-subject design (i.e., da Costa, Rapoff, Lemanek, & Goldstein, 1997), quasi-experimental designs (e.g., Smith, Seale, Ley, Mellis, & Shaw, 1994), and pre-post control group experiments (e.g., Holzheimer, Mohay, & Masters, 1998; Smith, Seale, Ley, Shaw, & Bracs, 1986). These studies have included a fairly equal number of males and females, with typically moderate or severe asthma, who are on daily medications to prevent asthma attacks. The age range of participants has been extreme (i.e., from 5 months to 18 years), even for studies working with groups of youths. For most studies the procedures followed to ensure participants were diagnosed with asthma were clear, but only one study (da Costa et al., 1997) directly targeted children who were nonadherent for participation. The studies used a variety of methods to assess medication adherence (e.g., serum assays, electronic devices, pill counts, asthma diaries, questionnaires) and health outcomes (e.g., pulmonary functioning, asthma knowledge, symptomatology, functional status). Unfortunately, the combinations of assessment methods and outcome variables in these studies were so divergent that any type of comparison is not possible. In addition, the reliability and validity of diary and questionnaire data on adherence and parent/physician ratings of symptoms and asthma control (e.g., Holzheimer
et al., 1998; Smith et al., 1986) could be questioned without confirmation by other methods, such as assays, pill counts, or direct observation.

Educational, organizational, and behavioral strategies have been used alone and in combination in studies pertaining to adherence and pediatric asthma. One study relied exclusively on organizational strategies to affect adherence rates (i.e., Eney & Goldstein, 1976), and two studies focused solely on educational strategies to affect adherence and health status (e.g., Holzheimer et al., 1998; LeBaron, Zeltzer, Ratner, & Kniker, 1985). The studies by da Costa et al. (1997), Smith et al. (1986), and Weinstein and Cuskey (1985) examined the effects of a combination of at least two strategies on adherence, but varied combinations of educational, organizational, and behavioral strategies were used. The remaining two studies implemented a multicomponent treatment program consisting of educational, organizational, and behavioral strategies to increase adherence rates and optimize functioning in other areas.

The educational component in these studies usually entailed verbal and written information given to parents and youths about asthma, asthma medications, management of asthma, and the importance of adherence. The study by LeBaron et al. (1985), however, specifically focused on the correct use of inhaled cromolyn sodium. The form in which this information was provided varied from leaflets, to videotapes, to slide shows, to books, to program handouts. Typically these educational sessions were held with individual children and their parents in the home (e.g., da Costa et al., 1997), during clinic visits (e.g., Smith et al., 1986), or in separately scheduled appointments (e.g., Holzheimer et al., 1998). Organizational strategies in five studies most often centered on tailoring the medication regimen and expanding the supervision of adherence by the physician (e.g., Baum & Creer, 1986; Eney & Goldstein, 1976; Weinstein & Cuskey, 1985).

The behavioral strategies emphasized either self-regulatory procedures, such as self-monitoring of pulmonary functioning and asthma management (e.g., Smith et al., 1994) or reinforcement-based procedures, such as contracting (i.e., Weinstein & Cuskey, 1985) and token systems (e.g., da Costa et al., 1997). The contracts included not only rewards and sanctions for medication adherence but also requirements for increased supervision and observation by parents. The token systems usually involved earning points for taking medications, exchanging points for privileges, and losing privileges for non-adherence. These behavioral strategies were implemented from 1 to 6 months, during weekly home or clinic visits, with telephone contacts between these visits.

Findings from five studies showed general improvements in both adherence and health outcome (e.g., peak flow rates, asthma symptoms), as well as treatment acceptability (i.e., da Costa et al., 1997; Eney & Goldstein, 1986; Holzheimer et al., 1998; Smith et al., 1986, 1994). In three studies positive effects were obtained only for adherence. But these effects should be interpreted cautiously since a control group was not included in one study (i.e., Weinstein & Cuskey, 1985), and between group comparisons could not be made because of the initially high levels of compliance in the control groups in the other two studies (i.e., Baum & Creer, 1986; LeBaron et al., 1985). Only two of the eight studies incorporated any follow-up period into their treatment effort (i.e., da Costa et al., 1997; Holzheimer et al., 1998).

Applying the Chambless/SPP criteria to treatments for nonadherence in pediatric asthma is challenging due to the varied combinations of educational, organizational, and behavioral strategies across studies and the lack of well-designed studies in general. Educational strategies used alone appear to fit Chambless/SPP criteria of promising interventions (see Table I). Holzheimer and colleagues’ study would be considered well controlled, whereas the study by LeBaron and associates is less rigorous because of the high level of adherence in the control groups in the other two studies (i.e., Baum & Creer, 1986; LeBaron et al., 1985). Only two of the eight studies incorporated any follow-up period into their treatment effort (i.e., da Costa et al., 1997; Holzheimer et al., 1998).

Organizational strategies, such as increased supervision by physicians, appear to be probably efficacious interventions (see Table I), whether implemented in isolation (Eney & Goldstein, 1976) or combined with education (Smith et al., 1986) or a behavioral intervention (Weinstein & Cuskey,
These studies used either quasi-experimental or well-controlled designs and adequate sample sizes (i.e., greater than 30 in each group). The study by Smith and colleagues also suggests that the addition of organizational strategies to educational strategies affects not only adherence but also health status.

The combination of behavioral strategies with either educational (da Costa et al., 1997) or organizational strategies (Weinstein & Cuskey, 1985) seems to be promising interventions according to the Chambless/SPP criteria (see Table I). This treatment approach does not fit within the probably efficacious category because only the study by da Costa and associates (1997) included controls, if one considers participants as their own controls.

Based on the two studies (i.e., Baum & Creer, 1986; Smith et al., 1994) that involved multicomponent treatment packages to improve adherence in pediatric asthma, this approach does not appear to fit any of the Chambless/SPP criteria (see Table I). Whereas the study by Baum and Creer (1986) used a comparison group, this group showed higher adherence rates at the beginning of the study than the treatment group. As with the study by LeBaron et al. (1985), Baum and Creer's study could not then be considered a well-controlled design. Some researchers in this area (e.g., Clark, 1977; Smith et al., 1994) propose that subjects should be used as their own controls when studying clinical outcomes in asthma; the use of traditional randomized controlled designs are not appropriate. If this proposal is followed, the quasi-experimental design used by Smith et al. (1994) would elevate the status of a multicomponent treatment package to a promising intervention.

The glaring differences in these eight studies in terms of sample characteristics, assessment measures, and treatment protocols hinder comparison across studies. Establishing the effectiveness of a treatment program for adherence to regimens in pediatric asthma will require the replication of specific protocols by different groups of investigators.

**JRA**

The research on efforts to improve regimen adherence in JRA is limited. Michael Rapoff at The University of Kansas Medical Center is responsible for the significant work done in this area. Appendix II describes the patient characteristics, assessment measures, treatment components, and results of the four studies published by Dr. Rapoff and his colleagues. These assessment measures reflect the emphasis on medication and lifestyle changes as part of the regimen components for treatment of JRA.

The four studies were single-subject designs and included a fairly representative sample of patients with this chronic illness (e.g., age ranges, forms of JRA), although all participants but one were female. The method and criteria used to determine nonadherence were rigorous: participants were less than 80% adherent with their medical regimen over a 1- to 2-month period. Various assessment methods were employed to measure both adherence (e.g., pill counts, parent observation of wearing splints and lying prone) and disease outcome (e.g., symptom ratings by parents, joint counts by rheumatologist).

The intervention approaches implemented emphasized behavioral strategies, along with either an educational or organizational component, and occurred in the homes of participants. The behavioral strategies included at a minimum self- or parent-monitoring and positive verbal feedback, and in two studies (e.g., Rapoff, Lindsley, & Christophersen, 1984; Rapoff, Purviance, & Lindsley, 1988b) tokens and back-up privileges for general compliance (e.g., cleaning room) and then adherence to the medical regimen (e.g., medications). Tokens were also withdrawn for negative behaviors or omission of appropriate behaviors. Educational

| Table I. Evaluation of Treatment Efficacy by Chronic Illness and Intervention |
|-----------------------------|-----------------------------|-----------------------------|
| Chronic Illness | Intervention | Treatment Efficacy |
| Asthma | Educational strategies | Promising intervention |
| | Organizational strategies | Probably efficacious intervention |
| | Behavioral strategies/ with one other strategy | Promising intervention |
| | Multicomponent treatment package | Future research needed to determine efficacy |
| JRA | Behavioral strategies with/without educational strategy | Probably efficacious intervention |
| Type 1 diabetes | Operant learning procedures | Probably efficacious intervention |
| | Cognitive/behavioral self-regulation procedures | Promising intervention |
| | Multicomponent treatment/self-management training | Probably efficacious intervention |
strategies centered on verbal instruction about prescribed medications, side effects of these medications, and the importance of medications and adherence in management of the illness. The education and behavioral strategies implemented in these studies were standardized in the extent that written handouts and protocols were given to parents and patients regarding JRA, the medical regimen, and strategies to improve compliance. Finally, a simplified regimen (i.e., dose change from 4 to 3 times a day) was used in the one study that included an organizational strategy (i.e., Rapoff et al., 1988b).

Results in these studies revealed improved adherence rates for all but one participant, but variable maintenance at follow-up. These studies are noteworthy in the consistent inclusion of follow-up data, especially for such extended periods of time (e.g., 9 months, 12 months).

According to the Chambless/SPP criteria, these four studies describe an intervention that would be considered probably efficacious (see Table I). To meet these criteria, at least two experiments must show the treatment to be more effective than a waiting-list control group; in these studies participants were considered their own controls due to the use of single-subject designs. In general, Rapoff and his colleagues provide evidence for the effectiveness of an intervention that focuses on behavioral strategies, with or without the addition of an education component, in increasing the adherence to medical regimens for JRA. A variety of reinforcement-based strategies seems equally effective in enhancing adherence, including a token system and social attention and feedback from family members. Comparison of this intervention to another treatment, either using single-subject designs or between-group designs, is the first step in validating this intervention as a well-established treatment.

**Type 1 Diabetes**

Of the many studies on diabetes, only 11 met the inclusionary criteria. Appendix III outlines the sample characteristics, methodology, and outcome of treatment studies on nonadherence and type 1 diabetes. A representative sample of youths participated in the studies in terms of age range (6 to 19 years) and gender, although most studies centered on later childhood and early adolescence. Minimal information, overall, was provided on other demographic characteristics of participants with respect to ethnicity and socioeconomic status. At least half of the studies directly targeted individuals who were nonadherent according to parent or physician report or documented insulin reactions (e.g., Gross, 1982; Snyder, 1987). Although parent and physician reports are not the most reliable and valid measure of adherence, these studies represent an advance from most studies in the adherence literature in which samples of convenience are used. Study designs were equally divided between single-subject methodology (e.g., Gross, 1982; Epstein et al., 1981) and true-experiments with control groups (e.g., Delamater et al., 1990; Satin, La Greca, Zigo, & Skyler, 1989), with nine studies including short-term follow-up (e.g., 2 weeks, 6 months).

Seven of the 11 studies focused on a failure to adhere to different diabetes regimen components (e.g., blood glucose monitoring, urine testing, dietary restrictions), obtained through direct observation (e.g., Lowe & Lutzker, 1979), self-monitoring (e.g., Schafer, Glasgow, & McCaul, 1982), or parent ratings of target behaviors (e.g., Gross, Magalnick, & Richardson, 1985). An objective measure of metabolic control, HbA1c/Ghb, was included in 9 of the 11 studies; this measure is similar to the health outcomes identified in the adherence literature on pediatric asthma. In addition to these measures of adherence and metabolic control, several studies included assessment of family conflict related to diabetes, parents’ and youths’ perceptions of and attitudes about diabetes, and diabetes knowledge (e.g., Epstein et al., 1981; Satin et al., 1989; Wysocki, Green, & Huxtable, 1989). Unfortunately, the mix of measures used across studies renders comparisons difficult.

This difficulty is also evident in the treatment procedures employed in each study in which programs consisted of varying combinations of procedures. Treatment procedures were based on operant learning principles (e.g., token system), social learning theory (e.g., role-playing, behavioral rehearsal), and cognitive-behavioral theory (e.g., self-monitoring). In addition, an educational component was evident in all 11 studies. The education provided to both children and their parents was related to diabetes and its management in general (e.g., Epstein et al., 1981), to specific aspects of the diabetic regimen such as blood glucose monitoring (e.g., Anderson, Wolf, Burkhart, Cornell, & Bacon, 1989), or to self-management/behavior management principles such as shaping and extinction (e.g., Gross, 1982; Gross et al., 1985). The role of education in these studies was varied, either serving
as one part of a multicomponent treatment package (e.g., Gross et al., 1985; Epstein et al., 1981) or as the standard of care provided to both experimental and control groups (e.g., Anderson et al., 1989; Delamater et al., 1990).

Seven of the 11 studies (e.g., Carney, Schechter, & Davis, 1983; Snyder, 1987; Wysocki et al., 1989) included some form of reinforcement directed toward aspects of the diabetic regimen (e.g., blood glucose monitoring, foot care). Contingent praise, tangible rewards (i.e., money), and points exchanged for daily privileges and weekly bonuses were consequences of adherence, with hospital admission a consequence of nonadherence.

Self-monitoring was often the initial component of a treatment package, in which goals for gradual improvements in adherent behavior were set based on self-monitoring data (e.g., urine testing, insulin use) (e.g., Schafer et al., 1982; Snyder, 1987). When these goals were met, children and adolescents earned privileges, which were negotiated by all individuals with the help of the therapist or researcher (e.g., extra spending money, special time with parents).

The development of decision-making skills or problem-solving skills was emphasized within self-management training in six studies (e.g., Delamater et al., 1990; Epstein et al., 1981; Gross et al., 1985). A skills training approach was typically followed in all studies (i.e., instruction, modeling, rehearsal, feedback, reinforcement), using a specified number of written modules. However, the nature of the treatment protocol diverged along three paths. In the studies by Gross and colleagues (1982, 1985) and Snyder (1987), general self-management skills (e.g., reinforcement, negotiation, contracting) were taught and then applied to managing diabetes on a daily basis or to nondisease-specific issues. In contrast, Epstein et al. (1981) directly targeted management of aspects of the diabetic regimen (e.g., insulin adjustment, diet) and disease-related issues (e.g., stress). Finally, Anderson et al. (1989) and Delamater et al. (1990) focused on training how to use self-monitoring of blood glucose levels to solve management problems, such as the effects of puberty or exercise on regimen adjustments.

According to the Chambless/SPP criteria, operant learning procedures that focused on direct reinforcement for increased adherence to specific regimen components (e.g., blood glucose monitoring, urine testing) would be considered a probably efficacious treatment (see Table I). Results of the two single-subject studies (i.e., Carney et al., 1983; Lowe & Lutzker, 1979) and one well-controlled experiment (i.e., Wysocki et al., 1989) support the effectiveness of operant procedures for improving adherence to individual regimen components. Mixed findings were, though, obtained in terms of metabolic control; decreases in HbA1c readings were obtained by Carney et al. (1983), but nonsignificant group differences in Ghb were found by Wysocki et al. (1989). For operant procedures to be deemed a well-established treatment for diabetes, adherence comparison to a psychological placebo or alternative treatment will be necessary. Such studies could be randomized group designs or a series of single-case designs. In addition, the effects of these procedures beyond a 4-month period are not known.

The studies by Schafer et al. (1982), and Satin et al. (1989) incorporated cognitive and behavioral self-regulation procedures (e.g., self-monitoring/goal setting, emotional/behavioral support) and direct reinforcement in their interventions. The combination of these two procedures would be considered a promising intervention (see Table I) rather than a probably efficacious treatment for several reasons. Most important is the variable or unreliable results obtained by Schafer et al. (1982) and Satin et al. (1989) with respect to adherence. Zero, one, or two regimen requirements were changed in their three subjects, with regression toward the mean at the 2-month follow-up. Satin et al. (1989) found increases from pretreatment to posttreatment in overall self-care for the multifamily and the multifamily plus simulation groups compared to the control group. However, this finding was based on asking parents to estimate their child’s overall self-care on a 5-point scale. In addition, while an outline of the treatment sessions was provided by Satin et al. (1989), it was not clear whether group leaders adhered to specific protocols or modules.

For cognitive and behavioral self-regulation procedures to be considered probably efficacious treatments, the exact nature of these procedures will require standardization in future studies in order for investigators across sites to implement them consistently. The extent to which support groups, such as the multifamily group in the Satin et al. study, are considered a psychological placebo will also need to be determined in comparisons with alternative treatments.

The final six studies evaluated the effects of a multicomponent treatment package that empha-
sized training in self-management skills. In these studies, decision-making skills, problem-solving skills, and negotiation skills were trained and either directed toward managing a daily multicomponent diabetic regime (Epstein et al., 1981; Gross, 1982; Gross et al., 1985) or using self-monitoring blood glucose levels to regulate insulin, diet, and exercise (Anderson et al., 1989; Delamater et al., 1990). The study by Snyder (1987) was included in this group due to the addition of problem-solving and negotiation skills training to operant and self-monitoring procedures. Within each study, treatment sessions followed a specified number of modules to train targeted management skills.

These multicomponent treatment packages fall within the category of probably efficacious treatments (see Table I), particularly those packages that focused on improving individual aspects of a diabetic regimen. Consistent improvements in adherence were found when one component of a diabetic regimen was targeted (e.g., Gross et al., 1985), but variable results were obtained when multiple components were addressed (e.g., Anderson et al., 1989). For example, in the study by Anderson et al. (1989), self-monitoring of blood glucose was used during exercise but not to adjust insulin doses or diet. Improvements in metabolic control, family conflicts, and treatment satisfaction were also obtained by individual studies when assessed.

To further validate a multicomponent intervention program for adherence to diabetes regimens, future studies will need to use the same measures of psychological adaptation, adherence, and health outcome and to standardize the self-management programs. In addition, the exact nature of the standard care and attention-placebo groups used in some of these studies (e.g., Anderson et al., 1989; Delamater et al., 1990) should also be examined as their therapeutic effects, such as goal setting and social support. These effects will need to be determined before such groups can be used for comparisons to established treatments.

**Future Intervention Research**

This review of treatment studies on regimen adherence indicates that operant-based or behavioral strategies are probably efficacious with respect to specific treatment components. Other individual strategies, such as education, self-monitoring, and multicomponent programs, are, at best, promising interventions. Single-subject experimental designs appear to offer the most consistent results and allow for tailoring treatments to individual patients. However, single-subject experimental designs will need to be conducted for individual chronic illnesses, especially as the Chambless/SPP criteria require comparisons with psychological placebos and alternating treatments. A range of single-subject designs is available, such as concurrent schedule strategy and extensions of the A-B-A design that can examine effects of psychological placebos and interactions (Hersen & Barlow, 1981). However, investigators will need to be creative and knowledgeable about the range of options available, without limiting themselves to use of withdrawal or reversal designs.

The use of prospective randomized clinical trials in regimen adherence may be premature at this time until more data are obtained on specific treatment strategies. The efficacy of only a few treatment strategies or programs has been documented so that comparisons to alternative treatments is impractical and basically of questionable utility. Future studies will also need to define more clearly psychological placebos due to the variable use of standard care as control or treatment groups in previous studies.

The generalizability of findings from individual studies is minimal due to the lack of information about specific characteristics of the patients and their families. Characteristics of the samples in treatment studies on regimen have not been consistently delineated, with the exception of age and gender. The ethnic background, socioeconomic status, and age at diagnosis have typically not been reported for individual participants or groups of participants. As such, the results from individual studies are then unique to specific patient populations in terms of demographic characteristics and chronic illnesses. The effectiveness of individual treatment strategies may also then be specific to individual patients or chronic illness groups.

The inconsistency in assessment measures, treatment protocols, and research designs within and across illness groups has ultimately limited the development and validation of well-established treatments in this area. In general, future research on regimen adherence will need to examine both the empirical and clinical effectiveness of any adherence intervention. Studies will need to address at least three areas of research: adequate definitions of adherence, accurate methods of assessing adherence, and appropriate designs to evaluate multi-
Conceptualizing Adherence

How adherence is conceptualized will affect the assessment measures chosen, the experimental designs, and the statistical analyses conducted, as well as how the data are interpreted. Rapoff (1999) has summarized and critiqued the essential components of various theoretical perspectives in the adherence literature, such as the health belief model, the transtheoretical model, and the applied behavior analytic model. These models have primarily been examined with adult patients with chronic illnesses, so their application to pediatric populations is unclear. An initial step in incorporating theory into future studies on adherence may be to target for change either cognitive or self-mediated thought processes or environmental contingencies, which may transcend theoretical perspectives (Rapoff, 1999).

Previous studies have viewed adherence as static rather than a continuous process (La Greca & Schuman, 1995). Adherence has not been measured over time in most studies for this reason, as well as practical limitations of settings in which adherence has been assessed. Conceptualizing adherence as a process that will change from initial diagnosis through subsequent regimen modifications suggests repeated measurement periods. Supporting this recommendation are findings that adherence decreases over time in most chronic illnesses (La Greca & Schuman, 1995; Rapoff & Barnard, 1991). Repeated assessment would signal when intervention strategies are necessary to promote adherence. The characteristics and treatment responses of those youths who are “consistently” adherent versus “sporadically” adherent also require further examination, in addition to how these concepts fit within the general definition of adherence (La Greca & Schuman, 1995).

Considering adherence as a process also concerns the recruitment of families for participation in research projects. A selection bias has been present in most projects in that families who are nonadherent do not participate or drop out prematurely (La Greca & Schuman, 1995; Rapoff & Barnard, 1991). The data provided by these families would, though, be invaluable in determining a base rate of nonadherence and in designing the most efficacious treatment components in multicomponent programs. To obtain more accurate estimates of adherence, Sackett (1979) suggests using “inception cohorts,” which entails recruiting all newly diagnosed patients who have been prescribed a specific regimen; all patients would then be followed whether or not they drop out of treatment. Rapoff and Barnard (1991) and Rapoff (1999) propose that an adherence database be developed using this methodology where adherence and clinical outcome data are collected at periodic intervals across different sites. Finally, future studies should recruit patients with low adherence and poor treatment outcomes, as they are likely to benefit most from adherence interventions. Few treatment studies on regimen adherence have, thus far, targeted patients with these characteristics. The variable results on the effectiveness of individual treatment strategies and multicomponent programs within and across chronic illnesses may be partly attributable to such recruitment methods.

Assessing Adherence

The second area of research centers on methods of assessing adherence. The minimal relationship between adherence and disease control continues to pose a problem for judging the effectiveness of interventions. Rapoff and Barnard (1991) and Rapoff (1999) encourage the development of reliable and valid clinical outcome measures, such as interviews and questionnaires on functional status. Future research should also consider parents and youths as active participants in the adherence process, whose opinions regarding goals of treatment and specific recommendations influence subsequent adherence (La Greca & Schuman, 1995; Rapoff & Barnard, 1991). Unfortunately, parental bias in reporting inflated adherence levels in their children is common (Rapoff & Christophersen, 1982). To decrease this bias, other adherence and clinical outcome measures that do not rely on parental or patient report (e.g., electronic monitoring) should be administered at random occasions over time (Lemanek, 1990; Rapoff & Christophersen, 1982). Interestingly, obtaining information continuously and from multiple sources is a recommendation consistent with assessment practices in clinical child psychology. Such practices should be more consistently adopted when assessing adherence in pediatric populations.
Currently, there is no gold standard for assessing adherence. Rapoff (1999) proposes that the gold standard for assessing medication adherence be continuous use of automated measures and periodic assays to confirm actual ingestion. In addition, the gold standard for nonmedication regimens could be a combination of periodic structured telephone interviews on task completion and periodic observation of task completion by caregivers. Whereas objective measures of adherence (e.g., blood and urine assays, direct observations) provide a more accurate estimate of adherence than indirect measures (e.g., interviews and ratings), the clinical utility and feasibility of more direct measures need to be considered in future basic and clinical research efforts.

Rapoff (1999) also outlines issues and recommendations regarding assessment in regimen adherence, including reactivity, representativeness, directness, reliability and validity, and interpretation of the data. This latter issue pertains to what standards to use in interpreting results from the assessment measure. Again, there is no gold or biological standard to judge adherence versus nonadherence for individual illnesses or patients (Rapoff, 1999). A final assessment issue, clinical and treatment utility, has been ignored in the literature and relates to whether assessments contribute to beneficial treatment outcome (Rapoff, 1999). Increased consistency between type of assessment measure (e.g., blood assay) and what is being measured (e.g., medications) may, in fact, improve the clinical and treatment utility of measures in this area. Whereas it is reasonable to consider a relationship between specific measures and constructs, there are no current guidelines for directly matching measures and regimen requirements for individual illnesses. These guidelines may be helpful in coordinating studies across investigators and illnesses, but the question of who will be responsible for establishing these guidelines will probably require lengthy discussion.

**Evaluating Intervention Strategies**

The third area of research involves appropriate evaluation of intervention strategies. Previous research has emphasized correlational studies rather than prospective between-group designs. Rather than continuing to attempt large-scale group designs in single centers, investigators should consider patient-focused research as an alternative research strategy (Howard, Moras, Brill, Martinovich, & Lutz, 1996). Traditional outcome research tries to answer the following two questions: (1) does it work under experimental conditions based on randomized clinical trials (efficacy questions) and (2) does it work in practice based on quasi-experimental designs (effectiveness question). In contrast, patient-focused research seeks to answer whether treatment works for this patient by continuously assessing the treatment progress of each patient. This approach also focuses on choosing appropriate outcome measures to assess progress and different interventions optimal for each phase of treatment. In terms of adherence, behavioral strategies may be the initial intervention examined to improve adherence to medications. Other strategies can then be introduced and assessed for their effectiveness in promoting more complex regimens and general self-management skills in individual children and adolescents.

Greater use of single-subject designs that rely on a fewer number of subjects and allow for examination of individual treatment components is a methodology suited to patient-focused research. To accommodate an increased emphasis on or greater allowance for single-subject designs, the Chambless/SPP criteria may need to be modified further. For example, replication across different sites for single-subject designs would be comparable to implementation by different investigators for group designs. In addition, replication across patients and regimens would increase external validity and, therefore, generalizability of the results obtained. Finally, single-subject designs would be the initial phase in “a phased studies approach” recommended by La Greca and Varni (1993). These designs would lead to single-site group studies and then multisite randomized controlled group designs.

Nonadherence to medical regimens is a well-documented problem in the pediatric literature. Research in this area has emphasized identifying correlates of nonadherence rather than designing intervention strategies. In those studies available, interventions that have targeted specific regimen components in individual patients have generally resulted in increased adherence. In contrast, multi-component treatment packages that focus on training a broader range of decision-making skills have produced mixed results. One of the biggest challenges in this area of research and clinical practice is the different methodologies used by investigators within and across illness groups. Ultimately, con-
sumers (e.g., youths, families, managed care compa-
nies) will require necessary documentation of the
cost benefits of interventions developed to promote
adherence in actual clinical practice. It will be chal-
lenging for researchers and clinicians to fulfill this
requirement in terms of consistency across sites and
chronic illnesses in methodology and implementa-
tion. However, these challenges will also bring the
potential for innovative assessment measures and
treatment protocols in future research to determine
the most efficacious and effective interventions that
foster and maintain adherence to pediatric medical
regimens.

Appendix I

Studies on Pediatric Asthma

asthma: Comparing the effectiveness of a developmentally appropriate asthma
education videotape and picture book. Child: Care, Health, and Development,
24, 85–99.

Sample. N = 80. Ages: 2 to 5 years old.

Diagnostic Criteria. Participants were required to re-
ceive daily asthma medication. Participants re-
cruited from child care centers, play groups, and
medical centers.

Experimental Design. Pretest posttest control group
design.

Assessment Measures. Child asthma knowledge ques-
tionnaire and parent-completed asthma diary of
nonadherence with medication, experience of
asthma symptoms, and need for medical care
(phone calls and visits to the doctor).

Treatment Protocol. Participants randomly divided
into control group and three treatment groups;
parent-child dyad included in session. Control
group (N = 16) saw videotape and read book unre-
related to asthma. Treatment groups (N = 15) varied
in whether viewed an asthma education videotape
and/or read an asthma book: Group 1—asthma vid-
etape and book; Group 2—asthma videotape and
unrelated book; Group 3—unrelated videotape and
asthma book.

Outcome. Gains in asthma knowledge for all treat-
ment groups, with greatest increases for asthma vid-
etape and asthma book group. Treatment groups
experienced fewer nonadherent days and fewer
days with wheezes or coughs than control group.
Medical consultation was sought less often by par-
ents and children who viewed the asthma videotape
and read the book compared to controls.

Follow-up. Continued gains in asthma knowledge in
all groups at 3-month follow-up.

LeBaron, S., Zeltzer, L. K., Ratner, P., &
of education for improving compliance
with cromolyn sodium (Intal®): The im-
portance of physician-patient commu-

Ethnicity: 1 African American, 4 Mexican-
American, and 26 Caucasian from low–middle eco-
nomic status.

Diagnostic Criteria. Participants diagnosed with mild
to moderate asthma and required to be on either
daily theophylline and/or beta-adrenergic agents
and cromolyn. Participants recruited from pediatric
allergy practices.

Experimental Design. Pretest posttest control group
design.

Assessment Measures. Patient knowledge of cromo-
lyn and ratings of degree of adherence (0 = totally
nonadherent to 10 = totally adherent), with spot
urine samples to assay cromolyn sodium level. Pa-
tient ratings of frequency of asthma attacks (0–10)
and severity of attacks (0–10) over past month. Pa-
tient medical history score and allergist medical his-
tory score that consisted of patient reported activity
level, exercise tolerance, night cough, and need for
increased asthma medication (0 = poor functioning
to 2 = functioning well). Objective medical data in-
cluding peak flow meter readings and pulmonary
function tests. Overall control of asthma as rated by
allergists from medical history and objective data.

Treatment Protocol. Three individual education ses-
sions about cromolyn sodium and mechanics of ad-
ministration for participants and their parents.
Noneducation group did not receive instruction.

Outcome. Greater knowledge about cromolyn so-
dium in education group. Increases in adherence
through self-reports and urine tests in education group; initial level of adherence in noneducation group was high. Nonsignificant differences in patient ratings, patient and medical history scores, overall medical data, and overall control of asthma.

Follow-up. No follow-up data reported.


Sample. N = 90 (n = 47 in treatment group). Ages: 3 to 16 years old.

Diagnostic Criteria. Participants diagnosed with chronic asthma and were recruited from a pediatric allergy clinic.

Experimental Design. Posttest control group design.

Assessment Measures. Serum and/or salivary theophylline levels measured on one occasion two hours after prescribed dose.

Treatment Protocol. Organizational strategy of physician supervision and monitoring.

Outcome. Greater percentage of participants in treatment group with therapeutic serum theophylline levels.

Follow-up. No follow-up data reported.


Sample. N = 196. Treatment group = 36 females and 57 males; control group = 42 females and 61 males. Ages: 5 to 16 years old.

Diagnostic Criteria. Participants diagnosed with moderately severe asthma, were prescribed continuous medication, and were followed by a hospital asthma clinic.

Experimental Design. Pretest and posttest control group design.

Assessment Measures. Parent interview and questionnaire on adherence, asthma, medication, and health beliefs. Parent and physician ratings of asthma control and symptoms on a 4-point Likert scale. Physician ratings of adherence on 4-point Likert scale. Pulmonary function tests.

Treatment Protocol. Education about medications and organizational strategy including increased physician supervision and tailored drug regimen during three clinic visits.

Outcome. Percentage of medication adherence and knowledge of asthma and medication greater in treatment group than in control group.

Follow-up. No follow-up data reported.


Sample. N = 90 (n = 47 in treatment group). Ages: 3 to 16 years old.

Diagnostic Criteria. Participants diagnosed with chronic asthma and were recruited from a pediatric allergy clinic.

Experimental Design. Posttest control group design.

Assessment Measures. Serum and/or salivary theophylline levels measured on one occasion two hours after prescribed dose.

Treatment Protocol. Organizational strategy of physician supervision and monitoring.

Outcome. Greater percentage of participants in treatment group with therapeutic serum theophylline levels.

Follow-up. No follow-up data reported.


Sample. N = 196. Treatment group = 36 females and 57 males; control group = 42 females and 61 males. Ages: 5 to 16 years old.

Diagnostic Criteria. Participants diagnosed with moderately severe asthma, were prescribed continuous medication, and were followed by a hospital asthma clinic.

Experimental Design. Pretest and posttest control group design.

Assessment Measures. Parent interview and questionnaire on adherence, asthma, medication, and health beliefs. Parent and physician ratings of asthma control and symptoms on a 4-point Likert scale. Physician ratings of adherence on 4-point Likert scale. Pulmonary function tests.

Treatment Protocol. Education about medications and organizational strategy including increased physician supervision and tailored drug regimen during three clinic visits.

Outcome. Percentage of medication adherence and knowledge of asthma and medication greater in treatment group than in control group.

Follow-up. No follow-up data reported.


Diagnostic Criteria. Identified for participation by responsiveness to medication, symptoms, and peak flow meter readings.

Experimental Design. One-group pretest posttest design.

Assessment Measures. Random serum theophylline levels. Symptom scores and medication cards completed by parents and collected monthly. Peak flow meter readings obtained during clinic visits.


Outcome. Greater percentage of participants with theophylline levels in the therapeutic range. No difference between adherent and nonadherent participants in terms of symptoms (decreased wheezing in all participants), medications (increased in all participants), and peak flow meter readings (increased in all participants).

Follow-up. No follow-up data reported.

Sample. N = 2. 8-year-old Caucasian female. 10-year-old Caucasian male.

Diagnostic Criteria. Participants diagnosed with moderate to severe asthma and were identified by pediatric allergist as nonadherent.

Experimental Design. Withdrawal design.

Assessment Measures. Daily electronic device (chronolog) of asthma medication by participants and records of points and privileges by parents. Pulmonary function tests and treatment acceptability ratings by participants and parents.

Treatment Protocol. Education and token economy.

Outcome. Modest improvement in adherence for both participants. Improvement in pulmonary function for one participant. High acceptability ratings by participants and children.

Follow-up. Decreased adherence during 3-month, 6-month, and 14-month follow-up for one participant assessed.


Sample. N = 16 (6 males each in treatment and control groups). Ages: 6 to 16 years old.

Diagnostic Criteria. Participants diagnosed with mild to severe asthma, were on maintenance regimen of theophylline-based compounds, and followed by hospital clinic.

Experimental Design. Pretest posttest comparison group design.


Treatment Protocol. Self-monitoring group consisted of 12 weekly sessions where self-monitoring data were collected. Self-management group consisted of 12 weekly sessions focusing on education and feedback and reinforcement.

Outcome. Increased adherence in self-management group; initial adherence in self-monitoring group high. No group differences in pill counts, peak flow readings, asthma attacks, medication schedules, and questionnaire data.

Follow-up. No follow-up data reported.


Diagnostic Criteria. Participants had moderately severe asthma and were followed by hospital asthma clinic.

Experimental Design. One-group pretest posttest group design.

Assessment Measures. Parent questionnaire on adherence, asthma, medication, and health beliefs. Parent and physician ratings of asthma control and symptoms on a 5-point Likert scale. Pulmonary function test. Diary cards of peak flow meter readings by participants on daily basis.

Treatment Protocol. Education about medications. Organizational strategy included increased physician supervision and tailored drug regimen. Behavioral strategies included self-monitoring and feedback regarding adherence to written action plan.

Outcome. Improvements in medication adherence, asthma control, symptoms, and peak flow readings.

Follow-up. No follow-up data reported.

Appendix II

Studies on JRA


Sample. N = 3 (all females). Ages: 11 to 18 years old. Ethnicity: 2 African American and 1 Hispanic.

Diagnostic Criteria. Youths diagnosed from 2 to 8 years with JRA. Participants recruited from local rheumatology clinic for nonadherence with prednisone medication.
Experimental Design. Multiple baseline across subjects.

Assessment Measures. Pill counts obtained from parents (1 participant) or from participants (2 participants) on a weekly basis.


Outcome. Increases in prednisone adherence in all participants.

Follow-up. Maintenance of adherence at 6 and 12 months.


Sample. N = 1 female 7 years old.

Diagnostic Criteria. Diagnosed at age 3 with systemic-onset JRA with persistent polyarthritis. Participant referred by rheumatologist for nonadherence.

Experimental Design. Multiple baseline across behaviors.

Assessment Measures. Parent observation and recording of adherence to medication, splint wearing, and prone lying on a daily basis.

Treatment Protocol. Token economy.

Outcome. Increase in adherence in all three behaviors.

Follow-up. Maintenance of adherence during 10-week follow-up.


Sample. N = 3 (all female). Ages: 3 to 13 years old.

Diagnostic Criteria. 3 year-old participant diagnosed at age 5 months with seronegative polyarticular JRA; 10-year-old participant diagnosed at age 5 years with pauciarticular JRA; 13-year-old participant diagnosed at age 4 months with seronegative polyarticular JRA. Participants referred from local rheumatology clinic for nonadherence.

Experimental Design. Multiple baseline across subjects.

Assessment Measures. Pill counts and parental ratings of adherence (1 = very noncompliant to 5 = very compliant) obtained on a weekly basis.


Outcome. Improvement on both measures for two of three participants.

Follow-up. Decrease in adherence at 4-month follow-up, but greater adherence than at baseline.


Sample. N = 1 male 14 years old.

Diagnostic Criteria. Diagnosed at age 25 months with polyarticular JRA. Participant recruited in a group study that identified nonadherence.

Experimental Design. Withdrawal design.

Assessment Measures. Pill counts obtained from parents (1 participant) or from participants (2 participants) on a weekly basis.

Outcome. Increases in prednisone adherence in all participants.

Follow-up. Maintenance of adherence at 6 and 12 months.


Sample. N = 1 female 7 years old.

Diagnostic Criteria. Diagnosed at age 3 with systemic-onset JRA with persistent polyarthritis. Participant referred by rheumatologist for nonadherence.

Experimental Design. Multiple baseline across behaviors.

Assessment Measures. Parent observation and recording of adherence to medication, splint wearing, and prone lying on a daily basis.

Treatment Protocol. Token economy.

Outcome. Increase in adherence in all three behaviors.

Follow-up. Maintenance of adherence during 10-week follow-up.


Sample. N = 3 (all female). Ages: 3 to 13 years old.

Diagnostic Criteria. 3 year-old participant diagnosed at age 5 months with seronegative polyarticular JRA; 10-year-old participant diagnosed at age 5 years with pauciarticular JRA; 13-year-old participant diagnosed at age 4 months with seronegative polyarticular JRA. Participants referred from local rheumatology clinic for nonadherence.

Experimental Design. Multiple baseline across subjects.

Assessment Measures. Pill counts and parental ratings of adherence (1 = very noncompliant to 5 = very compliant) obtained on a weekly basis.


Outcome. Improvement on both measures for two of three participants.

Follow-up. Decrease in adherence at 4-month follow-up, but greater adherence than at baseline.


Sample. N = 1 male 14 years old.

Diagnostic Criteria. Diagnosed at age 25 months with polyarticular JRA. Participant recruited in a group study that identified nonadherence.

Experimental Design. Withdrawal design.

Assessment Measures. Pill counts obtained from parents (1 participant) or from participants (2 participants) on a weekly basis.

Outcome. Increases in prednisone adherence in all participants.

Follow-up. Maintenance of adherence at 6 and 12 months.


Sample. N = 1 female 7 years old.

Diagnostic Criteria. Diagnosed at age 3 with systemic-onset JRA with persistent polyarthritis. Participant referred by rheumatologist for nonadherence.

Experimental Design. Multiple baseline across behaviors.

Assessment Measures. Parent observation and recording of adherence to medication, splint wearing, and prone lying on a daily basis.

Treatment Protocol. Token economy.

Outcome. Increase in adherence in all three behaviors.

Follow-up. Maintenance of adherence during 10-week follow-up.


Sample. N = 3 (all female). Ages: 3 to 13 years old.

Diagnostic Criteria. 3 year-old participant diagnosed at age 5 months with seronegative polyarticular JRA; 10-year-old participant diagnosed at age 5 years with pauciarticular JRA; 13-year-old participant diagnosed at age 4 months with seronegative polyarticular JRA. Participants referred from local rheumatology clinic for nonadherence.

Experimental Design. Multiple baseline across subjects.

Assessment Measures. Pill counts and parental ratings of adherence (1 = very noncompliant to 5 = very compliant) obtained on a weekly basis.


Outcome. Improvement on both measures for two of three participants.

Follow-up. Decrease in adherence at 4-month follow-up, but greater adherence than at baseline.


Sample. N = 1 male 14 years old.

Diagnostic Criteria. Diagnosed at age 25 months with polyarticular JRA. Participant recruited in a group study that identified nonadherence.

Experimental Design. Withdrawal design.

Assessment Measures. Pill counts obtained from parents (1 participant) or from participants (2 participants) on a weekly basis.

Outcome. Increases in prednisone adherence in all participants.

Follow-up. Maintenance of adherence at 6 and 12 months.


Sample. N = 1 female 7 years old.

Diagnostic Criteria. Diagnosed at age 3 with systemic-onset JRA with persistent polyarthritis. Participant referred by rheumatologist for nonadherence.

Experimental Design. Multiple baseline across behaviors.

Assessment Measures. Parent observation and recording of adherence to medication, splint wearing, and prone lying on a daily basis.

Treatment Protocol. Token economy.

Outcome. Increase in adherence in all three behaviors.

Follow-up. Maintenance of adherence during 10-week follow-up.


Sample. N = 3 (all female). Ages: 3 to 13 years old.

Diagnostic Criteria. 3 year-old participant diagnosed at age 5 months with seronegative polyarticular JRA; 10-year-old participant diagnosed at age 5 years with pauciarticular JRA; 13-year-old participant diagnosed at age 4 months with seronegative polyarticular JRA. Participants referred from local rheumatology clinic for nonadherence.

Experimental Design. Multiple baseline across subjects.

Assessment Measures. Pill counts and parental ratings of adherence (1 = very noncompliant to 5 = very compliant) obtained on a weekly basis.


Outcome. Improvement on both measures for two of three participants.

Follow-up. Decrease in adherence at 4-month follow-up, but greater adherence than at baseline.


Sample. N = 1 male 14 years old.

Diagnostic Criteria. Diagnosed at age 25 months with polyarticular JRA. Participant recruited in a group study that identified nonadherence.

Experimental Design. Withdrawal design.

Assessment Measures. Pill counts obtained on a weekly basis. Daily parent ratings of morning stiffness (0 = no stiffness to 3 = severe stiffness), activity level (0 = normal activity to 2 = very little activity), and pain complaints (0 = no complaints to 3 = frequent complaints). Joint evaluations completed by rheumatologist.

Treatment Protocol. Organizational strategy (simplified regimen) and token economy.

Outcome. Increase in pill counts, and changes in parent ratings of symptoms and active joint counts.

Follow-up. Maintenance of adherence at a 9-month follow-up.

Appendix III

Studies on Diabetes


**Sample.** $N = 3$ (1 female). Ages: 10 to 14 years old. Ethnicity: Caucasian.

**Diagnostic Criteria.** 14-year-old male diagnosed at age 10 with diabetes. 11-year-old male diagnosed at age 5 years with diabetes. 10-year-old female diagnosed at age 5 years with diabetes. Participants referred by physician for nonadherence.

**Experimental Design.** Multiple baseline across subjects.

**Assessment Measures.** Monitoring of blood glucose by parent and participants obtained weekly basis. Glycosylated hemoglobin levels (HbA1c).

**Treatment Protocol.** Direct reinforcement consisting of parent praise and point system.

**Outcome.** Increases in blood glucose monitoring in all three participants. Decreases in HbA1c in all three participants.

**Follow-up.** Maintenance of adherence and metabolic control at 4-month follow-up.

**Lowe, K., & Lutzker, J. R. (1978).** Increasing compliance to a medical regimen with a juvenile diabetic. *Behavior Therapy, 10*, 57–64.

**Sample.** $N = 1$ female 9 years old.

**Diagnostic Criteria.** Diagnosed at age 5 with diabetes. Participant referred by pediatrician due to nonadherence.

**Experimental Design.** Multiple baseline across behaviors.

**Assessment Measures.** Monitoring of urine testing by participant. Diabetes regimen knowledge and skills test.

**Treatment Protocol.** Education and token economy.

**Outcome.** Increases in dietary adherence, urine testing, and foot care.

**Follow-up.** Maintenance of adherence during 10-week follow-up.


**Sample.** $N = 42$. Mean age = 14 years. 15 in each treatment group and 12 in control group.

**Diagnostic Criteria.** Identified as nonadherent to self-monitoring blood glucose by parents. Participants and family interested in using reflectance meter with memory for self-monitoring blood glucose.

**Experimental Design.** Pretest posttest control group design.

**Assessment Measures.** Automatic recording of blood glucose levels. Glycosylated hemoglobin levels (GHB). 24-hour recall interviews with parent and participants about exercise, injection, diet type, diet amount, and testing/eating frequency. Parent and participant questionnaires involving attitudes about diabetes, social supports, and knowledge of diabetes.

**Treatment Protocol.** Six group meetings over 18-week period. Meter only treatment group earned money for bringing in meters at set intervals. Meter plus contract treatment group earned money contingent on glucose testing frequency. Control group received standard medical care.

**Outcome.** Increase in adherence with blood glucose monitoring in meter plus contract group. No differences in overall adherence, GHb levels, or questionnaire data.

**Follow-up.** No follow-up data reported.


**Sample.** $N = 32$. 11 in multifamily group (7 females), 12 in multifamily plus simulation group (9 females), and 9 in control group (4 females). Participants mostly middle class.

**Diagnostic Criteria.** Mean duration of diabetes was 5.9 years ($\pm 2.6$ years). Participants were recruited from diabetes unit at university hospital.

**Experimental Design.** Pretest and posttest control group design.

**Assessment Measures.** Parent estimate of participants’ self-care using 5-point Likert scale. HbA1c levels. Parent and participant scale of family environment.
Sample. $N = 4$ Males. Ages: 10 to 12 years old.

**Diagnostic Criteria.** Diagnosed with diabetes greater than 1 year. Identified by physician as nonadherent.

**Experimental Design.** Multiple baseline across subjects.

**Assessment Measures.** Percentage monitoring of urine testing by participants. Test of behavior modification principles and procedures.

**Treatment Protocol.** Standardized 6-week self-management training program consisting of education, modeling and role-playing, contracting, and negotiation.

**Outcome.** Increase in urine testing in all participants. Increase in mean performance on behavior modification test.

**Follow-up.** Maintenance of adherence at 2-week follow-up in all participants. Maintenance of adherence at 8-week follow-up in 2 participants.


Sample. $N = 14$. 7 in treatment group (3 females) and 7 in control group (5 females). Ages: 9 to 13 years old. Majority of participants in two-parent households.

**Diagnostic Criteria.** Diagnosed with diabetes between 1 and 12 years.

**Experimental Design.** Pretest posttest control group design.

**Assessment Measures.** Likert rating scale of adherence (1 = strongly disagree to 7 = strongly agree) completed by parents. Parenting monitoring of diabetes related conflicts and daily occurrence of target behaviors. HbA1c levels. Test of behavior modification principles and procedures for participants. Parent evaluation form of program effectiveness.

**Treatment Protocol.** Standardized 6-week self-management program consisting of education, modeling and role-playing, contracting, negotiation.

**Outcome.** Increase in urine testing in all participants. Increase in mean performance on behavior modification test.

**Follow-up.** Maintenance of adherence at 2-week follow-up in all participants. Maintenance of adherence at 8-week follow-up in 2 participants.


Sample. $N = 3$ (2 females). Ages: 16 to 18 years old.

**Diagnostic Criteria.** Diagnosed with diabetes between 4 and 9 years. Identified by physician as nonadherent.

**Experimental Design.** Multiple baseline across behaviors.

**Assessment Measures.** Participants self-monitoring of target behaviors: urine testing, insulin use, exercise, wearing diabetic information bracelet, and blood glucose.

**Treatment Protocol.** Sequential introduction of self-monitoring, goal setting, and behavioral contacting during 8-week period.

**Outcome.** Improvement in adherence to wearing bracelet for one participant, and to exercise and urine testing for additional participant. No improvements in adherence in third participant. Decrease in HbA1c for first two participants.

**Follow-up.** Maintenance of adherence at 2-month follow-up.

crease in diabetes related conflict only in treatment group. Improvements in metabolic control in both groups.

Follow-up. Maintenance of adherence at 6-month follow-up.


**Sample.** N = 1 14-year-old male.

**Diagnostic Criteria.** Identified as nonadherent by parent and physician.

**Experimental Design.** Case report.

**Assessment Measures.** Self-monitoring by participant of target behaviors: urine testing, insulin use, and diet. Independent checks of monitoring by parent and school nurse.

**Treatment Protocol.** Self-monitoring, behavioral contract, and family therapy.

**Outcome.** Increase in number of target behaviors. Decrease in antisocial behavior and family conflicts. Increase in school attendance.

Follow-up. Maintenance of adherence at 1-month follow-up, but deterioration of gains at 6-month follow-up.


**Sample.** N = 19; 6 participants in group 1 (5 females), 7 participants in group 2 (5 females), and 6 participants in group 3 (4 females). Ages: 8 to 12 years old.

**Diagnostic Criteria.** Diagnosed with diabetes between 9 months and 8 years. No history of psychiatric problems and followed by children’s hospital.

**Experimental Design.** Multiple baseline across groups.

**Assessment Measures.** Daily urine testing with adherence to urine testing measured by marked item technique. GHb levels, fasting plasma glucose levels, and serum lipids. Participant knowledge of and attitude about diabetes. Parent satisfaction rating of program.

**Treatment Protocol.** 12-week program with 6 modules emphasizing education and parent-child behavioral contracts.

**Outcome.** Increase in percentage of negative urine tests across groups. Nonsignificant changes in GHb and plasma glucose levels or insulin units. High program satisfaction ratings.

Follow-up. Maintenance of adherence at 2-month follow-up.


**Sample.** N = 36; 12 (6 females) in conventional, supportive, and self-management groups. Ages: 3 to 16 years old. Majority of participants were Caucasian.

**Diagnostic Criteria.** Newly diagnosed with diabetes, no history of psychiatric disorders or other chronic illnesses, and followed by pediatric diabetes clinic. Participants enrolled during initial hospitalization.

**Experimental Design.** Pretest, posttest control group design.

**Assessment Measures.** Logbook of self-monitoring of blood glucose levels, food intake, and time intervals between injections and meals. HbA1c levels. Pancreatic B-cell activity measured by C-peptide. Hospital chart review of blood glucose and serum bicarbonate levels at diagnosis, frequency of severe hypoglycemia, and hospitalizations for ketoacidosis.

**Treatment Protocol.** Conventional group received education and standard care with parents and participants. Supportive group and self-management group consisted of 7 sessions with parents and participants 4 months after discharge, with booster sessions at 6 and 12 months. The supportive group emphasized education plus discussion of coping with regimen, family involvement, and self-monitoring of blood glucose levels. The self-management group focused on education, plus problem-solving skills and contingent praise in using blood glucose monitoring for daily self-management of diabetes.
Outcome. No difference between groups in frequency of self-monitoring of blood glucose levels or in timing of injections and meals. Fewer dietary deviations in self-management group compared to conventional group. HbA1c improved in all three groups at 6-month session, but continued improvement obtained only for self-management group at 12-month session. No group differences in hypoglycemia or diabetic ketoacidosis.

Follow-up. No difference in adherence or self-management behaviors. Lower HbA1c levels in self-management group compared to supportive group and conventional group at 2-year follow-up.


Sample. N = 60; 30 (16 females each group) in standard care and intervention groups. Ages: 11 to 14 years old.

Diagnostic Criteria. Diagnosed with diabetes over 1 year and followed by pediatric diabetes clinic.

Experimental Design. Pretest posttest control group design.

Outcome. No difference between groups in frequency of self-monitoring of blood glucose levels or in timing of injections and meals. Fewer dietary deviations in self-management group compared to conventional group. HbA1c improved in all three groups at 6-month session, but continued improvement obtained only for self-management group at 12-month session. No group differences in hypoglycemia or diabetic ketoacidosis.

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Diagnostic Criteria. Diagnosed with diabetes over 1 year and followed by pediatric diabetes clinic.

Experimental Design. Pretest posttest control group design.


