

Implementing Behavioral Intervention Components in a Cost-Effective Manner:

An Analysis of the Incredible Years Program

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ABSTRACT

Interventions to prevent conduct disorder (CD) often involve multiple treatment components that target several contexts within a child's life (i.e. both home and school atmospheres). Researchers suggest that "stacking" intervention components in this way is more effective than single-component interventions. But whether or not this approach is cost-effective remains unanswered. Multiple waves of data from the Incredible Years Series – an established multi-component CD intervention – are used to examine the cost-effectiveness of delivering multiple, stacked intervention components vs. delivering single intervention components. Cost-effectiveness analysis (CEA) provides decision makers with important economic data that can be used to select a program implementation. The roles of implicit vs. explicit budget constraints, as well as the CEA concepts of strict and extended dominance, are demonstrated using Incredible Years data. We find that <fill this in>

Conduct disorder (CD) and its precursor, Oppositional Defiant Disorder (ODD), are among the most common emotional and behavioral disorders affecting children and youth (Institute of Medicine, 1989), occurring in an estimated 10 percent of young children (Institute of Medicine, 1989; Webster-Stratton & Reid, 2003). Children with CD often engage in a variety of behaviors that are costly to themselves, their families and society (Institute of Medicine, 1989; Webster-Stratton & Reid, 2003). These children frequently lack critical social and self-regulation skills necessary for making friends; the absence of these skills increases children's risk of peer rejection and isolation (Kaiser & Hester, 1997). Approximately 40 percent of youth who develop childhood-onset CD will eventually develop adult antisocial personality disorder as well (Kazdin, 1995).

CD puts youth at risk for other costly outcomes such as weapon use and substance abuse and increases the likelihood of teenage pregnancy and dropping out of school (Robins and Price, 1991; Bardone, Moffitt, Caspi, Dickson, Stanton, & Silva, 1998; Scott, 1998). Such children often become involved with public, child-serving systems, such as juvenile justice. This involvement creates incarceration costs, juvenile court costs, costs of productivity lost due to incarceration, and victim costs all borne by society (Cohen, 1998). Recent studies estimate that one life of crime results in societal costs ranging from \$1.3 to \$1.5 million (Cohen, 1998; Snyder & Sickmund, 1999). One heavy drug user costs society between \$370,000 and \$970,000, while one high school dropout costs society between \$243,000 and \$388,000 (Cohen, 1998).

Although incidence of CD is higher among adolescents (Searight, Rottnek, & Abby, 2001), a small minority of "early starters" begin to display conduct disorder symptoms as early as preschool (Moffitt, 1993). Without intervention, childhood-onset CD generally results in bleaker trajectories than adolescent-onset CD (Searight et al., 2001).

While the figures concerning individual and societal effects of CD are discouraging, promising treatment and prevention programs are being developed. Effective CD treatments may reduce crime and provide cost savings to society while improving children's life trajectories. These treatments often combine multiple components that target risk factors across several domains (Kaiser & Hester, 1997). Typically, multi-component treatments focus on the home and school settings, and parent, teacher, and peer communication skills.

While the effectiveness of multi-component CD interventions has been demonstrated, their cost-effectiveness is largely unknown. This article considers the differential cost-effectiveness of delivering multiple treatment components in combination versus a single component delivery method. We also review cost-effectiveness methodology and consider economic decision making involving multiple components.

This framework is used to evaluate the cost-effectiveness of The Incredible Years Parents, Teachers, and Children Training Series – an evidence-based multi-component intervention created to treat young children with early-onset conduct problems.

PRIOR RESEARCH

Treating Conduct Problems

Effective and early intervention must be provided before patterns of negative behaviors become habitual (i.e. Kaiser & Hester, 1997; Webster-Stratton & Reid, 2003). Therefore, interventions designed for very young children may be more successful in treating conduct problems than those designed for school-age children (Keenan & Wakschlag, 2000). A large body of research currently indicates that multi-component interventions are most effective for preschool and early-school-age children. One example is the Incredible Years (IY) Series; it has been identified as an effective CD/ODD treatment and prevention program for young children by

the Office of Juvenile Justice and Delinquency Prevention (Webster-Stratton, 2000).

Additionally, an independent APA review committee reported the IY Series as only one of two evidence-based multi-component treatments that has been shown to reduce conduct problems in young children (Brestan & Eyberg, 1998).

Although multi-component treatments may most reliably reduce negative behaviors, agencies may implement just one component to minimize costs. However, this practice may ultimately prove inefficient. A higher effect size for multi-component treatments may justify their increased cost. On the other hand, if the effect size for multi-component treatments is only slightly larger, agency resources may be better used in within a multi- treatment approach.

The relative cost-effectiveness of alternative approaches depends on the way in which the choice problem is framed. Evidence-based multi-component treatments have little value if the intervention is too expensive for anyone to be able to implement. Similarly, if the cost of a multi-component intervention strictly limits the number of children able to be treated, health decision makers may need to consider alternative implementation strategies that treat substantially more children slightly less effectively. Therefore, in order to select the most efficient implementation strategy for preschool and early-school-age populations, information regarding individual components' success rates or effect sizes and financial feasibility must be made available.

Cost-Effectiveness Evaluation of Social Interventions

Since economic resources are limited, especially those for social intervention and prevention programs (Plotnick & Deppman, 1999), funds should be spent as efficiently as possible (in a way that maximizes societal benefits while minimizing societal costs). Analyses weighing interventions' effectiveness against their costs are necessary for making economically sound decisions; if an intervention's costs outweigh its benefits, society would benefit from funding

other, more cost-effective interventions with similar goals (Plotnick & Deppman, 1999). Similarly, within the realm of multi-component interventions, information weighing one component combination's costs and effectiveness against that of other component combinations helps agencies determine the most cost-effective implementation strategy.

Economic evaluation can take any of several forms. Perhaps better known, benefit-cost analysis involves measuring both the costs and the benefits of a program in dollar terms. Cost-effectiveness analysis (CEA), on the other hand, does not assign monetary costs to all benefits; program costs are assigned monetary values while program benefits are valued in non-monetary units (Johannesson, 1995). Generally, CEA produces cost-effectiveness ratios, which represent dollars spent per unit change in the outcome of interest. CEA requires fewer research dollars but does not provide a "bottom line" for the program; however, it is quite useful for comparing programs. Programs with lower cost-effectiveness ratios are preferred to those with higher ratios.

CEA may be particularly helpful for determining the most efficient treatment implementation strategy for young children. Unlike benefit-cost analysis, CEA produces immediate results by incorporating program effectiveness measures that are not assigned monetary values; typical benefit-cost analyses of behavioral interventions would normally require prospective public health data including crime, substance use, and school-drop out rates. Such information would take years to collect if behavioral interventions were targeted toward very young children.

Recent interest in the scope and efficiency of health prevention programs, as well as limited funding for health interventions, has stimulated cost-effectiveness research within many fields of health study. Studies incorporating CEA commonly focus on health prevention programs such as those designed to decrease transmittal rates of HIV/AIDS, increase smoking cessation initiatives,

and avert costly side effects associated with diabetes and depression (i.e. Pinkerton, Holtgrave, Johnson-Masotti, Turk, Hackl, DiFranceisco, et al., 2002; Song, Raftery, Aveyard, Hyde, Barton, and Woolacott, 2002; Hoerger, Bethke, Richter, Sorensen, et al., 2002; Raikou, Gray, Briggs, Stevens, Cull, McGuire, et al., 1998; Scott, Palmer, Paykel, Teasdale, Hayhurst, 2003; Miller, Chilvers, Dewey, Fielding, Gretton, Palmer, et al. 2003).

METHODS

The current study applies CEA methodology to data generated from repeated implementations of the Incredible Years Series. Given the multiple formats available for this program, cost-effectiveness analyses can inform health decision makers as to which Incredible Years treatment format would be most cost-effective given their agency's unique budget constraints.

The Incredible Years (IY) Parent, Teacher and Children's Series: Program Design and Goals

Program History and Goals. The Incredible Years Parents, Teachers, and Children Training Series – developed by Carolyn Webster-Stratton, Ph.D., and evaluated by colleagues at the University of Washington's Parenting Clinic – is a multi-component program designed to treat young children (ages 3 to 8) with early-onset conduct problems. Based on implementation methods, the IY Series also has been adapted to serve as a cost-effective, community-based prevention program for children at risk for the development of CD. By serving as both a CD treatment and prevention program, the IY Series is applicable to an enormous percentage of young children. Over the past 20 years, this intervention has been repeatedly implemented in both clinic and real-world contexts such as mental health settings and schools.

Ultimately, the IY Series strives to prevent delinquency, drug abuse, and violent acts among high-risk children. However, immediate goals of the program include the reduction of conduct

problems in children; the enhancement of social, emotional, and academic capabilities of children; the promotion of parental competence and positive discipline strategies; the strengthening of families as well as the school-home connection; and the enhancement of teacher classroom management skills (Webster-Stratton, 2000).

The IY Series is comprised of three main single treatment components that each focus on different contexts and types of social interaction a child encounters in his or her daily life. The three treatment components include (1) a child-based program (referred to as Child Training or CT); (2) a parent-based program (referred to as Parent Training or PT); and (3) a teacher-based program (referred to as Teacher Training or TT). CT and PT curricula is delivered to participants over a series of weekly small group sessions led by trained CT or PT group leaders; teachers taking part in TT receive the program content during a 4-day long training workshop. For a detailed description of treatment component goals, curriculum, and implementation methods, please see Webster-Stratton (2000).

Webster-Stratton and colleagues have implemented the IY Series using these three single treatment components either alone (i.e. CT program alone) or stacked in various combinations (i.e. CT plus TT and/or PT). Different combinations of the IY components are recommended depending on the child population being targeted.

Program Success. The IY Series has been effective in reducing the frequency of children's conduct problems regardless of treatment locale. Service agencies (mental health agencies, child welfare, and schools) continue to implement the IY Series and large-scale diffusion of the program has occurred across the United States, Canada, UK, and Norway. Agencies adopting the IY Series are responsible for budgeting for treatment materials (videotapes, group leader manuals, parents' and children's books), training from certified IY trainers, and ongoing

consultation with IY trained staff. Following the initial material, training, and consultation fees, CT, PT, and TT may be offered to participants at minimal cost to the service agency.

The current literature has assessed the impact of participant characteristics, program intensity, and stacked treatment categories on the effectiveness of the IY Series. Numerous randomized control group studies by the developer (i.e. Webster-Stratton, 1990; Webster-Stratton & Hammond, 1997; Webster-Stratton & Reid, 1999a; Webster-Stratton & Reid, 1999b; Webster-Stratton, Reid & Hammond, 2001) and by independent investigators (i.e. Taylor, Schmidt, Pepler, & Hodgins, 1998; Miller & Rojas-Flores, 1999; Scott, Spender, Doolan, Jacobs, & Aspland, 2001; Barrera, Biglan, Taylor, Gunn, Smolkowski, Black, et al., 2002) strongly support the assertion that the IY Series consistently improves child behavior across a range of indicators. However, no investigation into the cost-effectiveness of stacking IY intervention components has been completed to date.

This paper will utilize cost and outcome data from the IY Series to examine the cost-effectiveness of stacking multiple intervention components versus delivering single intervention components. Traditional CEA theory is employed, along with conventional CEA decision criteria, to produce financial data that offers insight into the economic appropriateness of various IY implementation strategies. This paper serves as the first study to date of the cost-effectiveness of stacked components within the context of the Incredible Years Child, Parent and Teacher Training Series.

Participant Characteristics

This paper combines data from 21 separate cohorts enrolled in six randomized clinical trials of the IY Series (Webster-Stratton, 1982; 1984; 1994; Webster-Stratton & Hammond, 1997; Webster-Stratton, Hollinsworth, & Kolpacoff, 1989; Webster-Stratton & Reid, 1999a). The

sample includes 459 children, ages 3-8, who have participated in IY Series CD research over the past 20 years. Data from these studies are able to be pooled because of common data collection procedures; all six studies measured program efficacy using an identical set of child behavior measures. Randomization and longitudinal follow-up occurred with each clinical trial.

The following criteria were required for entry into the Incredible Years clinical-based treatment-outcome trials: (1) the child was between 3 and 8 years of age; (2) the child had no debilitating physical impairment, intellectual impairment, or history of psychosis and was not already receiving psychological treatment; (3) the primary clinic referral reason was for conduct problems such as noncompliance, aggression, and oppositional behavior that continued for more than six months; (4) parent-report symptoms on the Eyberg Child Behavior Inventory (ECBI) were clinically significant (more than two standard deviations above the mean); and (5) the child met criteria for oppositional defiant disorder (ODD) and/or conduct disorder (CD) according to either the Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised (DSM-III-R) or the DSM-IV (1994) depending on the child's study entry date (Webster-Stratton & Reid, 2003).

Following baseline assessments, families were assigned to one of seven conditions: (1) Child Training only (CT); (2) Parent Training only (PT); (3) Child Training and Parent Training (CT+PT); (4) Parent Training and Teacher Training (PT+TT); (5) Child Training and Teacher Training (CT+TT); (6) Child Training, Parent Training, and Teacher Training (CT+PT+TT); and (7) a control condition (CON). A more detailed summary of participant characteristics may be found below in Table 1.

(Table 1 about here)

Estimating Treatment Costs

To estimate per-child costs of the IY treatment categories (excluding the control condition), total per-child costs were first estimated for each of the three IY single components (CT, PT, and TT). Costs were derived using a series of financial estimates provided by the developer of the IY Series. These estimates included fees associated with training and ongoing supervision of CT and PT group leaders and trained teachers; group leader salary including time for peer review, self-study and preparation; costs of providing materials for participants; and additional fees necessary for actual program implementation (i.e. childcare costs, dinners). The payor (or agency) perspective was used to determine costs; these financial estimates included all fees for which that agency is responsible. All costs associated with a particular facet of IY implementation were assumed to be the same across study sites despite regional differences in cost of living. CEA ratios generated in this paper reflect financial estimates based on 2003 dollars.

After total per-child costs were estimated for each of the three IY single components (CT, PT, and TT), these estimates were summed to generate total per-child costs for each of the four stacked treatment combinations (CT+PT, PT+TT, CT+TT, and CT+PT+TT) (i.e. total per-child cost of CT+PT = total per-child cost of CT + total per-child cost of PT). Our calculations were then adjusted to account for cost savings resulting from delivering multiple components to a single child. For example, the CT+PT condition requires the purchase of only one set of parent manuals at the cost of \$179.40 per 12 parents; therefore, this fee is not duplicated when summing total per child costs for CT and PT to form the stacked CT+PT treatment combination. Table A1, located in Appendix A, lists per-person cost estimates for each of the IY treatment categories excluding the control condition.

Cost Estimate Assumptions. Total per-child cost estimates did not include costs associated with providing the space required for group sessions or childcare. It is assumed that agencies and schools implementing IY will provide on-site space in which group leader and teacher training as well as program sessions may be conducted.

Various cost categories used to calculate total per-child cost estimates for each treatment component (CT, PT, and TT) represent one-time program initiation costs. The above estimates assume that each new CT group leader, PT group leader, and trained teacher complete just one sequence of IY Series following certification. More than likely, however, newly trained group and classroom facilitators will lead more than one sequence of each IY component. Because leaders complete training only prior to the first IY training sequence, training costs depreciate as the number of children participating in IY increases. Similarly, after the first sequence of IY is complete, costs associated with one-time purchases of materials are not included in additional sequences of IY. Moreover, the time needed for CT and PT group leaders and trained teachers to review and prepare intervention materials diminishes with each group after the initial group run. Therefore, with each additional cohort of participants, total per-child costs per treatment category decrease.

Calculating Treatment Outcomes

The analyses involved pre-test and immediate post-test assessments for two key outcomes: (1) a combined 5-item Negative Child Behavior Score as measured by independent home observations according to the Dyadic Parent-Child Interactive Coding System – Revised (DPICS-R) and (2) a teacher-reported Total Behavior Problem Score as measured by the Behar Preschool Behavior Questionnaire (PBQ). These observational and report variables represent impartial views of the children’s behaviors across settings and capture treatment impact on

problem behaviors at home and school. (Not all children participating in IY were in school at the time of treatment; therefore, the sample size for the Behar analysis is somewhat reduced.)

Children who display behavioral problems may act out in one particular setting or may display pervasive negative behavior across multiple contexts. By exploring treatment effects through home- and school-based outcome variables, health decision makers will have a clearer idea of how well a particular treatment category reduces child behavior symptomatic of CD across multiple contexts.

The DPICS-R records behaviors of conduct-disordered children and their parents in a home setting (Reid, Webster-Stratton, and Baydar, 2004). Thirty-nine parental and eight child behavioral categories are assessed during 30-minute in-home observations by third-party observers (Reid et al., 2004). For this analysis, one outcome variable (Negative Child Behavior Score) was formed by combining data from five separate negative behavior measures:

(1) negative physical actions, (2) destructive behaviors, (3) yell/cry/whine, (4) “smart talk”, and (5) overall behavior valence (Beauchaine, Webster-Stratton, and Reid, in press). The PBQ (Behar, 1977) identifies children as young as age 3 who display symptoms of emotional problems. A total problem score is formed from 36 teacher-reported items measuring three behavioral constructs: hostile-aggressive, anxious-fearful, and hyperactive-distractible behavior.

A difference score was created for the outcome variable by subtracting each child’s post-test score from their pre-test score. Difference scores for each treatment category were standardized and divided by the standard deviation of the pre-test control group score. One-sided t-tests were performed to determine whether treatment categories’ difference scores were significantly different from zero.

Because both outcome measures code negative child behavior highly, post-test scores were expected to be lower than pre-test scores; lower post-test scores indicate that the IY treatment categories reduced the frequency of negative child behaviors.

Choosing a Treatment Category for Implementation

Often, the process of choosing the most cost-effective implementation strategy among a series of alternatives is neither straightforward nor based on strict guidelines. Frequently, the component or combination of treatment components selected is the easiest or cheapest to deliver. Also, the nature of the agency implementing the program may influence implementation strategy. Schools may opt for behavioral interventions that involve both teachers and children; they may be less likely to engage parents due to cost or logistical difficulties. Similarly, mental health agencies are more likely to involve parents in the treatment process; however, they are less likely to engage teachers due to similar involvement difficulties.

Because financial constraints largely influence the decision-making process, health decision makers must have all relevant financial information prior to treatment selection; this information includes per-person cost and effectiveness estimates for each IY treatment categories plus information regarding the agency's budget constraints. Social dollars to fund public health programs are scarce; the nature of an agency's budget constraints plays an important role in determining which implementation strategy among alternatives is considered most cost-effective. The following section details the decision-making process for agencies working under explicit budget constraints.

Explicit Budget Constraints

Explicit budget constraints are defined as the specific dollar amount (D) available for treating a condition in a specific population (i.e. a health system has \$50,000 to treat ADHD in a clinic-

based population of 100 young children) (Bala & Zarkin, 2002). This scenario is likely more relevant to many health decision makers depending on availability of funding. For example, small agencies, such as individual schools or local health departments, planning to adopt a public health prevention program are likely limited by a scarcity of public school system or local government funds. Explicit budget constraints help guide CEA analyses. The following sections describe the basics of CEA and how to interpret cost-based findings when limited by explicit budget constraints.

Cost-Effectiveness Methodology

Cost-effectiveness analysis involves two cost-effectiveness ratios: (1) *average* cost-effectiveness ratios (ACERs) and (2) *incremental* cost-effectiveness ratios (ICERs). Reflecting its emphasis on implicit budget constraints, the economics literature emphasizes the latter, but as discussed below, the former is also useful (Bala & Zarkin, 2002).

ACERS. This ratio represents the costs for which a given treatment will produce a one-unit change in outcome. For the purposes of this paper, a treatment's ACER indicates the cost for which the given IY treatment category provides a one standard deviation decrease in negative child behavior as measured by the DPICS-R or Behar outcome measures. Depending on the nature of the health intervention, treatment ACERs may represent the cost per child vaccinated, the cost per death averted, or the cost per case of breast cancer detected. The formula for generating the ACER for hypothetical Treatment A is summarized below:

$$ACER_A = \frac{\text{Treatment A's Average Total Cost Per Child } (C_A)}{\text{Treatment A's Average Total Effectiveness Per Child } (E_A)}$$

An average cost-effectiveness ratio of \$5,000 for Treatment A would indicate that Treatment A costs \$5,000 to produce a one-unit change in health outcome.

The ACER is used

ICERS. Whereas ACERs provide information regarding the cost-effectiveness of one treatment, ICERs compare the cost and effectiveness of one treatment relative to another. ICERs are expressed as monetary values and represent the incremental (or marginal) cost of one treatment relative to the other divided by the incremental benefits (Bala & Zarkin, 2002). For example, $ICER_{XY}$ indicates the price per unit outcome an individual would pay for the more effective Treatment Y as compared with Treatment X for each unit of effectiveness beyond that produced by Treatment X.

To form ICERs, individual per-person costs from two separate treatments are subtracted from one another and divided by the difference in per-person effectiveness. The formula for deriving the incremental cost-effectiveness ratio of Treatment A vs. Treatment B is summarized below:

$$ICER_{AB} = \frac{C_A - C_B}{E_A - E_B}$$

Assume that Treatment A costs \$10,000 and produces 5 units of effectiveness while Treatment B costs \$20,000 and produces 9 units of effectiveness. $ICER_{AB}$ $((\$10,000 - \$20,000) / (5 - 9))$ is \$2,500 indicating that an individual would pay \$2,500 per unit outcome to achieve the four additional outcome units produced by implementing the more effective Treatment B.

A very large ICER indicates that the more effective program achieves its greater effectiveness at substantial costs. For example, if Treatment A's cost and effectiveness remained the same, but Treatment B's costs rose to \$500,000 to produce 9 units of effectiveness, $ICER_{AB}$ $((\$10,000 - \$500,000) / (5 - 9))$ would equal \$122,500. This large $ICER_{AB}$ value indicates that an individual would now pay \$122,500 per unit outcome to achieve the four additional outcome units produced by implementing the more effective Treatment B. Large ICER values indicate considerable decreases in a treatment's cost-effectiveness.

A negative ICER indicates that one treatment is both less expensive and more effective than another treatment category. For example, if the cost of Treatment A remained \$10,000 to produce 5 units of outcome, but Treatment B's costs decreased to \$2,000 to produce 9 units of outcome, $ICER_{AB} ((\$10,000-\$2,000)/(5-9))$ would equal $-\$2,000$. The ICER value indicates that an individual would essentially *gain* \$2,000 per unit outcome to achieve the four additional outcome units produced by the more effective Treatment B. Therefore, Treatment B is both cheaper and more effective than Treatment A and represents the only logical choice when deciding between which of these two treatments to implement. Economists refer to Treatment B as “strictly dominating” Treatment A. CEA involves the identification of two separate types of dominance among program implementation options. Identifying dominance helps health decision makers to eliminate illogical program choices, thus narrowing down the field of alternatives from which they will eventually choose an implementation format.

Identifying Dominated Treatment Categories

As described by Drummond, Stoddart, and Torrance (1997), one program strictly dominates another if it produces greater gains in effectiveness at lower costs. Health decision makers eliminate strictly dominated programs from consideration because an alternative exists that is both cheaper and more effective.

Extended dominance occurs when programs' ICERs do not increase as programs' effectiveness increases (Bala & Zarkin, 2002; Drummond et al, 1997). To identify occurrences of extended dominance, all programs *not* excluded by strict dominance are ranked by increasing effectiveness, and ICERs are computed. Extendedly dominated programs are identified as those with ICERs larger than the ICER of the next ranked more effective program (Bala & Zarkin, 2002). Conceptually, if health decision makers choose to implement an extendedly dominated

program, they are missing an opportunity to implement the next more effective program for a per-unit-outcome cost lower than that of the extendedly dominated program. While choosing to implement an extendedly dominated program may seem illogical, as described later, health decision makers limited by explicit budget constraints may be required to do so.

RESULTS

Determining the Most Cost-Effective IY Implementation Strategy

When limited by explicit budget constraints, an agency implementing the IY Series should choose the implementation strategy that maximizes effectiveness without exceeding available budget constraints. When choosing an implementation strategy, illustrating cost, effectiveness, and the budget constraint graphically is helpful.

-- Figure 1 about here --

Figure 1 depicts the six IY treatment categories' per-child cost and effectiveness as measured by the combined 5-item DPICS-R variable. Per-child costs are along the Y-axis with per-child effectiveness along the X-axis for all treatment categories (excluding the control condition). A curve known as the *efficiency frontier* is generated by excluding any program that lies above a line segment joining any two other programs (Bala & Zarkin, 2002). The key to creating an efficiency frontier is to draw line segments joining programs lying as far right as possible to exclude as many programs lying to the left of the frontier. Efficiency frontiers identify dominance among treatment categories; any category located above or to the left of the efficiency frontier indicates that it is either strictly or extendedly dominated (Bala & Zarkin, 2002). The efficiency frontier in Figure 4 indicates that the CT, PT, CT+TT, PT+TT, and CT+PT treatment categories are either strictly or extendedly dominated. (PT+TT is strictly dominated by PT, while CT, CT+TT, PT, and CT+PT are extendedly dominated by CT+PT+TT).

-- Figure 2 about here --

Figure 2 depicts each treatment categories' per-child cost and effectiveness as measured by the Behar Total Problem Score. An efficiency frontier connects the CT, CT+TT, and CT+PT treatment categories to one another. Because they do not lie along the efficiency frontier, the PT, PT+TT, and CT+PT+TT treatment categories represent either strictly or extendedly dominated treatment categories. In this scenario, all three categories are strictly dominated; two treatments (CT and CT+TT) exist which are both cheaper and more effective than the treatment categories excluded from the efficiency frontier.

Next, health decision makers should plot the horizontal line $Y=D$ so that it intersects with the efficiency frontier. Again, under explicit budget constraints, the goal is to select the program or programs producing the greatest gains in effectiveness at a price less than or equal to D (the total dollar amount available per-child). The following sections explain how health decision makers identify cost-effective implementation strategies under explicit budget constraints.

Explicit Budget Constraint Scenario: DPICS-R Negative Child Behavior Score. If an agency is able to spend \$2,500 per child, and all children must receive the same treatment, health decision makers should implement PT only. Although this treatment category is extendedly dominated, PT represents the most effective treatment category with a per-child cost less than $D=\$2,500$. If children may receive different treatments, health decision makers should implement both PT and CT+PT+TT in the following line segment proportions: XB/AB receive treatment A and AX/AB receive treatment B, where letter A represents PT, letter B represents CT+PT+TT, and letter X represents the point at which the horizontal line $Y=\$2,500$ intersects the efficiency frontier (Bala & Zarkin, 2002). If an agency is able to spend \$1,250 per child, and

all children must receive the same treatment, health decision makers should implement CT. Again, although this treatment category is extendedly dominated, CT is the treatment category that maximizes child gains at a per-child cost less than $D=\$1,250$. Finally, if an agency is not able to spend at least $\$1,164.48$ per child – the per-child cost of the cheapest treatment category (CT) – no treatment category should be implemented.

Explicit Budget Constraint Scenario: Behar Total Problem Score. Under the same hypothetical explicit budget constraint of $D=\$2,500$, if all children must receive the same treatment, health decision makers should implement CT+TT; this category represents the most effective treatment with per-child costs less than or equal to $D=\$2,500$. If children may receive different treatments, health decision makers should implement CT+PT and CT+TT in the line segment proportions summarized above. If an agency is able to spend $\$1,250$ per child, and all children must receive the same treatment, health decision makers should implement CT.

The Behar Total Problem Score data reflect another interesting outcome: while the per-child treatment costs of CT, CT+TT, and CT+PT differ substantially ($\$1,164.48$, $\$1,453.73$, and $\$2,713.31$, respectively), their per-child effectiveness scores do not (0.52, 0.53, and 0.55 standard deviations decrease in negative child behavior, respectively). Therefore, if an agency has a hypothetical explicit budget constraint of $\$2,800$ per child, and teacher skills training rather than parent skills training is the desired focus of the intervention, they should strongly consider implementing CT+TT rather than CT+PT (the most effective treatment category with per-child treatment costs less than or equal to $D=\$2,800$); if an agency decided to implement CT+TT rather than CT+PT, they would be able to treat substantially more children for a very slight trade-off in effectiveness. However, if parent skills training rather than teacher skills training is the major focus of the intervention, health decision makers should implement CT+PT because it

more appropriately addresses the specific needs of target children. Again, if an agency is not able to spend \$1,164.48 per child, no treatment category should be implemented.

The pooled IY Series data used for this study included seven measures of treatment effectiveness. If health decision makers have per-child treatment effectiveness data for multiple child outcome measures, they should plot the line $Y=D$ across graphs for each outcome variable. If a treatment category is selected for implementation across more than one outcome variable, health decision makers are increasingly confident in their decision to implement that particular treatment. For this paper, post-test difference scores across each of the seven outcome variables were analyzed; five of these seven variables assess children's externalizing behaviors consistent with CD. Across four of the five externalizing measures, the PT+TT treatment category was immediately identified as a strictly dominated treatment. On the other hand, the CT+PT+TT treatment category was neither strictly nor extendedly dominated across three of the five externalizing measures examined, indicating its potential as a cost-effective implementation strategy.

It is important to note that decisions to implement a particular IY treatment category should consider the child's pervasiveness of CD symptoms. For example, if a child displays behavior problems in the home, it does not make sense for health decision makers to implement TT only. Therefore, while per-child cost and effectiveness data, as well as budget constraint information, guide the CEA decision-making process, it is important to consider children's specific needs by determining pervasiveness of negative behaviors across settings and contexts.

POLICY IMPLICATIONS

The Incredible Years Series is an evidence-based, multi-component intervention designed to treat and prevent early-onset CD among very young children. This intervention has been adopted

by hundreds of agencies seeking to provide children and their families with a comprehensive behavioral intervention. As agencies continue to implement the IY Series both within the United States and abroad, they must determine which implementation strategy maximizes children's gains while remaining within agencies' budget constraints. Cost-effectiveness analysis helps agencies implementing the IY Series to spend their resources in the most efficient manner, thus producing the largest possible effect size in the largest possible child population.

The CEA data generated in this paper have policy implications within the realm of juvenile justice systems, public school systems, and child welfare systems. Given the large literature detailing the enormous societal costs resulting from negative behaviors associated with CD, investigations into the economic appropriateness of CD prevention may yield new efforts to re-organize financial resources for widespread implementation of behavioral interventions. Again, it is important to realize that cost-effectiveness data should be combined with information regarding the specific needs of children to be treated. Health decision makers should strive to match the nature of children's pervasiveness of negative behavior with a treatment program that targets the desired contexts while minimizing costs. By doing so, health decision makers are able to select the most cost-effective treatment likely to be effective with a particular group of young children. Additionally, health decision makers should consider that even the most expensive of the Incredible Years Series implementation strategies – CT+PT+TT – is considerably low in cost when compared with the cost of incarceration, substance use, crime, and other negative outcomes that may result when children displaying early-onset conduct problems are not treated effectively.

CONCLUSIONS

This article used data from multiple waves of the Incredible Years series to examine the differential cost-effectiveness of delivering multiple stacked treatment components versus a single component delivery method. CEA is a useful analytic approach to study how competing programs do or do not maximize gains while minimizing costs. CEA is also practical for evaluating treatments and interventions targeted toward very young children. In such interventions, data involving crime, substance use, school drop-out rates, etc. are not available for a number of years post-test. Whereas typical benefit cost-analysis would most likely require prospective data, CEA provides immediate financial estimates by incorporating effectiveness measures without assigning monetary values.

The CEA methodology presented in this paper allows health decision makers to examine a treatment's effectiveness according to a specific type of outcome. If health decision makers are most interested in a particular result, they can perform CEA to gain insight into treatment effectiveness for the primary outcome of interest. For example, if an agency considers parent skills training to be the most important proximal outcome, and child skills training is distal to parent change, decision makers are able to perform CEA analyses using parent behavior outcome data (i.e. parenting style or parent discipline data). Therefore, CEA analysis aids decision makers not only in choosing a treatment that maximizes gains while minimizing costs, but in choosing a treatment that maximizes *specifically desired* gains while minimizing costs. Despite its versatility and utility, however, CEA alone will not provide health decision makers with a fool-proof method of determining the "best" program to implement within their target population.

Although a treatment category may represent the most cost-effective option for decreasing negative child behaviors associated with CD, treatment decisions should take into account familial attributes. For example, the family's comfort and satisfaction with the treatment

approach, their probability of adherence to specific IY treatment categories, and quality of life changes that may be brought about by participation in such a program should be considered prior to implementation. Furthermore, it is important to note that while a program may be considered cost-effective, whether or not agencies and schools choose to adopt these interventions will depend on their willingness and ability to pay for CD interventions, treatments, and training.

It is important for health decision makers to consider the nature of the child's problems that will be treated before selecting a treatment category among a series of alternatives. For example, if a child displays pervasive behavior problems across multiple contexts, a treatment category that targets these multiple foci within a child's life may be preferred despite its higher per-child costs. Similarly, if a child displays negative behavior in just one setting (i.e. home or school), spending funds on a treatment category that addresses multiple contexts may be considered excessive.

When choosing an implementation strategy, health agencies should also consider secondary populations that are served by each treatment category. For example, treatment categories that include PT may provide additional benefits for those siblings of target children or for promoting greater maintenance of changes in the long term. Likewise, treatment categories that incorporate TT impact not only the target child, but the entire classroom of children and any future children with behavior problems that this teacher interacts with.

For this reason, it is important for health decision makers to conduct their CEA using outcome data from appropriate measures. If health decision makers are primarily interested in reducing children's negative behaviors at home, they should choose to perform CEA using outcome data gathered from a home observational measure. On the other hand, if the prime goal of health decision makers is to reduce negative behaviors in the classroom, they should consider

treatment category effectiveness as measured by teacher-report or classroom observational measures. The next stage of this research will be to combine this type of cost-effectiveness analysis with additional decision-making factors that take into account the specific nature of individual child or family's problems.

The data employed in this study present a small number of methodological limitations. The cost-effectiveness estimates generated here are based on immediate post-test behavioral outcomes of children age 3-8; therefore, estimates may not reflect the experiences of older children diagnosed with CD who may take part in the IY Series. Also, future research should examine if and how dominance among treatment categories varies when using immediate follow-up outcome data versus one-year follow-up outcome data; incorporating one-year follow-up assessments would offer insight into treatments' cost-effectiveness over time. Finally, Miller et al. (2003) argue that cost-effectiveness ratio point estimates based on average and incremental cost and outcome differences among treatments fail to capture uncertainty within the data. To capture the entire data distribution, cost-effectiveness acceptability curves should be generated (Miller et al., 2003). This methodology represents an avenue of future research involving IY data.

Finally, by using CEA alone to make judgments regarding the implementation of mental health interventions, health decision makers may fail to consider societal viewpoints regarding treatment worth. As noted in Jensen, Garcia, Glied, Crowe, Foster, et al. (in press) there are no monetary threshold values that serve as guidelines for determining the precise cost at which a treatment may be considered "cost-effective"; furthermore, announcing that one health intervention is "cost-effective" while another is not "cost-effective" may imply judgment about societal values concerning the worth of treatment benefits. Therefore, while CEA theory may

help health decision makers to choose one implementation format from a series of potential implementation formats, a broader societal perspective on the treatment and prevention of CD (i.e. not budget information alone) should be considered along with cost-effectiveness data when choosing a health program for implementation.

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Figure Captions

Figure 1: The six experimental Incredible Years treatment categories are plotted. Standardized post-test scores are measured by the Combined 5-Item DPICS-R Negative Child Behavior Score.

Figure 2: The six experimental Incredible Years treatment categories are plotted. Standardized post-test scores are measured by the Behar Total Problem Score.

Table 1: Participant Summary Statistics by Incredible Years Treatment Category

Treatment Category	N	Child Ethnicity	Average Child's Age (Months) at Intake	Average Mother's Age (Years) at Child Intake
CT	54 Boy: 43 Girl: 11	Caucasian: 48 Hispanic: 0 Black: 4 Other: 2	72.3	36.1
PT	292 Boy: 215 Girl: 77	Caucasian: 265 Hispanic: 3 Black: 4 Other: 20	59.6	34
CT+PT	38 Boy: 27 Girl: 11	Caucasian: 31 Hispanic: 1 Black: 2 Other: 4	72.4	35.4
PT+TT	24 Boy: 22 Girl: 2	Caucasian: 21 Hispanic: 0 Black: 1 Other: 2	67.4	38.3
CT+TT	11 Boy: 9 Girl: 2	Caucasian: 7 Hispanic: 1 Black: 0 Other: 3	74.3	35.6
CT+PT+TT	19 Boy: 17 Girl: 2	Caucasian: 16 Hispanic: 1 Black: 0 Other: 2	71	39.9
Control	21 Boy: 19 Girl: 2	Caucasian: 18 Hispanic: 0 Black: 0 Other: 3	68.9	36.1
Total	459 Boy: 352 Girl: 107	Caucasian: 406 Hispanic: 6 Black: 11 Other: 36	69.4	36.5

Table A1: Mean Per-Child Costs by Incredible Years Treatment Category

Treatment Category	CT	PT	CT / PT	PT / TT		CT / TT		CT / PT / TT	
				PT	TT	CT	TT	CT/PT	TT
Fees - Leader / Teacher Training									
IY Trainer's Time for CT Leaders(3 8-hour days)	\$3,600.00		\$3,600.00			\$3,600.00		\$3,600.00	
IY Trainer's Time for PT Leaders (3 8-hour days)		\$3,600.00	\$3,600.00	\$3,600.00				\$3,600.00	
IY Trainer's Time for TT Teachers (4 8-hour days)					\$4,800.00		\$4,800.00		\$4,800.00
CT Leader-in-Training's Time (3 8-hour days)	\$480.00		\$480.00			\$480.00		\$480.00	
PT Leader-in-Training's Time (3 8-hour days)		\$480.00	\$480.00	\$480.00				\$480.00	
TT Teacher-in-Training's Time (4 8-hour days)					\$400.00		\$400.00		\$400.00
Fees - Training / Group Materials									
CT Dina Series Materials	\$975.00		\$975.00			\$975.00		\$975.00	
CT Dina Series Puppet	\$269.00		\$269.00			\$269.00		\$269.00	
CT Dina Series Lesson Plans	\$150.00		\$150.00			\$150.00		\$150.00	
CT Dina School Handouts for 6 Children	\$13.50		\$13.50			\$13.50		\$13.50	
PT Training Materials		\$14.95	\$14.95	\$14.95				\$14.95	
PT Session Materials		\$1,300.00	\$1,300.00	\$1,300.00				\$1,300.00	
PT Leader Manual		\$90.00	\$90.00	\$90.00				\$90.00	
CT and PT Parent Manuals (12)	\$179.40	\$179.40	\$179.40	\$179.40		\$179.40		\$179.40	
TT Teacher Handbook					\$25.00		\$25.00		\$25.00
TT Teacher Handouts					\$10.00		\$10.00		\$10.00
Additional Fees - Staff Time									
CT Leader's Time in Sessions	\$880.00		\$880.00			\$880.00		\$880.00	
CT Weekly Supervision	\$440.00		\$440.00			\$440.00		\$440.00	
PT Leader's Time in Sessions		\$720.00	\$720.00	\$720.00				\$720.00	
PT Leader Additional Time		\$480.00	\$480.00	\$480.00				\$480.00	
TT Consultation Costs					\$390.00		\$390.00		\$390.00
Additional Fees - IY Implementation									
PT Group Session Meals		\$1,000.00	\$1,000.00	\$1,000.00				\$1,000.00	
PT Group Session Babysitting Fees		\$1,080.00	\$1,080.00	\$1,080.00				\$1,080.00	
PT Session Cab Vouchers		\$240.00	\$240.00	\$240.00				\$240.00	
PT Session Day Care Costs		\$288.00	\$288.00	\$288.00				\$288.00	
TT Training Session Snacks					\$160.00		\$160.00		\$160.00
Total	\$6,986.90	\$9,472.35	\$16,279.85	\$9,472.35	\$5,785.00	\$6,986.90	\$5,785.00	\$16,279.85	\$5,785.00

Divided by Number of Children Served	6	6	6	6	20	6	20	6	20
Adjusted Total (Cost per Child)	\$1,164.48	\$1,578.73	\$2,713.31	\$1,578.73	\$289.25	\$1,164.48	\$289.25	\$2,713.31	\$289.25
Total For This Treatment Combination	\$1,164.48	\$1,578.73	\$2,713.31	\$1,867.98		\$1,453.73		\$3,002.56	

Figure 1: Treatment Category Per-Child Cost and Effectiveness as Measured by the Combined 5-Item DPICS-R Negative Child Behavior Score

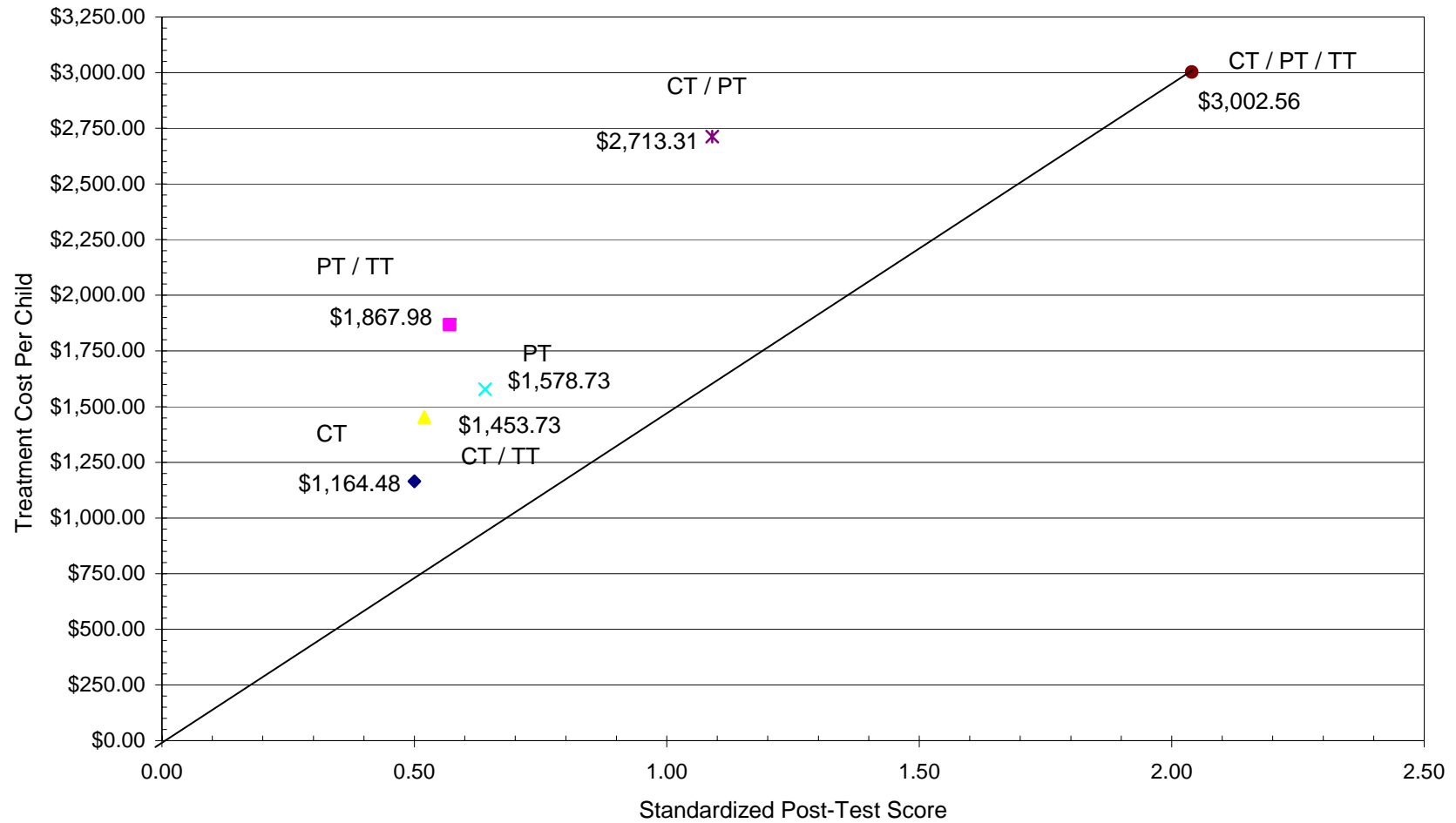


Figure 2: Treatment Category Per-Child Cost and Effectiveness as Measured by the Behar Total Problem Score

