Economic Evaluations of Mental Health Programs for Children and Adolescents in the United

States: A Systematic Review

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Disclosures. There is no funding to report for the current project. JYS receives funding from the Psi Chi Honor Society and the health policy research scholars program. JLS receives grant and research support from the National Institutes of Health (DP5OD28123), the Klingenstein Third Generation Foundation, the American Psychological Foundation, and Limbix, Inc. JLS is also under contract with New Harbinger Publications to co-author a therapeutic workbook for adolescents and with Oxford University Press to co-edit a book on low-intensity mental health interventions for youth. The authors report no other financial conflicts.

Abstract

The United States (US) spent 201 billion dollars on mental health related concerns in 2016, ranking mental illness as the leading cause of disability and the single largest source of economic burden worldwide. With mental health related treatment costs and economic burden only projected to rise, there is an increasing need for cost-inclusive evaluations of mental health interventions in the US. This systematic review evaluated the intervention characteristics and the quality of 9 economic evaluation studies (e.g., cost-effectiveness, cost-benefit) of youth mental health services conducted in the US from 2003 to 2019. Existing evaluations suggest that certain mental health interventions for youth, among the few that have been formally evaluated, may be cost-effective and cost-beneficial. However, intervention characteristics were generally homogenous, a majority of studies did not adhere to the standard of economic evaluations of the CHEERS checklist, and outcome measures were not consistently clinically useful; limiting the utility of such youth mental health economic evaluations to policymakers. By adhering to standards of economic evaluations and diversifying the characteristics of interventions subject to economic evaluations, intervention researchers can increase confidence in conclusions about which youth mental health interventions are cost-effective or cost-beneficial and more meaningfully inform evidence-based mental health policy.

Key Words: Economic Evaluations, Mental Health Programs, Child and Adolescent Mental Health, Health Policy, Systematic Review

Pre-registration:

https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020158621

Introduction

Mental health disorders are the most costly conditions in the United States (Roehrig, 2016), the leading cause of disability (World Health Organization, 2011), and the single largest source of economic burden worldwide, over cardiovascular disease, chronic respiratory disease, cancer, or diabetes (Bloom et al., 2011). Great progress has been made in creating evidence-supported youth mental health interventions, but a myriad of implementation barriers prevent these interventions from alleviating the economic and emotional burden of mental health disorders. One of the most frequently-cited, system-level implementation barriers is the high cost associated with evidence-based therapies (Bond et al., 2014; Buchanan et al., 2005; Roundfield & Lang, 2017). Establishing and sustaining evidence-based mental health services is resource-intensive: It requires continuous investment in high-cost resources such as personnel (e.g. clinicians, supervisors, external trainers) and overhead (e.g. facilities, insurance, continuing education, licensing fees, assessment materials, etc.).

For example, agencies spend on average \$65,192 per year to sustain trauma-focused cognitive behavioral therapy (TF-CBT) services, excluding initial training costs (Roundfield & Lang, 2017). It is no surprise that diverse stakeholders (county officials, agency directors, program managers, clinical staff) have rated *limited funding* as the most important and least modifiable barrier to implementing evidence-based practices (EBPs; Aarons et al., 2009). Patients also identify high treatment costs as a significant barrier to *receiving* mental health treatment (SAMHSA, 2014); high treatment costs place an even greater burden on people of color and low-income families, who are more vulnerable to developing mental illness (González, 2005).

Thus, there is a critical need to prioritize interventions with the greatest net benefit to society. Disseminating and maintaining the use of EBPs is resource-intensive and involves a tremendous investment when funding is finite. Therefore, it is critical to prioritize the implementation of interventions with the greatest *net benefit* to society to reduce and prevent youth mental health disorders. An intervention's net benefit provides important information about how its delivery costs, clinical (non-monetary) outcomes, and economic (monetary) outcomes relate to those of standard treatment (i.e., treatment as usual [TAU]) for a given mental health condition (Eells, 1999; Wellander et al., 2016).

A treatment that costs less than TAU but fails to produce desired clinical and economic outcomes would not be considered a worthy investment because it would produce a negative net benefit ($< \$0$). A *cost-effective* intervention produces a positive non-monetary net benefit ($\geq \$0$), such as a remitted diagnosis, at a cost that is equal to or less than what a decision-maker is paying for the current TAU (Neumann et al., 2017). A *cost-utility* analysis is a cost-effectiveness analysis that uses a quality-adjusted life year (QALY) gained as the outcome, which is an estimate of life expectancy and quality of life that is related to being in a diseased state, such as having depression, cancer, or both (Whitehead & Ali, 2010). A *cost-beneficial* intervention “pays for itself” by producing a positive monetary net benefit through long-term cost savings to society, such as reduced health care use, criminal justice involvement, and employment disruption (Eells, 1999; Wellander et al., 2016). Given that 50% of lifetime mental illness onset is age 14 (Kessler et al., 2005), early-life and preventative interventions have the greatest potential to be cost-beneficial if evaluated over a time period of several years (Jones, 2013).

Clinicians and policymakers share a goal of minimizing the costs of delivering mental health services while also serving the most people in need (Yates, 2020). *Cost-minimization*

studies emphasize cost differences between TAU and another intervention that are assumed to be equally effective (Neumann et al., 2017). However, sometimes treatment will both cost more and be more effective than TAU. The cost-effectiveness of such a treatment is determined by a policymaker's willingness-to-pay threshold, or the amount of money they are willing to pay to produce an outcome of interest that is also pre-determined by a policymaker, such as a depression-free day or one QALY gained (Neumann et al., 2017).

Ensuring the Implementation of Evidence-Based Practices through Policy.

A meta-analysis by Weisz and colleagues (2013) found that EBPs are more effective at reducing youth mental health symptomatology than TAU, but only about 5 to 7 percent of children receive such specialty services (U.S. Public Health Service, 1999). Currently, evidence-based practices for youth mental health disorders are inconsistently translated into clinical practice and policy frameworks have been identified as a critical ingredient to increasing access to evidence-based mental health interventions (Saxena et al, 2007; Purtle et al., 2020); policy change is the most efficient way to implement interventions with the greatest *net benefits* for youth mental health because policymakers' funding decisions directly impact how and which EBPs are delivered. For example, Hoagwood and colleagues (2018) analyzed how decisions made on NIMH funding priorities have directly impacted the advancement of intervention research and its implementation success; thus, it goes on to cite concerns regarding the 42% funding reduction in children's mental health services research from 2005 to 2015. If disseminating evidence-based mental health interventions becomes a research-informed policy priority, such interventions can become more accessible to those in need, particularly to families in underserved communities.

Despite more than five decades of evidence suggesting that certain youth mental health interventions effectively reduce or prevent psychopathology, extant studies seldom inform policy decisions around allocating federal and state-level funds to deliver mental health services (Bogenschneider & Corbett, 2010; Weiss, 1979). *This may be because the clinical trials that are standard in psychological science do not provide the information that policymakers need to guide their decision-making.* When legislators were asked about what research information they would prefer for making policy decisions related to mental health/substance abuse research, “policy rated budget impact” and “cost-effectiveness research” was most often indicated as “very important” (Purtle et al., 2018).

Thus, in order to inform evidence-based policy, we must first establish which interventions to invest in; that is, we need to understand which treatments and services offer the greatest net benefits to society. Conducting economic evaluations, or evaluations of multiple mental health interventions’ cost-effectiveness or cost-benefit, can help policymakers decide how to allocate taxpayer dollars for the greatest societal net benefit. Economic evaluations can help policymakers fund treatments whose cost-effectiveness or cost-benefit is deemed favorable compared to TAU, given costs of TAU, clinical outcomes of interest, and budgetary constraints (Bala & Zarkin, 2002). Absent rigorous economic evaluations, it is impossible to determine which interventions are most cost-effective and cost-beneficial to youths, families, and society.

The current status of economic evaluations for youth mental health treatment in the US is unknown. The last known review of cost-effectiveness research in youth mental health interventions was conducted with search dates ending in 2003 (Romeo et al., 2005). This review identified 21 studies that included a full economic evaluation of psychotherapies, pharmacotherapies, prevention efforts, or other supports focusing on psychiatric problems.

Among the 21 studies, seven studies evaluated interventions focused on externalizing or disruptive behavioral disorders; two studies evaluated treatments for depressive disorders; one study focused on developmental disorders; two studies looked at treatments for psychosis; and one study evaluated a treatment for comorbid substance use. Ten of the studies were conducted in the US, and the rest were conducted in the United Kingdom (4), Canada (3), Australia (1), Sweden (1), Norway (1), and the Netherlands (1). Authors concluded that the number and quality of economic evaluations were limited by poor methodological rigor (e.g. small sample sizes, not comprehensively measuring costs) and incorporation of a narrow range of stakeholder perspectives.

Separately, narrower reviews that focus on specific disorders (Leibson & Long, 2003), mental health prevention programs (Zechmeister et al., 2008), parenting interventions that are not focused directly on improving youth mental health (Duncan et al., 2017), and one type of economic evaluation (cost-effectiveness analysis) (Kilian et al., 2010) have been conducted since then. However, a systematic review of *all* economic evaluation research of youth mental health interventions—including cost-effectiveness analysis, cost-utility analysis, cost-minimization, and cost-benefit analysis —has not been conducted since Romeo’s 2003 review, despite great shifts that have altered the modern-day economic landscape. For example, the great recession in 2009 not only reduced state and federal level budgets, but also left a mark on the health care system as a whole: Health care spending sharply declined due to an increased number of patients who lost their insurance along with their job and government assistance programs like Medicaid/Medicare. The affordable care act has also been implemented since then.

Additionally, none of the above-mentioned reviews focused specifically on economic evaluations conducted in the US, which creates a major gap in *national* understanding of

different mental health interventions' net benefit. Certainly, intervention costs can be compared across countries using currency conversions and purchasing power parity, as can clinical outcomes (e.g. Sava et al., 2009). However, there are vast differences across countries' research and policy-making priorities, which directly shape the number and quality of economic evaluations conducted, as well as whether findings from these evaluations are communicated to national policymakers for practical use. Economic evaluations have been long standing research and health care priority in European countries to inform health care policy (Evers et al., 2007). The role that economic evaluations play in guiding policy in the US is less clear, with some evidence suggesting that the US is less likely to use results of cost-effectiveness analyses for pharmaceuticals than European countries due to a fear that relying on cost-effectiveness evaluations would stifle innovation by disincentivizing the creation of high-cost interventions that would be viewed less favorably than lower-cost counterparts (Baumgardner & Neumann, 2017; Cohen, Malins & Shahpurwala, 2013). It is possible that the single-payer (i.e., government-provided) health care systems in European countries have more to gain, in the form of cost savings, by using findings from economic evaluations to guide national health care policy; in other words, single-payer system health care priorities stand in contrast to the priorities of private insurance companies in the US, which is to make a profit.

Differences in health care landscapes between the US and European countries do not mean that economic evaluations are less useful in the US than in Europe. Interest in economic evaluations for youth mental health interventions in the US is growing (Purtle et al., 2018), but the prevalence and quality of such economic evaluations have yet to be explored, particularly for youth mental health interventions (NIMH, 2001). As such, the existing youth mental health literature may be ill-suited to meet US policymakers' information preferences and needs.

To enable our field to be better equipped to persuade policymakers to prioritize cost-effective youth mental health interventions, **we must begin to report not only whether interventions *reduce psychopathology*, but *what they cost to implement*, and whether, as well as for whom, they confer *net benefits***. A 'bird's-eye view' of what we know about the costs, effectiveness, cost-effectiveness, and cost-benefit of youth mental health treatments may (1) help justify research expenditures in prevention and intervention efforts to reduce the emotional and economic costs of such disorders, (2) help decision-makers allocate limited resources, and (3) guide clinics' and families' selection of which youth treatment(s) to pursue—a choice that frequently comes down to cost.

The Current Review

In order to start assessing and reporting the cost-effectiveness of treatments, it is necessary to gauge the current state of economic evaluations for youth mental health interventions. This review will lay the groundwork necessary for building a more *interpretable*, *policy-compatible* body of literature on the net benefits of youth mental health interventions. Thus, the current systematic review had four aims: First, we evaluated the characteristics of interventions that were subject to economic evaluations (e.g., target problems, treatment length, provider types). Second, we examined the quality of existing economic evaluations of youth interventions designed to improve mental health problems (symptoms or diagnoses of anxiety, depression, behavioral problems, or other psychiatric concerns), referred to as “mental health services” hereinafter, conducted since 2003 in the US using health care economics standards (Husereau et al., 2013; Neumann et al., 2017). Economic evaluations were characterized per the attributes and variables of interest, with the goal of synthesizing present knowledge and identifying outstanding questions. Third, we evaluated the utility of results for clinicians and

policymakers alike. Finally, future directions for the economic evaluations of youth mental health interventions are proposed.

Method

Search Strategy

We performed a pre-registered systematic literature search (https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020158621) in PubMed, PsycINFO, ERIC, MEDLINE, and ProQuest Dissertations, and OpenDissertations (date range: September 2003 to October 2019) to identify peer-reviewed and unpublished manuscripts that contained at least one economic evaluation—defined by the inclusion of a cost-effectiveness analysis, cost-utility analysis, cost-minimization analysis, and cost-benefit analysis—of an intervention designed to improve mental health problems in children and adolescents. Contrary to plan, the EconLit database was not included in our search as the authors were not able to gain access. Three clusters of search terms were used. Terms relating to economic evaluations included: economic evaluation, cost-effectiveness analysis, cost effectiveness analysis, cost-utility analysis, cost utility analysis, cost-benefit analysis, or cost benefit analysis. Terms related to mental health included: mental health, mental illness, therapy, psychotherapy, intervention, program, treatment, or service. Terms indicating the population of interest included: youth, child, children, adolescents, teens, or young adults. The full list of search terms and strategy is outlined in the pre-registration.

Inclusion and Exclusion Criteria

Inclusion criteria for studies in the review were as follows: (1) included at least one economic evaluation (e.g. cost-effectiveness analysis, cost-utility analysis, cost-minimization analysis, and cost-benefit analysis) of an intervention designed to improve mental health

problems in children and adolescents (mean within-study age of 18 years and younger), (2) reported at least one specific dollar amount reflecting the estimated cost and/or financial benefit of some feature of a service or program (both trial-based economic evaluations (TBEEs) and model-based economic evaluations (MBEEs) were included), (3) was a *full* economic evaluation, meaning that the study compared both costs and effects of two or more conditions, (4) evaluated a psychosocial (non-pharmacological) service, (5) included economic evaluations of lay-provider (e.g. teachers, nurses, primary care physicians, hospital staff, other) or parent-directed interventions, as long as the service being evaluated was specifically designed to improve some youth mental health outcome (as opposed to parents' or providers' behaviors or functioning) and the stated goal of the program is to benefit youth mental health outcomes, not parent- or provider-level outcomes, and (6) included an economic evaluation of an intervention, program, or service delivered in the US.

Study Extraction, Screening and Coding

The 3 stages of screening included: (1) initial extraction and preliminary screening of articles using titles and abstracts, (2) secondary screening of articles using full texts, and (3) data extraction of all variables of interest. The first and last author conducted the initial extraction. Then the first and second authors completed the initial screening based on the information provided in the title and abstract. The full text of the articles was reviewed when disagreements were present to assess the eligibility of each study. At the second stage screening, the full text of all included articles was extracted and examined. The rate of agreement to include or exclude a study was 86.36%. All disagreements between coders were resolved via discussion. Then, the remaining 9 articles were fully double coded by the first and second authors for sample and

intervention characteristics as well as economic evaluation characteristics. Agreement on all coded variables were excellent (ICC = 0.998 - 1.000).

Sample and intervention characteristics coded included authors' names, year of publication, participant demographics, sample type, intervention(s) name, primary problem targeted by the intervention, treatment length, treatment setting, treatment provider, treatment format, and retention rates. The sample and intervention characteristics of all 9 included studies are summarized in Table 1. Economic evaluation specific variables were adapted from the CHEERS checklist (Husereau et al., 2013) and included treatment costs, time horizon, analysis type, evaluation perspective, outcome types, uncertainty characterization, valuation year, and a summary of the economic evaluation results. The economic evaluation characteristics of all included studies are summarized in Table 2. The full coding manual outlining the coded variables and their operationalized definition is available here <https://osf.io/59q2k/>.

Results

Study selection and inclusion

The search identified 658 studies, of which 22 full texts were retrieved for further screening. Ultimately, 9 studies met the inclusion criteria and were included in this review. Reasons for study inclusion versus exclusion at each stage are included in Figure 1.

Characteristics of included studies

All evaluated interventions were designed for children or adolescents (mean age = 9.46) targeting primarily oppositional, conduct, and behavioral problems (n = 4), depression or mood problems (n = 1), attention and hyperactivity problems (n = 1), substance use problems (n = 1), eating disorders (n = 1), and non-specific, broad mental health problems (n = 1). The majority of studies recruited a community sample (n = 6), which indicated a non-treatment seeking

population regardless of clinical indication, and three studies recruited from an outpatient therapy sample. The mean sample size for the study was 291(ranging from 22 to 566). Additionally, of the 5 studies that reported race/ethnicity data, all but one study included a majority-white sample (>50%), and six studies that reported child participant's biological sex had majority female samples (>50%). Intervention participants varied quite a bit: three interventions focused on youth only, one intervention focused on parent only, two involved parent and youth, one focused on youth and school staff, and two involved all youth, parent, and school staff.

The settings that the intervention took place were diverse: one was delivered in an outpatient setting, one in a primary care setting, three in schools, another three in a combination of these settings, and one did not report the intervention setting as it combined data from 6 different clinical trials. In regards to treatment format, 4 studies evaluated individual interventions, 3 studies evaluated group interventions, one mixed individual and family interventions, and one used a mixture of group and community-based interventions. Most treatments were delivered by Masters level clinicians (N = 4), followed by school staff (N = 2), then a combination of providers (N = 2), and one study did not report the type of provider. Further, interventions varied immensely in length, ranging from 3 sessions to 88 sessions and 3 days to 2 years. Similarly, follow-up periods ranged from no follow-ups at all to 24-month follow-ups, which led to retention rates (reported in 5 studies) that are difficult to directly compare since studies reported various rates of intervention completion, post-treatment measure completion, or follow-up measure completion. Although monetary and non-monetary outcomes were documented for each study (outlined in Table 2), the efficacy of interventions, independent

of costs, were not explicitly coded because we were primarily interested in the *relationship* between efficacy and costs.

Economic Evaluation Descriptives

Evaluation Types. Based on the authors' descriptions of their economic evaluation type (full, operationalized definitions can be accessed here: <https://osf.io/59q2k/>), seven were described as cost-effectiveness studies, one was described as a cost-benefit study (Dopp et al., 2018), and one was described as a cost-effectiveness and cost-benefit study (Wang, 2011). The authors' evaluation types largely emulated the study evaluation type determined by coders, who identified six cost-effectiveness studies, one cost-benefit study (Dopp et al., 2018), and two studies with both cost-benefit and cost-utility analyses (i.e., cost-effectiveness studies that used QALYs as the effectiveness outcome; Dickerson et al., 2018; Wang, 2011).

Evaluation Design. A *trial-based economic evaluation* (TBEE) and a *model-based economic evaluation* (MBEE) both estimate the relationship between the costs to deliver a treatment and the financial (i.e., benefits), as well as functional (e.g. symptom or quality of life improvement) outcomes of a treatment. Data from a clinical trial, which usually focuses on treatment efficacy, is used in TBEEs and data from the existing literature is used to simulate cost and effectiveness of treatments in MBEEs (Neumann et al., 2017).

Most of the studies ($7/9 = 78\%$) were TBEEs, and the remaining were MBEEs. Based on the authors' definitions, of the seven TBEEs, five ($5/7 = 71\%$) were cost-effectiveness analyses, one was a cost-benefit analysis (Dopp et al., 2018), and one was both a cost-effectiveness and cost-benefit analysis (Dickerson et al., 2018). Although both MBEEs were cost-effectiveness evaluations (Dino et al., 2008; Wang et al., 2011), each took a different approach to defining treatment costs, outcomes, and their relationship.

Time Horizon. A *time horizon* refers to the length of time over which costs and outcomes are assessed (Husereau et al., 2013). Time horizons of at least 13 months are considered ideal in economic evaluations, although horizons of 10 or more years are sometimes needed to observe an intervention's full financial benefit, particularly for youth (Honeycutt et al., 2015). All but two studies reported a time horizon. Of these studies, time horizon was ≤ 6 months for one study ($1/7 = 14\%$; Honeycutt et al., 2015), 7-12 months for two studies ($2/7 = 29\%$; Dino et al., 2008; Tran et al., 2018), and ≥ 13 months for four studies ($4/7 = 57\%$; Dickerson et al., 2018; Dopp et al., 2018; Ocasio et al., 2015; and Wang et al., 2011).

Perspective. Different stakeholders, such as a health care system, agency provider, and mental health service recipients, invest different types and amounts of resources in providing and receiving psychological services (Basu, 2016; Yates, 2020). Each of these stakeholders, therefore, adopts a unique cost *perspective*. The most generalizable perspective to adopt in an economic evaluation is the societal perspective because it incorporates the cost of all resources that are used to deliver and access a treatment (e.g., provider facilities, provider treatment delivery time, family transportation, and treatment time, etc.). One study did not specify a cost perspective (Ocasio et al., 2015). The remaining studies adopted a provider ($3/8 = 38\%$; Dino et al., 2008; Foster et al., 2007; Honeycutt et al., 2015), societal ($3/8 = 38\%$; Dickerson et al., 2018; Tran et al., 2018; Wang et al., 2011) or state government ($1/8 = 13\%$; Dopp et al., 2018) perspective. The state government perspective used by Dopp and colleagues (2018) combined the participant (e.g. costs incurred due to reduced quality of life), taxpayer (e.g., social service costs avoided), and societal (e.g. costs incurred for medical services, reduced productivity) perspectives.

Data analyses.

Treatment Costs. A majority of included studies reported intervention delivery costs per youth (6/9 = 67%); one study reported total program costs only (Wang et al., 2011); one study reported program costs per family only (Dopp et al., 2018); and one study reported program costs per school only (Foster et al., 2007). Honeycutt and colleagues (2015) did not report costs for their comparator (control) intervention. Ocasio et al., (2015) did not report the year during which their costs were estimated, i.e., their valuation year, so it was estimated in June 2007 United States Dollars (USD), which was the half-way point of their 3-year recruitment period between 2006 and 2009.

When including TAU interventions with \$0 costs in two studies (Foster et al., 2007; Tran et al., 2018), the average and median cost/youth was \$1,998 (SD = \$1,413, *Min* = \$0, *Max* = \$4,319) and \$2,010 in 2020 USD, respectively; when \$0 TAU interventions were excluded, the average and median cost/youth was \$2,264 and \$2,064, respectively (SD = \$1,288, *Min* = \$596).¹

Two studies (Dino et al., 2008; Wang, 2011) included the cost of training providers to deliver an intervention, which is also referred to as a fixed cost (Basu, 2016). Other fixed costs, such as the cost of developing an intervention, were not included in any study. Direct costs include resources required to deliver an intervention, such as therapist time or treatment-related materials. Indirect costs include resources that support intervention delivery, such as administrative overhead (e.g., time spent in supervision, time spent maintaining facilities). When calculating intervention costs, four studies included direct costs and five included both indirect and direct costs.

¹ We estimated the cost/youth by dividing total intervention costs (\$46,803 in 2008 USD) by the number of youth served (254) in Wang and colleagues' (2011) study. Dickerson and colleagues (2008) reported both adjusted and unadjusted per youth means; we used their adjusted means in our mean and median cost/youth calculations.

Cost-benefit analysis. For the single cost-benefit analysis, the more expensive condition generated greater cost-savings through reduced use of services related to child maltreatment and out-of-home placement (Dopp et al., 2018).

Cost-effectiveness analyses. Among the eight TBEE and MBEE cost-effectiveness studies, outcomes of interest varied considerably. *Cost-effectiveness ratios* (CERs) and *incremental cost-effectiveness ratios* (ICERs) are two cost-effectiveness outcome metrics that provide different types of information about the relationship between the costs and effects of different treatments. CERs are averaged across patients; the treatment with the lowest CER, or lowest average cost per single outcome unit (e.g. cost per depression-free day) is usually considered the more cost-effective alternative if one treatment is also statistically significantly more effective than the other. ICERs, on the other hand, present the *additional* cost needed to produce an *additional* effect when comparing one treatment (usually TAU) to another treatment. There is a debate in the literature about which cost-effectiveness outcome measure is more useful to decision-makers (cf. Hoch & Dewa, 2008 for a review). Health economists generally favor ICER reporting because looking at incremental, instead of total, cost-effectiveness ratios assumes that minimizing the *additional* cost of each *additional* unit compared to TAU helps decision-makers use their resources more efficiently than minimizing the *total* cost of a single outcome unit. Ultimately, ICERs help decision-makers decide whether an additional unit of effectiveness is worth the additional cost. Since standardized measures are used to calculate QALYs, health economists also encourage reporting an ICER using a QALY as the effectiveness measure to make cost-effectiveness results comparable across studies (Hoch & Dewa, 2008; Neumann et al., 2017).

ICERs were only reported for three of these ($3/8 = 38\%$) studies. We could not compare ICERs /QALY across studies because only one of these studies reported such a metric (Dickerson et al., 2018). In one study, the ICER for primary care CBT for depression vs. TAU was $-\$20,282$ in 2008 USD ($-\$24,788$ 2020 USD) at 1-year follow-up and $-\$10,721$ at the 2-year follow-up. A negative ICER could mean that the treatment with the lowest cost is more effective, or that the treatment with the highest cost is less effective. The ICER denominators in the other two studies were discounted life years (Dino et al., 2008) and resolved ADHD-Inattentive cases (Tran et al., 2018). Different time horizons (7-12 months and ≥ 13 months) further complicated ICER comparisons across studies.

Cost-effectiveness ratios were reported in three of the eight cost-effectiveness studies (French et al., 2018; Honeycutt et al., 2015; Wang et al., 2011) and two studies reported costs and outcomes separately instead of as a cost per outcome ratio (CER) or incremental cost per outcome ratio (ICER) (Foster et al., 2007; Ocasio et al., 2015).

The two studies that reported costs per QALY described using “cost-effectiveness” analyses instead of “cost-utility” analyses; these descriptions are still consistent with economic terminology (Neumann et al., 2017). In one included study (Wang et al., 2011), authors did not describe including a cost-benefit component, but they reported both non-monetary (disordered weight control behavior and bulimia nervosa prevented; QALYs) and monetary outcomes (net health care costs saved), thus meeting criteria for this review. In this study, authors simulated a control group and included medical cost savings in their ratio’s numerator by subtracting the costs of the intervention from the medical costs that were assumed to be spent without an intervention to produce a cost-effectiveness ratio of *net medical cost savings* per QALY, instead

of the more common incremental *intervention* cost per QALY (i.e., ICER) or cost savings per intervention cost (i.e., benefit-cost ratio, see Dopp et al., 2018).

Two cost-effectiveness evaluations used clinically and practically relevant outcome measures: resolution of clinically problematic child behavior (French et al., 2018) and resolution of ADHD-Inattentive status (Tran et al., 2018). The remaining cost-effectiveness evaluations used outcomes that were clinically useful, but arguably less practically useful, such as a 1-point (Honeycutt et al., 2015), 1-standard deviation (Foster et al., 2007), and percentage improvement (Ocasio et al., 2015) from baseline scores on standardized clinical outcome measures described in Table 2.

Two studies reported higher effectiveness at lower costs compared to control conditions as measured by a greater number of depression-free days and QALYs (Dickerson et al., 2018) and a greater number of prevented obesity cases and disordered eating behaviors (Wang et al., 2011). Two studies reported higher effectiveness at higher costs, as measured by preventing smoking behavior and saving discounted life years (Dino et al., 2008) and resolving ADHD-Inattentive type cases (Tran et al., 2018). In one of these studies (Tran et al., 2018) the two index treatments were more effective than and also had higher costs than TAU, but the dominant of the two index treatments depended upon the decision-maker's willingness-to-pay threshold.

One study "stacked" intervention components to determine which of the six combinations of intervention components were cost-effective, yet neither CERs nor ICERs were formally reported (Foster et al., 2007). Four of the conditions (i.e., intervention combinations) produced statistically significant improvements in teacher- and observer-reported child problem behavior scores, and the dominant treatment depended upon the decision-maker's willingness-to-pay threshold (Foster et al., 2007). One study was based on a pilot clinical trial of two interventions

that shared a basic treatment strategy and only differed in the presence or absence of “technology enhancement” (Honeycutt et al., 2015; p. 503). The cost-effectiveness, in the form of an average CER, was only reported for the intervention without technology enhancements and was compared to a hypothetical “no treatment” condition that was expected to have neither a measurable cost nor outcome (Honeycutt et al., 2015). Another study also did not have a treatment comparator and did not report a cost-effectiveness metric (Ocasio et al., 2015). The relationship between costs and effectiveness differed based on the cost perspective being adopted in French et al., 2018: Clinic-based treatment produced similar outcomes, as measured by reductions on a measure of parent-reported problematic child behavior, to home-based treatment at a lower cost from the provider and overall perspective.

Uncertainty. Sample and methodological heterogeneity across studies can increase uncertainty about whether cost, effectiveness, and cost-effectiveness/cost-benefit findings can be generalized to the population and compared across studies (Husereau et al., 2013). It is standard practice in health care economics to characterize uncertainty inherent in parameters, statistical models, as well as the methodology used to calculate costs, effectiveness, and cost-effectiveness/cost-benefit (Husereau et al., 2013; Jain, Grabner, & Onukwugha, 2011; Neumann et al., 2017).

A majority of studies (7/9 = 78%) characterized uncertainty in some way, i.e., took into account how heterogeneity in the patient sample, population parameters, model assumptions, and methodology could impact cost-effectiveness and cost-benefit findings. Statistical uncertainty was handled through bootstrapping for two of the seven (29%) studies and methodological uncertainty was accounted for in three of the nine studies, two of which used discount rates (Dopp et al., 2018; Wang et al., 2011) and one of which varied multiple cost inputs (Tran et al.,

2018). Cost-effectiveness acceptability curves (CEAC) were reported in three of the seven (43%) studies to account for uncertainty in the probability that one intervention, compared to another, will be dominant (i.e., will produce superior outcomes at lower or higher costs than TAU) across different willingness-to-pay thresholds. Only one of the studies that featured a CEAC reported an ICER/QALY (Dickerson et al., 2018). This was also the only study that reported an ICER/QALY. One of these studies presented an average CER instead of an ICER based on the assumption that a hypothetical “no treatment” condition would not have a measurable cost or effect (Honeycutt et al., 2015)²; another study reported cost and effectiveness data, separately, that could be used to calculate an ICER, but did not report formal ICERs (Foster et al., 2007).

Discussion

Economic evaluations can provide critical information necessary to strategically allocate limited resources and have the potential to shape evidence-based mental health policy. However, the current systematic review highlights the dearth of economic evaluations conducted in the US with only 9 articles meeting our inclusion criteria over the span of 16 years. Notably, most (67%) of the economic evaluations included in the review were published in the last 5 years, which suggests that economic evaluations of youth psychosocial interventions have been gaining popularity in the US. However, this number is still minuscule when compared to the 453 randomized clinical trials for youth mental health problems conducted in the last 50 years (Weisz et al., 2017).

Homogeneous characteristics of interventions evaluated.

The interventions evaluated in the included studies were largely homogeneous: All studies evaluated in-person, face-to-face interventions (as opposed to self-administered or digital

² An average CER can be considered an ICER when the costs and effectiveness of a comparator are each expected to be 0.

interventions), mostly delivered by highly-trained mental health professionals (versus paraprofessional) and spanned an average of 16.54 sessions, reflecting common formats and durations of traditional models of psychosocial treatments (Weisz et al., 2017).

Such results are in sharp contrast to the proliferation of novel, potentially low cost, as well as cost-effective intervention options now available to youths, providers, and families. Such low-intensity intervention options include digital mental health interventions (e.g., online, app-based, and self-administered activities) and mental health interventions that require fewer resources than traditional mental health interventions (e.g., single-session interventions or interventions delivered by paraprofessionals), each of which have received increasing empirical attention during the time-frame of this review (2003-present; Bennett et al., 2019; Firth, Torous, Nicholas, Carney, Pratap, et al., 2017; Firth, Torous, Nicholas, Carney, Rosenbaum, et al., 2017; Lattie et al., 2019; Schleider & Weisz, 2017; Stoll et al., 2020). Similarly, the noted reviews and meta-analyses of non-face to face and low-intensity interventions examined efficacy and effectiveness, but did not examine costs or the relationship between costs and effectiveness.

Traditional long-term, in-person psychotherapy is a high-cost treatment delivery system because it requires extensive patient and provider resources. Given that interventions that require significantly fewer resources (e.g. single session interventions) have demonstrated comparable effectiveness to traditional psychotherapy (Schleider & Weisz., 2017), it is critical to evaluate alternative delivery systems that have the potential to be more scalable, lower cost, and potentially more cost-efficient relative to traditional mental health treatment options (Yates, 2020).

Additionally, economic evaluations included in our review largely evaluated programs targeting behavioral problems and programs targeting internalizing disorders and traumatic stress

are notably missing. This may be due to the greater financial impact that behavioral problems are thought to have on society when compared to internalizing disorders. For example, children with conduct disorder are more likely to engage in crime and violence (Hodgins et al., 2008), which can lead to detention law enforcement interaction, victim-related services, and legal services, which are highly costly to society. Internalizing disorders may be costly to society through less direct sources, such as parent employment disruption to care for a depressed or anxious child. However, getting a thorough economic understanding of the treatments targeting various childhood mental health disorders is critical to serving children and adolescents who often have highly comorbid presentations.

Mixed Quality and Utility of Economic Evaluations.

The quality and methodological rigor of the economic evaluations varied, but the overall quality did not adhere to economic evaluation standards that recommend reporting a time horizon of greater than one year, reporting a societal costing perspective, comparing a novel treatment to TAU treatment for a given condition, and reporting ICERS (Neumann et al., 2017). Reporting an ICER / QALY is also the gold standard cost-effectiveness metric to allow for cost-effectiveness comparisons across studies (Neumann et al., 2017). Only one of the nine economic evaluations met all of these criteria (Dickerson et al., 2018).

Unfortunately, the quality and utility of economic evaluations since 2003 do not seem to have improved since the last known comprehensive review (Romeo et al., 2005): The economic evaluations included in our review still do not offer information about which mental health interventions are likely to be cost-effective to treat a target problem. Our recommendations also align with those from other reviews of economic evaluations: Greater methodological rigor and consistency is needed in this area of research (Evers et al., 1997; Romeo et al., 2005).

Results of cost-effectiveness and cost-benefit studies answer different types of questions: cost-effectiveness studies tell policymakers about the tradeoff between a treatment's cost and effectiveness; cost-benefit studies help policymakers decide whether it is worthwhile to invest in a new treatment (Hoch & Dewa, 2008). Using costs as *outcomes*, as in cost-benefit studies, may be more easily understandable and useful to policymakers. Although intervention delivery costs were comparable with a majority of studies providing a valuation year (average cost to deliver an intervention was \$1,998 2020 USD per youth), this estimated cost per youth should be interpreted with caution. There was considerable heterogeneity in cost perspectives across studies, which can directly and dramatically shape costs, as well as cost-effectiveness and cost-benefit estimates. For example, one study included in the review reported that it cost \$950.19 per youth to deliver PCIT in the clinic from the provider perspective based on the amount of time PCIT providers spent providing therapy and doing therapy-related activities, such as clinical documentation and supervision; when patient time, clinic facilities, and PCIT equipment were added to provider costs, PCIT delivery costs nearly doubled to \$1,821.47 per youth (French et al., 2018). Further, most studies did not characterize uncertainty, which reduces the confidence that clinicians and policymakers can make in the generalizability of the cost-effectiveness or cost-benefit findings to a population.

Lastly, only one study (11%) reported societal perspective costs, which is the preferred perspective to adopt when conducting economic evaluations (Neumann, 2009). This number is substantially lower than the 41% of cost-utility analyses (i.e., cost-effectiveness studies with QALYs as the outcome) that reported costs from a societal perspective between 1976 and 2005 and suggests that it may be more difficult to calculate societal perspective costs for mental health interventions (Neumann, 2009). Societal perspectives are considered critical because they take

all costs of intervention delivery into account, regardless of who incurs those costs. This prevents one perspective, such as the taxpayer's perspective, from taking priority over other perspectives, like the patient, provider, or agency perspective. In fact, policymakers most frequently adopt the long-term societal perspective when making funding decisions (Neumann et al., 2017).

Varying assessments of outcomes and comparators further complicate the interpretability of ICER rates across studies. Only one study reported the gold standard ICER/QALY. In this study, ICERs/QALY gained were less than half of the conservative \$50,000/QALY threshold traditionally used to guide treatment expenditures in the US (Neumann et al., 2014). Only two of the seven TBEEs used TAU as the comparator intervention. When making decisions about allocating existing resources, policymakers look to invest in novel treatments that produce better outcomes for lower costs, or better outcomes for the same or higher costs, compared to *the cost of TAU* for a given disorder. If researchers compare their intervention to no treatment or to another novel intervention, as a majority of studies in this review did, then even dominant ICERs will have limited value to policymakers.

Most critically, the methods adopted in the included economic evaluations produced results that are not easily comparable across economic evaluations *or* different interventions. This lack of comparability partially stems from cost-effectiveness approaches being more common than cost-benefit approaches in general, and in the present review. Cost-effectiveness studies are difficult to compare across trials when measures of intervention effectiveness vary, as they did among studies in the present review. For example, readers of included studies are not able to evaluate whether parent child interaction therapy (PCIT; French et al., 2018) or Child Training (CT; Foster et al., 2007) is the more cost-effective treatment for behavioral problems in youth, despite the fact that economic evaluations exist for both treatment models. Since neither

PCIT nor CT was compared to TAU in their respective study, results from both studies would not help policymakers decide whether to invest in either of these interventions over and above TAU (Hoch & Dewa, 2008). This significantly diminishes the usefulness of such information to policymakers.

Limitations and areas for growth. Upon first look, the results of the reviewed economic evaluations paint a generally positive picture of the cost-effectiveness of several youth mental health interventions. Almost all of the studies claimed that the active intervention of interest was cost-effective or cost-beneficial in relation to a comparator. This finding mirrors the dodo bird phenomenon observed in psychotherapy research (Elliott et al., 2015; Rosenzweig, 1936), whereby the effects of all therapies are thought to be comparable due to underlying commonalities, and may also be the result of publication bias. It is unclear how many of these interventions can be deemed cost-effective relative to each other and TAU for a given mental health concern.

It is important to underscore that a novel intervention's cost-effectiveness depends upon: (1) the costs and effectiveness of the current standard of care for a given problem (i.e., TAU), (2) budgetary constraints, (3) a decision-maker's willingness-to-pay threshold for a given outcome improvement, and (4) the clinical utility of the unit of effectiveness. In the current review, TAU was the comparator in two of the nine studies, willingness-to-pay thresholds were discussed in three of the nine studies, and a majority of studies did not have clinically useful effectiveness metrics that were also relevant to policymakers.

Nevertheless, existing evaluations suggest that mental health interventions for youth can be cost-effective and cost-beneficial. However, **greater adherence to economic evaluation standards is needed to increase confidence in these conclusions and make this information**

more relevant to clinicians and policymakers. While methodological standards from the medical field exist in the economic literature to allow for comparisons across studies (Neumann et al., 2017), we found that such standards were not consistently implemented in economic evaluations of youth mental health interventions. This may be due to fundamental differences between medical and mental health intervention delivery systems, outcomes of interest, and public interest.

There exists much more heterogeneity in mental health intervention research compared to the medical field and economic evaluation standards may need to be modified to better illuminate the economic impact of youth mental illness on society. Despite multiple recommendations about how to conduct cost-effectiveness analyses of mental health interventions (Crowley et al., 2018; Yates, 2018); Kaplan et al., 2019; Yates, 1985; 1996), there is still a need to achieve consensus on how to apply cost-effectiveness analysis to mental health interventions. As clinical researchers take steps toward this goal, it is important to recognize that the goals of economic evaluations conducted in clinical psychology and the priorities of economists, clinicians, agencies, clients, or policymakers may not always align. It is critical to pay special attention to how economic evaluation guidelines for mental health interventions can bridge priority differences and maximally benefit the various disciplines and perspectives.

Future Directions/Recommendations. As clinical researchers begin to take an interest in conducting economic evaluations, taking the first step can be confusing and overwhelming due to the varying standards and guidelines. Below we outline some concrete, actionable recommendations, based on existing economic evaluation guidelines (Neumann et al., 2017) and the results of this review, in the hopes of spurring more cost-inclusive research of youth mental health services:

1. Design studies with cost-effectiveness or cost-benefit components specified a priori, and document those a priori decisions regarding how to operationalize those costs (e.g., via formal pre-registration). Keeping a record of cost evaluations from the beginning of study design, along with effectiveness components, will allow the resources necessary to provide an intervention to be more precisely estimated. A thorough guide to costing mental health interventions has been written by Shearer and colleagues (2016) and Yates (1996).
2. Undertake efforts to increase cost-benefit approaches when evaluating youth-focused interventions. Researchers can collect information on the frequency of health care service visits and criminal justice involvement (e.g., nights spent in a detention facility, number of arrests, number of court appearances), as well as parent lost productivity. Unit costs can then be estimated for each of these services/activities as outcomes: Procedure codes and reimbursement rates can be used to estimate health care service costs and existing literature can be used to estimate the cost of criminal justice services and lost productivity (e.g. Witters & Liu, 2013). Section 4.6 in the updated Washington State Institute for Public Policy (WSIPP) model, which was used in one of the cost-benefit studies in this review (Dopp et al., 2018), also contains a wealth of information about the cost of youth mental illness to society that can be used to inform cost-benefit evaluations of youth mental health services (WSIPP, 2019).
3. Implement microcosting approaches to identify cost inputs, or resources needed to conduct activities for procedures that produce certain outcomes (see Yates, 1996). Microcosting approaches such as time-driven activity based costing (TDABC) have also been employed in business, health care, and mental health sectors to estimate the costs of

treatment activities and can complement information about implementation costs (Cidav et al., 2020).

4. Adopt the societal costing perspective, in line with existing economic evaluation standards (Neumann et al., 2017) to help satisfy policymaker's preferences and efficiently use researcher's resources given that conducting economic evaluations is very resource-intensive.
5. Use a time horizon of greater than 1 year to evaluate outcomes, in line with existing economic evaluation recommendations and increase the likelihood of seeing the cost-effectiveness or cost-benefit potential of an intervention (Neumann et al., 2017).
6. Calculate CERs or ICERs using intent to treat samples as attrition is common in outpatient settings and it is important to include the resources that non-completers have consumed. However, non-completers who did not complete any treatment sessions (those dropped out prior to the first session) should not be included because their treatment costs are zero. The following documents can be used to help researchers decide whether to report CERs or ICERs: Hoch & Dewa, 2008; Honeycutt et al., 2006.
7. In line with recommendations for economic evaluations, we recommend that health-related quality of life (i.e, health utility) measures be implemented to produce QALYs (Neumann et al., 2017). There are a variety of health utility measures that have been validated on youths, but there is not a consensus on a gold standard measure because psychometric qualities vary based on population characteristics (diagnosis, age range, country of origin); Ravens-Sieberer, Karow, Barthel, & Klasen (2014, Table 1) provides an excellent a summary of the psychometric properties of such measures. Increasing the number of economic evaluations reporting ICER/QALY as a cost-effectiveness metric

will ensure comparability across different cost-effectiveness/cost-utility trials and maximize policymakers' confidence in which treatments have the potential to be cost-effective vs. TAU.

8. Perform sensitivity analyses using recommendations found in Jain, Grabner, and Onukwugha (2011) to determine how a treatment's cost-effectiveness or cost-benefit fares in comparison to variations in cost and outcome assumptions. A tutorial for conducting a probabilistic sensitivity analysis in R for cost-effectiveness evaluations can be found in the article written by Williams and colleagues (2017).

To support this critical work, efforts to prioritize economic evaluations need to be made on multiple fronts. National and local funding organizations should consider economic evaluations of youth mental health interventions a funding priority. We also call on insurance companies and health care economists to expand their evaluations of mental health interventions for youth psychopathology. Although calculating costs, effectiveness, benefits, CERs, and ICERs can be conducted by anyone with basic arithmetic skills, economic analyses that improve the quality of economic evaluations, such as probabilistic sensitivity analyses (i.e, CEACs) and QALY calculations, are more esoteric. Transdisciplinary collaborations between psychological scientists, public health experts, and economists have the potential to improve the quality of economic evaluations of youth mental health services.

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Figure 1. Flow Chart for Study Identification, Screening, and Inclusion

ECONOMIC EVALUATIONS OF YOUTH MENTAL HEALTH INTERVENTIONS

Table 1. Descriptive of Studies Included in Review

Authors & Year	N	M Youth Age	% White	% Male	Sample Type	Primary Target Problem	Interventions	Clinical Sample Type	Treatment Length (Sessions)	Treatment Length (Days)	Treatment Setting	Treatment Provider	Treatment Format	Retention Rates
French, Yates & Fowles (2018)	264	4.80	62.12 %	69.70 %	Outpatient Therapy Sample	Oppositional, conduct, behavioral problems	Clinic PCIT; Home PCIT	Clinical cutoff not assessed	12-16	NR	Outpatient Clinic; Home-based	MA-level clinicians; BA-level therapists	Individual	Completers: Clinic PCIT: 33.15%; Home PCIT: 64.66%
Ocasio et al. (2015)	334	3.5	NR	NR	Community Sample	Oppositional, conduct, behavioral problems	Preschool-based mental health intervention	Clinical cutoff not assessed	NR	365-730	School/After-school	MA-level clinicians	Group	NR
Dopp et al. (2018)	86	13.88	22.10 %	44.20 %	Outpatient Therapy Sample	Mental health difficulties due to abuse/neglect	MST-CAN; EOT	Clinical cutoff not assessed	MST-CAN: 88; EOT: 76	MST-CAN: 231.04; EOT: 121.60	School/After-school; Home-based; Community	MA-level clinicians	Individual; Family	Completers: MST-CAN: 98%
Dickerson et al. (2018)	212	14.65	88.21 %	27.50 %	Outpatient Therapy Sample	Depression; mood problems	CBT+TAU; TAU	All sample met formal diagnostic criteria	CBT+TAU: 9 TAU: NR	CBT+ TAU: 63; TAU: 56	Primary Care	MA-level clinicians	Individual	85.8% at 12 months; 87.7% at 24 months
Tran et al. (2018)	196	8.6	NR	NR	Community & Outpatient Therapy Sample	Attention/hyperactivity problems	CLAS; PFT; TAU	All sample met formal diagnostic criteria	CLAS: 32; PFT: 16; TAU: NR	CLAS: 70-91 PFT: 70 - 91 TAU: 70 - 91	Outpatient Clinic; School/After-school	Doctoral-level psychologist; MA-level clinicians; BA-level therapists	Group; Community based	At post-treatment: CLAS: 98.65%; PFT: 100%; TAU: 94.12%
Honeycutt et al. (2015)	22	5.75	NR	50.00 %	Community Sample	Oppositional, conduct, behavioral problems	HNC; Control	All sample met formal diagnostic criteria	HNC: 8-12; Control: NR	HNC: 70 Control: NR	Outpatient Clinic	MA-level clinicians	Individual	Completers: HNC: 80%; Control: NR
Foster et al. (2007)	459	5.78	88.45 %	76.69 %	Community Sample	Oppositional, conduct, behavioral problems	CT; PT; CT+PT; PT+TT; CT+TT; Control	All sample met formal diagnostic criteria	CT: 3; PT: 3; CT+PT: 6; PT+TT: 7; CT+TT: 7;	CT: 3; PT: 3; CT+PT: 6; PT+TT: 7; CT+TT: 7;	NR; combined multiple trials	NR; combined multiple trials	Group	NR; combined multiple trials

									CT+PT+TT: 10; Control: 0	CT+PT+TT: 10; Control: 0				
Dino et al. (2008)	566	16.19	81.30 %	NR	Communi- ty Sample	Substance use problems	NOT; BI	Clinical cutoff not assessed	NOT: 10; BI: 1	NOT: 70; BI: 1	School/After- school	School staff delivered	Group	NR
Wang, Nichols & Austin (2011)	480	12	NR	0.00%	Communi- ty Sample	Eating disorders	Planet Health	Some met clinical criteria, but not required	NR	NR	School/After- school	School staff delivered	Individual	NR

Table 1 Note. Brief Intervention: BI; Cognitive Behavioral Therapy: CBT; Child Life and Attention Skills: CLAS; Child Training: CT; Enhanced Outpatient Treatment: EOT; Helping the Noncompliant Child: HNC; Multisystemic Therapy for Child Abuse and Neglect: MST-CAN; Not on Tobacco: NOT; Not Reported: NR; Parent Child Interaction Therapy: PCIT; Parent Focused Treatment: PFT; Parent Training: PT; Treatment As Usual: TAU; Teacher Training: TT

Authors & year	Interventions	Time horizon	Perspective	Analysis	Outcome/ICER denominator	Other uncertainty ^a	Parameter uncertainty	Valuation year (USD)	Results / QALYs
French, Yates & Fowles (2018)	Clinic PCIT (139); Home PCIT (125)	Not specified	Patient, provider, administrator, overall	TBEE; CEA	Clinical to normal range on ECBI-I & P	None	None	2015	Clinic PCIT vs home PCIT CER: \$965 vs \$3363 from provider perspective and \$1911 vs. \$3,890 from combined perspective. Home PCIT vs clinic PCIT: \$355 versus \$443 from the client perspective and \$128 versus \$392 from the administrator perspective. Home PCIT was more effective than clinic PCIT at a higher cost from the provider and overall perspective before controlling for number of sessions. Clinic PCIT was more deemed more cost-effective than home PCIT from provider and overall perspectives.
Ocasio et al. (2015)	Preschool-based mental health intervention (334)	≥13 mos.	Unknown	TBEE; CEA	% improvement from baseline on PKSB-2	None	None	NR	Cost of providing intervention was \$900 per child per year and associated with 10-15% improvements from baseline scores on PKSB-2. The cost in relationship to the change in behavior was deemed favorable. ICER N/A.
Dopp et al. (2018)	MST-CAN (44); EOT (42)	≥13 mos.	State government	TBEE; CBA	Net benefits (CTS)	3.5% discount rate	Varied cost and benefit valuation	2015	The cumulative net benefit of MST-CAN was \$26,655 per family, meaning there was a \$3.31 savings per \$1 spent on MST-CAN. MST-CAN (\$15,961/family) cost more than EOT (\$795/family), but resulted in greater benefits to the "whole state" relative to EOT.
Dickerson et al. (2018)	CBT+TAU (106); TAU (106)	≥13 mos.	Societal	TBEE; CBA & CEA	Depression-free day (CDRS); net benefits (CASA, CHSS); QALY	Bootstrapped CIs	Varied effectiveness; CEAC	2008	12-month follow-up brief primary care CBT vs. TAU ICERs: -\$51/DFD, -\$20,282/DFD-QALY. 24-month follow-up ICERs: -\$155/DFD, -\$10,721/DFD-QALY. CBT was more effective at a lower cost. CBT also dominated TAU at the end of 2-year follow-up due to reduced service use (cost-offset).
Tran et al. (2018)	CLAS (73); PFT (74); TAU (49)	7-12 mos.	Societal	TBEE; CEA	Resolved ADHD-I case (CSI)	Varied cost inputs	None	2011	ICER per resolved ADHD-I case, PFT vs. TAU: \$3,227, CLAS vs. PFT: \$4,994; CLAS vs TAU: \$3,997. CLAS and PFT were more effective than TAU at a higher cost.
Honeycutt et al. (2015)	HNC (10); "experimental tx" (9)	≤ 6 mos.	Provider	TBEE; CEA	1-point improvement on ECBI-I	Bootstrapped CIs	CEAC	2010	HNC CER: \$13. The probability of the HNC program being cost-effective would exceed 90% if decision makers were willing to pay ≥ \$20 per 1-point improvement in the ECBI intensity score.
Foster et al. (2007)	CT; PT (54); CT+PT (292); PT+TT (38); CT+TT (24); CT+PT+TT (19); No tx (21)	Not specified	Provider	TBEE; CEA	1-standard deviation improvement on DPICS-R & PBQ	None	CEAC	2003	For PBQ scores, at willingness to pay thresholds <\$2,500, "no treatment" dominated; >\$2,500, PT + TT dominated. For DPICS scores, at willingness to pay thresholds <\$2,500, "no treatment" dominated; >\$2,500, CT + PT + TT dominated. The treatments with the lowest (CT), third lowest (PT), third highest (PT+TT), and second highest (CT+PT) costs were statistically effective. ICERs NR.

Dino et al. (2008)	NOT (313); BI (253)	7-12 mos.	Provider	MBEE; CEA	DLYs saved	None	Varied costs and transition probabilities	2000	ICER N.O.T. vs. B.I.: \$442.65/DLY saved. N.O.T was more effective at a higher cost compared to B.I.
Wang, Nichols & Austin (2011)	Planet Health (254)	≥13 mos.	Societal	MBEE; CEA	Net savings / QALY	3% discount rate	Varied costs, effectiveness, time horizon, transition probability, & prevalence	2010	Planet Health CER: Net savings of \$2,966, per QALY gained. Planet Health was more effective at a lower cost.

Table 2 Note. Child and Adolescent Services Assessment: CASA; Cost-benefit analysis: CBA; Cost-effectiveness analysis: CEA; Cost-effectiveness ratio: CER; Children's Depression Rating Scale-Revised: CDRS; Child Health Services Screen: CHSS; Child Symptom Inventory: CSI; Detailed Child Services Form: DCSF; Child Tactics Scale: CTS; Discounted Life Year: DLY; Depression-free day: DFD; Dyadic Parent-Child Interactive Coding System-Revised Negative Child Behavior Score: DPICS-R; Disordered Weight Control Behavior: DWCB; Eyberg Child Behavior Inventory-Intensity and Problem subscales: ECBI; Model-based economic evaluation: Incremental cost-effectiveness ratio: ICER; Model-based economic evaluation: MBEE; Behar Preschool Behavior Questionnaire - Total Problem Behavior Score: PBQ; Preschool and Kindergarten Behavior Scales: PKSB-2. Quality-adjusted life-year: QALY; Trial-based economic evaluation: TBEE.

^a Includes statistical (e.g. bootstrapped confidence intervals), methodological, and modeling uncertainty using definitions from Jain, Wagner, & Onukwugha, 2011 for model and trial (i.e., regression) based economic evaluations.

Table 3. Definition of Economic Evaluation Terms

Term	Definition
Cost-Benefit Analysis (CBA)	Analysis of the costs of two or more treatments in relation to monetary outcomes (e.g. reduced criminal justice costs)
Cost-Minimization Analysis (CMA)	Analysis of the costs of two or more treatments that assume equal treatment effectiveness.
Cost-Effective Analysis (CEA)	Analysis of the costs of two or more treatments in relation to non-monetary outcomes (e.g. remission from depression symptoms)
Cost-Utility Analysis (CUA)	Analysis of the costs of two or more treatments in relation Quality Adjusted Life Years (QALY) gained.
Cost-Effectiveness Ratios (CERs)	Cost-effectiveness outcome metric that represents the cost per single non-monetary outcome unit (e.g. remitted depression diagnosis).
Incremental Cost-Effective Ratios (ICERs)	Cost-effectiveness outcome metric that represents the additional cost needed to produce an additional effect when comparing one treatment to another.
Quality Adjusted Life Years (QALY)	Estimate of life expectancy and quality of life that is related to being in a diseased state.
Trial-Based Economic Evaluations (TBEE)	A clinical trial that estimates costs, effectiveness, and benefits.
Model-Based Economic Evaluations (MBEE)	A simulation of the costs, effectiveness, and benefits of two or more treatments using data from existing literature.
Time Horizon	Length of time over which costs and outcomes are assessed in a study.
Perspective	A stakeholder's viewpoint that determines the resources that are included in intervention cost estimations.