COLLABORATIVE ASSESSMENT AND MANAGEMENT OF SUICIDALITY IN THE AFTERCARE FOCUS STUDY: COSTS, COST-EFFECTIVENESS, BENEFITS, AND COST-BENEFIT

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ABSTRACT

Previous data from a randomized controlled trial suggest that the Collaborative Assessment and Management of Suicidality (CAMS) is more effective than standard care (SC) in reducing suicidal ideation, symptom distress, and hopelessness in suicidal patients treated within a "next-day appointment" setting following psychiatric hospitalization. The current study sought to examine the economic costs, benefits, cost-effectiveness, and cost-benefit of CAMS versus SC in a larger replication randomized controlled trial. The cost of delivering each treatment was estimated at the individual level from the healthcare system, patient, and overall perspectives. Benefits were assessed based on healthcare expenditure cost savings and reduced wage loss. Effectiveness-cost ratios, cost-benefit ratios, and net benefit were calculated and analyzed using generalized linear modeling. Treatment costs were significantly lower in CAMS from all perspectives at 3-, 6-, and 12-month follow-ups. Both conditions improved with respect to suicidal ideation and behavior; treatment effects were comparable with the exception of CAMS participants evidencing significantly lower suicidal ideation severity at 12 months. Effectiveness-cost ratios for suicidal ideation improvement were significantly higher in CAMS at 6-month follow-up from the patient perspective and at 12-month follow-up from all three perspectives; there were no significant group differences with respect to suicidal behaviors. Treatment conditions produced equivalent benefit and net benefit; however, CAMS was associated with

significantly greater cost-benefit from the healthcare and overall perspectives. The current study suggests that CAMS is an effective intervention for the treatment of suicidality within a next-day appointment setting and may have economic advantages over standard care.

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CHAPTER 1

INTRODUCTION

Suicide is a global public health challenge that accounts for over 700,000 deaths per year worldwide (World Health Organization, 2021). While many countries have seen a decline in suicide mortality rates in past decades (Naghavi, 2019), the U.S. experienced a 35% increase in the suicide rate between 1999 and 2018 (10.5 versus 14.2 per 100,000 individuals, respectively; Hedegaard et al., 2020). In 2021, suicide ranked as the 11th leading cause of death across all ages in the U.S. with 1.7 million suicide attempts resulting in approximately 48,000 suicide deaths (Centers for Disease Control and Prevention & National Center for Health Statistics, 2021; Substance Abuse and Mental Health Services Administration, 2022). Beyond suicidal behaviors, 15.6 million American adolescents and adults struggled with serious thoughts of suicide in the past 12 months (Substance Abuse and Mental Health Services Administration, 2022), highlighting the need to expand the scope of suicide prevention efforts to include suicidal ideation as an intervention target in and of itself (Jobes & Joiner, 2019). Consequently, the U.S. has repeatedly recognized suicide prevention as a national priority over the past 20 years (Office of the Surgeon General & National Action Alliance for Suicide Prevention, 2012, 2021; U.S. Center for Mental Health Services & U.S. Office of the Surgeon General, 2001; U.S. Public Health Service, 1999).

Suicide, suicide attempts, and suicidal ideation take a tremendous emotional and physical toll on individuals, family members, friends, and communities. Recent findings suggest that each suicide affects 135 people within the individual's social network (Cerel et al., 2019) and that exposure to suicide is associated with a greater likelihood of anxiety, depression, suicidal ideation, and suicide attempt (Cerel et al., 2016; Hill et al., 2020). Additionally, fatal and nonfatal suicide attempts also pose a significant economic burden to society, costing an

estimated $93.5 billion per year in 2013 dollars (approximately $121 billion in 2023 dollars) in direct medical costs and indirect economic costs, such as productivity losses (Shepard et al., 2016). A more recent examination that included costs related to medical care, work loss, and value of statistical life loss estimated that the total economic cost of suicide mortality in the U.S. was approximately $463 billion in 2019, with non-fatal self-harm injuries costing an additional $26.7 billion.

Individuals at risk of suicide are increasingly being treated in emergency departments during crisis. Between 2006 and 2013, the rate of emergency department visits related to suicidal ideation doubled among American adults; by the end of this period, almost 1% of all emergency department visits involved suicidal ideation (Owens et al., 2017). Consequently, emergency department crisis care has been identified as an important system to focus suicide prevention efforts (Office of the Surgeon General & National Action Alliance for Suicide Prevention, 2012). Given that emergency and inpatient services are under increasing pressure to ensure immediate safety and quickly refer to outpatient treatment, improving the transition from hospital-based to community-based care has emerged as a key target (Forte et al., 2019; Knesper et al., 2010; Larkin & Beautrais, 2010; Shand, Vogl, et al., 2018).

The first few months following discharge from psychiatric hospitalization has been repeatedly shown to represent a period of extremely high risk for suicidal behaviors (Bickley et al., 2013; Hunt et al., 2006, 2006, 2009; Meehan et al., 2006; Qin & Nordentoft, 2005; Yim et al., 2004). Risk appears to be consistently highest within the first month post-discharge but can remain elevated for months or even years (Chung et al., 2017). A recent meta-analysis reported pooled suicide rates of approximately 3,000 per 100,000 person years in the first week and 2,000 per 100,000 person years in the first month post-discharge. For context, these suicide rates are

respectively about 300 and 200 times the global suicide rate (Chung et al., 2019; World Health Organization, 2016). Beyond suicidal behaviors, individuals recently discharged from their first psychiatric hospitalization are also at increased risk for a variety of other adverse outcomes, including accidental death, hospitalization due to violence, and both crime perpetration and victimization (Walter et al., 2019).

Several possible explanations have been suggested for this period of increased vulnerability to suicide. To start, hospitalization is not, by itself, treatment. Indeed, frequently the only treatment administered is psychotropic medication intended to target an underlying mental disorder, despite limited empirical evidence of impact on suicidal risk (Jobes & Chalker, 2019; Zalsman et al., 2016). Rather, the primary objective of inpatient psychiatry is to ensure the safety of the patient and others (Bowers et al., 2005), often through approaches such as means restriction, constant observation, and environmental safeguards (Cardell et al., 2009; Knesper et al., 2010; Lieberman et al., 2004; Russ, 2016). Although these approaches may prevent an immediate suicide attempt, there is no empirical evidence that they provide therapeutic benefit or decrease suicidal behaviors in the long term (Knesper et al., 2010; Manna, 2010). Rather, they are more in line with the organizational prioritization of stabilization and rapid discharge, after which therapy can presumably be received in community settings (Awenat et al., 2019). Consequently, many individuals are discharged from psychiatric hospitalization without sufficient recovery from their presenting illness (Forte et al., 2019).

The transition from hospital to home also presents a number of challenges for psychiatric patients. Interviews with recently discharged formerly suicidal patients indicate that this period is often characterized by feelings of vulnerability, disorientation, isolation, and uncertainty (Cutcliffe et al., 2012; Owen-Smith et al., 2014). At the same time, individuals are also

confronted with the social stressors that existed prior to hospitalization (e.g., problematic personal relationships or financial hardship; Owen-Smith et al., 2014; Schechter et al., 2016), in addition to new stressors associated with being hospitalized (e.g., stigma; Chung et al., 2016). Amidst this difficult period of adjustment, recently discharged patients often experience a discontinuity of care. Across studies, about 50% of formerly suicidal patients discharged from an emergency department or inpatient psychiatry reportedly do not receive follow-up mental health care within the first month (Appleby et al., 1999; Cooper et al., 2013; Olfson et al., 2012; Schmutte et al., 2020; Spittal et al., 2017). This is particularly concerning in light of findings that failure to engage in outpatient follow-up care is associated with increased risk of post-discharge suicide attempts (Deisenhammer et al., 2019; Kan et al., 2007; Meehan et al., 2006).

Loss of contact with mental health care after discharge may occur as a result of both system- and patient-level factors. Clinical practice guidelines for the management of suicidal patients generally recommend that referral to community treatment be discussed with the patient as part of comprehensive discharge planning (American Psychiatric Association, 2003; National Institute for Health and Clinical Excellence, 2004). Unfortunately, many patients report leaving the hospital without receiving a referral to follow-up care (Cooper et al., 2013; Shand, Batterham, et al., 2018). This is especially problematic for patients who were not connected to the mental health system prior to hospitalization as it can be difficult to navigate finding an appropriate provider; indeed, individuals with a prior connection have five times greater odds of contact with follow-up care post-discharge (Spittal et al., 2017). Even if the patient does receive a mental health referral during upon discharge, gaining timely access to these services can still be challenging as many patients may have difficulty even getting past clinic voicemail to schedule an appointment (Rhodes et al., 2009).

Ensuring access to and engagement in post-discharge aftercare is essential to preventing suicide (Knesper et al., 2010; Tondo et al., 2006). The National Strategy for Suicide Prevention stipulates that outpatient follow-up care should be initiated as soon as possible, ideally within 48 hours of discharge (National Action Alliance for Suicide Prevention, 2019; Office of the Surgeon General & National Action Alliance for Suicide Prevention, 2012). To facilitate a timely transition, patients without a plan for outpatient treatment are sometimes offered a next-day appointment (NDA) to ensure continuity of care. NDAs are intended as a short-term bridging strategy for patients at risk of "falling through the cracks." Visits generally entail an intake assessment, evaluation for re-hospitalization if in immediate crisis, medication management, and linkage support to appropriate longer-term treatment resources as necessary.

While the NDA approach is associated with increased adherence to discharge plans (Knesper et al., 2010), the therapeutic benefit to suicidal patients may be compromised by a lack of adequately trained clinicians and suicide-specific evidence-based therapies in these settings (Jobes, 2012; Palmieri et al., 2008; Wakai et al., 2020). The Collaborative Assessment and Management of Suicidality (CAMS; Jobes, 2006, 2016) has been identified as a promising suicide-specific therapeutic framework to match the demands of NDA settings. To date, CAMS has amassed a substantial evidence base demonstrating its effectiveness in reducing suicidal ideation, overall symptom distress, depression, and hopelessness in randomized-controlled trials (RCTs) across a variety of settings (Andreasson et al., 2016; Comtois et al., 2011; Jobes et al., 2017; Pistorello et al., 2021; Ryberg et al., 2019; Santel et al., 2023). In addition to its clinical effectiveness, CAMS is also an attractive option for NDA settings owing to its ability to increase clinicians' confidence and willingness to work with suicidal patients (LoParo et al., 2019;

Schuberg et al., 2009) and relatively high level of trainability, adaptability, and scalability for implementation across different health systems.

Pilot data from a feasibility study of CAMS versus standard care (SC) in an NDA outpatient treatment setting indicated that CAMS participants demonstrated significantly better and sustained improvements in suicidal ideation, overall symptom distress, and hopelessness compared to SC after 12 months, in addition to significantly higher treatment satisfaction and retention to care (Comtois et al., 2011). Although these findings support the effectiveness of CAMS in an NDA setting, what remains to be examined is the relationship between costs and outcomes in this context. Cost-inclusive evaluations are necessary to determine the *value* of an intervention compared to possible alternatives in order to maximize resource allocation in financially-constrained community healthcare environments (Yates, 1996). Such evaluations include cost-effectiveness analysis (i.e., the relationship between cost of intervention and clinical outcomes) and cost-benefit analysis (i.e., the relationship between cost of intervention and monetary outcomes; Yates, 2009).

In previous studies of suicidal patients in outpatient military treatment facilities, CAMS was found to have comparable costs to usual care conditions (Jobes et al., 2005; McCutchan et al., 2020) and greater benefit and cost-benefit after 12 months (McCutchan et al., 2020). While these findings are promising indications of the value of CAMS, it is unknown if they generalize to broader treatment settings and patient populations. Consequently, the purpose of the current study is to examine the costs, effectiveness, benefit, cost-effectiveness, and cost-benefit of CAMS vs. SC in the Aftercare Focus Study (AFS), an RCT of treatment for recently discharged suicidal patients in an NDA setting. Specifically, we predict the following:

- Hypothesis 1: CAMS will be no more costly than SC. Previous studies indicate that there is no significant difference in direct care costs (i.e., resource use directly attributable to patient care) between CAMS and usual care conditions (Jobes et al., 2005), and that costs of additional indirect activities (e.g., training and implementation) are relatively minimal at the individual level (McCutchan et al., 2020). Therefore, we anticipate that intervention costs will be comparable between conditions in the current study.
- Hypothesis 2: CAMS will be more effective (i.e., have better clinical outcomes) than SC across follow-ups. CAMS has amassed a substantial evidence base demonstrating clinical effectiveness, likely as a result of its overt focus on reducing suicidal ideation and behaviors and high degree of acceptability among patients and therapists. We predict that in the current study CAMS would demonstrate significantly greater clinical improvements related to suicidal ideation, suicidal behaviors, and re-hospitalization compared to SC.
- Hypothesis 3: CAMS will be more beneficial (i.e., have better monetary outcomes) than SC across follow-ups. Suicidal ideation and behaviors are associated with significant economic loss due to increased health service utilization and decreased productivity (Shepard et al., 2016). Because CAMS was anticipated to lead to greater and more rapid clinical improvement in suicidality than SC, we predict that such economic losses would be reduced accordingly, thus resulting in cost savings.
- Hypothesis 4: CAMS will be more cost-effective than SC across follow-ups. Per Hypotheses 1 and 2, CAMS is predicted to be equally costly but more effective than SC; thus, we anticipate that CAMS will be significantly more cost-effective.

- Hypothesis 5: CAMS will be more cost-beneficial than SC across follow-ups. Per Hypotheses 1 and 3, CAMS is predicted to be equally costly and more beneficial than SC. Thus, we anticipate that CAMS will be significantly more cost-beneficial and demonstrate significantly greater net benefit.

CHAPTER 2

METHOD

Design

The current study was a secondary data analysis of the "Aftercare Focus Study" (AFS; Comtois et al., 2023), a well-powered randomized-controlled feasibility trial of CAMS versus enhanced standard care (SC) intended to replicate and extend a smaller NDA RCT (Comtois et al., 2011). In the AFS, participants were randomly assigned to either CAMS or SC using a stratified, blocked randomization strategy and were matched on gender, number of suicide attempts, and level of impairment. Outcome assessments were conducted at baseline, 1-month, 3-month, 6-month, and 12-month time points by research personnel masked regarding participants' treatment condition. The AFS trial was funded by the American Foundation for Suicide Prevention and approved by the University of Washington and Catholic University of America Institutional Review Boards. The current archival study was approved by the American University Institutional Review Board.

Participants

Patients

Patient participants in the AFS study were 150 individuals who were suicidal recruited from inpatient psychiatry units, emergency departments, and consultation-liaison psychiatry services across the Seattle metropolitan area, with referrals primarily coming from two University of Washington medical centers, Harborview Medical Center and the University of Washington Medical Center. Inclusion criteria for participation were (a) inpatient or emergency service admission; (b) lifetime suicide attempt and current hospital admission for suicidality OR current hospital admission for suicide attempt; (c) treating clinician has determined that the

patient does not have appropriate outpatient mental health appointment in the next two weeks (other than an NDA) and NDA is an appropriate disposition plan; (d) consented to study procedures, including random assignment to treatment condition.

Exclusion criteria were (a) under age 18; (b) insufficient English to understand the study procedures and provide informed consent; (c) too psychotic or manic, aggressive, or cognitively impaired such that outpatient therapy is not indicated; (d) patient not stable enough to be discharged home for a minimum of 24 hours prior to first NDA; (e) court-ordered to outpatient treatment; (f) patient lived a significant distance away that attending weekly therapy sessions would not be feasible. Inclusion and exclusion criteria were assessed by referring hospital providers to determine who might be eligible for the study. The primary study was powered to detect a 50% reduction in suicide events (the primary treatment effect; power = .8 and $\alpha = .05$) with a sample of 200 participants; however, recruitment challenges resulted in enrollment of only 75% of that target. Ultimately, 197 individuals were assessed for eligibility; 46 individuals were excluded because they did not meet inclusion criteria ($n = 16$) or declined to participate ($n = 30$). Of the 150 individuals enrolled in the study, 75 were randomized to CAMS and 75 were randomized to SC. A detailed CONSORT diagram with outcome assessment completion rates is available in the primary study publication (Comtois et al., 2023).

Therapists

Therapists providing treatment in the AFS study consisted of existing Harborview Mental Health and Addiction Services (HMHAS) staff and two additional therapists hired through standard advertising venues and processes used by HMHAS. Therapists with CAMS experience were only recruited into the CAMS condition; therapists without CAMS experience were eligible for either condition. The final sample of study therapists participating in the intent-to-treat phase

of the trial (n = 9) consisted of seven licensed clinical social workers and two clinical psychologists. Mean years of practice experience since professional degree were 15 (SD = 8.12) for CAMS therapists and 15.67 (SD = 14.5) for SC therapists.

Treatments

CAMS

CAMS is a suicide-focused therapeutic framework guided by the Suicide Status Form, a comprehensive assessment, treatment-planning, tracking, and outcome clinical tool. CAMS relies upon an empathetic and collaborative alliance between therapist and patient geared toward developing a shared understanding of the patient's suicidality. The index session focuses on developing a stabilization plan to facilitate safety and stability by increasing the patient's ability to cope in times of crisis and the initial identification of patient-articulated suicidal "drivers" become the focus of CAMS-guided treatment planning. Subsequent sessions use a problem-focused approach to identify and treat patient-defined "drivers" that compel the patient to consider suicide. The CAMS framework is intended to be flexible and therapists may employ their own treatment approach to target and treat suicidal drivers; adherence to CAMS requires empathy, collaboration, honesty, and a suicide-focused approach. The length of CAMS-guided care is determined by each patient's time to resolution of symptoms (defined as three consecutive sessions of low suicidal risk and effective management of any remaining suicidal thoughts, feelings, and behaviors) but typically consists of 4 to 12 weekly individual sessions (Jobes, 2006, 2016).

SC

The SC condition in the AFS entailed standard post-discharge outpatient care as provided in the HMHAS Intake and Brief Intervention Service (IBIS). Of note, NDA appointments were

not always literally “next day” but were always offered within one-week post-discharge based on how quickly the patient could recover and come to the clinic. Usual care for an NDA patient typically includes an intake session and evaluations by a counselor or case manager as well as a psychiatrist or psychiatric nurse practitioner, followed by individual sessions with a counselor or case manager and ongoing medication management as needed. Treatment ends when the crisis is deemed resolved, typically within 1-3 months, at which time the patient is referred to appropriate community follow-up care as necessary (e.g., primary care for medication management or additional mental health treatment). To ensure internal validity, the NDA standard care condition was “enhanced” in that it specified a minimum of four individual treatment sessions (the minimum number of sessions in CAMS).

Protocols Common to Both Treatments

There were several treatment protocols common to both the CAMS and SC conditions. First, therapists for both conditions were recruited and hired through standard HMHAS procedures, had comparable HMHAS NDA training and counseling or psychotherapy experience, and followed standard HMHAS procedures aside from those specific to the study treatment protocol. Second, medication management was conducted by the same psychiatrist in both conditions according to standard pharmacology practice. Third, treatment was conducted until the crisis was considered resolved (as defined by each condition), at which time all participants received standard HMHAS referral options and support, as necessary. Fourth, if a patient was considered to be at sufficiently significant risk to require inpatient hospitalization, therapists followed standard HMHAS procedures for referral to inpatient care. Finally, if a participant was not experiencing any reduction in suicidality such that another treatment option might be more appropriate, the participant would be withdrawn from the study to allow the

opportunity for needed care (however, no participants required withdraw for this reason throughout the course of the study).

Treatment Setting

Study treatment was provided at a research clinic created at Harborview Medical Center in Seattle, WA, upstairs from the HMHAS community mental health center where NDAs are typically conducted through the IBIS. To maximize external validity, the research clinic was operated in accordance with HMHAS standard policies and procedures as closely as possible. Study therapists engaged with HMHAS leadership and clinical and psychiatric staff to manage participants in the same manner they would in the IBIS and offered the same referral resources as IBIS for both emergency and post-study follow-up care.

Measures

Demographic and Baseline Characteristics

The Demographic Data Scale (Linehan, 1992) was administered at baseline to gather extensive demographic information from participants. An adapted version, the Demographic Data Scale-Revised, was administered at 6- and 12-month follow-up assessments to ascertain changes to demographic characteristics that may change over time (e.g., occupational history, relationship status, living situation).

Suicidal Ideation

The Beck Scale for Suicide Ideation (BSS; Beck et al., 1988) is a 19-item self-report version of the Scale for Suicide Ideation-Current (SSI-C; Beck et al., 1997) measuring the intensity of suicidal ideation over the past week. The BSS was administered at baseline and follow-up outcome assessments used to assess suicidal ideation severity (total score of 0-38) and resolution (i.e., a total score of zero). The BSS been found to be a valid and reliable measure of

suicidal ideation across a variety of different settings and samples (Barnhofer et al., 2009; Beck et al., 1988, 1997; Brown et al., 2000; Crane et al., 2014; Healy et al., 2006; Hirsch & Conner, 2006; Pinninti et al., 2002) and has demonstrated measurement invariance in the longitudinal assessment of suicidal patients (de Beurs et al., 2015). Currently, there are no existing cutoff scores or classifications of severity levels for the BSS; rather, it is recommended that any positive response prompt further assessment (Reinecke & Franklin-Scott, 2005).

Self-Inflicted Injury

The Suicide Attempt Self-Injury Count (SASIC; Linehan et al., 2006; Linehan & Comtois, 1996) is a brief interview assessing total number of past self-inflicted injuries and corresponding method, intent, medical risk severity, and lethality. In the current study, lifetime and recent (over the past year) versions were administered at baseline and a recent (since previous assessment) version was administered at follow-up time points. SASIC responses were used to determine a total count of suicidal behaviors performed in any given assessment period. The SASIC has demonstrated equivalent interviewer ratings to the Suicide Attempt Self-Injury Interview, which has been found to have good reliability, validity, and sensitivity to change in suicidal patients (Linehan et al., 2006).

Health Service Utilization

The Treatment History Interview-Short Form (THI-SF; Linehan & Heard, 1987) is a semi-structured interview that captures treatment history including outpatient and inpatient psychiatric services, medical clinic visits, emergency treatments, and medication usage. At baseline, the THI-SF measured treatment history over the past year; in follow-up assessments, the THI-SF measured treatment history since the previous assessment. THI-SF responses were used to examine both clinical outcomes (e.g., re-hospitalization) and monetary outcomes (e.g.,

service utilization). The THI has been found to have high convergent validity with medical records (r = .99) in hospitalized patients. Pilot studies found no significant differences between THI self-report and therapist records for number of psychotherapy hours (Linehan & Heard, 1987).

Potential Covariates

To account for potential confounding in the relationship between condition and primary outcomes, several theoretically relevant covariates will be examined for inclusion in models. The Outcome Questionnaire-45 (Lambert et al., 1996) assessed key domains of mental health functioning. The EuroQol-5 Dimension (EuroQol Group, 1990) assessed self-rated health status. The Short Inventory of Problems (Alcohol/Drug; Miller et al., 1995) assessed self-reported substance use and associated consequences. The CAMS Rating Scale (Jobes, 2016) assessed CAMS therapist adherence (and, conversely, SC therapist non-adherence) to the CAMS framework.

Costs

The costs of delivering treatment were estimated in two ways. Primary cost analyses examined the costs, cost-effectiveness, and cost-benefit of CAMS versus SC for recently discharged suicidal patients an NDA setting. These analyses focused on estimating costs (and relative effects and benefits) at the intervention level to assess the comparative value of two treatment alternatives. A secondary cost analysis estimated the costs of delivering suicide-focused treatment at the practice level under two scenarios: (1) treatment delivery was embedded in an existing healthcare system and (2) treatment delivery required establishment of a new clinical facility. This descriptive analysis was intended to provide practical information for decision-makers considering implementation of suicide-focused treatment services across

different healthcare practice settings, particularly in light of a growing movement toward establishing standalone suicide prevention clinics (Enos, 2019; Erlangsen et al., 2015; Lahoz et al., 2020). Of note, cost analyses at the intervention level did include practice expenses. However, these costs (with the exception of training and consultation activities) were not micro-costed as in the clinic cost analyses; rather, they are captured as a percentage of direct care costs consistent with Medicare reimbursement rates.

Primary Cost Analyses: Treatment Interventions

The costs and benefits of each treatment condition were estimated from three perspectives: healthcare system, patient, and overall (healthcare system + patient). All costs were adjusted to reflect 2022 USD to enhance generalizability for future dissemination.

Healthcare System Perspective

Training and Implementation Activity Costs. A micro-costing approach was used to estimate the cost of training and implementation activities required to deliver each treatment condition beyond standard clinical practice (Chapel & Wang, 2019; Neumann et al., 2016; Yates, 1996). Micro-costing represents a 'bottom-up' approach which entails developing an inventory of activities performed, identifying necessary inputs for each activity, assigning a cost to each input, and then summing resources consumed (quantity x cost) across all inputs. In the current study, training and implementation activities were inventoried based on intervention protocols, administrative data systems, and qualitative interviews as feasible and appropriate. Resource inputs, including person time, facilities, travel, and materials, and their respective unit costs were identified for each activity. Total costs per activity was calculated by multiplying resource inputs by per-unit costs, which were then summed to determine the total cost for training and non-clinical implementation activities across each condition. Because training and implementation

costs were incurred at the condition-level, a fixed, per-individual cost was calculated by dividing total cost of activities based on inputs described below by the total number of individuals who could be treated. For greater generalizability, the denominator is not the number of study participants treated but rather reflects the estimated number of patients that these trained CAMS therapists might ultimately treat with the CAMS intervention during their employment in this clinical setting based on anticipated caseload and tenure. The applied denominator (N = 1,440 total for four therapists) was estimated using the assumptions of (a) a typical caseload of 15 patients per therapist; (b) an average treatment course of six weekly therapy sessions per patient (based on observed data); (c) 50 weeks worked per year per therapist; and (d) an average tenure of three years per therapist.

Time. Costs for time were estimated in hourly units for the therapist, administrator, and other personnel based on annual salary plus fringe benefits, divided by 2080 hours (an assumed 40 hours per week). Annual base salaries were estimated using the Bureau of Labor Statistics Occupational Employment Statistics Query System based on geographical area and occupation (U.S. Bureau of Labor Statistics, 2022b). Fringe benefit rates were estimated based on 2022 national average by industry, occupation, and region (U.S. Bureau of Labor Statistics, 2022a).

Facilities. When not available through study records, facility costs for training and implementation activities were estimated based on the current median cost for office space of similar dimensions in the closest available locality (Seattle, WA; LoopNet.com, 2022). Electricity consumption was estimated based on the average annual energy consumption for an outpatient health care building by square footage in the Commercial Building Energy Consumption Survey (U.S. Energy Information Administration, 2012) and electricity costs were then estimated using 2022 commercial electricity costs in Washington per the Department of

Energy (U.S. Energy Information Administration, 2022). Furniture, fixture, and equipment costs were estimated based on study records or typical market value.

Travel. Travel costs reflect resources needed for personnel to attend on-site trainings of CAMS study therapists. Costs of airfare, lodging, rental car, meals and incidental expenses were assumed to be consistent with General Services Administration (GSA) allowable rates for each category (U.S. General Services Administration, 2022b).

Materials. Costs for materials (e.g., CAMS manual or other educational materials) were estimated per item based on study receipts, treatment protocols, and/or information obtained in key informant interviews.

Treatment Delivery Costs. The cost of delivering treatment in each condition (i.e., direct clinical care) was estimated at the individual level based on the number, type, and duration of treatment visits attended as documented in THI-SF assessments and validated by administrative study records. Each study-related clinical encounter was assigned an appropriate Current Procedural Terminology (CPT; American Medical Association, 2019) code and costed based on Medicare reimbursement rates per the 2022 Physician Fee Schedule (Tumeh et al., 2005; U.S. Centers for Medicare & Medicaid Services, 2022). This same procedure was applied to missed treatment visits (i.e., no-shows) to reflect the missed opportunity to deliver services and collect payment for dedicated provider time (Kheirkhah et al., 2016; Mieloszyk et al., 2018). Any therapy services received outside of the study protocol were included in cost estimation to enhance generalizability for future implementation; rather they were considered outcomes and examined as benefits.

Patient Perspective

Patient participants also incurred costs to receive study treatment. Using a human capital approach (van den Hout, 2010), patient time was valued as estimated lost earnings based on median hourly wage in the Seattle locality by self-reported occupation (U.S. Bureau of Labor Statistics, 2022b) plus fringe benefits (U.S. Bureau of Labor Statistics, 2022a). Transportation costs to and from the treatment facility were estimated based on study personnel reports of typical transportation methods used by participants and reimbursement records, when available. Mass transit transportation costs (~45% of treatment visits) were estimated based on median local roundtrip fares (King County, 2022), personal vehicle transportation costs (~45% of treatment visits) were estimated based on the 2022 GSA mileage reimbursement rate for median roundtrip distance to clinic (U.S. General Services Administration, 2022a), and rideshare services transportation costs (~10% of treatment visits) were estimated based on the typical fare breakdown for rides within Seattle city limits (Uber, 2022). Because the exact transportation method of each participant was unknown, the costs of all transportation types were proportionally summed and then divided by the total number of study treatment visits (N = 1,062) to calculate an average transportation cost per visit that was applied to all participants.

In the current analyses, direct care costs of treatment services are captured in the healthcare system perspective; however, it was assumed that participants incurred out-of-pocket costs for prescription medications. Medication costs from the patient perspective were estimated based on self-reported medication compliance and median Medicare standard cost sharing by drug tier (Cubanski & Damico, 2021).

Effectiveness

The primary clinical outcomes of interest were suicidal ideation (severity and resolution) and suicidal behaviors (number of past-year suicide events [defined as suicide deaths, suicide

attempts, or acute hospitalizations to prevent suicide] and attempts).

Benefits

Healthcare System Perspective

Cost-savings benefits were assessed based on non-study-related treatment healthcare expenditures for behavioral health services, crisis services, and psychiatric medications using the THI-SF. Direct care costs for these services were estimated based on regional Medicare reimbursement rates. The index crisis episode (i.e., emergency department visit and/or psychiatric hospitalization) precipitating study enrollment was included in the baseline assessment of past-year healthcare expenditures. All services received after the initiation of study treatment were considered benefits (i.e., outcomes).

Patient Perspective

Benefits to patient participants were assessed as increased earnings as a result of decreased productivity loss from time spent in non-study-related treatment. Patient time was again valued based median hourly wage in the Seattle locality by self-reported occupation (U.S. Bureau of Labor Statistics, 2022b) plus fringe benefits (U.S. Bureau of Labor Statistics, 2022a). As a measure of sensitivity, patient time was also analyzed using the assumption of a standardized wage across all participants (specifically, the median hourly wage in the Seattle region across all occupations plus fringe benefits); findings under this assumption were consistent with those where the value of patient time varied by occupation.

Secondary Cost Analyses: Clinic Costs

The costs of establishing and maintaining clinical space for the delivery of suicide-focused treatment services in the study were estimated under two scenarios. The first scenario reflected the actual study conditions, in which treatment was partially embedded within an

existing healthcare system and thus was able to avoid certain costs through shared resources. The second scenario represented the estimated costs of establishing a new, separate clinical facility to provide such treatment services. Clinic cost analyses were conducted separately from treatment intervention cost analyses because (a) all study participants (SC and CAMS, $N = 150$) received treatment in the same clinic and (b) these clinic cost estimates are intended to inform broader establishment of suicide-focused treatment centers which may provide an array of different interventions. Costs were estimated for a two-and-a-half-year period (i.e., 30 months), consistent with the approximate duration of treatment services provided in the study. Resources required to provide treatment services in the clinic were inventoried based on key informant interviews with study personnel. Using a micro-costing approach, total clinic costs were estimated by multiplying unit costs per resource by resource consumption. Costs included the facilities, personnel, equipment, and materials needed to establish the clinic and to deliver services on a continuing basis.

Data Analysis Plan

An intent-to-treat approach was used for analyses that included all participants who completed a baseline assessment. To examine the longitudinal impact of CAMS compared to SC on repeated-measures outcomes, generalized linear mixed models (GLMMs) were used with link functions specified based on each variable's respective distribution (e.g., Gaussian for normally-distributed variables, gamma for skewed, non-negative variables, negative binomial for count variables, and logistic for binary variables). GLMMs are well-suited to longitudinal analyses because they can handle incomplete data and non-independence between observations (Fitzmaurice & Ravichandran, 2008). They also tend to be superior estimators of healthcare cost and expenditure variables that are not normally distributed compared to ordinary least squares

regression models with data transformation (Malehi et al., 2015). In the current study, all regression models included condition, time, and an interaction term as fixed effects, with a random intercept for participants and random slope for participants by time. Nesting of participants within study therapists was examined to account for potential between-therapist differences but did not improve model fit and therefore was not included as a random effect. A stepwise procedure was used to identify appropriate covariates as fixed effects terms. Variables with extreme outliers were Winsorized at the 2nd and 98th percentiles to improve the precision of statistical point estimates (Ghosh & Vogt, 2012; Weichle et al., 2013). Robust standard errors were used as a conservative measure against bias created by heteroscedasticity.

In the effectiveness analyses, suicidal ideation was a semi-continuous variable bounded at zero and thus a substantial proportion of zero observations were expected. Consequently, suicidal ideation was examined using separate negative binomial-logit hurdle models at each follow-up time point (Boulton & Williford, 2018). The first portion of the hurdle models was a logistic regression examining group differences in likelihood of having any suicidal ideation (yes/no) and the second part of the model was a negative binomial regression examining group differences in the count of the suicidal ideation outcome, conditional on having any suicidal ideation. The two-part model approach allowed for inference about treatment effect on both suicidal ideation resolution and severity outcomes. Suicidal behaviors were examined using logistic regression and negative binomial regression models. Cost-effectiveness was determined by calculating individual-level cost-effectiveness ratios (CERs; derived as the cumulative cost of treatment divided by the change in outcome) to capture the average cost per effect. Additionally, incremental CERs (ICERs; derived as the difference in average costs of each treatment divided by the difference in average effects) were calculated to represent the additional cost per unit of

clinical gain. Confidence intervals were calculated using a bootstrap resampling approach with 5,000 replications with replacement (Briggs et al., 1997) and bootstrapped ICERs were plotted on a cost-effectiveness plane using the STATA 'heabs' and 'heapbs' packages (Gallacher, 2017).

Benefits were examined (a) between-participant as group differences in cumulative healthcare expenditures at each follow-up time point between CAMS using longitudinal GLMMs and (b) within-participant as individual-level change in pre- versus post-intervention healthcare expenditures using linear regression to compare individuals' baseline versus 12-month follow-up. Within-participant benefits analyses were restricted to participants who had both baseline and 12-month follow-up cumulative benefits data to ensure comparable 12-month periods before and after treatment (n = 91). Participants who died during the course of the study were excluded from benefit analyses at any subsequent time point. Cost-benefit was determined by calculating individual-level cost-benefit ratios (CBRs; derived as the cumulative monetary benefit of treatment divided by the cumulative cost) and net benefit (derived as the cumulative benefit minus the cumulative cost of treatment). Group differences in cost-benefit variables were examined using linear regression. All statistical analyses were conducted using Stata v.17.0.

CHAPTER 3

RESULTS

Missing Data

Study retention rates in the intent-to-treat sample were 83%, 77%, 76%, and 71% for CAMS and 87%, 79%, 76%, and 75% for SC at 1-, 3-, 6-, and 12-month follow-ups, respectively. A detailed CONSORT diagram is presented in the primary study outcomes publication (Comtois et al., 2023). Separate logistic regression models revealed no statistically significant differences in odds of missing data based on treatment condition, age, gender, ethnicity, sexual orientation, marital status, income, employment status, education level, number of lifetime suicide attempts, or baseline suicidal ideation severity at any follow-up time point. Treatment cost data was obtained via administrative records (rather than via self-report), and thus there was no missing data for these outcomes regardless of whether participants completed follow-up assessments. Wherever appropriate, longitudinal generalized regression models were applied to allow utilization of all available data. In instances where such approaches were not applicable (e.g., when underlying model assumptions were violated) for repeated measures outcomes, time-naive models were used to examine fixed effects at each time point separately (Hall et al., 2001).

Demographic and Baseline Characteristics

Sociodemographic and clinical characteristics are presented in Table 1. The full intent-to-treat study sample consisted of 150 participants. Approximately half of participants identified as male (48.0%), 41.3% as female, and 10.7% as transgender or non-binary, with a mean age of 33.8 years (*SD* = 12.4, range = 18-79). Participants predominantly identified as White (62.7%), heterosexual (56.1%), and single (70.7%). The mean BSS score at baseline was 11.44 (*SD* =

10.4); for context, scores ≥3 and ≥6 have been reported to be most predictive of future suicidal behavior in samples of outpatients (Brown et al., 2000) and individuals treated for suicide attempt (de Beurs et al., 2016), respectively. Participants also reported an average of 8.92 (SD = 43.7; median = 2, interquartile range = 1-4) lifetime suicide attempts. Approximately 21% of the sample were 'major repeaters' (individuals with ≥5 lifetime suicide attempts), which is higher than the 10-15% reported in other samples of suicide attempters (Bille-Brahe et al., 1996; Blasco-Fontecilla et al., 2014; Kreitman & Casey, 1988). There were no statistically significant differences between the CAMS and SC conditions with regard to sociodemographic or baseline clinical characteristics, with the exception of lifetime count of suicide attempts. Negative binomial regression indicated that the SC participants had a significantly greater count of lifetime suicide attempts (*IRR* = 0.38, 95% CI [0.23, 0.62], $p < 0.001$).

Table 1

Baseline Sociodemographic and Clinical Characteristics

Characteristic	**Total Sample** (*N* = 150) *M*(*SD*) or *N*(%)	**CAMS** (*n* = 75) *M*(*SD*) or *n*(%)	**SC** (*n* = 75) *M*(*SD*) or *n*(%)
Age	33.80 (12.4)	33.51 (12.3)	34.09 (12.5)
Gender			
Male	72 (48.0)	37 (49.3)	35 (46.7)
Female	62 (41.3)	28 (37.3)	34 (45.3)
Transgender/Non-binary	16 (10.7)	10 (13.3)	6 (8.0)
Ethnicity			
White	94 (62.7)	47 (62.7)	47 (62.7)
Black/African American	6 (4.0)	4 (5.3)	2 (2.7)
Latinx	5 (3.3)	2 (2.7)	3 (4.0)
Asian	11 (7.3)	7 (9.3)	4 (5.3)
Hawaiian Native/Other Pacific Islander	2 (1.3)	0 (0.0)	2 (2.7)
Native American/Alaska Native	1 (0.7)	0 (0.0)	1 (1.3)

Characteristic	Total Sample (N = 150) M(SD) or N(%)	CAMS (n = 75) M(SD) or n(%)	SC (n = 75) M(SD) or n(%)
Biracial/Multiracial	31 (20.7)	15 (20.0)	16 (21.3)
Marital Status			
Single, never married	106 (70.7)	57 (76.0)	49 (65.3)
Married	15 (10.0)	7 (9.3)	8 (10.7)
Separated	6 (4.0)	3 (4.0)	3 (4.0)
Divorced	22 (14.7)	7 (9.3)	15 (20.0)
Widowed	1 (0.7)	1 (1.3)	0 (0.0)
Sexual Orientation			
Heterosexual	83 (56.1)	43 (58.1)	40 (54.1)
Gay/Lesbian/Homosexual	21 (14.2)	9 (12.2)	12 (16.2)
Bisexual	26 (17.6)	11 (14.9)	15 (20.4)
Pansexual	10 (6.7)	7 (9.5)	3 (4.1)
Other	8 (5.4)	4 (5.4)	4 (5.4)
Education			
Some high school	13 (8.7)	9 (12.0)	4 (5.3)
High school graduate or GED	29 (19.3)	16 (21.3)	13 (17.3)
Business/Technical School/Associates/Other	20 (13.3)	7 (9.3)	13 (17.3)
Some college	54 (36.0)	26 (34.7)	28 (37.3)
Bachelor's Degree	19 (12.7)	9 (12.0)	10 (13.3)
Some graduate school or Graduate Degree	15 (10.0)	8 (10.7)	7 (9.3)
Employment			
Unemployed	55 (36.7)	26 (34.7)	29 (38.7)
Disabled/Retired	28 (18.7)	12 (16.0)	16 (21.3)
Employed <40 hours per week	38 (25.3)	19 (25.3)	19 (25.3)
Employed ≥40 hours per week	29 (19.3)	18 (24.0)	11 (14.7)
Income			
None	8 (6.5)	3 (5.0)	5 (7.8)
Less than $10,000 per year	26 (21.0)	15 (25.0)	11 (17.2)
$10,000 - $24,999 per year	36 (29.0)	14 (23.3)	22 (34.4)

Characteristic	Total Sample (N = 150) M(SD) or N(%)	CAMS (n = 75) M(SD) or n(%)	SC (n = 75) M(SD) or n(%)
$25,000 - $49,999 per year	32 (25.8)	18 (30.0)	14 (21.9)
More than $50,000 per year	22 (17.7)	10 (16.7)	12 (18.8)
BSS Score	11.44 (10.4)	10.93 (11.0)	11.35 (9.9)
Lifetime Suicide Attempts			
None	6 (4.3)	5 (7.0)	1 (1.5)
One	43 (30.7)	19 (26.8)	24 (34.8)
Two	38 (27.1)	21 (29.6)	17 (24.6)
Three	13 (9.3)	7 (9.9)	6 (8.7)
Four	10 (7.1)	4 (5.6)	6 (8.7)
Five or more	30 (21.4)	15 (21.2)	15 (21.8)

Note: BSS = Beck Scale for Suicide Ideation. Univariate linear regression and chi-square tests revealed no significant group differences in baseline demographic or clinical characteristics, with the exception of number of lifetime suicide attempts.

Treatment Characteristics

At 12 months, participants in the CAMS condition attended significantly fewer study therapy sessions with a therapist/case manager compared to SC participants (M = 5.04 [SD = 4.81] for CAMS, M = 7.47 [SD = 6.80] for SC; IRR = 0.68, 95% CI [0.50, 0.91], p = .01). The average number of study psychiatrist sessions attended was comparable between conditions (M = 0.71 [SD = 1.46] for CAMS, M = 0.95 [SD = 1.45] for SC; p = .34), as was total number of study treatment sessions attended (M = 10.71 [SD = 7.99] for CAMS, M = 12.76 [SD = 8.53] for SC; p = .11). With regard to missed visits (i.e., no-shows), SC participants had a significantly higher number of missed study treatment sessions compared to CAMS (M = 2.07 [SD = 2.58] for CAMS, M = 3.24 [SD = 3.18] for SC; IRR = 1.58, 95% CI [1.07, 2.34], p = .02).

Treatment Costs

Table 2 displays the Resource x Activity table used in micro-costing procedures for the estimation of CAMS training and consultation activities. Training and implementation costs

totaled $7,505.86 or $5.21 per patient who might ultimately be treated (N = 1,440). The SC condition did not incur any training or implementation costs above and beyond standard practice.

Table 2

Resource x Activity Table for CAMS Training and Consultation Activities

Resource	Unit Measure	Unit Cost	Units Required	Total Resource Cost
Review CAMS Manual				
Time				
Clinicians	1 hour	$41.01[a]	12	$492.12
Materials	1 manual	$37.85	4	$151.40
Complete Online CAMS Course				
Time				
Clinicians	1 hour	$41.01[a]	24	$984.24
Other				
Registration Fee	1 user	$179.00	4	$716.00
Attend On-site Training				
Time				
Clinicians	1 hour	$41.01[a]	32	$1,312.32
Study Investigators	1 hour	$98.60[b]	8	$788.80
Facilities				
Office Space	1 hour	$10.59	8	$84.72
Electricity	1 kW hour	$0.0941	27.6	$2.60
Materials	1 page	$0.10	250	$25.00
Travel				
Airfare	1 roundtrip ticket	$638.00	1	$638.00
Lodging	1 room/night	$176.00	2	$352.00
Lodging	1 room/night	$176.00	2	$352.00
Rental Car	1 day	$35.00	3	$105.00
Meals & Incidental Expenses Per Diem	1 day	$59.25 (travel days); $79.00	3	$197.50
Case Consultation[c]				
Time				
Clinicians	1 hour	$41.01	16	$656.16
Consultation Fee	1 hour	$250.00	4	$1,000.00
TOTAL				**$7,505.86**
Per-Individual Cost[d]				$5.21

Note. kW = kilowatt. [a]Unit cost for study clinicians includes a 30.4% fringe rate (Private industry workers by metropolitan areas, West region [Seattle]; U.S. Bureau of Labor Statistics, 2022a); [b]Unit cost for study investigators includes a 28.5% fringe rate (Private industry workers by metropolitan areas, South region [DC]; U.S. Bureau of Labor Statistics, 2022a); [c]Assumes a total of four hourly group consultation calls, as is typical in real-world CAMS implementation training. [d]The per-individual training and consultation cost was derived by dividing the total cost by the estimated number of patients that these trained CAMS therapists might ultimately treat with the CAMS intervention during their employment in this clinical setting based on anticipated caseload and tenure (N = 1440 clients).

Descriptive statistics for total cumulative treatment costs at each time point and from each perspective are displayed in Table 3 and Figure 1 (see Appendix A for cumulative treatment costs in hours of person-time). Mean cumulative treatment costs were consistently lower for CAMS participants compared to SC participants across all three perspectives. From the healthcare system perspective, the average cumulative treatment cost at 12 months were $886.37 (*SD* = 717.29) for CAMS and $1,435.85 (*SD* = 977.50) for SC. A breakdown of costs by category (i.e., training and consultation, therapist and case manager sessions, psychiatrist visits, and no-shows) from this perspective is presented in Appendix B. Mean cumulative treatment costs were notably lower from the patient perspective, ranging from $264.17 (*SD* = $420.77) for CAMS and $378.20 (*SD* = $371.44) for SC. The discrepancy between the two perspectives is unsurprising; participants did not incur any costs as a result of no-showing an appointment, whereas the healthcare system incurred an opportunity cost. From the overall perspective, average total treatment costs at 12 months were $1,150.53 per participant (*SD* = $1,070.23) for CAMS and $1,814.04 per participant (*SD* = $1,070.23) for SC.

As expected, treatment cost data was right skewed and thus GLMMs with a gamma family and log link were utilized to compare treatment costs between conditions at each follow-up time point. Treatment costs from the patient perspective included some observations of zero (*n* = 13); consequently, a constant of $1.00 was added to all observations. All models controlled for number of lifetime suicide attempts at baseline in light of group imbalance. Fixed effects results of GLMMs from each perspective are displayed in Appendix C. From the healthcare system perspective, CAMS was associated with significantly lower treatment costs at each follow-up time point with a pattern of increasing effect over time (βs = -0.18, -0.23, -0.32, and -0.32 at 1-, 3-, 6-, and 12-month follow-ups, respectively; *p*s < 0.01). Model results from the

patient perspective were similar; however, significant group differences did not emerge until 3-month follow-up (βs = -0.18, -0.26, and -0.26 at 3-, 6-, and 12-month follow-ups, respectively; $p < 0.01$). From the overall perspective, the effect of treatment condition was marginally significant at 1-month follow-up (β = -0.17, $p = 0.06$), after which CAMS was associated with significantly lower cumulative treatment costs at 3-, 6-, and 12-month follow-ups (βs = -0.23, -0.31, and -0.31; ps < 0.01).

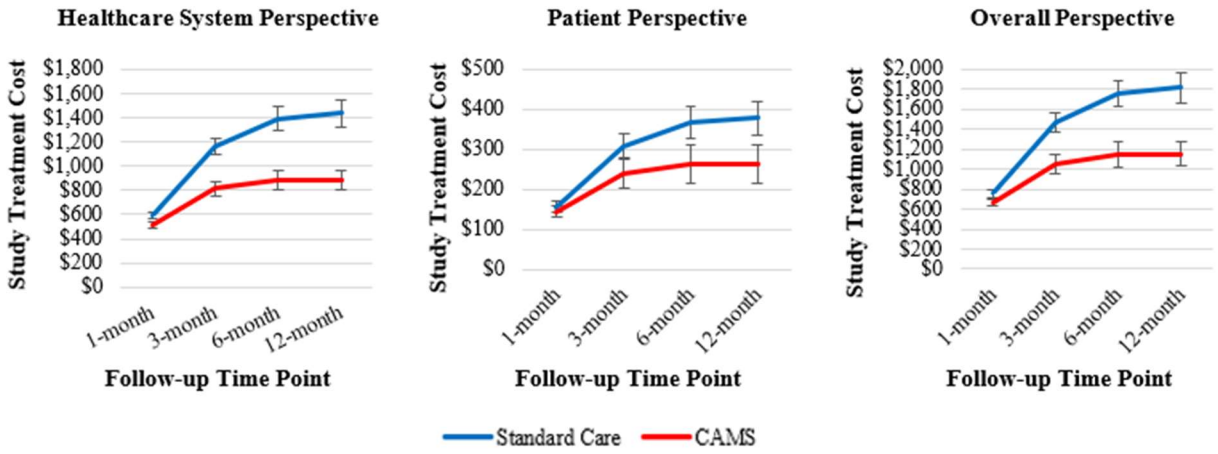
Table 3

Descriptive Statistics for Total Cumulative Treatment Cost by Condition and Time

	Healthcare System		**Patient**		**Overall**	
Time	**SC** *M(SD)*	**CAMS** *M(SD)*	**SC** *M(SD)*	**CAMS** *M(SD)*	**SC** *M(SD)*	**CAMS** *M(SD)*
1 month	$598.26 ($239.82)	$518.30 ($237.21)	$156.11 ($115.44)	$144.40 (115.42)	$754.38 ($308.90)	$662.70 ($322.08)
3 months	$1,159.92 ($591.88)	$814.13 ($489.90)	$308.63 ($263.50)	$238.98 ($318.41)	$1,468.55 ($794.27)	$1,053.10 ($806.18)
6 months	$1,389.58 ($870.76)	$883.63 ($711.44)	$366.09 ($344.18)	$263.75 ($419.64)	$1,755.66 ($1,151.77)	$1,147.38 ($1,063.72)
12 months	$1,435.85 ($977.50)	$886.37 ($717.29)	$378.20 ($371.44)	$264.17 ($420.77)	$1,814.04 ($1,293.39)	$1,150.53 ($1,070.23)

Figure 1

Mean Cumulative Study Treatment Costs Across Time



Note. Error bars reflect standard errors

Effectiveness

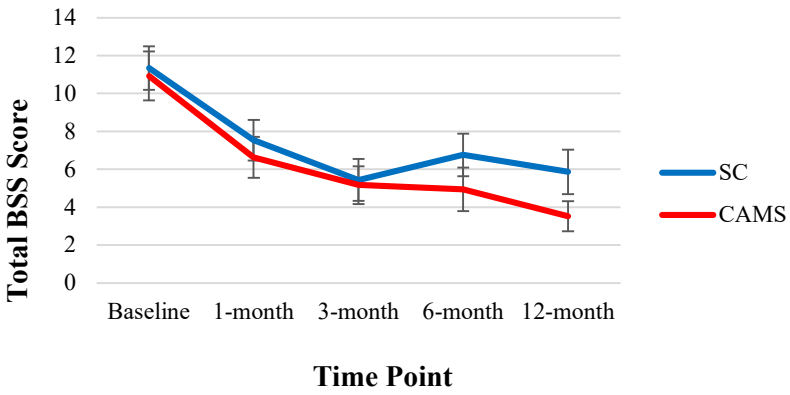
Suicidal Ideation

Figure 2 displays trajectories of mean BSS scores by condition over the course of the study. Descriptively, mean suicidal ideation severity scores decreased in both conditions over time from baseline. There was a marginally significant imbalance between conditions at baseline such that SC participants were marginally more likely to report the presence of any suicidal ideation (OR = 0.53, *SE* = 0.20, 95% CI [0.26, 1.09], $p = .09$); consequently, regression models examining suicidal ideation at follow-up time points controlled for this imbalance. Results from negative binomial-logit hurdle regression models examining suicidal ideation outcomes at each time point are displayed in Appendix D. The first part of the hurdle models, the logistic portion, evidenced no treatment effect at any time point, indicating that CAMS and SC participants had comparable odds of having any suicidal ideation (i.e., resolution of suicidal ideation). The second part of the hurdle models, the negative binomial portion, evidenced a significant treatment effect only at 12-month follow-up, indicating that conditional on reporting any suicidal

ideation at this time, CAMS participants had significantly lower suicidal ideation severity than SC participants (β = -0.57, *SE* = 0.23, 95% CI [-1.03, -0.11], *p* = .02).

Figure 2

Mean Total BSS Score Trajectories Across Time by Condition



Note. Error bars reflect standard errors

Suicidal Behavior

At 12-month follow-up, 38.9% of CAMS participants and 37.5% of SC participants had any past-year suicide event. On average, CAMS participants reported 0.98 (*SD* = 1.99) suicide events compared to 0.66 (*SD* = 1.03) for SC. Logistic and negative binomial regression models controlling for past-year suicide events at baseline indicated that there were no significant differences between groups with regard to the presence of past-year suicide events (OR = 0.95, *SE* = 0.39, *p* = .89) or count of past-year suicide events (β = 0.13, *SE* = 0.38, *p* = .74) at 12 months. With regard to suicide attempts specifically, 27.8% of CAMS participants and 21.4% of SC participants made any past-year suicide attempt at 12-months; groups did not differ significantly in this respect (OR = 1.68, *SE* = 0.79, *p* = 0.27).

At the treatment condition level, the number of past-year suicide crises decreased by 68% in the SC condition and 62% in the CAMS condition (restricted to participants with both baseline

and 12-month follow-up observations). Past-year suicide attempts decreased by 79% and 61% respectively, corresponding to an estimated 65 suicide attempts prevented in SC and 53 suicide attempts prevented in CAMS.

Benefits

Table 4 presents descriptive statistics for total cumulative healthcare expenditures for each condition by follow-up time point and perspective. Longitudinal trajectories of mean total cumulative healthcare expenditures by condition for each perspective are displayed in Figure 3. At baseline, mean past-year total healthcare expenditures were comparable between the two conditions across perspectives (*p*s = .52 - .56). At 12 months, mean total cumulative past-year healthcare expenditures were lower in CAMS compared to SC by $1,726.42, $1,253.68, and $2,879.49 per participant from the healthcare system, patient, and overall perspectives, respectively. However, GLMMs of cumulative total healthcare expenditures did not evidence any significant differences between SC and CAMS at any follow-up time point from any perspective after controlling for baseline healthcare expenditures, age, and lifetime suicide attempt count (see Appendix E for fixed effects model results). Due to a higher proportion of observations of zero, group comparisons of healthcare expenditures by category of service (i.e., outpatient behavioral health, medical providers, crisis services, and medications) were conducted using separate two-part models (logistic regression for presence of any expenditures since baseline followed by GLM with gamma family and log link for expenditures greater than zero). At 12 months, treatment conditions did not differ significantly with respect to the presence or magnitude of expenditures for any category of services from any perspective after controlling for baseline healthcare expenditures, age, and lifetime suicide attempt count (see Appendix F for two-part model results).

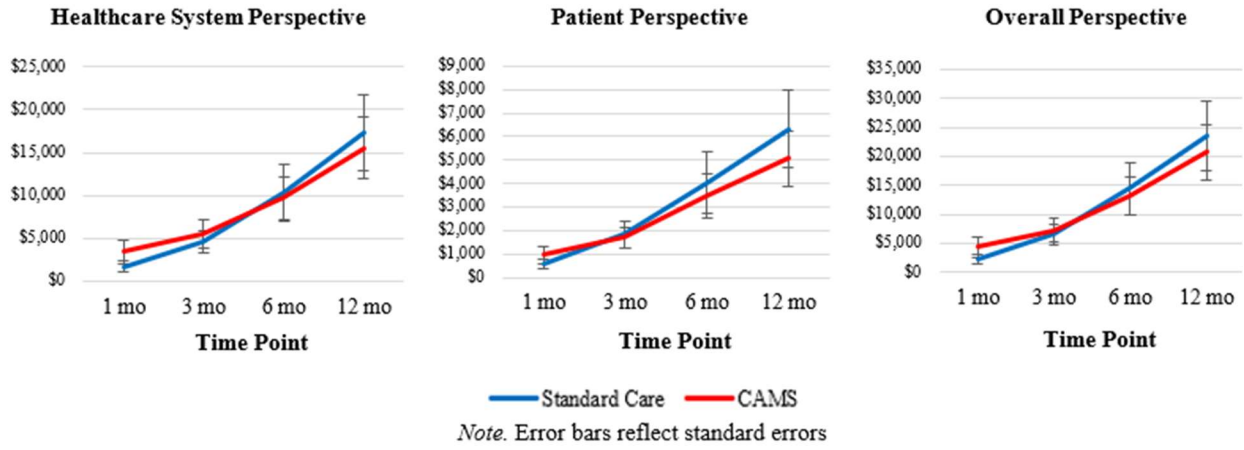
Table 4

Descriptive Statistics for Total Cumulative Healthcare Expenditures from each Perspective

		Healthcare System		Patient		Overall	
Time	***N***	**SC** *M(SD)*	**CAMS** *M(SD)*	**SC** *M(SD)*	**CAMS** *M(SD)*	**SC** *M(SD)*	**CAMS** *M(SD)*
1 month	122	$1,755.17 ($4,944.88)	$3,425.49 ($11,126.46)	$603.41 ($1,576.30)	$962.20 ($2,747.87)	$2,358.58 ($6,366.37)	$4,387.69 ($13,746.25)
3 months	112	$4,607.33 ($9,108.86)	$5,518.16 ($12,504.82)	$1,896.69 ($4,271.68)	$1,693.76 ($3,410.74)	$6,504.02 ($12,900.18)	$7,211.91 ($15,658.40)
6 months	104	$10,395.33 ($23,343.83)	$9,686.63 ($17,828.44)	$4,046.23 ($9,308.02)	$3,504.09 ($6,915.88)	$14,441.56 ($32,184.47)	$13,190.72 ($24,192.32)
12 months	93	$17,292.77 ($29,843.98)	$15,566.35 ($24,554.43)	$6,323.87 ($11,213.90)	$5,070.19 ($8,060.62)	$23,615.64 ($40,322.24)	$20,736.15 ($31,972.71)

Figure 3

Mean Cumulative Total Healthcare Expenditures by Condition, Time, and Perspective



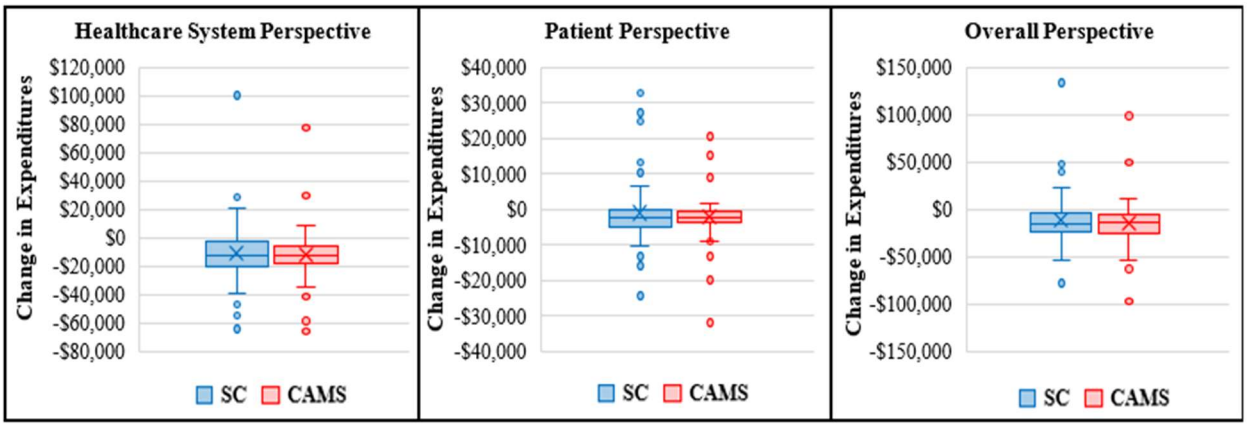
Note. Error bars reflect standard errors

Finally, in examining within-subject treatment effects, mean changes in pre- versus post-intervention total past-year healthcare expenditures suggested that both conditions experienced reduced healthcare spending in the year after initiating treatment (i.e., cost savings), with CAMS participants evidencing greater reductions compared to SC on average. Mean changes in past-year healthcare expenditures per participant for CAMS versus SC were -$11,944.54 (*SD* =

22,612.48) and -$10,437.45 (*SD* = 25,837.53) from the healthcare system perspective, -$2,115.55 (*SD* = 8,234.86) and -$1,032.05 (*SD* = 10,013.51) from the patient perspective, and -$14,060.09 (*SD* = 29,830.89) and -11,469.49 (*SD* = 34,385.42), respectively (see Figure 4). Of note, these estimates of total healthcare expenditures do not include medication spending, as baseline data was not available for this category of expense. Because values of past-year healthcare expenditure change were continuous and included non-positive observations, GLMs with a Gaussian family and identity link were used to compare treatment conditions. Results of these models indicated that group differences in pre- versus post-intervention past-year expenditures were not significant from any perspective after controlling for age and lifetime suicide attempt count (*p*s = .87 - .95). Residual errors of the linear models were kurtotic and right-skewed; consequently, nonparametric quantile regression models were conducted to examine group differences in median past-year healthcare expenditures changes. Results of these analyses were consistent with GLM findings (*p*s = .34 - .87).

Figure 4

Boxplots of Pre-/Post-Intervention Change in Past-Year Total Healthcare Expenditures



Cost-Effectiveness

Cost per clinical effect

Descriptive costs per clinical effects at the treatment condition level are displayed in Table 5. At 12 months, the cost per resolved case (i.e., BSS total score = 0), cost per past-year suicide event prevented, and cost per past-year suicide attempt prevented were consistently lower in the CAMS condition compared to SC across all perspectives.

Table 5

Treatment Condition-level Cost per Effect from each Perspective

	Healthcare System		Patient		Overall	
Effect	**SC**	**CAMS**	**SC**	**CAMS**	**SC**	**CAMS**
Cost per resolved case	$3,113.00	$1,714.79	$889.38	$534.61	$4,002.38	$2,249.40
Cost per past-year suicide event prevented	$1,166.10	$628.07	$331.30	$197.05	$1,497.40	$825.12
Cost per past-year suicide attempt prevented	$1,399.32	$994.35	$397.56	$309.54	$1,796.88	$1,303.89

Note. Analysis restricted to cases with data at both baseline and 12-month follow-up

Cost-effectiveness ratios

At the individual level, cost-effectiveness ratios (CERs) were calculated to examine suicidal ideation symptom improvement relative to treatment costs. CERs were calculated as effect divided by cumulative cost (versus the more typical cost divided by effect) due to a substantial number of observations of zero change in BSS total score since baseline, which would preclude calculation of a CER if used as the denominator. Consequently, ECRs (effectiveness-cost ratios) reflect improvement (in points) in BSS total score compared to baseline per hundred dollars spent on treatment. Mean ECRs by condition, time point, and perspective are presented in Table 6. Given that ECRS were continuous and contained non-positive observations, GLMMs with a Gaussian family and identity link were used to examine

group differences across time points. Results of these models evidenced significant time x condition interactions suggesting CAMS participants had higher (i.e., more favorable) ECRs at 6-month follow-up from the patient perspective (β = 2.90, *SE* = 1.14, *p* = .01) and at 12-month follow-up from all three perspectives (healthcare system perspective β = 0.62, *SE* = 0.29, *p* = .03; patient perspective β = 3.58, *SE* = 1.13, *p* = .01; overall perspective β = 0.48, *SE* = 0.23, *p* = .03), holding lifetime suicide attempts constant (see Appendix G for full fixed effects results of these models). Residual errors of the linear mixed model were kurtotic and skewed; consequently, nonparametric quantile regression models were utilized to examine group differences in median ECRs at each time point separately; results of these models were largely inconsistent with the GLMM findings. Quantile regression models evidenced no significant group differences at the median (i.e., 50% quantile) at any time point or from any perspective, suggesting that the most 'typical' CER is comparable between treatment groups.

Table 6

Effectiveness-Cost Ratios for Suicidal Ideation Severity Improvement by Condition and Time

	Healthcare System		**Patient**		**Overall**	
Time	**SC** *M(SD)*	**CAMS** *M(SD)*	**SC** *M(SD)*	**CAMS** *M(SD)*	**SC** *M(SD)*	**CAMS** *M(SD)*
1 month	1.00 (1.90)	3.65 (21.06)	3.00 (6.75)	2.82 (8.15)	0.77 (1.48)	0.66 (1.45)
3 months	0.64 (1.28)	0.85 (1.47)	2.29 (4.66)	3.89 (8.05)	0.49 (0.98)	0.67 (1.15)
6 months	0.65 (1.70)	1.02 (1.71)	1.41 (2.74)	4.69 (9.53)	0.54 (1.50)	0.78 (1.29)
12 months	0.63 (1.23)	1.03 (1.64)	2.03 (2.80)	5.57 (11.35)	0.51 (0.92)	0.80 (1.30)

Note. Effectiveness-cost ratios represent improvement (in points) on the BSS scale compared to baseline per hundred dollars spent on treatment

Individual-level ECRs were also calculated to examine improvement in suicidal behaviors (specifically, reduction in suicide events) relative to treatment costs. Due to the

relative infrequency of suicide events observed in the study, suicide events were examined across the full one-year follow-up period rather than at each time point in comparison to the number of past-year suicide events at baseline. These ECRs were again calculated as effect divided by cost due to observations of zero effect which would result in undefined ECRs as the denominator. Mean ECRs from the healthcare system, patient, and overall perspectives respectively were 0.65 (*SD* = 2.74), 1.41 (*SD* = 4.71), and 0.59 (*SD* = 2.72) for CAMS and 0.06 (*SD* = 0.64), 0.65 (*SD* = 2.17), and 0.05 (*SD* = 0.54) for SC. Generalized linear modeling from each perspective evidenced no significant group differences in ECRs for improvement in suicidal behavior after controlling for number lifetime suicide attempts (*p*s = .20 - .51), suggesting comparable costs per reduction in past-year suicide events. Again, residual errors of the linear mixed model were highly kurtotic and skewed. Subsequent nonparametric quantile regression models indicated that CAMS participants had significantly higher ECRs (i.e., greater reduction in suicide events per hundred dollars spent) compared to SC participants from each perspective (β = 0.09, *SE* = 0.03, *p* = .002 from the HCS perspective; β = 0.23, *SE* = 0.11, *p* = .048 from the patient perspective, and β = 0.07, *SE* = 0.02, *p* = .005 from the overall perspective).

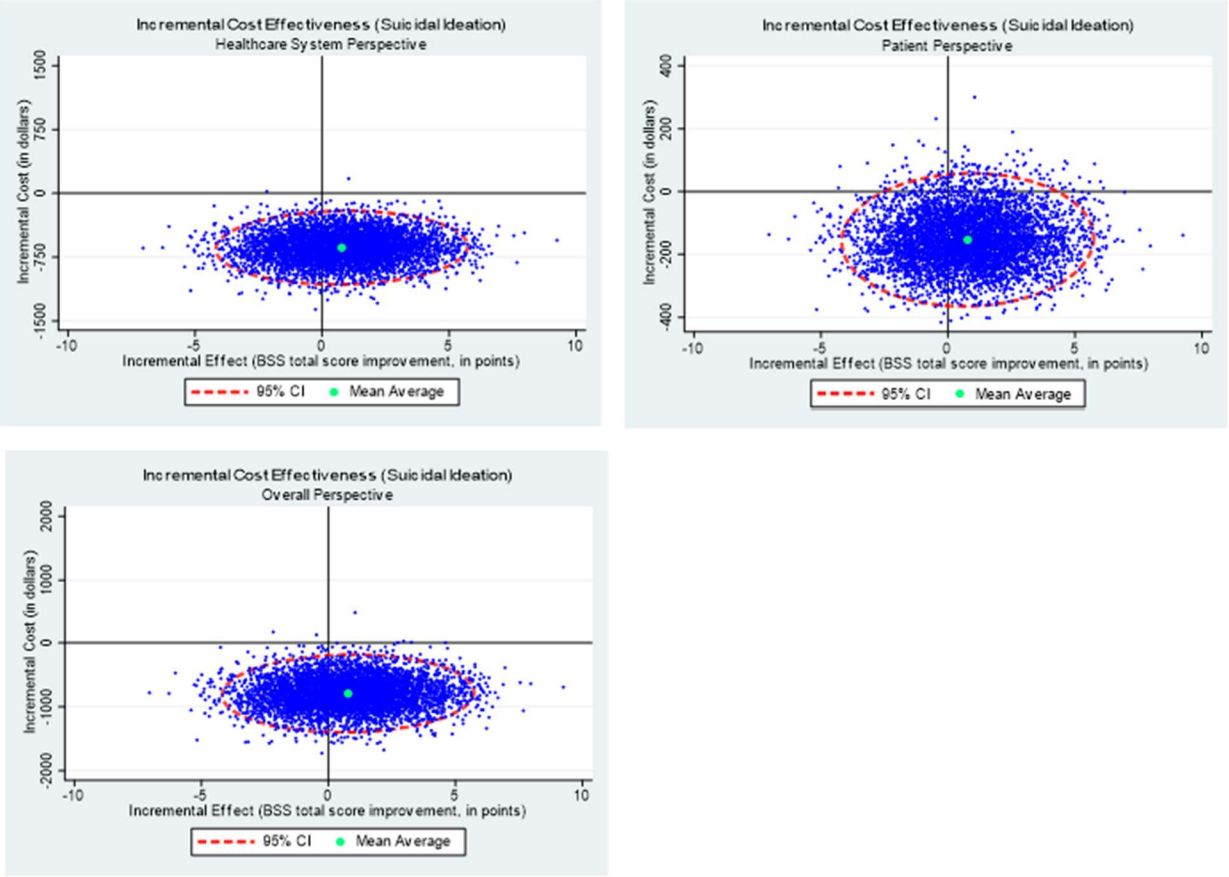
Incremental cost-effectiveness ratios

With regard to suicidal ideation, CAMS treatment cost $807.28, $194.43, and $1,001.71 less per participant than SC to produce an additional one-point reduction in BSS total score at 12-month follow-up from the healthcare system, patient, and overall perspectives, respectively. With regard to suicidal behavior, CAMS treatment cost $2,566.41, $600.04, and $3,166.45 less per participant than SC to produce an additional decrease of one past-year suicide event at 12-month follow-up from the healthcare system, patient, and overall perspectives, respectively. ICERS for suicide attempts were similarly lower at -$4,316.68, -$1,031.65, and -$5,348.33 per

each additional decrease of one past-year suicide attempt. These ICERs indicate that the CAMS intervention dominates SC by yielding better outcomes at a lower cost across all perspectives, although 95% confidence intervals (bootstrapped with 5,000 replications) indicate a substantial degree of uncertainty related to incremental effectiveness that may suggest possible tradeoff (see Figures 5 and 6 for cost-effectiveness scatterplots for suicidal ideation and behavior outcomes, respectively). At the treatment condition level, ICERs for number of resolved cases (i.e., BSS total score = 0) at 12 months indicate that CAMS treatment cost $18,559.25, $4,609.62, and $23,168.86 less compared to SC treatment to produce one additional resolved case from the healthcare system, patient, and overall perspectives, respectively. Still, these estimates should be interpreted with caution as ICERs were calculated based on aggregated data (because resolution was a categorical variable) and thus estimating uncertainty was not feasible.

Figure 5

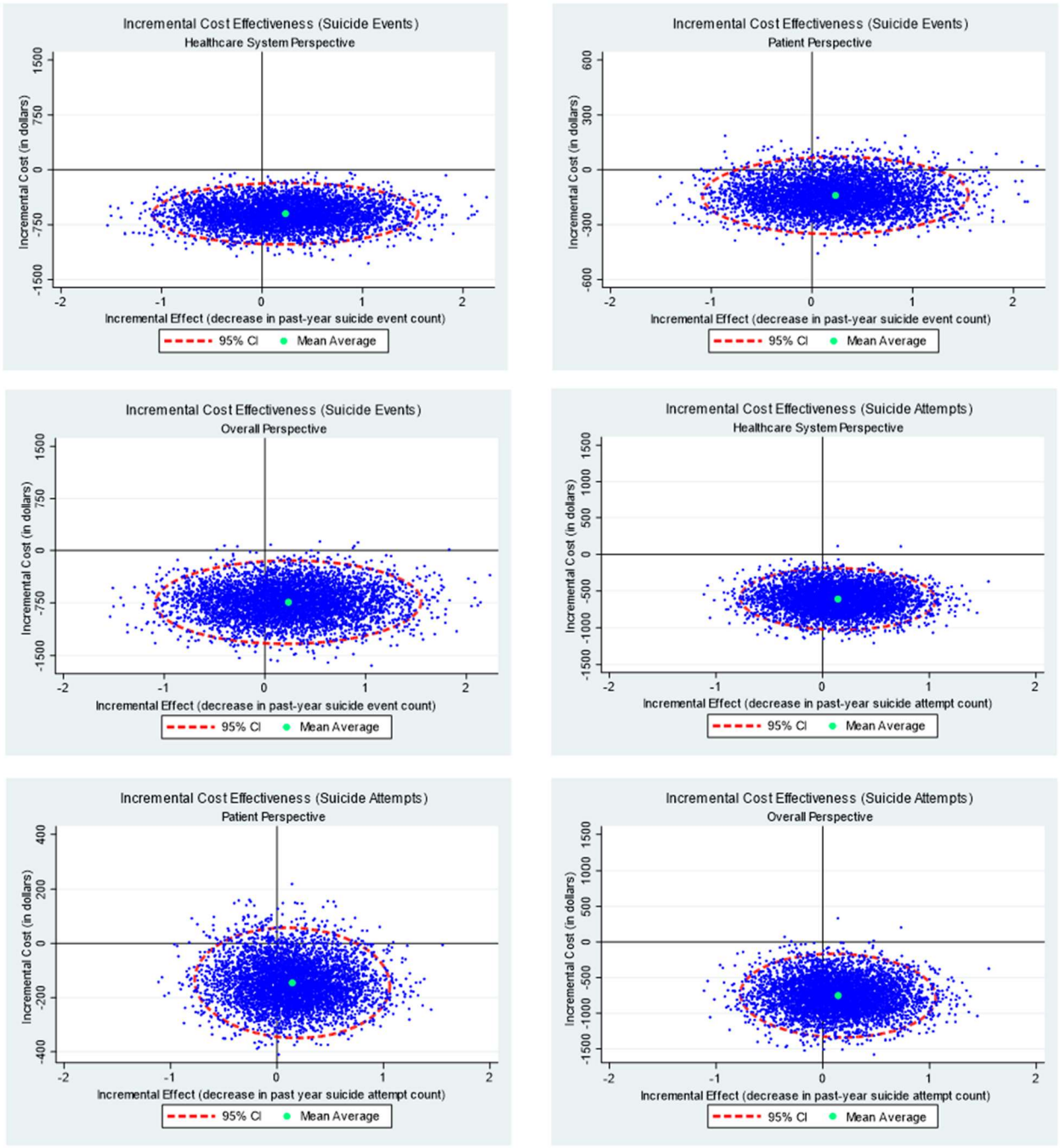
Incremental Cost Effectiveness Scatter Plots with 95% Confidence Intervals for Suicidal Ideation at 12-month Follow-up



Note. The origin of the cost-effectiveness plane represents the cost and effectiveness of Standard Care

Figure 6

Incremental Cost Effectiveness Scatter Plots with 95% Confidence Intervals for Suicidal Behavior (Suicide Events and Suicide Attempts) at 12-month Follow-up



Note. The origin of the cost-effectiveness plane represents the cost and effectiveness of Standard Care

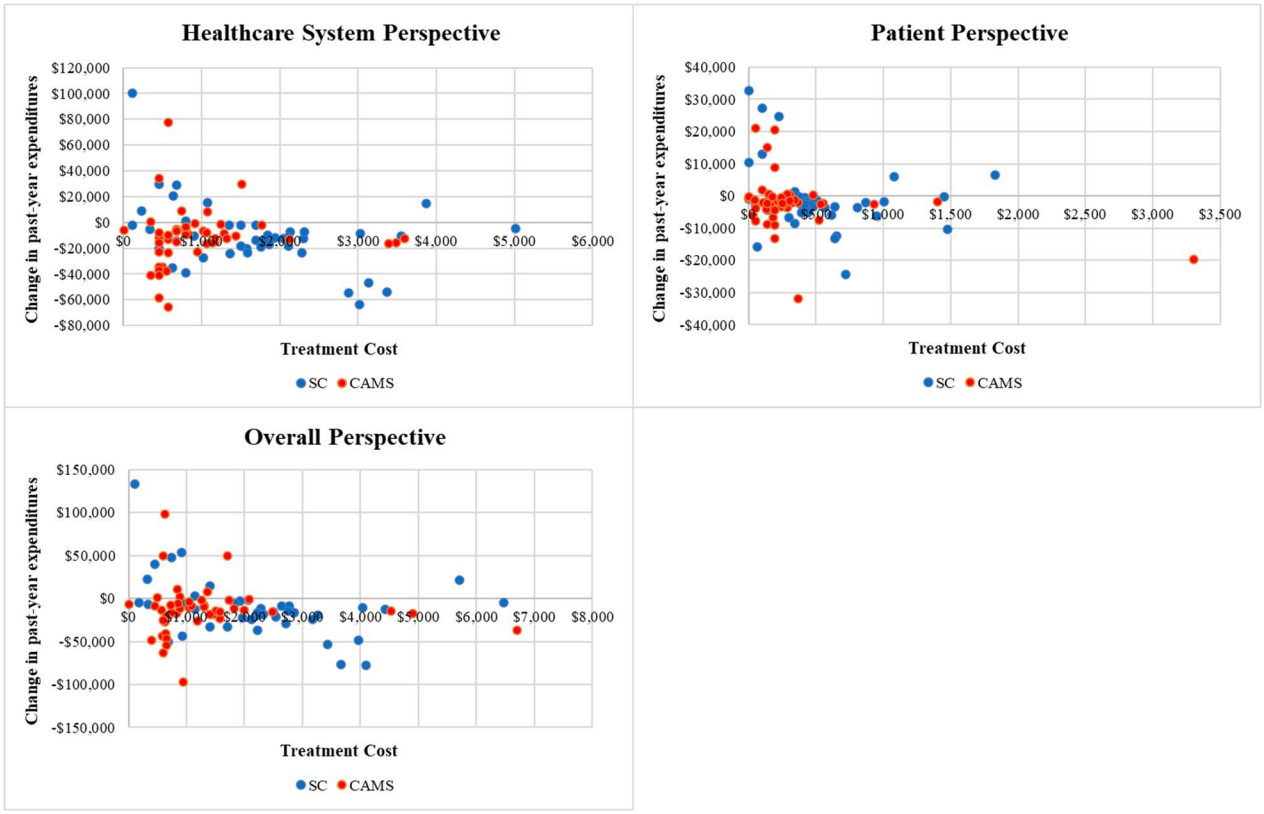
Cost-Benefit

Cost-Benefit Ratios

Cost-benefit ratios (CBRs) were calculated at the individual level to examine benefit (i.e., change in past-year healthcare expenditures at 12 months versus baseline; negative change represents cost savings) per dollar spent on treatment. CBR analyses were restricted to participants who had both baseline and 12-month follow-up cumulative benefits data (n = 91). Of note, five participants did not incur any treatment costs from the patient perspective thus resulting in undefined CBRs and were excluded from CBR analysis from that perspective. Figure 7 displays a graphical representation of individual-level treatment costs relative to change in past-year total healthcare expenditures at 12-month follow-up from each perspective. Mean CBRs from the healthcare system, patient, and overall perspectives, respectively, were -45.73 (*SD* = 177.52), -5.76 (*SD* = 81.77), and -43.42 (*SD* = 181.85) for CAMS and 13.24 (*SD* = 134.85), -3.21 (*SD* = 65.87) and 21.62 (*SD* = 178.19) for SC. Consistently lower CBRs in the CAMS condition suggest greater cost savings in past-year healthcare expenditures per dollar spent on treatment compared to SC. GLMs revealed these group differences to be significant from the healthcare system (β = -18.51, *SE* = 8.34, p = 0.026) and overall perspectives (β = -17.77, *SE* = 9.00, p = 0.048) but not the patient perspective (p = .70) after controlling for age and lifetime suicide attempt count. Residual errors of the linear models were kurtotic and skewed, potentially a reflection of outliers remaining after Winsorization (n = 11 to 13 remaining observations per perspective that were greater than 1.5 interquartile ranges above the upper quartile or below the lower quartile). Nonparametric quantile regression models were subsequently conducted to examine group differences in median CBRs and evidenced no significant group differences in cost-benefit from any perspective (ps = .28 - .87).

Figure 7

Change in Past-Year Cumulative Total Healthcare Expenditures by Intervention Costs at 12-month Follow-up



Note. Negative values for change in past-year expenditures represent cost savings

Net Benefit

Within-subject net benefit was calculated as the post-intervention change in past-year total healthcare expenditures after accounting for the cost of the treatment intervention. Mean net benefit at 12-months from the healthcare system, patient, and overall perspectives, respectively, was -$10,958.38 (*SD* = 22,67.37), -$1,787.18 (*SD* = 8,076.97), and -$12,745.55 (*SD* = 29,818.17) for CAMS and -$8,743.74 (*SD* = 25,436.44), -$543.12 (*SD* = 9,928.77), and -$9,286.86 (*SD* = 33,902.09) for SC, indicating that both treatments resulted in cost savings after factoring in treatment cost. Linear modeling revealed no significant group differences in net

benefit after controlling for age and lifetime suicide attempt count from any perspective (*p*s = .91 - .96). Nonparametric median regression results were consistent with these findings (*p*s = .43 - .88).

Secondary Cost Analyses: Clinic Costs

The cost of establishing and maintaining clinical space for the delivery of suicide-focused treatment services in the study were estimated under two scenarios. The first scenario reflected the actual study conditions, in which treatment was partially embedded within an existing healthcare system and thus was able to avoid certain costs through shared resources. The second scenario represents the estimated costs of establishing a new, separate clinical facility to provide such treatment services. The clinic costs described in this section were estimated separately from treatment intervention costs because (a) all study participants (SC and CAMS, $N = 150$) received treatment in the same clinic and (b) these clinic cost estimates are intended to inform broader establishment of suicide-focused treatment centers. A detailed description of clinic cost estimates under each scenario is displayed in Table 7. Costs were estimated for a two-and-a-half-year period (i.e., 30 months), consistent with the duration of treatment services provided in the study. Anticipating costs over a longer horizon will require taking into account additional factors. Between 2012 and 2022, the average Consumer Price Index 12-month percent change (i.e., the increase in cost of consumer goods and services) was 2.51% (U.S. Bureau of Labor Statistics, 2023). Additionally, some durable goods required for clinic operations will exceed their expected lifetime over time and would need to be replaced; for example, the estimated useful life of a computer is approximately five years (U.S. Internal Revenue Service, 2023).

Scenario 1: Actual Study Conditions

In this first scenario, resources such as office space, utilities, and some furnishings were

available at no additional cost to the clinical team as they were already paid for by the HMHAS system or the University of Washington Department of Psychiatry. Due to study funding constraints, some other materials (e.g., some furniture items and printer/scanner) were either purchased used or donated by study personnel. The total estimated clinic cost based on actual study conditions is $738,300.53, equaling $6,152.50 per month per therapist or $4,922.00 per individual treated ($N = 150$) during the two-and-a-half-year study treatment period. Of course, study conditions likely underestimate the potential number of individuals that can be treated in a real-world clinic, in part due to restrictions on participant eligibility and recruitment approaches inherent in clinical trials that are notably more challenging in studies targeting suicidal individuals (Jerant et al., 2022; Nugent et al., 2019). Under more real-world assumptions, it is likely that the clinic could serve far more individuals, resulting in lower clinic costs per individual treated. For example, conservatively assuming that each therapist carries a caseload of ten individuals for an average of 15 weeks per course of therapy (see Treatment Characteristics section), a clinic with four full-time therapists could treat approximately 300 individuals over a two-and-a-half-year period, at a clinic cost of $2,461.00 per individual treated.

Scenario 2: Establishing New Clinic

This second scenario assumes no existing resources can be leveraged to offset the costs of establishing and operating the treatment clinic. In addition to greater up-front facilities and equipment costs, this scenario assumes the continuing requirement of a case manager on staff, in that therapists are not as familiar with or well-connected to the broader healthcare system and thus cannot so easily absorb case management services as occurred in the study. The total estimated cost to establish and operate a new suicide-focused clinic is $1,229,197.12, equaling $10,243.31 per month per therapist or $8,194.65 per individual treated ($N = 150$) during the two-

and-a-half-year study treatment period. Under the more real-world assumptions described in the first scenario ($N = 300$ individuals treated over this same period), the clinic cost would be $4,097.32 per individual treated.

Table 7

Description of Suicide-Focused Treatment Clinic Cost Estimates Under Different Scenarios

SCENARIO 1: COSTS UNDER STUDY CONDITIONS		
Resource	**Cost**	**Cost Assumptions and Calculation**
Facilities		
Furniture	$51.00 (one time)	1 desk ($1) + 1 filing cabinet ($10) + 2 chairs ($20) + 1 bookshelf ($10) + 1 end table ($10) = $51 total[a]; Purchased from University of Washington surplus property sale to supplement existing furniture
Equipment		
Electronic Health Record System		
Setup	$1,250.00 (one time)	$250/user × 5 users = $1,250.00[a]
Implementation	$420/month ($6,720.00 total for study duration)	$50/month/clinician user × 5 users + $10/month/office staff user × 1 user + $160/month/psychiatrist user = $420/month[a]; Purchased electronic health system was only used for 16 months of study period before being replaced by a free documentation system created by research personnel for practical reasons, $420/month × 16 months = $6,720 total
Monitor	$297.84 (one time)	Used to webcast consultation meetings in conference room[a]
Webcams	$327.39 (one time)	4 webcams (1/office × 4 offices) = $327.39[a]
Materials		
Office Supplies	$42.00/month	Includes consumable office supplies such as pens, paper, ink, tissues, hand sanitizer, etc[a]
Personnel		
Office Manager	$4,437.95/month	Equivalent of 1 full-time position (40 hours/week); $40,840 annual wage[b] + 30.4% fringe[c] = $53,255.36/year; $53,255.36 / 12 months = $4,437.95/month
Therapists	$14,215.78/month	Equivalent of 2 full-time positions (100% effort, 40 hours/week), no cost for Standard Care therapists as they were compensated as HMHAS employees. $65,410 annual wage[b] + 30.4% fringe[c] = $85,294.64 /year; $85,294.64 / 12 months = $7,107.89/month per therapist; $7,107.89/month × 2 therapists = $14,215.78/month total
Case Manager	$1,070.80/month ($9,637.20 total for study duration)	Part-time position (20% effort, 8 hours/week); $49,270 annual wage[b] + 30.4% fringe[c] = $64,248.08/year; $64,248.08 × 20% effort = $12,849.62/year; $12,849.62 / 12 months = $1,070.80/month; Case manager only provided services for 9 months before clinical

		responsibilities were absorbed by therapists for practical reasons, $1,070.80/month × 9 months = $9,637.20
Psychiatrist	$5,304.84/month	Part-time position (15% effort, 6 hours/week); $325,450 annual wage[b] + 30.4% fringe[c] = $424,386.80/year; $64,248.08 × 15% effort = $63,658.02/year; $63,658.02 / 12 months = $5,304.84/month
Total Initial Costs	**$1,926.23**	
Total Monthly Operating Costs	**$24,000.57 – $25,491.37**	
TOTAL COSTS OVER 2 ½ YEARS[d]	**$738,300.53**	

SCENARIO 2: COSTS TO ESTABLISH NEW CLINIC		
Resource	**Cost**	**Cost Assumptions and Calculation**
Facilities		
Rent	$4,781.25/month	1500ft^2 × $38.25/year[e] = $57,375; $57,375/year / 12 months = $4,781.25
Electricity	$219.96/month	1500ft^2 × 18.7kW[f] = 28,050kW/year; 28,050kW/year × $0.0941[g] = $2,639.51/year; $2,639.51/year / 12 months = $219.96/month
Network		
Installation	$99.00 (one time)[g]	
Service	$240.00/month	Assumed $65/month for internet service + ($25/month/user × 7 users) for phone service = $240.00/month[h]
Furniture	$4,250 (one time)	8 armchairs (2/office × 4 offices) =$2,400; 4 desks (1/office × 4 offices) = $800; 4 desk chairs (1/office × 4 offices) = $300; 4 lamps (1/office × 4 offices) = $300; 4 waiting room chairs = $300; 1 filing cabinet = $150[h]
Equipment		
Electronic Health Record System		
Setup	$1,250.00 (one time)	$250/user × 5 users = $1,250.00
Implementation	$420/month	$50/month/clinician user × 5 users + $10/month/office staff user × 1 user + $160/month/psychiatrist user = $420/month[a]
Computers	$8,750 (one time)	5 computers (1/office × 4 offices + 1/waiting room)[h]
Monitor	$297.84 (one time)	Used to webcast consultation meetings in conference room[a]
Printer/scanner/copier	$300.00 (one time)[e]	
Clocks	$60.00 (one time)	4 clocks (1/office × 4 offices) = $60[h]

White noise machines	$220.00 (one time)	4 machines (1/office × 4 offices) = $220[h]
Webcams	$327.39 (one time)	4 webcams (1/office × 4 offices) = $327.39[h]
Materials		
Office Supplies	$200.00 (initial) + $50.00/month	Includes consumable office supplies such as pens, paper, ink, tissues, hand sanitizer, etc[h]
Personnel		
Office Manager	$4,437.95/month	Full-time position (40 hours/week); $40,840 annual wage[b] + 30.4% fringe[c] = $53,255.36/year; $53,255.36 / 12 months = $4,437.95/month
Therapists	$28,431.56/month	Equivalent of 2 full-time positions (100% effort, 40 hours/week); $65,410 annual wage[b] + 30.4% fringe[c] = $85,294.64 /year; $85,294.64 / 12 months = $7,107.89/month per therapist; $7,107.89/month × 4 therapists = $28,431.56/month total
Case Manager	$1,070.80/month	Part-time position (20% effort, 8 hours/week); $49,270 annual wage[b] + 30.4% fringe[c] = $64,248.08/year; $64,248.08 × 20% effort = $12,849.62/year; $12,849.62 / 12 months = $1,070.80/month
Psychiatrist	$5,304.84/month	Part-time position (15% effort, 6 hours/week); $325,450 annual wage[b] + 30.4% fringe[c] = $424,386.80/year; $64,248.08 × 15% effort = $63,658.02/year; $63,658.02 / 12 months = $5,304.84/month
Total Initial Costs	**$15,754.23**	
Total Monthly Operating Costs	**$39,651.52**	
TOTAL COSTS OVER 2 ½ YEARS[d]	**$1,229,197.12**	

Note. kW = kilowatt hours; all cost estimates in 2022 dollars. [a]Based on study records and/or key informant interviews with study personnel; [b]Annual mean wage based on occupational title in the Seattle-Tacoma-Bellevue, WA area per (BLS Occupational Employment Statistics Query System, 2022); [c]Employer Costs for Employee Compensation for private industry workers by Seattle-Tacoma, WA metropolitan area (BLS, 2022); [d] Time period reflects duration of active study treatment delivery for N = 150 study participants; [e]Average annual cost for office space for lease in Seattle per square foot (www.loopnet.com); [f]Average annual energy consumption for outpatient health care building (U.S. Energy Information Administration, 2012); [g]Average annual energy cost per kilowatt hour for commercial buildings in Washington State (U.S. Energy Information Administration, 2022); [h]Estimated based on market review

CHAPTER 4

DISCUSSION

The current study used data from an RCT to examine the cost, effectiveness, benefit, cost-effectiveness, and cost-benefit of CAMS versus SC for the treatment of individuals who were suicidal and recently discharged from hospitalization in an NDA setting. A combination of micro-costing and gross-costing methods were used to evaluate cost-related outcomes from the healthcare system, patient, and overall perspectives. We hypothesized that CAMS would be no more costly, more effective, and have greater benefits, cost-effectiveness, and cost-benefit compared to SC. Additionally, the current study sought to descriptively characterize the costs of establishing and operating a clinic dedicated solely to the provision of suicide-focused services.

Treatment Costs

We anticipated that the costs of the treatment interventions would be comparable; however, results suggested CAMS had significantly lower cumulative treatment costs than SC from all perspectives at 3-, 6-, and 12-month follow-ups. The lower cost of CAMS appears to be driven by participants attending significantly fewer study therapy sessions in addition to having significantly fewer visit no-shows during their course of treatment. Of note, the reduced study treatment service utilization in the CAMS condition does not reflect greater dropout rates; in fact, a higher proportion of CAMS participants completed treatment to SC (54.7% versus 42.7%, respectively), although this difference was not significant. Further, participants in the CAMS and SC conditions had comparable treatment satisfaction ratings (Comtois et al., 2023). It is possible that discrepancies in average number of therapy sessions reflect CAMS' suicide-focused approach, which may lead to faster resolution of suicidality compared to alternative interventions that may focus on broader treatment targets. Another plausible explanation might be that the use

of the structured SSF form and criteria for resolution of suicidal crisis in the CAMS intervention bolsters clinicians' confidence in treatment completion compared to SC, in which crisis resolution was determined by more subjective clinician judgement. This would be consistent with extant literature suggesting that brief training in an empirically-based suicide assessment and treatment approach is associated with increased clinician confidence and modified clinical practices in working with suicidal patients (LoParo et al., 2019; Oordt et al., 2009). Finally, the lower observed cost of the CAMS intervention despite added training and consultation activities over and above that of SC suggests that the costs of these activities were relatively minimal when spread across the entire clinical population that might benefit from them.

Effectiveness

Participants in both conditions generally improved clinically over the course of the study and the treatment interventions demonstrated comparable effectiveness with regard to suicidal ideation and behavior. However, CAMS participants evidenced significantly lower suicidal ideation severity at 12-month follow-up than SC participants. These findings are consistent with a previous study in a similar population reporting more robust effects at the most distal assessment time point for CAMS and may suggest greater treatment durability (Comtois et al., 2011; Jobes et al., 2016). Of note, the primary manuscript of the current study also reported significantly greater reduction in suicidal ideation severity in the SC condition at 3-month follow-up (Comtois et al., 2023). The discrepancies between these findings and the current secondary analyses are likely the result of differing statistical approaches, as the primary study manuscript used longitudinal mixed effects models to analyze suicidal ideation variables whereas the current analyses examined each time point separately. Overall, the results of this secondary effectiveness analysis are somewhat consistent with the broader evidence base of CAMS'

effectiveness. With regard to suicidal ideation, there appears to be substantial empirical support for more robust treatment effects of CAMS compared to treatment alternatives than observed in the current study (Swift et al., 2021). As suggested by Comtois et al. (2023), this may be due to characteristics of the current study population, which reported high levels of impairment beyond suicide risk related to substance use, medical illness, lack of housing, and insufficient funds for basic needs. Data from previous RCTs have suggested that CAMS might be less effective in treating patients with such comorbidities (Huh et al., 2018; Pistorello et al., 2021; Ryberg et al., 2019). Additionally, procedures related to the enrollment of study treatment clinicians appears to have resulted in clinicians in both conditions having more dedicated time to see participants than might otherwise occur in a more naturalistic context, which may have further diluted differences in treatment effects. With regard to suicidal behavior outcomes, our findings of CAMS' equivalence in treatment effect compared to treatment alternatives is consistent with the larger evidence base. Still, it should be noted that CAMS is effective in reducing suicide crisis events and attempts (Swift et al., 2021).

Benefit

We anticipated that CAMS participants would have lower cumulative healthcare expenditures as a result of treatment, thus generating benefit in the form of cost savings from the healthcare and overall perspectives and increased productivity (i.e., reduced wage loss) from the patient perspective. Findings from the current study indicated that while CAMS was associated with lower average total healthcare and productivity expenditures from each perspective at 12-month follow-up, group differences were not significant. These results are not entirely consistent with a previous economic evaluation in which CAMS demonstrated significantly greater cost savings benefit at 6-month follow-up (McCutchan et al., 2022). The benefit in this previous

evaluation corresponded to the assessment time point after a window of greater treatment effectiveness. In the current study, group differences in treatment effectiveness did not emerge until 12-month follow-up, thus it is possible that greater corresponding benefit may have been observed if assessed at a later time point. Despite a lack of significant treatment effect on healthcare expenditure benefit, it is worth noting that CAMS's comparable spending on non-study-treatment healthcare services suggests that the shorter course of treatment (in terms of average number of therapy sessions) described in the treatment cost section was adequate and did not result in greater uptake of services following study treatment completion compared to SC participants who attended a greater number of therapy sessions on average.

When examining within-participant benefit in the form of cost savings in past-year healthcare expenditures at 12-months compared to baseline, both treatment conditions evidenced reductions in total past-year spending from each perspective. These post-treatment decreases in healthcare spending appear to be above and beyond that of the index crisis event, as 42% of participants required additional emergency department or inpatient psychiatric visits during the follow-up year. No significant group differences were observed from any perspective, although CAMS participants consistently evidenced greater cost savings on average.

Cost-Effectiveness

Cost-effectiveness was examined by calculating effectiveness-cost ratios (ECRs) for clinical effects of interest. ECRs for suicidal ideation, which represented the improvement (in points) in BSS total score compared to baseline per hundred dollars spent on treatment, were significantly higher in the CAMS condition at 6-month follow-up from the patient perspective and at 12-month follow-up from all three perspectives. These findings suggest CAMS is associated with greater effect on suicidal ideation relative to the cost of treatment, which is

unsurprising given its significantly lower average total treatment cost and significantly greater reduction in suicidal ideation severity at 12-month follow-up. The added significant group difference at 6-months from the patient perspective may be due to the fact that treatment costs from this perspective did not include no-showed visits, as participants did not incur costs as a result of these occurrences. Reducing this source of variability in the treatment cost may have increased the likelihood of finding group differences in ECR analyses from the patient perspective. Still, these findings should be interpreted with some caution as nonparametric analyses did not evidence any significant group differences at the median ECR at any time point or from any perspective; thus, the most 'typical' ECR is likely comparable between treatment groups. ECRs for suicidal behavior represented the improvement in past-year suicidal behavior (specifically, reduction in suicide events) at 12-month follow-up compared to baseline per hundred dollars spent on treatment. Although average ECRs were higher in the CAMS condition across all perspectives, no significant group differences were found. These results may reflect equivalent treatment effectiveness with respect to suicidal behavior. Treatment effects on mean ECRs may also be obscured by substantial skew in the CER distributions, particularly for CAMS participants. Indeed, non-parametric analyses of ECRs for suicidal behavior indicated that CAMS was associated with a significantly higher conditional median across all perspectives.

Given that the SC condition represented a current standard practice, incremental cost-effectiveness ratios (ICERs) were used to examine the additional cost per additional unit of effect that might be gained by choosing to implement CAMS as a treatment alternative (Yates, 2023). ICERs for suicidal ideation varied between CAMS costing $194.43 to $1,001.71 *less* than SC per additional one-point reduction in BSS total score from the patient and overall perspectives, respectively. ICERs for suicidal behavior varied between CAMS costing $600.04 to $3,166.45

less than SC per to produce an additional decrease of one past-year suicide event at 12-month follow-up from the patient and overall perspectives, respectively. These ICERs suggest that offering CAMS would actually cost less per clinical gain achieved than SC in this setting across all perspectives, although the uncertainty observed around ICER point estimates should be also considered.

At the treatment condition-level, cost per resolved case, cost per past-year suicide event prevented, and cost per past-year suicide attempt prevented were all consistently lower in the CAMS condition from each perspective. Across these clinical outcomes, CAMS costs were 22% to 46% lower than SC costs. Although these cost differences are based on aggregated data and thus were not statistically analyzed, they provide valuable practical information for decision-makers regarding cost per clinical effects which can be extrapolated to understand potential impact to their particular setting. Taken together, these results offer support for the cost-effectiveness of CAMS in line with the broader evidence base (Swift et al., 2021).

Cost-Benefit

Cost-benefit was examined by calculating cost-benefit ratios (CBRs) representing change in past-year healthcare expenditures at 12 months versus baseline per dollar spent on treatment. On average, CAMS participants reduced their past-year total healthcare expenditures across all perspectives, whereas SC participants actually increased spending by $13.24 and $21.62 for each dollar spent on treatment from the healthcare system and overall perspectives, respectfully. CBRs in the CAMS condition were lower across all perspectives, suggesting greater cost savings in past-year healthcare expenditures per dollar spent on treatment compared to SC. However, these group differences were only statistically significant from the healthcare system and overall perspectives. Findings from subsequent non-parametric analyses were not consistent, evidencing

no significant group differences in conditional median CBRs from any perspective. With respect to net benefit, both treatments produced benefit (i.e., cost savings) after factoring in the cost of treatment. Average net benefit was consistently greater in the CAMS condition across all perspectives; however, no significant group differences were evidenced in either parametric or non-parametric regression analyses.

Limitations and Future Directions

The current study is a secondary analysis of RCT data. Although trial-based economic evaluations certainly have some advantages, high internal validity and patient-level cost and outcome data among them, there are also problems with this approach that were relevant to the current study. The current study suffered from a high degree of missing data due to participant dropout. Despite efforts to mitigate this issue through an intent-to-treat approach and use of generalized linear mixed models, it is still possible that participants lost to follow-up differed systematically from completers, thus leading to biased or misleading results (Faria et al., 2014). Future analyses might consider the use of multiple implementation techniques to replace missing values, although there is empirical evidence to suggest that mixed-model analysis does not necessarily require multiple imputation for the analysis of longitudinal data (Twisk et al., 2013). Additionally, the study was limited to 12 months of follow-up data collection, precluding observation of more long-term participant outcomes. This may be particularly problematic in the current study as group differences in treatment effectiveness did not emerge until the 12-month follow-up assessment. Future studies would benefit from including model-based economic evaluation techniques for longer-term extrapolation of cost-effectiveness and cost-benefit (Petrou & Gray, 2011). Another disadvantage associated with our trial-based evaluation is generalizability. Our cost estimation, particularly under a micro-costing approach, was specific to

the infrastructure, workflow, and capacity of the particular healthcare setting in which the study was conducted and thus may differ from other settings. Further, resource use was likely impacted by the nature of treatment being delivered within a research study (Drummond, 2015). As described by Comtois et al. (2023), study therapists were allotted more dedicated time to see participants than might occur under standard clinical practice, which resulted in participants receiving more care. Such artifacts of research procedures may ultimately impact treatment costs and effect sizes, rendering them less externally valid in real-world settings. Further examination of CAMS in NDA settings using more pragmatic trial designs would bolster confidence in the generalizability of the current findings. Finally, despite a robust randomization procedure, treatment conditions in the current study differed significantly with regard to participants' lifetime history of suicide attempts at baseline. Although our analyses aimed to minimize potential confounding by controlling for this variable in all models, it is still possible that other related, unobserved characteristics about these individuals had an influence of treatment effect. Still, it should be noted that testing for baseline differences in randomized controlled trials can be misleading and thus has become increasingly discouraged (de Boer et al., 2015); thus, the true impact of the imbalance is questionable.

The nature of healthcare cost and expenditure data, which is typically characterized by marked positive skewness and a substantial proportion of zero observations, posed a challenge for statistical analyses. All linear regression models related to economic outcomes in the current study exhibited non-normal distributions, thus suggesting that typical ordinary least squares regression may result in biased estimation. Although we implemented more sophisticated regression methods of GLMMs with a gamma family function and two-part hurdle models in line with current empirically-based recommendations (Deb & Norton, 2018; Malehi et al., 2015),

some continuous outcomes contained non-positive values and thus such models could not be used; instead, they were replaced by GLMMs with a Gaussian family function as a parametric approach supplemented by quantile regression as a nonparametric approach. Difficulty arose when the results from these two approaches were inconsistent, leading to interpretative uncertainty around true effect versus estimation bias.

The current study extended previous economic evaluations of CAMS by adopting multiple perspectives. Although our approach did represent the costs and outcomes pertinent to a broader range of stakeholders, it did not adequately capture a societal perspective that aims to provide a complete description of costs and outcomes, both health-related and non-health-related, regardless of whom experiences them directly (Garrison et al., 2018). It is widely recommended that the societal perspective be included in economic evaluations of health interventions in order better approximate the intervention's impact on the broader welfare of society, which may impact its overall value (Garrison et al., 2018; Neumann et al., 2016; Sanders et al., 2016). Indeed, one systematic review reported that adding societal costs to economic evaluations of interventions in depression actually changed cost-effectiveness results in 24% of the evaluations (Duevel et al., 2020). Incorporating a broader societal perspective into future cost analyses of CAMS, particularly in patient populations as medically complex and functionally impaired as the current study, will enhance our understanding of its true value across multiple sectors.

Finally, it is noteworthy that a large proportion of the current study population identified as lesbian, gay, bisexual, pansexual, transgender, and/or non-binary. This is consistent with extensive evidence that gender and sexual minorities are at heightened risk for suicidal thoughts and behaviors (Adams et al., 2017; Hottes et al., 2016; Lyons et al., 2019; Miranda-Mendizábal

et al., 2017; Ream, 2019). There is research to suggest that sexual and gender minorities may experience poorer mental health treatment outcomes compared to heterosexual and cisgendered individuals due to a variety of personal, interpersonal, and structural factors (Beard et al., 2017; Crawford et al., 2016; Pachankis, 2018; Rimes et al., 2019). Consequently, future analyses of CAMS, and indeed any suicide prevention intervention, should consider special examination of this subset of the population to explore potential mediators and moderators of treatment costs and outcomes. These findings may facilitate adaptations to ensure culturally appropriate treatment and inform implementation strategies that promote accessibility, quality, and efficiency in the services provided to sexual and gender minority individuals, all of which may have profound economic implications.

Conclusion

Suicide continues to be a serious public health challenge despite national and international prioritization as a key health target (Office of the Surgeon General & National Action Alliance for Suicide Prevention, 2021; World Health Organization, 2013). High suicide rates among individuals recently discharged from psychiatric hospitalization, in particular, have persisted for several decades (Chung et al., 2017), signaling the need for improved suicide prevention practices in this high-risk population. Results from the current study suggest that the CAMS intervention delivered within an NDA setting is associated with clinical improvements in post-discharge attempters; further, CAMS treatment may be less expensive and more cost-effective and cost-beneficial compared to treatment as usual in this population. These findings shed light on the potential value of CAMS relative to treatment alternatives and offer useful information to researchers, clinicians, and healthcare and policy decision-makers seeking to maximize resource allocation in resource-constrained environments.

APPENDIX A

Table A1

Descriptive Statistics for Total Cumulative Treatment Cost (in Hours of Person-Time) by Condition and Time

	Healthcare System				**Patient**		**Overall**	
	Therapist		Psychiatrist					
Time	**SC** *M(SD)*	**CAMS** *M(SD)*	**SC** *M(SD)*	**CAMS** *M(SD)*	**SC** *M(SD)*	**CAMS** *M(SD)*	**SC** *M(SD)*	**CAMS** *M(SD)*
1 month	4.07 (1.50)	4.03 (1.48)	0.47 (0.56)	0.30 (0.51)	3.25 (1.81)	3.18 (2.01)	4.54 (1.69)	4.33 (1.73)
3 months	8.25 (3.89)	6.28 (3.72)	0.68 (0.86)	0.50 (0.82)	6.50 (4.65)	5.03 (4.22)	8.94 (4.34)	6.78 (4.27)
6 months	9.95 (5.94)	6.83 (5.07)	0.73 (0.96)	0.53 (0.93)	7.73 (6.38)	5.42 (5.35)	10.68 (6.42)	7.36 (5.70)
12 months	10.35 (7.00)	6.84 (5.09)	0.73 (0.96)	0.53 (0.93)	8.01 (7.20)	5.43 (5.38)	11.08 (7.48)	7.37 (5.72)

Note. Therapist costs include case management services. Costs from the healthcare system and overall perspectives include attended visits as well as visit no-shows to reflect opportunity costs.

APPENDIX B

Table B1

Descriptive Statistics for Cumulative Study Treatment Costs by Category, Group, and Time from the Healthcare System Perspective

Time	SC				CAMS			
	Training/ Consultation	**Therapist Visits *M*(*SD*)**	**Psychiatrist Visits *M*(*SD*)**	**No-Shows *M*(*SD*)**	**Training/ Consultation**	**Therapist Visits *M*(*SD*)**	**Psychiatrist Visits *M*(*SD*)**	**No-Shows *M*(*SD*)**
1 month	$0	$354.16 ($198.20)	$82.75 ($109.85)	$161.35 ($212.21)	$5.21	$333.54 ($196.90)	$52.78 ($95.29)	$134.32 ($167.13)
3 months	$0	$736.89 ($530.19)	$114.27 ($157.36)	$308.75 ($322.87)	$0	$527.22 ($424.63)	$83.91 ($141.76)	$205.33 ($234.90
6 months	$0	$737.43 ($530.52)	$119.18 ($165.37)	$377.31 ($387.30)	$0	$527.42 ($424.76)	$87.59 (156.53)	$228.91 ($283.15)
12 months	$0	$925.27 ($846.18)	$119.18 ($165.37)	$391.40 ($409.00)	$0	$569.47 ($542.16)	$88.82 ($162.55)	$230.41 ($288.28)

Note. Training and consultation costs reflect a one-time, fixed, per-individual cost; case management services are included as part of therapist visits

APPENDIX C

Table C1

Final Estimation of Fixed Effects in Treatment Cost Models by Perspective

	Healthcare System			Patient			Overall		
	β	*SE*	*p*	β	*SE*	*p*	β	*SE*	*p*
Intercept	6.37	0.56	<0.001	4.54	0.19	<0.001	6.58	0.06	<0.001
Time									
3 months	0.54	0.05	<0.001	0.45	0.05	<0.001	0.53	0.05	<0.001
6 months	0.67	0.07	<0.001	0.55	0.07	<0.001	0.65	0.07	<0.001
12 months	0.67	0.07	<0.001	0.55	0.07	<0.001	0.65	0.07	<0.001
Condition	-0.18	0.08	0.03	-0.12	0.27	0.66	-0.17	0.09	0.06
Time x Condition									
3 months	-0.23	0.07	<0.001	-0.18	0.07	0.007	-0.23	0.07	<0.001
6 months	-0.32	0.08	<0.001	-0.26	0.08	0.002	-0.31	0.08	<0.001
12 months	-0.32	0.08	<0.001	-0.26	0.08	0.002	-0.31	0.08	<0.001
Lifetime Suicide Attempt Count	0.001	<0.001	<0.001	0.001	0.004	0.49	0.00	0.00	0.006

Note. $N = 560$ observations, $n = 4$ observations per participant; fixed effects used robust standard errors; coefficients represent the effect of each variable on the log of total cumulative treatment costs.

APPENDIX D

Table D1

Negative Binomial Hurdle Model Results Examining the Effect of Treatment Condition on Total BSS Score at each Time

		Logistic Portion				**Negative Binomial Portion**			
	N	β	*SE*	95% CI	*p*	β	*SE*	95% CI	*p*
Time									
1 month	113	-0.14	0.44	-1.01 - 0.73	0.76	0.11	0.15	-0.19 - 0.41	0.48
3 months	105	-0.40	0.43	-1.24 - 0.45	0.36	-0.01	0.18	-0.36 - 0.34	0.96
6 months	100	0.41	0.43	-0.44 - 1.26	0.35	-0.02	.21	-0.43 - 0.38	0.91
12 months	108	-0.01	0.41	-0.81 - 0.78	0.97	-0.57	0.23	-1.03 - -0.11	0.02

Note. All models controlled for presence of any suicidal ideation at baseline and specified robust standard errors.

APPENDIX E

Table E1

Fixed Effects Results of Total Benefits Models

Variable	β	*SE*	95% CI	*p*
Healthcare Perspective				
Intercept	3.59	0.47	2.67 – 4.52	0.00
Condition	0.34	0.34	-0.33 – 1.02	0.31
Time				
3 months	1.07	0.11	0.85 – 1.30	0.00
6 months	2.01	0.17	1.67– 2.34	0.00
12 months	2.73	0.19	2.35 – 3.11	0.00
Condition x Time				
CAMS x 3 months	0.06	0.19	-0.30 – 0.42	0.75
CAMS x 6 months	-0.17	0.25	-0.66 – 0.32	0.51
CAMS x 12 months	-0.32	0.28	-0.86 – 0.22	0.24
Baseline Past-Year Expenditures	0.00	0.00	0.00 – 0.00	0.00
Lifetime Suicide Attempt Count	0.00	0.98	-0.01 – 0.01	0.98
Age	0.04	0.47	0.02 – 0.06	0.00
Patient Perspective				
Intercept	2.61	0.42	1.78 – 3.43	0.00
Condition	0.46	0.32	-0.16 – 1.09	0.15
Time				
3 months	1.01	0.12	0.78 – 1.25	0.00
6 months	1.90	0.16	1.59 – 2.21	0.00
12 months	2.67	0.19	2.31 – 3.04	0.00
Condition x Time				
CAMS x 3 months	0.04	0.18	-0.31 – 0.39	0.81
CAMS x 6 months	-0.10	0.23	-0.55 – 0.35	0.67
CAMS x 12 months	-0.32	0.26	-0.83 – 0.18	0.21
Baseline Past-Year Expenditures	0.00	0.00	0.00 – 0.00	0.00
Lifetime Suicide Attempt Count	0.00	0.00	-0.004 – 0.01	0.71
Age	0.03	0.01	0.01 – 0.05	0.00
Overall Perspective				
Intercept	3.84	0.45	2.95 – 4.73	0.00
Condition	0.37	0.34	-0.30 – 1.04	0.28
Time				
3 months	1.07	0.12	0.84 – 1.29	0.00
6 months	2.00	0.17	1.67 – 2.34	0.00
12 months	2.76	0.20	2.38 – 3.14	0.00
Condition x Time				

Variable	β	*SE*	95% CI	*p*
CAMS x 3 months	0.05	0.18	-0.31 – 0.41	0.80
CAMS x 6 months	-0.17	0.25	-0.66 – 0.32	0.49
CAMS x 12 months	-0.35	0.28	-0.89 – 0.19	0.20
Baseline Past-Year Expenditures	0.00	0.00	0.00 – 0.00	0.00
Lifetime Suicide Attempt Count	0.00	0.00	-0.005 – 0.01	0.78
Age	0.30	0.01	0.02 – 0.05	0.00

APPENDIX F

Table F1

Results of Two-Part Regression Models Examining Cumulative Benefits by Category at 12-month Follow-up

		Logistic Portion				Gamma Portion			
	N	β	*SE*	95% CI	*p*	β	*SE*	95% CI	*p*
Healthcare Perspective									
Outpatient Behavioral Health	86	0.84	0.75	-0.63 – 2.30	0.27	0.36	0.25	-0.13 – 0.86	0.15
Medical Provider	95	0.28	0.83	-1.36 – 1.91	0.74	-0.15	0.29	-0.65 – 0.35	0.55
Crisis Services	102	0.48	0.46	-0.43 – 1.39	0.30	-0.14	0.33	-0.80 – 0.51	0.67
Medications	96	0.12	0.74	-1.33 – 1.58	0.87	-0.24	0.40	-1.03 – 0.55	0.55
Patient Perspective									
Outpatient Behavioral Health	86	0.56	0.78	-0.97 – 2.09	0.47	0.07	0.37	-0.66 – 0.81	0.85
Medical Provider	95	0.29	0.83	-1.33 – 1.91	0.72	-0.35	0.27	-0.88 – 0.17	0.19
Crisis Services	102	0.28	0.48	-0.67 – 1.23	0.57	-0.02	0.43	-0.85 – 0.82	0.97
Medications	96	-0.33	0.62	-1.55 – 0.89	0.60	-0.34	0.54	-1.38 – 0.69	0.52
Overall Perspective									
Outpatient Behavioral Health	86	0.58	0.78	-0.94 – 2.10	0.45	0.31	0.29	-0.25 – 0.87	0.28
Medical Provider	95	0.28	0.83	-1.35 – 1.91	0.74	-0.19	0.26	-0.70 – 0.32	0.47
Crisis Services	102	0.19	0.47	-0.72 – 1.11	0.68	-0.09	0.34	-0.76 – 0.57	0.78
Medications	96	-0.12	0.74	-1.33 – 1.58	0.87	-0.27	0.42	-1.09 – 0.54	0.51

Note. All models used robust standard errors and controlled for age, lifetime suicide attempt count, and baseline expenditures for each respective category, if data available.

APPENDIX G

Table G1

Fixed Effects Results of Cost-Effectiveness Ratios (Total BSS Score Improvement)

Variable	β	*SE*	95% CI	*p*
Healthcare Perspective				
Intercept	0.83	0.24	0.36 – 1.29	0.00
Condition	-0.03	0.94	-0.72 – 0.67	0.94
Time				
3 months	-0.30	0.28	-0.65 – 0.06	0.10
6 months	-0.39	0.21	-0.80 – 0.01	0.06
12 months	-0.38	0.20	-0.77 – 0.01	0.06
Condition x Time				
CAMS x 3 months	0.21	0.28	-0.33 – 0.76	0.45
CAMS x 6 months	0.46	0.28	-0.09 – 1.00	0.10
CAMS x 12 months	0.62	0.29	0.06 – 1.19	0.03
Lifetime Suicide Attempt Count	0.01	0.002	0.00 – 0.01	0.02
Patient Perspective				
Intercept	2.92	0.94	1.08 – 4.76	0.00
Condition	-0.12	1.30	-2.66 – 2.42	0.93
Time				
3 months	-1.01	0.70	-2.37 – 0.35	0.15
6 months	-1.51	0.74	-2.97 – 0.05	0.04
12 months	-0.88	0.74	-2.33 – 0.57	0.24
Condition x Time				
CAMS x 3 months	1.81	0.97	-0.10 – 3.72	0.06
CAMS x 6 months	2.90	1.14	0.68 – 5.13	0.01
CAMS x 12 months	3.58	1.13	1.11 – 6.04	0.01
Lifetime Suicide Attempt Count	0.002	0.01	-0.02 – 0.03	0.89
Overall Perspective				
Intercept	0.65	0.19	0.29 – 1.02	0.00
Condition	-0.04	0.27	-0.57 -0.49	0.87
Time				
3 months	-0.23	0.13	-0.49 – 0.32	0.09
6 months	-0.31	0.15	-0.59 – -0.02	0.04
12 months	-0.27	0.16	-0.57 – 0.04	0.09
Condition x Time				
CAMS x 3 months	0.20	0.20	-0.20 – 0.60	0.32
CAMS x 6 months	0.36	0.21	-0.05 – 0.77	0.08
CAMS x 12 months	0.48	0.23	0.04 – 0.92	0.03
Lifetime Suicide Attempt Count	0.003	0.002	-0.001 – 0.01	0.14

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