



1 Abstract

2 Rural youth suicide represents a major source of mental health inequity in the United States  
3 (US). School-based suicide prevention programs may provide an effective avenue to address this mental  
4 health crisis among rural youth. This study’s primary goal is to demonstrate the feasibility and  
5 acceptability of a novel implementation approach (utilizing teachers from a neighboring school) for  
6 delivering the Youth Aware of Mental Health (YAM) program, an evidence-based, universal youth suicide  
7 prevention curriculum, to high school students in rural Montana. We will recruit approximately 1300 9<sup>th</sup>  
8 grade student in four Montana schools. Using a non-inferiority design, we will randomize classrooms in  
9 each school to be instructed by a teacher from another school (YAM-TE; experimental) or a traditional  
10 external instructor (YAM-EXT; control). We will assess program fidelity of both YAM training and  
11 implementation via independent observer and instructor-reporter ratings. Youth will complete  
12 measures of acceptability at post-YAM and outcome measures at pre-YAM, post-YAM, and 12-month  
13 follow-up. Standard and mixed linear and logistic regression models will be used to test the main  
14 hypothesis that the YAM-TE does not differ from YAM-EXT regarding fidelity (teachers) and acceptability  
15 (teachers and youth). Exploratory analyses will test moderation of the intervention effect (e.g., sex,  
16 poverty) and the mediating effect of mental health literacy, belongingness, and perceived  
17 burdensomeness on the intervention effect. Results of this pilot study will inform the development of  
18 subsequent, fully powered noninferiority trials. Our long-term goal is to scale YAM-TE for  
19 implementation across rural US communities or, if culturally appropriate, more globally.

1 **1. INTRODUCTION**

2 **1.1. Suicide Prevalence and Risk among United States Rural Youth**

3 Youth suicide is a growing mental health problem and rural youth suicide represents a major  
4 source of mental health inequity in the United States (US). Suicide is second only to accidental deaths in  
5 causing fatality in US youth aged 12-18 years, and rates have increased nationwide over the past 20  
6 years [1-4]. Rural youth are especially at risk [5-7], with nearly twice the rates of suicides compared to  
7 their urban peers [8, 9]. For example, in Montana (MT), the suicide rate among 12- to 18-year-olds of  
8 17.9 per 100,000 well exceeds the national average 6.4/100,000 [1]. Suicide-related thoughts or  
9 behaviors also are more common in rural youth; for example, consistently, over the past decade (and as  
10 illustrated using the latest available data, YRBSS 2019 [10]), more MT youth than youth across the US  
11 reported that they had seriously considered suicide (23.4% vs. 18.8%,  $p < .001$ ), made a suicide plan  
12 (19.5% vs. 15.7%,  $p < .001$ ), or attempted suicide (10% vs. 8.9%, n.s.) in the past 12 months [11-13].  
13 Prevalence of these reports of suicide intent or attempts have increased both nationally and in MT over  
14 the past few years. Finally, “feeling sad or hopeless to a degree that affected some usual daily activities,”  
15 a strong predictor of suicidal ideation and attempts, has been reported by a large (and growing) number  
16 of youth [14, 15]. For example, the prevalence rose from 26.1% in 2009 to 36.7% in 2019 in the total US  
17 sample and from 27.3% to 36.7% in the MT sample [10].

18 Various theories have been proposed to explain risk for suicide across diverse age and  
19 racial/ethnic groups and across geographic locations, all describing risk as multifactorial across multiple  
20 risk domains (individual characteristics, familial or interpersonal, social or cultural [16-20]), and  
21 emphasizing negative intrapersonal states (e.g., negative emotions; feeling socially disconnected or a  
22 sense of thwarted belongingness; perceiving oneself as unduly burdensome [17]) and adverse life events  
23 (e.g., parental loss; maltreatment [21]) as risk-, and positive social norms and relationships as protective  
24 factors [22, 23]. Mental health problems are significantly associated with suicide and most decedents

1 with a current mental health problem experienced depression [23, 24]. Connecting at-risk individuals to  
2 mental health resources is a key element of suicide prevention [6]. Yet only a minority of those in need  
3 do access care, and low mental health literacy and stigma are commonly noted barriers [25-28].

4 Rural youth face increased suicide risk (beyond common risk factors they share with their urban  
5 counterparts), including low mental health literacy [29], high mental health stigma [30, 31], lack of  
6 mental health services, social isolation [5, 32], poverty, and a pessimistic outlook on the future. Lower  
7 mental health literacy among rural vs. urban populations may impede recognition of emotional distress  
8 or psychopathology as concerns that warrant treatment [29, 31, 33, 34]. Self-stigmatization and fear of  
9 being stigmatized for seeking mental health care may be particularly acute in small communities where  
10 “everyone is in everyone else’s business” and where self-reliance is highly valued [34-37]. Many rural  
11 states are mental health services “deserts;” for example, in 2019, all MT counties were “Mental Health  
12 Care Professional Shortage Areas [38]. In rural states, the combination of vast geographic expanses with  
13 low population density, of long distances to and limited availability of mental health services [39], mean  
14 that rural youth live in under-resourced settings and represent an under-served population [6, 40].  
15 Prevalent household poverty further exacerbates rural youth’s challenges [41] arising from physical and  
16 social isolation due to large distances between homes or lack of transportation; from feeling socially or  
17 politically excluded due to poverty or minority group status; and from lack of job prospects creating a  
18 sense of feeling trapped and hopeless about the future [42]. Individuals residing in rural communities  
19 also have been shown to have greater access to lethal means, increasing the likelihood that a suicide  
20 attempt will result in death [42-46].

21 These scientific advances in identifying suicide risk and protective factors notwithstanding,  
22 research has yielded only modest success in predicting suicide attempts [47-51]. Therefore, experts have  
23 called for “upstream,” developmentally tailored suicide prevention programs that strengthen coping and

1 resilience [52] and readily reach youth [53-56]. In under-resourced communities with under-served  
2 populations in the US, schools often are the one public institution accessible to all.

### 3 **1.2. School-based Universal Prevention Programs are Well-suited for Addressing Rural Youth**

#### 4 **Suicide Risk**

5           There is expert consensus that school-based universal suicide prevention efforts are needed to  
6 complement targeted or treatment approaches for several reasons [55-60]. One, schools have high  
7 reach even in rural or frontier communities: School attendance until age 16 is free and mandatory in all  
8 US states, with some states requiring students to remain in school until 17 or 18 years of age [61]; and  
9 school districts typically provide free transportation to students for whom walking to school is not an  
10 option for health or safety reasons. Therefore, neither poverty nor geographic location should prevent  
11 students from school attendance. Two, there is synergy between schools' educational mission and focus  
12 on healthy child development and the goals of suicide prevention curricula [55-59, 62, 63]. Moreover,  
13 offering a suicide prevention program as part of the regular school curriculum on health and mental  
14 health topics ensures efficient and cost-effective intervention access for most youth, even in resource-  
15 poor communities [64]. Rural schools often face budgetary challenges that preclude offering a full suite  
16 of suicide intervention programs (e.g., targeted prevention or treatment of youth who attempted  
17 suicide). Therefore, school authorities favor a universal approach when facing budget constraints [65,  
18 66]. Three, in many rural US communities, schools serve as a location for providing mental health care to  
19 youth and their families [40, 42]. Adolescents are reluctant to seek mental health care [67, 68], and  
20 those who do access medical care are unlikely to receive mental health care [69, 70]. Hence, school-  
21 based universal programs have high reach by not requiring that students access care (unlike suicide  
22 screening in primary care) or self-identify symptoms such as depression as problems requiring treatment  
23 (as would be the case for targeted prevention). And four, by being offer to all students, universal  
24 prevention programs avoid the potential risk of stigmatization arising from targeted prevention [59, 71].

1           Despite these advantages of school-based universal suicide prevention programs, knowledge  
2 gaps remain. Systematic reviews of psychosocial youth suicide prevention studies have noted that,  
3 overall, few studies have focused on universal interventions [58], and while there have been studies of  
4 interventions designed for *elementary* school children (e.g., the Good Behavior Game [72, 73] or the  
5 Promoting Alternative Thinking Strategies curriculum [74]), research of school-based universal suicide  
6 prevention programs for *adolescents* is limited. Moreover, except for small pilot efforts, there have been  
7 no studies of such programs when implemented in rural schools [59]. We propose to evaluate the  
8 effectiveness of an evidence-based universal suicide prevention program (Youth Aware of Mental  
9 Health, YAM) when adapted for implementation in low-resource, rural schools.

### 10 **1.3. Why YAM is a Promising Universal Youth Suicide Prevention Program for Rural Youth**

11           YAM [75] is a manualized, universal suicide prevention curriculum designed for delivery during  
12 regular school classes by trained instructors and assistants who are not part of the school staff [75-77].  
13 The YAM program comprises 5 modules, including an initial didactic lesson followed by highly interactive  
14 sessions including small group work and role plays that draw upon students' personal experiences. The  
15 rationale for using external instructors and assistants rather than school staff for program delivery is  
16 that students may be more open to participate fully in interactive class activities (e.g., role plays  
17 involving sensitive topics) without fear that revealing personal information might impact how school  
18 staff would interact with or evaluate student in the future.

19           YAM was found superior both in reducing suicide attempts and in cost-effectiveness versus  
20 other school-based universal suicide prevention programs in a large European cluster-randomized  
21 clinical trial. Specifically, the "Saving and Empowering Young Lives in Europe" (SEYLE) study randomized  
22 schools in 10 European countries to one of three youth suicide prevention interventions or a control  
23 condition. The sample comprised ~11,000 9<sup>th</sup> graders. Only the YAM program was found superior to the  
24 control condition: Students receiving the YAM program showed significantly reduced suicidality,



1 scenarios to be culturally suitable to US youth). This culturally adapted YAM version was evaluated in 11  
2 high schools (81.3% school participation) in TX and MT for feasibility and acceptability [78] and for  
3 effectiveness in improving mental health literacy and reducing stigma [79]. YAM was delivered to 1,878  
4 students (9<sup>th</sup> grade: 91.7%) during regular classes by trained instructors and assistants. Satisfaction  
5 surveys among school staff (N=49), parents (N=59) and students (N=398) found that YAM was well-  
6 received. Moreover, mental health knowledge and help seeking for depression or suicidal ideation  
7 increased, and stigma scores decreased in students who received YAM in the MT/TX study [79].

8         The MT/TX study team conducted a subsequent feasibility study in 10 small MT schools, changing  
9 the delivery format by using trained land-grant Extension agents instead of the original model of  
10 external instructors and assistants [80]. Feasibility was measured as the percentage of schools willing to  
11 offer the program and acceptability was measured using student ratings. Results suggested that YAM is  
12 feasible and acceptable in rural schools. Specifically, 77% of invited schools participated and student  
13 ratings were highly favorably: 89.1% of youth rated “agree” or “strongly agree” to “it is a good idea to  
14 provide young people with a mental health and risk behavior prevention program in schools;” 70.3%  
15 reported they were pleased with YAM; 70.7% thought YAM should be suggested for other schools and  
16 70.1% of youth thought students would find the program appropriate. Future studies should gather  
17 more detailed information from students about opportunities for program improvements.

18         These US-based offerings of YAM were supported by state funding for implementation expenses,  
19 enabling schools to offer the curriculum without costs to schools for the recruitment and training of the  
20 YAM instructors/assistants or for their time spent delivering the prevention intervention. Our team  
21 collected informal feedback from superintendents and school principals about their budgetary resources  
22 for picking up implementation costs. The resounding feedback was that the resources required for  
23 recruiting and training external YAM staff were unduly burdensome. Instead, school officials expressed a  
24 strong preference for their own staff to be trained as YAM program instructors/assistants. Yet, the YAM

1 developers have been firm in their belief that the efficacy of YAM may be undermined if students are  
2 being taught by their own teachers. The opportunity for youth to share and utilize their personal stories  
3 as the basis of discussions and roleplay scenarios without concern that a teacher may in future  
4 interactions (e.g., grading; letters of recommendation, etc.) relate differently to students who divulged  
5 potentially sensitive personal information is deemed central to students' engagement with and the  
6 efficacy of YAM. To resolve this dilemma, we propose a pilot study to lay the groundwork for a  
7 subsequent, fully-powered RCT study testing the efficacy of a novel implementation model for YAM,  
8 teacher exchanges (YAM-TE) versus the standard model involving external instructors/assistants (YAM-  
9 EXT).

10 **1.5. Study Aims: Exploring the Feasibility and Acceptability of a Teacher Exchange Model and**  
11 **Collecting Preliminary Outcome Data for YAM-TE versus YAM-EXT**

12 Our long-range goal is to conduct an RCT study testing the efficacy of implementing YAM using a  
13 teacher exchange model (TE) rather than the standard model involving external instructors (EXT).  
14 Specifically, we propose to develop an implementation strategy involving neighboring schools  
15 exchanging teachers for teaching the YAM curriculum. In each participating school, teachers would be  
16 trained to serve as YAM instructors/assistants, but the instructional staff from one school would deliver  
17 the curriculum in the designated partner school, and vice versa. Embedding YAM instructors within  
18 schools is consistent with expert recommendations for making prevention interventions scalable and  
19 sustainable [81].

20 We believe the teacher exchange model would be suitable for communities with more than one  
21 middle- or high school or with like schools in close-by ( $\leq 30$  miles) communities. These characteristics  
22 apply to a substantial number of MT communities: There are 15/15 Class AA schools ( $\geq 825$  pupils) and  
23 17/22 Class A schools ( $\geq 340-825$  pupils) where exchanges could occur in the same town; there are  
24 18/40 Class B schools ( $>120-340$  pupils) that could partner with near-by town. We envision that the

1 primary targets for YAM-TS would be Schools AA-B. If proven feasible in our pilot study, the YAM-TE  
2 model could be implemented across MT and similar states in the US.

3 Before embarking on a fully-powered trial, pilot work is needed to answer questions about the  
4 feasibility of the proposed implementation strategy, as well as about the feasibility of methodological  
5 components such as recruitment and retention of research participants, randomization, assessment  
6 procedures, and training protocols. As recommended in a seminal paper on pilot studies [82], because  
7 they are by definition underpowered, pilot studies should not use control groups for the primary  
8 purpose of testing the differential efficacy of the novel versus original intervention. Rather, inclusion of  
9 a control group is advantageous for examining whether different interventions are associated with  
10 differential recruitment or attrition, whether randomization procedures can be implemented, and other  
11 aspects pertaining to the ultimate implementation of both intervention conditions. A primary focus of  
12 pilot studies is feasibility, i.e., whether a study protocol be executed or needs to be modified because  
13 some or all elements are unacceptable (e.g., participants decline participation or drop out; participants  
14 fail to complete assessments) or do not work (e.g., training fails to result in competent instruction of the  
15 program) which can be quantified as described below. Using a non-inferiority design, our pilot study will  
16 randomly assign classes to YAM-TE or YAM-EXT to address three aims, described next.

17 1.5.1. Aim 1: Examine the feasibility and acceptability of the teacher exchange model, YAM-TE.  
18 The proximal outcomes are fidelity (can TE staff deliver the YAM curriculum as competently as EXT?) and  
19 the number of YAM sessions taught as scheduled (are TE staff as adherent to the teaching schedule, i.e.,  
20 available to teach the class, as the EXT staff?). The primary outcomes are acceptability of YAM-TE to  
21 students (do students exposed to TE rate acceptability at comparable levels to students exposed to  
22 EXT?) and teachers (are teachers willing to endorse the TE model after completion of the pilot study?).

23 1.5.2. Aim 2: Examine the feasibility and acceptability of the research methods. We will  
24 quantify feasibility of a) randomization as the number of classes who receive the assigned YAM

1 implementation format/the number of randomized classes; b) recruitment as the number of students  
2 who agree to provide assessment data (have parental consent and student assent and attend  
3 assessment sessions)/the number of students invited to participate; c) retention as the number of  
4 students who completed subsequent assessments (post-YAM; 12-months)/ the number of students who  
5 provided baseline data; and d) assessment procedures as the number of students enrolled in the study  
6 with at least 90% of item completion, at each assessment point.

7 1.5.3. Aim 3: Gather preliminary outcome data. A proximal primary outcome (measured at end  
8 of the YAM program) is willingness to seek help, and distal primary outcomes (measured at a 12-month  
9 follow-up) include suicidal ideation and attempts. Secondary proximal outcomes include changes in  
10 students' mental health literacy, help seeking, and psychosocial functioning. We also will measure  
11 potential moderators (e.g., sex; family poverty [83]) and potential mechanisms [84] explaining YAM  
12 distal primary outcomes (increased: help seeking; belongingness; coping; reduced: perceived  
13 burdensomeness; depression [85-87]). We expect non-inferiority of YAM-TE versus YAM-EXT on all  
14 outcomes; all analyses regarding our feasibility study's third aim are exploratory.

## 15 2. METHOD

### 16 2.1. Overview and Study Design

17 We will employ a noninferiority design (combining implementation and effectiveness methods)  
18 [88] and randomize (at each school) course sections to receive YAM-TE (experimental group) or YAM-  
19 EXT (control group). As shown in Figure 2, students will be asked to complete a baseline assessment the  
20 week prior to receiving the YAM curriculum. YAM will be taught in 5 class periods (60 minutes each),  
21 spread across 3 weeks. Post-assessments will be performed upon completion of the final YAM lesson;  
22 longer-term program impact will be measured at 12-month follow-up.

23 Insert Figure 2 about here

### 24 2.2. YAM Curriculum and Training



1 protocols and following study protocols such as responding to and reporting adverse events. During  
2 YAM implementation, all instructors will participate in bi-weekly supervision meetings (separate for TE  
3 or EXT) via videoconference and may request, as needed, consultation with a trainer.

### 4 **2.3. Participants and Recruitment**

5 2.3.1. Participating Schools and Randomization. We will invite four public high schools in MT  
6 that reflect the type of rural school most likely suited for the proposed implementation model: schools  
7 need to be large enough to have an adequately sized pool of teaching staff interested in becoming  
8 trained YAM instructors and geographically close enough to another school for switching instructors,  
9 thus preserving the YAM requirement that instructors do not teach students from their own school. At  
10 each school, the entire 9th grade will be organized into sections of 20-25 students based on the grade's  
11 course schedule. Given current enrollments, we expect to offer 10-12 sections (5-6 YAM-TE, 5-6 YAM-  
12 EXT), per school. Sections will be randomized such that at each school, approximately half of the  
13 students will be exposed to YAM-TE (i.e., program delivery by two trained teaching staff employed by  
14 another school) and about half of the students will be exposed to the standard YAM delivery format  
15 (i.e., two external, trained instructors). By randomizing at the level of section within a school rather than  
16 at the level of school, we control for seasonal factors that might affect implementation (e.g., weather  
17 related school delays; seasonal effects on mood or health behaviors; etc.).

18 2.2.2. Students. At each school, all 9<sup>th</sup>-grade students will receive the YAM curriculum as part of  
19 their health curriculum during regular school periods and be invited to participate in the feasibility  
20 study. Of the approximately 1300 pupils eligible for study inclusion, we expect a minimum response rate  
21 (receipt of both parental/guardian consent and student assent) of 55%, for a total study sample of ~ 715  
22 youth. There are several reasons for targeting 9<sup>th</sup> grade students: 1) the original YAM program was  
23 designed for and tested among 14-16 year-old youth in the 9<sup>th</sup> grade; 2) developmentally 9<sup>th</sup> grade is a  
24 stressful transition period for youth in the United States as they are entering high school [90, 91]; and 3)

1 12-month median prevalence estimates of depression in mid-to-late adolescence are much higher than  
2 in childhood (4-5% vs. <1%, respectively) and cumulative probability rising from 5% in early adolescence  
3 to 20% at the start of emerging adulthood [92].

#### 4 **2.4. Instruments and Procedures**

5 Our implementation outcome measures [76, 77] are informed by the SELYE study [76], literature  
6 on implementing school-based curricula [93], and theoretical protective and risk factors for suicide  
7 among rural youth [6, 18, 42, 94, 95]. Given our emphasis on feasibility and acceptability of the novel  
8 implementation model, we propose fewer distal outcome measures than the original YAM to  
9 accommodate participating schools' concerns about the study taking up too much class time.

10 2.4.1. Instructor Assessment of the Feasibility of YAM-TE versus YAM-EXT. We will ask  
11 instructors about their experience both post-training and post-program delivery the following questions  
12 on a 5-point Likert scale (strongly disagree to strongly agree): "The YAM training was worth my time"  
13 (post-training) and "Teaching the YAM program was worth my time" (post-YAM) [96]. Additionally, we  
14 will ask instructors to answer these open-ended questions (3 post-training and 4 post-YAM  
15 implementation): "What did you like the most about the YAM training?" "What did you like the least  
16 about the YAM training?" "What are your recommendations to improve the YAM training?" "What did  
17 you like the most about teaching the YAM program?" "What did you like the least about teaching the  
18 YAM program?" "What are your recommendations to improve the YAM program?" "What could be done  
19 to better support you in your role as YAM instructor?" [89].

20 Fidelity will be measured via classroom observation and instructors' self-report, using checklists.  
21 Classroom observations will be conducted by trainers during 5 randomly selected YAM sessions per  
22 YAM-TE or YAM-EXT. Observers will be a neutral presence in the classroom; they will use the Fidelity  
23 Checklist (same as self-report checklist, below) to assess key components of the session as well as rating  
24 the quality of implementation. Observers will not provide feedback to instructors at the time of

1 observation; rather, instructors will receive summary reports upon completion of the study. No youth  
2 will be identified on the Fidelity Checklist. After each YAM class, TE and EXT instructors will complete a  
3 fidelity self-report checklist, indicating (yes/no) whether core YAM content or activities comprising a  
4 session was covered (e.g., session 1: “clearly reviewed symptoms of depression, giving examples for  
5 each”). In an open text box next to each checklist item, instructors may comment on student  
6 engagement in discussion around the curriculum; how adequately prepared instructors felt to lead the  
7 discussion; and whether (and if so why) any topics were not covered. On a standard form, instructors  
8 will record any changes made to key components during sessions and any issues or barriers they  
9 experienced implementing session content. Self-assessments should take no more than five  
10 minutes/YAM session to complete.

11       2.4.2. Youth Assessments of the Acceptability of YAM-TE versus YAM-EXT. Upon completing the  
12 YAM program, youth will be asked to rate six items (using a 5-point Likert scale), asking whether they  
13 thought YAM was helpful; added to their understanding of mental health; enhanced their knowledge  
14 and skills; was respectful of their cultural background; whether they trusted the instructor; and whether  
15 the instructor was skilled at teaching YAM. Via two open-ended questions, youth will be asked to report  
16 two things they liked about YAM and what, if anything, they would change about the program.

17       2.4.3. Youth Demographic Characteristics, Assessments of Outcomes. Youth will complete  
18 baseline, post-YAM (outcomes/mediators only), and 12-month assessments in a computer lab or using  
19 iPADS during health class. Based on pilot work, we expect youth assessments to take about 30 minutes.

20       Demographic Questionnaire. Youth will be asked to report age; sex (male, female, nonbinary);  
21 race/ethnicity, receipt of free school lunch during the current school year, and a question concerning  
22 family food insecurity adapted from the USDA Food Security Survey Model [97] (“In the previous 12  
23 months was there any time your family has run out of food and not been able to purchase more?”). We  
24 will use Goodman et al.’s adaptation of the “MacArthur ladders” to assess socioeconomic status. The

1 MacArthur ladders have been found to be reliable across culturally diverse samples of children [98].  
2 Youth indicate “at this time,” on which rung of the pictorial 10-rung ladder they believe their family  
3 stands relative to other families in the US society (*subjective SES*). Anchor points are provided at 10 (“at  
4 the top are the people who are the best off-- have the most money, the highest amount of schooling;  
5 and the jobs that bring the most respect”) and at 1 (“at the bottom are the people who are the worst  
6 off—they have the least money, little or no education, and no job or the jobs that no one respects”) [99,  
7 100]. To measure perceived social status among their school peers, students will be presented with  
8 another ladder (“Now assume that the ladder is a way of picturing your school”) and asked to place  
9 themselves relative to other students. Rung 10 represents “the people in your school with the most  
10 respect, the highest grades, and the highest standing,” and rung 1 represents “the people no one  
11 respects, no one wants to hang around with, and have the worst grades.” In a large adolescent  
12 community sample, each of the ladders and the ladders combined explained about 10% of unique  
13 variance of adolescents’ depression scores [99].

14 Depression and suicidal behaviors. Three standardized Youth Risk Behavior Survey questions  
15 (response choices: yes/no) will be included: “During the past 12 months, did you ever feel so sad and  
16 hopeless almost every day for two weeks or more in a row, that you stopped doing some usual  
17 activities?”; “Have you ever seriously thought about killing yourself?”; “Have you ever tried to kill  
18 yourself?” [101].

19 Psychological risk factors for youth suicide, behavioral health problems, and impairment. We  
20 will use 8 items of the Interpersonal Needs Questionnaire [102] to measure Thwarted Belongingness  
21 (e.g., “These days, I feel like I belong”) and Perceived Burdensomeness (e.g., “These days, I feel like a  
22 burden on the people in my life”), each rated on a 4-point scale (1 = Not at all true for me to 4 = Very  
23 true for me). We will use the 25-item Strengths and Difficulties Questionnaire (SDQ) [103] to measure  
24 emotional symptoms, conduct problems, hyperactivity and/or inattention, peer relationship problems

1 and pro-social behavior. The SDQ has been validated extensively [104] and was used in the YAM trial  
2 [75, 105]. We will measure past-12-month impairment due to a mental (item 1) or alcohol/drug (item 2)  
3 problem; sleep disturbance using 4 items from the PROMIS Pediatric Disturbances Item Bank, which was  
4 validated for youth ages 8 to 17 years [106]; and subjective well-being using the 5-item WHO Well-being  
5 Scale (WHO-5) (0 = worst possible to 5 = best possible quality of life) and has been shown to provide  
6 reliable assessment of adolescents' subjective well-being [77, 107, 108]. We will use the 4-item  
7 subscales "Cognitive Decision Making" (e.g., "You thought about what would happen before you  
8 decided what to do"), "Direct Problem Solving" (e.g., "You tried to make things better by changing what  
9 you did"), "Control" (e.g., "You told yourself you could handle whatever happens"), and "Optimism"  
10 (e.g., "You told yourself that things would get better") of the Children's Coping Strategies Checklist –  
11 Revised (CCSC-R) [109, 110]. Youth will be asked to rate how often they usually use a strategy to solve  
12 their problems or make themselves feel better within the past month on a 4-point scale (1 = Never to 4  
13 = Most of the time). The CCSC-R has been used to assess coping behaviors in youth ages 9-15 years from  
14 various demographic backgrounds and participating in youth mental health interventions [52, 111].

15 Mental health literacy, help seeking confidence and behaviors. We will use 7 items from the  
16 Depression Knowledge Test [112] to measure students' knowledge acquisition related to core content of  
17 YAM and one open-ended question about knowledge of local mental health resources. We will assess  
18 youth's confidence to seek help, using a 5-point Likert scale (1 = Not confident at all to 5 = Very  
19 confident), asking "How confident are you to seek help if you had a) an alcohol or drug problem, b)  
20 depression, anxiety, or another emotional problem, and c) thoughts about killing yourself?" [113]. We  
21 will ask 3 questions about help seeking (yes/no): "In the past 12 months, have you talked to a medical  
22 doctor or other professional (psychologists, counselors, nurse, other healing professionals) about a)  
23 problems with feeling depressed or anxious problems, b) drinking alcohol or taking drugs, or c) thinking  
24 about killing yourself or having made an attempt to kill yourself?"

1 **2.5. Data Analysis Plan**

2 2.5.1. Preliminary Data Evaluation. Prior to analysis, the data will be audited for quality and  
3 completeness, including missing data patterns and evaluation of distributions. The equivalence of the  
4 random assignment of groups will be assessed by comparison of intervention groups on demographic  
5 and clinical characteristics. Should groups differ on any characteristics, these variables will be used as  
6 covariates in the analyses.

7 2.5.2. Analysis of Primary Hypotheses. To date, there have been no RCT studies evaluating the  
8 use of TE instructors to deliver the YAM program. Hence, there is no historical evidence for determining  
9 a noninferiority margin (M1) to test the hypothesis that the YAM-TE does not differ from the standard  
10 YAM-EXT regarding fidelity (teachers) and acceptability (teachers and youth). In the absence of  
11 statistical evidence, we will use Cohen’s [114] recommendations for a moderate effect size to define  
12 M1. For quantitative outcomes, M1 will be Cohen’s  $d = 0.5$  (YAM-TE performs worse than YAM-EXT), and  
13 for binary outcomes, M1 will be relative risk (RR) = 1.90 (YAM-TE performs worse than YAM-EXT). The  
14 results of these pilot study analyses will inform the development of a statistically informed M1 for the  
15 YAM-TE compared to YAM-EXT in a future fully powered noninferiority trial.

16 Linear (continuous outcomes) and logistic (binary outcomes) regression analyses will be used to  
17 test hypotheses for teacher outcomes. Separate regression models will be tested to estimate  
18 unadjusted intervention effects and intervention effects adjusted for potential confounding variables  
19 (e.g., sex). Parameter estimates from these analyses will be used to calculate effect sizes and 95%  
20 confidence intervals for the difference between the YAM-TE and YAM-EXT groups. If the 95% confidence  
21 interval for the effect size exceeds M1, that is, the effect size for the inferiority of the YAM-TE relative to  
22 the YAM-EXT is greater than Cohen’s  $d=0.5$  or  $RR=1.90$ , this would suggest that the YAM-TE is inferior to  
23 the YAM-EXT, and we cannot reject the null hypothesis that the YAM-TE does not differ from the YAM-  
24 EXT on the outcomes.

1 Mixed linear and logistic regression analysis will be used to test hypotheses for youth outcomes,  
2 adjusting for clustering of students within teacher/trainer. Separate regression models for post-  
3 intervention student acceptability will be tested to estimate unadjusted intervention effects and  
4 intervention effects adjusted for potential confounding variables (e.g., gender, ethnicity). Models  
5 evaluating other student outcomes will adjust for pre-intervention variables, in addition to potential  
6 confounding variables (e.g., sex, ethnicity). The parameter estimates from these analyses will be used to  
7 calculate effect sizes and 95% confidence intervals for the difference between the YAM-TE and YAM-EXT  
8 groups. If the 95% confidence interval for the effect size exceeds the non-inferiority margin, that is, the  
9 effect size for the inferiority of the YAM-TE relative to the YAM-EXT is greater than Cohen's  $d=0.5$  or  
10  $RR=1.90$ , this would suggest that the YAM-TE is inferior to the YAM-EXT, and we cannot reject the null  
11 hypothesis that the YAM-TE does not differ from the YAM-EXT.

12 Exploratory analyses will include testing moderation of the intervention effect by potential  
13 modifier variables (e.g., sex, family poverty). Hierarchical mixed models will be used to test the  
14 mediating effect of mental health literacy, belongingness, and perceived burdensomeness on the  
15 intervention effect. Additional exploratory analyses may involve incorporating teacher/trainer outcomes  
16 in the mixed models as predictors of youth outcomes, as well as teacher/trainer outcomes, by  
17 intervention group interactions to evaluate the potential moderating effect of teacher/trainer  
18 characteristics on intervention group differences in student outcomes.

## 19 **2.6. Ethical Considerations**

20 The study will not commence until approved by the Institutional Review Board (IRB) of the  
21 participating university and by the local school district's superintendent office. A draft IRB protocol is  
22 provided in Supplement A. Past studies have shown that asking about suicide does not increase risk for  
23 self-harm [115, 116]; and the two questions we will ask student are taken from a widely-used youth

1 suicide risk assessment tool already given to students in the four participating schools [11]. Safety will  
2 be measured by TE and EXT instructors' completion of an adverse event checklist after each YAM class.

### 3 **3. DISCUSSION**

4 We expect our study to expand the science of youth suicide prevention by targeting an as-yet  
5 under-served study population, rural youth, and evaluating a teaching model that preserves the goal of  
6 providing YAM by instructional staff unfamiliar to the students, yet that may be superior regarding  
7 sustainability for resource-strapped rural communities (YAM-TE). Our study is designed to collect  
8 feasibility and acceptability data concerning all aspects of the prevention trial: program delivery format,  
9 recruitment, and assessment strategies and measures. It also will generate pilot data concerning  
10 proximal (end of program) and distal outcomes.

#### 11 3.1. Limitations and Future Directions

12 Several limitations warrant consideration. One, the YAM curriculum is designed to engage all  
13 youth in a classroom to share their perspective or provide specific examples of challenges they  
14 encounter in their daily lives. As such, the proposed study will not endeavor to create separate  
15 adaptations by ethnic group, but rather will maintain YAM's universal prevention approach. That said,  
16 for interventions in states such as MT, we believe that developing and testing a cultural adaptation of  
17 YAM for implementation in Native American reservation schools represents an important goal but  
18 exceeds the scope of our study and warrants being the focus of a separate study. Related, in US states  
19 with other ethnic or racial minorities (e.g., African American youth or Latinx youth), studies are needed  
20 to examine the cultural appropriateness and efficacy of YAM. Two, the TE delivery model is envisioned  
21 to work in communities where neighboring schools are located close enough for exchanging teachers  
22 without undue time burdens of transportation costs. For geographically more isolated schools, the  
23 standard EXT model may still be the better option; alternatively, in states with land-grant universities,  
24 the Extension model may be a sustainable option. Three, generalizability of findings will depend in part

1 on robust student participation. We believe that the feasibility study approach is invaluable for  
2 gathering information about optimizing strategies for securing parental consent and student assent.  
3 While the proposed study will be carried out in one rural US state (MT), if proven feasible and based on  
4 pilot data promising to be effective, we believe the YAM-TE model can be applied in other US states and  
5 may ultimately offer a model for other countries.

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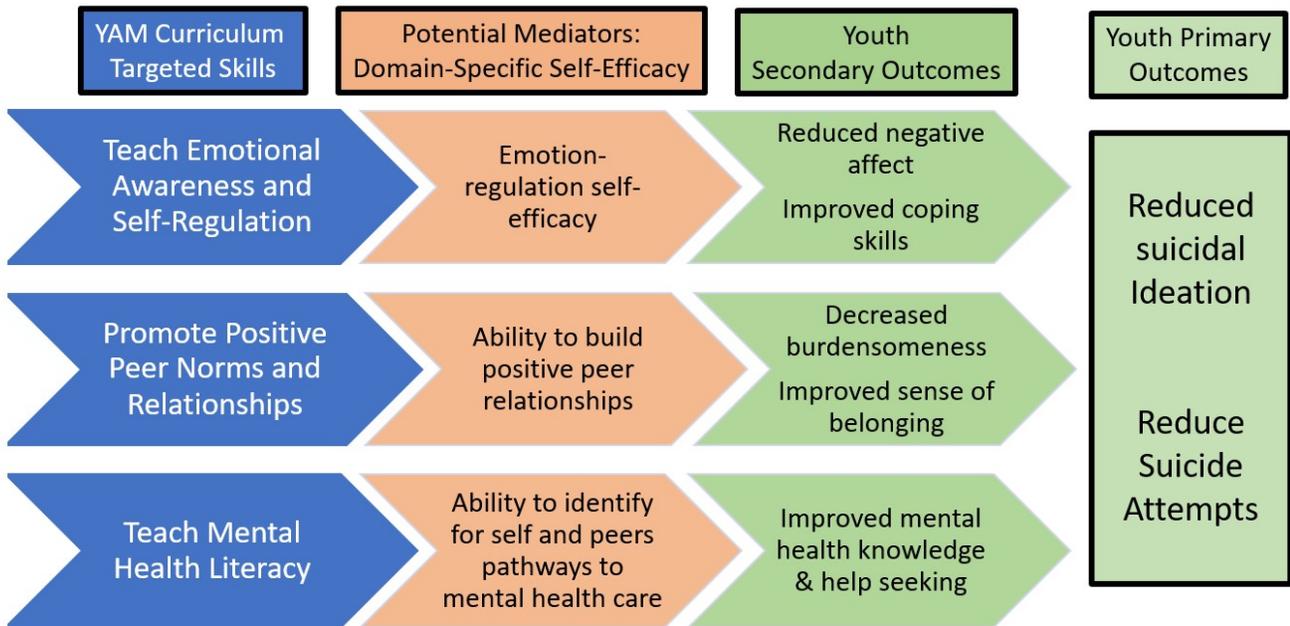


Figure 1. Model of Action: From skills-building curricular targets to positive youth outcomes

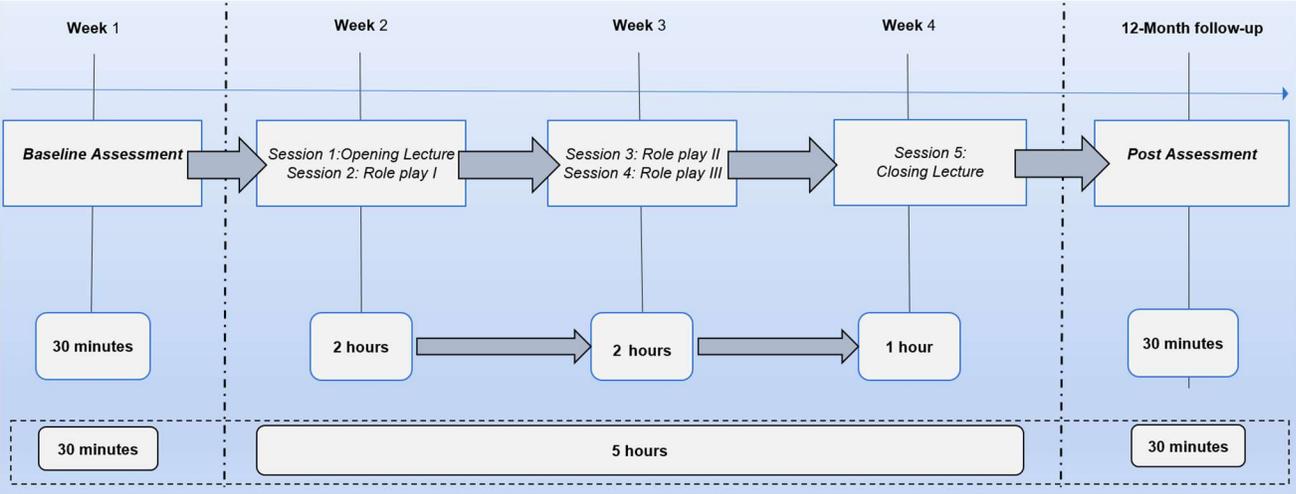


Figure 2: Timeline of program delivery and youth assessments

## Youth Aware of Mental Health (YAM) Program Sessions

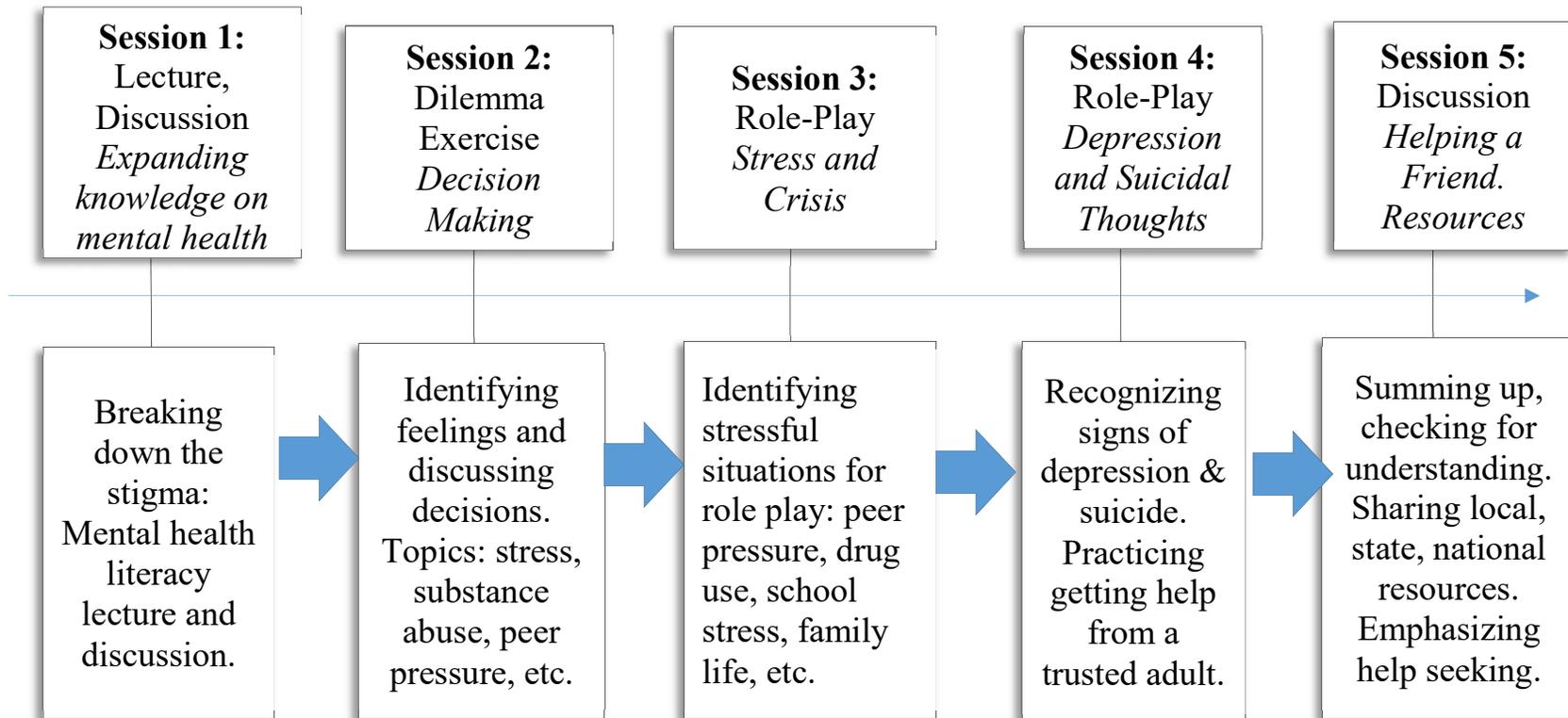


Figure 3: YAM Session Content and Primary Teaching Mode