Oxford Health NHS
NHS Foundation Trust

Study Title: A comparison of usual care versus usual care plus a smartphone self-harm prevention app (BlueIce) in young adolescents aged 12-17 who self-harm.

Internal Reference Number / Short title: RCT of a self-help app (BlueIce) for young people who self-harm

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Confidentiality Statement

This document contains confidential information that must not be disclosed to anyone other than the Sponsor, the Investigator Team, host organisation, and members of the Research Ethics Committee, unless authorised to do so.

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1. SYNOPSIS

Study Title	A comparison of usual care versus usual care plus a smartphone self-harm prevention app (BlueIce) in young adolescents aged 12-17 who self-harm.	
Internal ref. no. / short title	Beating Adolescent Self-Harm (BASH)	
Study Design	Single blind, two-arm, randomised controlled trial. Participants will be randomised to (i) usual face to face mental health care (UC) and (ii) usual face to face mental health care plus BlueIce (UC+BI).	
Study Participants	138 young people: (i) aged 12-17 (ii) attending specialist CAMHS (iii) history of self-harm (i.e. 2 or more episodes of self-harm over the past 12 months). Young people will be excluded if they are: 1) suicidal, 2) diagnosed with psychosis, 3) where there are current safeguarding concerns (i.e. the young person has suffered abuse within the last 6 months or is the subject of a safeguarding investigation), 4) experience a significant developmental disorder (e.g. autism) which interferes with their ability to use the app.	
Planned Sample Size	N=138	
Planned Study Period	1st September 2019 – 30th June 2023	
	Objectives	**Outcome Measures**
Primary	To determine the effectiveness of UC + BI compared with UC in reducing self-harm.	Assessed by the Risk-Taking and Self-Harm Inventory for Adolescents (RTSHIA)
Secondary	To determine the effectiveness of UC+BI compared to UC on the secondary outcomes of mood anxiety, hopelessness general behaviour and impact sleep To determine the acceptability of BlueIce To assess the cost and cost effectiveness of UC+BI compared to UC	 Mood and Feelings Questionnaire, Revised Child Anxiety and Depression Scale Beck Hopelessness Scale Strength and Difficulties Questionnaire. Sleep Condition Indicator Post-use semi-structured interviews. Cost per QALY adjusted life years on the RTSHIA assessed by the CHU9D.

2. ABBREVIATIONS

Define all unusual or 'technical' terms related to the project. Add or delete as appropriate to your study. Maintain alphabetical order for ease of reference.

CI	Chief Investigator
CRF	Case Report Form
GCP	Good Clinical Practice
GP	General Practitioner
ICF	Informed Consent Form
NHS	National Health Service
NRES	National Research Ethics Service
PI	Principal Investigator
PIL	Participant/ Patient Information Leaflet
R&D	NHS Trust R&D Department
REC	Research Ethics Committee
SOP	Standard Operating Procedure

3. BACKGROUND AND RATIONALE

3.1. SELF-HARM

Self-harm is the intentional self-poisoning or self-injury, irrespective of type of motive or the extent of suicidal intent [1]. Community studies consistently report a lifetime risk of 13-18% for adolescent self-harm [2-4]. The incidence of self-harm is increasing, particularly in teenage girls [4]. Of those who self-harm, half will report multiple self-harming events [5]. Our local school survey of 5030 young people aged 12-16 found 15% reported acts of self-harm over the past 12 months with 55% of these reporting multiple self-harm [6.] In community surveys, self-cutting is the most commonly reported method of self-harm whereas self-poisoning is more common in those who present at accident and emergency departments [3, 4, 7]. Comparatively few episodes of self-harm result in hospital presentations with most being undertaken in private and remaining hidden [8.] Self-harm is associated with several mental health disorders particularly depression [1, 5] and there is a strong association between self-harming thoughts and self-harming behaviours and suicide attempts in both community [2] and clinical groups [9, 10].

Summary: Self-harm in young people is common and is associated with significant mental health needs and burden.

3.2. REDUCING ADOLESCENT SELF-HARM IS A PRIORITY

Improving child mental health is a cross governmental priority. In July 2014 a Department of Health and NHS England taskforce examined how to improve child and adolescent mental health care. Future in Mind [11] set out an ambitious agenda for prioritising and improving child mental health over the next 5 years. In terms of self-harm, a cross governmental approach to reducing rates of suicide was detailed in the National Suicide Prevention Strategy [12] which identified children and young people as a particularly vulnerable group. The third progress report published in 2017 noted that there had been an increase in suicides in adolescents aged 15-19 and of those who died, over half

had previously self-harmed [13]. Finally, reducing self-harm could result in significant cost savings. It has been estimated that more than 200,000 episodes of self-harm are treated at emergency hospital departments each year [14.] The mean hospital cost per episode of self-harm is £809 resulting in a total cost to general hospitals in England being £161.8 million per year [13]. The costs of a psychosocial risk assessment of young people under the age of 18 following self-harm is estimated to be £392 [14].

Summary: Improving child and adolescent mental health and preventing self-harm are government priorities which could offer significant cost savings to the NHS.

3.3. INTERVENTIONS FOR ADOLESCENTS WHO SELF-HARM ARE LIMITED

NICE [1] and the Cochrane review 1[5] have noted a lack of evidence for the treatment of self-harm in young people. The Cochrane review identified 11 trials evaluating self-harm interventions for adolescents involving 1,126 participants. This compares with 55 trials involving 17,699 participants that have evaluated self –harm interventions with adults [41]. We were able to identify a further 6 trials that have been published since the Cochrane review. Of these, the results of the most recent and largest studies were mixed. For example, Cottrell et al 2018 [16], failed to find the superiority of family therapy over treatment as usual (n=832) whilst McCauley et al 2018 [17], found Dialectical Behaviour Therapy more effective than individual and group supportive therapy (n=173). Both interventions were delivered by trained mental health specialists during face to face meetings over several months. No studies have evaluated the use of technology to support self-harm interventions with youth. The Cochrane review concluded that "there is not much evidence on which to draw conclusions on the effects of interventions for self-harm in this population"(p 44) [15]. The review suggested that therapeutic assessment, mentallization, dialectical behaviour and cognitive behaviour therapy warrant further evaluation and recommended that new therapeutic interventions should be developed in collaboration with patients to ensure that they meet their needs.

Summary: Limited evidence suggests that DBT and CBT show promise but new interventions developed collaboratively with young people are required.

3.4. THE POTENTIAL OF DIGITAL TECHNOLOGY

Information and communication technologies can increase access to care and improve health outcomes [18]. Adolescents are, familiar with, and frequent users of, technology. The 2016 Ofcom survey shows that 98% of young people aged 12-15 have Internet access with 91% owning a smartphone [19]. One form of digital technology, smartphone apps, are available for a range of mental health problems [20]. There are over 3 million smartphone apps available to download from Google play and over 2 million from the app store. It has been estimated that there are around 165,000 health related apps and of these approximately 48,000 are related to mental health. However, their development has significantly outpaced research and the evidence for their efficacy is largely unknown. Our recent systematic review found very few had been developed for children and young people; none addressed self-harm and only one app had been evaluated in a randomised controlled trial [21]. The need to evaluate apps is important since there are concerns that they could be ineffective or unsafe [22].

Summary: Young people are digital natives with smartphone apps offering the potential to support mental health interventions.

3.5. BLUEICE A SMARTPHONE APP FOR YOUNG PEOPLE WHO SELF-HARM

DEVELOPMENT: we co-designed with young people a smartphone app, BlueIce, to help them manage urges to self-harm. The idea arose from the PIs clinical work where it emerged that nearly all young people who were self-harming had access to their smartphone at the time of self-harm. This theme was explored and developed through a series of workshops. Young people with a lived experience of self-harm discussed (i). the concept (would an app be helpful?), (ii). what it should look like (examples of apps liked and used) (iii) design (font, colours, flow) and (iv). content (evidence based and ideas young people found helpful).

OVERVIEW OF CONTENT: BlueIce includes a mood diary, menu of personalised mood lifting activities and automatic routing through safety checks to delay or prevent self-harm [23]. It provides a personalised toolbox of mood lifting strategies based on CBT and DBT. Mood lifting activities are designed to improve mood and include a personalised music library of uplifting music, photo library of positive memories, physical activities, mood changing activities, audio-taped relaxation and mindfulness exercises, identification and challenging of negative thoughts, a contact list of key people to call or text and distress tolerance activities. After using the mood lifting section young people re-rate their mood and if their urge to self-harm has not reduced they are automatically routed to emergency numbers (Childline, 111) they can call.

SECURITY AND ACCESS: BlueIce is password protected and is available for android and apple smartphones. It is installed on the young person's smartphone via a single use download code which is held centrally by the project team. No information is transmitted from BlueIce nor saved on servers or sites. All information entered by the young person is saved on their smartphone within the app. BlueIce has met the safety and security standards required to be posted on the NHS app library (https://apps.beta.nhs.uk/) and is available, via licence, for child and adolescent mental health services to provide free to their patients (https://www.oxfordhealth.nhs.uk/blueice/). BlueIce is not freely available to directly download but is a prescribed app, i.e. designed to be used alongside a face to face intervention offered by Child and Adolescent Mental Health Services (CAMHS).

INITIAL EVALUATION: We undertook an open case study of 44 young people aged 12-17 attending specialist CAMHS [24]. We identified no safety issues and app acceptability was very good. After a two-week familiarisation phase, 92% of young people wanted to use BlueIce and at the end of the 12-week study 88% wanted to keep it [24]. Qualitative interviews highlighted that BlueIce was very well received and led to some subsequent changes in the final version of the app (addition of different emotions on mood wheel, android version, feedback option) [25]. After 12 weeks of use, symptoms of anxiety and depression significantly reduced; 73% of young people reported that they had stopped or reduced their self-harm with BlueIce preventing 308 incidents of potential self-harm [24].

Summary: In our initial work BlueIce has proven to be safe and acceptable, has improved mood and prevented episodes of self-harm in three quarters of users

Aim: To determine the effectiveness, cost- effectiveness and acceptability of adding BlueIce to usual face to face specialist mental health care (UC+BI) compared to usual face to face specialist mental health care (UC) in the reduction of self-harm in adolescents.

3.6. Methodology

DESIGN: Single blind, two-arm, randomised controlled trial. Participants will be randomised to (i) usual face to face mental health care (UC) and (ii) usual face to face mental health care plus BlueIce (UC+BI).
SETTING: Specialist CAMHS outpatient clinics provided by Oxford Health NHS Foundation Trust located across Bath and North East Somerset, Buckinghamshire, Oxfordshire, Swindon and Wiltshire.
TARGET POPULATION: 138 young people: (i) aged 12-17 (ii) attending specialist CAMHS (iii) history of self-harm (i.e. 2 or more episodes of self-harm over the past 12 months). Young people will be excluded if they are: 1) suicidal, 2) diagnosed with psychosis, 3) where there are current safeguarding concerns (i.e. the young person has suffered abuse within the last 6 months or is the subject of a safeguarding investigation), 4) experience a significant developmental disorder (e.g. autism) which interferes with their ability to use the app.
IDENTIFICATION. We will use the process we employed in our initial study where the decision to approach a young person is made by their CAMHS clinician [23]. The clinician will provide the young person and their carers (if under 16) with the project invitation sheet and research contact details.
CONSENT: For those who make contact, a Research Assistant will contact the young person and, if under 16, their parents or carer to discuss the project information sheet and answer any questions. During COVID-9, consent will be obtained over the telephone. The young person/parent/carer's response to each of the questions will be entered by the researcher on the consent/assent form. The researcher will date and sign the consent/assent form and will email/send a copy to participants. Signed and dated consent from the young person (if over 16) or signed parental consent and young person assent (if under 16) will be obtained.
ALLOCATION: Computer generated randomisation will be independently undertaken by Exeter Clinical Trials Unit. Participants will be randomised in a 1:1 ratio to either UC or UC+BI.
HEALTH TECHNOLOGY: UC+ BI. In addition to the specialist face to face intervention young people will receive from their CAMHS clinician they will also receive access to the BlueIce app. BlueIce is a self-help app co-designed with young people who self-harm. BlueIce is an application for android and apple smartphones. It contains a mood diary, personalised toolbox of mood lifting strategies that are available to the young person 24/7 and automatic routing to emergency contact numbers. (i). Mood diary. The young person is able to monitor their mood each day. For each mood rating the young person has the option of adding a note to record any particular reason why they might be feeling as they do. Their rating and notes are saved in a calendar which the young person and therapist can review to look for changes and patterns over time. (ii). Mood lifting. If the young person rates their mood as low they will automatically be routed to the mood lifting section of BlueIce. Alternatively, if at any time the young person would like to access this section they can do so directly from the main menu. This section contains a menu of mood lifting activities personalised according to the interests of the young person. The activities are designed to counter the common reasons why young people self-harm (to punish themselves; emotional relief; feeling hopeless) and draws on common methods used in cognitive behaviour therapy (CBT) and dialectical behaviour therapy (DBT). The mood lifting section includes 8 activities. 1). Photo library. The young person can upload and save photographs, inspirational quotes and pictures that are associated with happy memories or which might make them feel good. These can be reviewed when low to help the young person remember the positive things in their life. 2). Music library. A music player is included where the young person can upload and store music they enjoy and which has a positive effect on how they feel. This playlist can be readily accessed when the young person is low as a way of improving their mood. 3). Physical activities. The young person can identify physical activities they enjoy such as sporting activities (e.g.

going for a run or riding a bike) or other aerobic activities such as walking the dog or playing with siblings. The young person can access their personalised list when low and be reminded about what they can do to get active to improve their mood. 4). Mood changing activities. BlueIce includes a section of activities that make the young person feel good. These could be things like making a cake, watching an episode of a favourite TV series, reading a book, playing with a pet. These provide the young person with a prompt list of activities they can use to change their mood when feeling down. 5). Relaxation and mindfulness exercises. Audio-recorded instructions for a 10-minute mindfulness session, calming visualisation and a quick controlled breathing exercise (4-7-8 breathing) are included. These can be used to help the young person manage any unpleasant emotions or distressing thoughts. 6). Identification of negative thoughts. This section includes a thought diary where the young person can record any troubling thoughts that are racing through their head. These can be directly typed into BlueIce where they are saved and can be reviewed at a later date. This allows identification of any particular themes that could be addressed during face to face work with their clinician. 7). Ride it out. This section draws on ideas from DBT and helps the young person to tolerate their distress. This includes instructions for an ice dive, a sensory toolbox and a pros and cons balance sheet for self-harming. 8). Call a friend. The final section contains the phone numbers of 3-5 people who the young person could contact if they were feeling low and in danger of self-harming. These would be people who make them feel happy and those they could talk with about how they are feeling. This section prompts the young person to reach out to others. (iii) Emergency contacts. After accessing the mood lifter, the young person is asked to re-rate their mood. If they are still low and feeling that they might harm themselves they will be routed through a series of questions to three emergency contact numbers (Childline, 111 or a nominated friend). The young person can select one of these options to automatically call/text emergency support.

Participants in UC+BI will be provided with a single use code to download the app, a user guide and demonstration video, and a help number to contact in case of problems. After one week, the BlueIce support assistant, who is not involved in the evaluation, will telephone the young person to check that installation was successful and to talk through any technical issues they may have encountered personalising the app. The young person is instructed to use the app as often as they want over the next 12 weeks. At the 12 -week assessment participants will be asked whether they want to keep BlueIce or have it removed from their phone.

Usual care (UC): Young people will receive specialist face to face interventions from their CAMHS clinician for 12 weeks. The nature, content and duration of this will be captured by the resource use questionnaire.

CONTAMINATION: BlueIce is a prescribed app and is not freely available for anyone to download and use. To download BlueIce participants need to activate a single use access code sent to their own smartphone. Single use access codes are held centrally by Oxford Health NHS Foundation Trust and access requests are sent to this project PI. We can therefore monitor who receives the download code and ensure that those in the usual care condition do not have access to it. Once the code is activated, BlueIce will automatically be installed on the participant's smartphone and the access code will no longer work. Participants are therefore unable to share/pass the app/access code to others.

ASSESSMENT SCEDULE: Data will be collected at: i) baseline, (ii) post-intervention (12 weeks), (iii) follow-up (6 months after randomisation). Data will be collected by Research Assistants, blind to treatment allocation. Participants will be given a £20 voucher after completing the final assessment.

(i) Baseline: Standardised self-report measures of self-harm, depression, anxiety, hopelessness, general behaviour, impact, sleep and health-related quality of life. Case note review: to detail resource use i.e. Emergency Department attendances, out of hours contacts, primary and secondary care attendances following incidents of self-harm in the preceding 6 months

(ii) Post-intervention (12 weeks): Standardised self-report measures of self-harm, depression, anxiety, hopelessness, general behaviour, impact, sleep and health-related quality of life will be repeated. Resource use questionnaire to detail Emergency Department attendances, out of hours contacts, primary and secondary care attendances following incidents of self-harm (baseline -12 weeks). Those in UC + BI will complete a semi-structured interview detailing their use, experience of, and satisfaction with BlueIce.

(iii) Follow-up (6 months after randomisation): Standardised self-report measures of self-harm, depression, anxiety, hopelessness, general behaviour, impact, sleep and health-related quality of life. Case note review to detail resource use i.e. Emergency Department attendances, out of hours contacts, primary and secondary care attendances following self-harm from 12 weeks to 6 months. Type and total hours of direct and indirect CAMHS intervention provided from baseline to 6 months

OUTCOME MEASURES: (i) Primary Outcome: *Risk-Taking and Self-Harm Inventory for Adolescents (RTSHIA)* [26]. Our assessment of self-harm will consist of three parts: a brief interview, completion of the Risk Taking and Self-harm Inventory and the provision of support and advice. *Part A: Interview.* We will use items from the Avon Longitudinal Study of Parents and Children (ALSPAC) (http://www.alspac.bris.ac.uk). Young people will be asked "have you ever hurt yourself on purpose in any way (e.g. by taking an overdose of pills or by cutting yourself) over the past 3 months?" Those who answer yes will be asked further questions about frequency, method, reason for self-harming, whether they sought medical help and suicidal intent. *PART B: RTSHIA*. Our primary outcome is self-reported self-harm assessed by the self-harm inventory of the RTSHIA. The RTSHIA was developed in the UK for use with adolescents (aged 11-19 years). It has been used as the primary outcome measure for a recent UK study evaluating a self-harm intervention for young people undertaken in the same setting (CAMHS teams) as we propose [27]. The inventory assesses the presence and frequency of a range of intentional self-injury (e.g. cutting, burning, self-hitting, self-poisoning) over a defined period. We will quantify the frequency of self-harm and will ask additional questions to clarify whether they sought medical help and suicidal intent. The RTSHIA has good reliability and validity [26, 27]. We will use information from this to categorise changes in self-harm from baseline to 12 weeks and 6 months as reduced/stopped vs same/increased. *Part C: Support and Advice*. At the end of the assessment young people will be given a list of contacts they can call if they are feeling worried about themselves. (ii) Secondary outcomes: The *Mood and Feelings Questionnaire* (MFQ) [28], is a self-report questionnaire for depression recommended by NICE consisting of 33 items rated as either "true" (scores 2), "sometimes true" (scores 1) or not true (scores 0). The MFQ has high criterion validity and correlates well with other measures of depression [28]. A total score of 27 and above is associated with major depression, 20 with mild depression and 16 with no mood disorder. The *Beck Hopelessness Scale* [29] consists of 17 true–false items measuring hopelessness and negative expectations for the future. Items endorsed as "true" are summed, with higher scores indicating greater hopelessness. The BHS has been widely used within adolescent samples and has consistently demonstrated strong psychometric properties. *Revised Child Anxiety and Depression Scale (RCADS*) [30] is a 47-item questionnaire with items corresponding to DSM-IV criteria for anxiety in the areas of social phobia, separation anxiety, obsessive compulsive disorder, panic disorder, generalised anxiety

disorder and for major depressive disorder. Each item is rated on a 4-point Likert scale of frequency which are summed to produce sub-scale and total anxiety scores. Age and gender related norms are used to identify clinically significant scores (total score ≥64-80). If the young person is under 16 we will also ask parents to complete this measure. The *Strengths and Difficulties Questionnaire (SDQ)* [31] is a widely used behavioural screening questionnaire consisting of 25 items assessing emotional symptoms, conduct problems, hyperactivity and/or inattention, peer relationship problems, and pro-social behaviour. If the young person is under 16 we will also ask parents to complete this measure. In addition to the total score, a secondary analysis will be undertaken on the impact scale. The *Sleep Condition Indictor (SCI)* is an eight item self-report measure assessing sleep and impact on daytime functioning over the previous month on a 4-point scale. The SCI is an internally consistent (α = .86) measure with a clinical cut-off <17 correctly identifying 89 % of those with probable DSM-5 insomnia disorder [46, 47]. (iii). Qualitative evaluation: We will use the semi-structured interview developed in our initial study [25] to assess participant's (a) experience of BlueIce including use, ratings of satisfaction, helpfulness, ease of use and whether they would recommend it to a friend. In addition we will assess (b) the degree to which BlueIce was implemented as intended. We will assess various areas including how the training video was used; what parts of the mood lifter were personalised; what content of the app was, and was not, used; how frequently BlueIce was used and for how long as well as identifying potential barriers and enablers to use. .Finally, (c) we will assess the number of times the young person used the emergency call on BlueIce and who they called. This will only be completed by UC+BI at 12 weeks. (iv). Economic Analysis: we will use the Child Health Utility 9D (CHUD 9D) in order to assess the health related quality of life (HRQoL). This preference-based generic HRQoL measure is designed specifically for use in the economic evaluation of health care interventions in young people 32. The *CHU9D* contains nine dimensions ('Worried', 'Sad', 'Pain', 'Tired', 'Annoyed', 'Schoolwork/homework', 'Sleep', 'Daily routine', and 'Activities'), each with five levels of functioning. The CHU 9D has been validated for self-completion by young people (aged 7–17 years) [33] and with child and adolescent mental health services [34]. We will use a resource use questionnaire to estimate resource use (including accidents and emergency and primary and secondary contacts) and costs of delivering the intervention.

SAMPLE SIZE: A 3-point difference on our primary outcome (RTSHIA) between treatment groups represents a clinically important difference [27.] However, we propose to adopt a more conservative approach and will power the study to detect a moderate effect representing a 2-point difference. With a SD of 3.6, 90% power, alpha set at 0.05, we will require 69 participants per group to be able to detect a medium effect. We aim to minimise attrition. Revised power calculation (July 2021, request for extension to NIHR): Based on actual retention at 12 weeks (84%) indicates that a total sample of 164 participants is required.

PARTICIAPNT FLOW: Original proposal: Our initial project showed that during the 3-months active recruitment phase we received 12 referrals per month. We will be conducting this study in the same setting and will use the same recruitment process and therefore anticipate similar rates. Over 14 months we will therefore recruit 172 young people. However, in order to allow for the possibility of (i) slow initial start and (ii) lower uptake in the usual care arm, we have planned for a 20-month recruitment period (recruiting 9 participants per month). Revised participation flow (July 2021, request for extension to NIHR)l: During the first COVID lockdown we had to pause recruitment for 3 months (March - June 2020). Our subsequent recruitment rate was lower than anticipated as clinical staff saw fewer patients and adjusted to more online, as opposed to face to face appointments. There was also a national decline in referrals to child mental health services, our recruitment group.

Based on actual recruitment rates for the 14 months the study had been open recruitment was 6 participants per month. To achieve the cohort required we extended recruitment to the end of June 2022.

ANALYSIS: (i) Statistical analysis. Our primary analysis will be at the end of the 12 week follow up of the last recruited participant. A Statistical Analysis Plan (SAP) will be developed by the trial statistician in consultation with the project management group, and agreed with the SSC before database lock. We will follow the CONSORT extension for reporting randomised controlled trails and will follow recommended guidelines for analysis of our data 35. Our primary analysis at 12-weeks will be analysed on an intention to treat principle. Although we are not expecting a significant amount of missing data at 12 weeks the impact of missing data will be assessed by comparing baseline covariates for missing and non-missing cases. In the event that there is evidence of bias being introduced into the analysis then further consideration, including but not limited to multiple imputation, will be given regarding how to address this.

Descriptive statistics will summarise baseline characteristics for each arm and patterns of missing follow-up data will be explored. We will undertake a per protocol analysis of our primary outcome, total scores on the RTSHIA. Regression analysis adjusting for baseline minimisation variables of age, gender, mood and self-harm frequency will be undertaken. We will conduct sensitivity analyses in which we adjust for prognostic variables for which there is a baseline imbalance between intervention arms. Further sensitivity analyses will use multiple imputation to deal with missing data.

Secondary outcomes: Similar regression analyses will be conducted for secondary outcomes (linear regression for numerical outcomes and logistic regression for binary outcomes). All secondary outcome measures will be compared between the groups and will include summary statistics and confidence intervals for measures of effect size.

Analysis of the 6-month data will be included in a repeated measures analysis to investigate the maintenance of any effect seen at 12 weeks. Analysis of the 6-month follow-up data will be undertaken using a repeated measures analysis of variance with both the 12 weeks and 6-month data being included. The analysis will also be adjusted for the baseline minimisation variables: age, gender, mood and frequency of self-harm as proposed for the primary analysis at 12 weeks. This analysis will focus on the maintenance of any treatment effect seen at the 12-week time point (ii) Economic analysis. We will follow good practice for conduct of economic evaluation in health technology assessment and findings will be reported in keeping with the CHEERS guidelines for cost-effectiveness studies. Primary CEA will present results against the primary outcome measure (RTSHIA), and against cost per QALY, using the CHU-9D. CEA will be presented to represent base case estimates and uncertainty will be considered via detailed sensitivity analyses. Results will include disaggregated data, as well as synthesis of cost and outcome data, and will include presentation of cost-effectiveness plane[38], cost-effectiveness acceptability curves, and detailed consideration of the broader impacts of the results reported. National unit costs will be obtained from available sources including PSSRU and NHS reference costs. The bootstrap method will be used to construct the confidence intervals for the incremental cost effectiveness ratio (ICER) estimates and cost effectiveness acceptability curves will be used to describe the likelihood of cost-effectiveness at different cost-effectiveness thresholds. Robustness will be assessed through sensitivity analyses. Multiple imputation will be used to “fill-in” missing cost and outcome data, making the assumption that the data are missing at random. Data on self-reported resource use will be compared with the self-harm assessment data that is recorded in clinical cases (CareNotes). Clinical records will be reviewed for Emergency Department attendances, out of hours contacts, or primary and secondary

care attendances following self-harm over two periods (6 months to baseline; baseline to 6 months). We will also quantify the number of face to face appointments and total number of hours of CAMHS input provided from baseline to 6 months. (iii). Qualitative analysis: Post BlueIce use interviews will be transcribed. Manual analysis and coding of the data will be undertaken with common themes being extracted and summarised.

TIMETABLE: Months 1-4: Recruit research staff, establish project database and infrastructure, liaise with CAMHS teams, familiarisation with assessments. Secure final ethical, research and trusts approvals. First meeting of the SSC; host a workshop with young people to review study research and recruitment processes, project information and consent forms, and website. Months 4-34: Recruit (n=164) participants, secure consent, randomisation, delivery of interventions. Complete baseline assessments. Coding quantitative measures and data entry. Month 12: Publication of trial protocol. Month 15; Second meeting of SSC. Months 7-37: Complete 12 week assessments, coding and entry of quantitative measures. Undertake post-use qualitative interviews (n=69) with UC+BI participants. Transcribing and coding of interviews. Months 10-40: Complete 6 month assessments. Case note reviews of emergency contacts for self-harm pre and post use, quantification of CAMHS intervention input, data coding and entry. Months 21-34: Pre-intervention resource use data collection from clinical records of emergency contacts and support following self-harm. Months 27-43: Undertake qualitative analysis and preparation of report/paper; Undertake quantitative analysis- data base cleansing and analyses. Post-baseline resource use data collection and economic analysis. Participation group workshop to review results and key findings. Month 37: Third meeting of the SSC (teleconference) Months 43: Final meeting of SSC to discuss findings and future plans Months 43 - 46: Prepare papers for publication, project write up & dissemination event

4. OBJECTIVES AND OUTCOME MEASURES

Objectives	**Outcome Measures**	**Timepoint(s) of evaluation of this outcome measure (if applicable)**
Primary Objective To determine the effectiveness of UC + BI compared with UC in reducing self-harm.	Assessed by the Risk-Taking and Self-Harm Inventory for Adolescents (RTSHIA)	Baseline, 12 weeks and 6 months
Secondary Objectives To determine the effectiveness of UC+BI compared to UC on the secondary outcomes of mood anxiety, hopelessness general behaviour and impact	Mood and Feelings Questionnaire, Revised Child Anxiety and Depression Scale Beck Hopelessness Scale Strength and Difficulties Questionnaire.	Baseline, 12 weeks and 6 months

sleep To determine the acceptability of BlueIce To assess the cost and cost effectiveness of UC+BI compared to UC	Sleep Condition Indicator Post-use semi-structured interviews. Cost per QALY adjusted life years on the RTSHIA assessed by the CHU9D.	 12 weeks Baseline, 12 weeks and 6 months
Tertiary Objectives	None	

5. STUDY PROCEDURES

5.1. Discontinuation/Withdrawal of Participants from Study

Each participant has the right to withdraw from the study at any time.

In addition, the participants CAMHS clinician may discontinue a participant from the study at any time if they consider that the young person's mental health has significantly deteriorated, their risk has increased i.e. active suicidal intent or initiation of a safeguarding investigation.

The reason for withdrawal will be recorded in the CRF.

5.2. Definition of End of Study

Recruitment to the study is scheduled to end on 30th June 2022 with the project end date being 30/06/2023.

6. SAFETY REPORTING

There is a possibility that BlueIce might have unintentional consequences and cause frustration or increase unpleasant feelings. For example, the app might crash; functionality might be frustrating whilst a greater focus on self-harm at times of crisis might inadvertently increase feelings of helplessness. This is a small risk and in our initial study we had no such incidents

To address this risk we will only use the app alongside existing therapeutic work where these issues will be regularly reviewed and assessed by the CAMHS therapist.

6.1. Definition of Serious Adverse Events

A serious adverse event is any untoward medical occurrence that:

- results in death
- is life-threatening
- requires inpatient hospitalisation or prolongation of existing hospitalisation
- results in persistent or significant disability/incapacity

Other 'important medical events' may also be considered serious if they jeopardise the participant or require an intervention to prevent one of the above consequences.

NOTE: The term "life-threatening" in the definition of "serious" refers to an event in which the participant was at risk of death at the time of the event; it does not refer to an event which hypothetically might have caused death if it were more severe.

6.2. Reporting Procedures for Serious Adverse Events

A serious adverse event (SAE) occurring to a participant should be reported to the REC that gave a favourable opinion of the study and to the sponsor where in the opinion of the Chief Investigator the event was 'related' (resulted from administration of any of the research procedures) and 'unexpected' in relation to those procedures. Reports of related and unexpected SAEs should be submitted within 15 working days of the Chief Investigator becoming aware of the event, using the HRA report of serious adverse event form (see HRA website).

More information is provided in the BASH protocol for defining, recording and reporting Adverse Events (AEs) and Serious Adverse Events (SAEs).

7. DATA MANAGEMENT

7.1. Access to Data

Direct access will be granted to authorised representatives from the Sponsor or host institution for monitoring and/or audit of the study to ensure compliance with regulations.

Research assessment data will be stored on password protected computers. Data will be anonymised using participant codes not names. A master sheet of names and participant codes and copies of signed consent will be kept in a locked filing cabinet separate from the database. Access to the filing cabinet and password protected data folder will be restricted to the CI and Research Assistant involved in this study.

7.2. Data Recording and Record Keeping

- Paper assessments will be anonymised with participant codes. These will not be retained and will be destroyed (shredded) at the end of the study.
- Interviews with young people will be audio-recorded. These interviews will not include personal identifiable information (use first name only). These will not be retained and will be wiped once the interviews have been transcribed.

- Assessment data will be saved on a password protected database on the Trust secure NHS central server. No personally identifiable data will be stored on the database. Access will be restricted to the CI and research team. The folders will be deleted after 5 years
- Assessment data may be collected on NHS laptops. This will not contain any personal identifiable information. Assessment data will be saved under the participant's code not name. Assessment data will be uploaded to the secure NHS central server as soon as possible and data on laptops will be removed.

8. QUALITY ASSURANCE PROCEDURES

The study may be monitored, or audited in accordance with the current approved protocol, GCP, relevant regulations and standard operating procedures.

The sponsor will monitor the progress of the study, centrally by reviewing a copy of the Ethics Annual Review form, and amendment information received by the R&D office. The study may be monitored to check for compliance with the protocol and ethical approval. Any concerns regarding study conduct will flag an audit or monitoring visit to identify and address areas requiring additional support and guidance.

9. ETHICAL AND REGULATORY CONSIDERATIONS

Recruitment: We will recruit young people who are being seen by specialist child and adolescent mental health services (CAMHS). BlueIce will be offered to those young people who are regularly self-harming and will be used alongside their CAMHS intervention. In order to ensure safety, the decision to offer BlueIce will be made by the CAMHS clinician providing their care.

High risk young people: Some young people seen by specialist CAMHS will have suicidal ideation. This is routinely assessed as part of the risk assessment undertaken by the CAMHS clinician at each appointment. Those with suicidal ideation or considered by their clinician to be at significant risk will be excluded from the study and will not be offered BlueIce. If suicidal ideation develops after BlueIce has been offered the app will be withdrawn.

Consent: The study involves a vulnerable group, young people with mental health problems, receiving a novel intervention. For participation in the study signed assent from the young person and parental consent will be obtained for those under 16 years of age. For those older than 16, signed consent from the young person will be obtained.

Unintentional Consequences: There is a possibility that BlueIce might cause frustration or increase unpleasant feelings. For example, the app might crash; functionality might be frustrating whilst a greater focus on self-harm at times of crisis might inadvertently increase feelings of helplessness.
To address this risk we will only use the app alongside existing therapeutic work where these issues will be regularly reviewed and assessed by the CAMHS therapist.

Safeguarding: There is a risk that young people may disclose information during research assessments that indicates possible abuse or harm. In all cases the local CAMHS team will be alerted and local safeguarding procedures will be followed.

9.1. Declaration of Helsinki

The Investigator will ensure that this study is conducted in accordance with the principles of the Declaration of Helsinki. Guidelines for Good Clinical Practice

The Investigator will ensure that this study is conducted in accordance with relevant regulations and with Good Clinical Practice.

9.2. Approvals

The protocol, informed consent and assent forms and participant information sheets will be submitted to an appropriate Research Ethics Committee (REC), and host institution(s) for written approval.

The Investigator will submit and, where necessary, obtain approval from the above parties for all substantial amendments to the original approved documents.

9.3. Reporting

The CI shall submit once a year throughout the study or on request, an Annual Progress report to the REC Committee, host organisation and Sponsor. In addition, an End of Study notification and final report will be submitted to the same parties.

9.4. Participant Confidentiality

The study staff will ensure that the participants' anonymity is maintained. The participants will be identified only by initials and a participants ID number on the CRF and any electronic database. All documents will be stored securely and only accessible by study staff and authorised personnel. The study will comply with the Data Protection Act, which requires data to be anonymised as soon as it is practical to do so.

9.5. Expenses and Benefits

No assessments will involve additional travel for participants. Assessments will either be undertaken at CAMHS clinics (when they attend their planned appointments) or at their home.

We have looked at guidance: Mental Health Research Network and INVOLVE (2013) Budgeting for involvement: Practical advice on budgeting for actively involving the public in research studies. We will therefore offer each participant £20 (in vouchers) to compensate for the time involved in completing assessments.

10. FINANCE AND INSURANCE

10.1. Funding

Research Funding has been obtained for this study from the NIHR RfPB totalling £352, 792

10.2. Insurance

The study is sponsored by Oxford Health NHS Foundation Trust who will provide indemnity for the duration of the study. NHS bodies are legally liable for the negligent acts and omissions of their employees. If a participant is harmed whilst taking part in a clinical research study as a result of negligence on the part of a member of the study team this liability cover would apply.

Non-negligent harm is not covered by the NHS indemnity scheme and NHS Trusts, therefore, cannot agree in advance to pay compensation in these circumstances.

In exceptional circumstances an ex-gratia payment may be offered.

11. PUBLICATION POLICY

The Investigators will be involved in reviewing drafts of the manuscripts, abstracts, press releases and any other publications arising from the study. Authors will acknowledge that the study was funded by the Health Foundation. Authorship will be determined in accordance with the ICMJE guidelines and other contributors will be acknowledged.

We will not use identifiable personal data when presenting the results. Quantitative data will be reported at a group, not individual level. Any quotes will be referred to as "participant X".

We will prepare and send a summary of the results to all participants and will provide a summary on our Trust website

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13. APPENDIX C: AMENDMENT HISTORY

Amendment No.	Protocol Version No.	Date issued	Author(s) of changes	Details of Changes made
1	1	29/08/2019	Paul Stallard	Updated the addition of the Sleep Condition Indicator to assess sleep (approved 29/08/2019)
2	1	18/05/2020	Paul Stallard	Change to consent process to include telephone consent
3	2		Paul Stallard	Revised project timeline and extension for recruitment