An evaluation of an innovative telephone app (BlueIce) for young people (aged 11-17) who self-harm

Background

Self-harm is defined as intentional self-poisoning or self-injury, irrespective of type of motive or the extent of suicidal intent [1]. Self-harm is a risk factor for suicide. Although suicide rates in those under the age of 18 are comparatively low approximately half of those who commit suicide have been found to have a previous history of self-harm [2]. However, the majority of self-harm in adolescence is self-destructive and often occurs without suicidal intent (non-suicidal self-injury).

Whilst suicide rates in this age group are low self-harm is unfortunately common with community studies from many countries consistently reporting a lifetime risk of 13-18% [3, 4, 5, 6, 7). Of those who self-harm, half will report multiple self-harming events [6]. For example, in a UK community survey of young people aged 12-16 from 8 schools 15% reported acts of self-harm over the past 12 months with 55% reporting self-harm over two consecutive six month episodes [8].

In community surveys in developed countries 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 [5, 6, 9]. However, comparatively few episodes of self-harm result in hospital presentations with most being undertaken in private and remaining hidden [10].

The aim of this study is to explore the safety, acceptability, feasibility and usability of a novel smart phone app BlueIce, with young people aged 12-18 years who are self-harming.

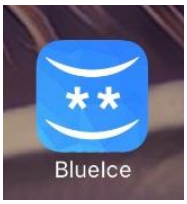
Methods

Setting and participants: This study was undertaken in specialist child and adolescent mental health services (CAMHS) provided by Oxford Health NHS Foundation Trust. The Trust serves a wide geographical area that includes Bath and North East Somerset, Buckinghamshire, Oxfordshire, Swindon and Wiltshire

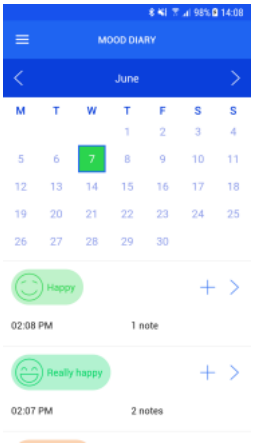
Eligibility: Participants were aged 12 -18 with a history of repeated self-harm. Participants may be currently self-harming (within the past 4 weeks) or have a history of self-harm and feel that they will harm themselves again. BlueIce is designed to be used alongside specialist CAMHS so young people must be in receipt of an on-going face to face CAMHS intervention.

Young people were excluded if they had active suicidal ideation and were seriously contemplating or planning a suicide attempt. Secondly, young people were excluded if they were diagnosed with psychosis or had a significant learning disability which might impede their ability to use the app. Thirdly, we excluded young people who had been subject to abuse within the last 6 months or were the subject of a safeguarding investigation. Finally, BlueIce is only available in English and we therefore excluded those who are unable to understand English.

BlueIce

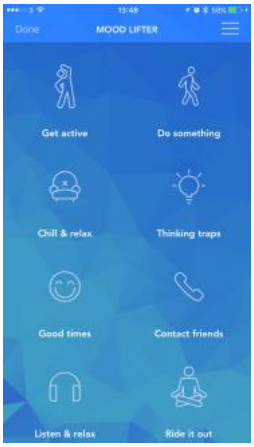


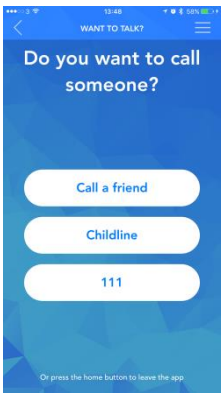
The app icon is discrete and makes no reference to self-harm.



Once opened the young person is invited to monitor their mood which is saved in their mood diary.

If feeling low, the young person is automatically routed to the mood lifting section of the app. This consists of 8 different sections, informed by evidence (CBT and CBT) which are personalised to reflect the young person's interests. These include: a photo library of happy memories; a music library of uplifting music; enjoyable physical activities; mood changing activities; audio relaxation and mindfulness exercises; negative thought diary and challenge; activities to tolerate distress and a priority list of friends to call.





After use the young person re-rates their mood and if still down will be routed to an emergency screen where they can request help.

Recruitment: Project information was provided to all 10 clinical teams followed by meetings to demonstrate BlueIce. Clinicians were provided with project information sheets which they were asked to discuss with eligible young people. Details of interested young people were passed by the clinician to the research team. The researcher contacted the young person to discuss the project and to obtain written consent. For those under the age of 16, parental consent was also obtained.

Procedure: Baseline assessments: Interested young people met with the research team to explain the study, obtain informed consent and complete baseline assessments. BlueIce was downloaded and personalised. The young person was asked to familiarise themselves with it over the following two weeks but not to use it times of distress. Familiarisation interview: A second meeting was

arranged 2 weeks later to discuss acceptability, possible use, and any safety issues. Those young people who decide to continue used BlueIce for the next 10 weeks. Post-use interview: A final interview was undertaken where baseline assessments were repeated, use and changes in self-harm were assessed.

Measures: Young people and their carers (if under 16 years of age) completed the Revised Child Anxiety Scales (RCADS) [18, 19, 20] and Strengths and Difficulties Questionnaire (SDQ) [21]. These provide an assessment of anxiety, depression and behavioural problems. Young people also completed the Mood and Feelings Questionnaire (MFQ) [22], a standardised measure to assess depression. All questionnaires were completed at baseline and after using BlueIce for 10 weeks.

Safety: Semi-structured interviews were undertaken post-familiarisation and at follow-up. These focused on safety and in particular whether BlueIce worked as intended (i.e. did not crash or freeze) and that it had no unintentional adverse effects and increase acts of self-harm. Finally, young people rated the extent to which BlueIce could be used at times of distress and whether it might help.

Acceptability: The number who wanted to use BlueIce after post-familiarisation will be recorded. Post-use interviews on will assess ease of use, helpfulness and whether they would recommend BlueIce to a friend.

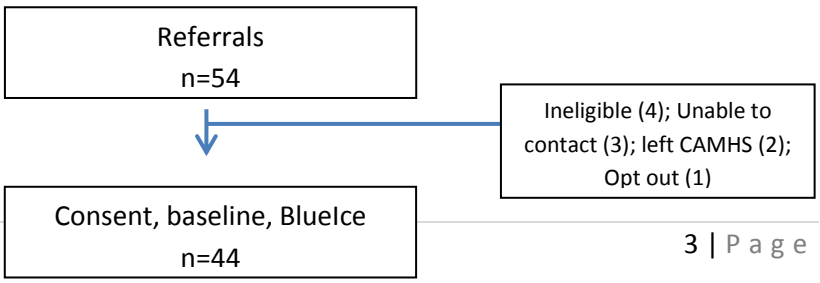
Self-harm: Information was obtained from referring clinicians about whether the young person had been self-harming in the 4 weeks before using BlueIce. During post-use interviews assessed whether the young person had self-harmed during the 10 week trial and whether BlueIce had helped to prevent any episodes of self-harm and if so, how many.

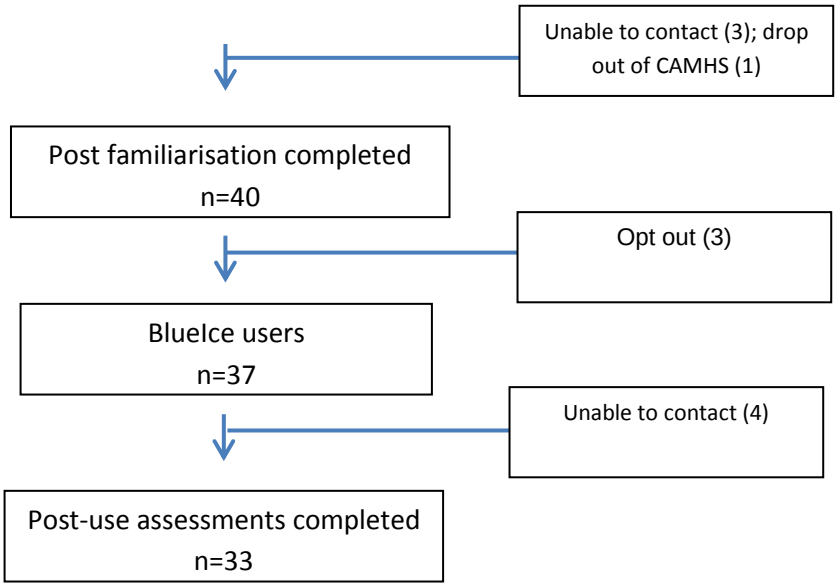
Results

a) Participant flow

37 different clinicians from 8 teams referred 54 young people between May and October 2017. All of the core CAMHS professional groups referred young people. Referrals were received from Child Psychologists and Psychotherapists (9), Senior Mental Health Practitioners (8), Nurses (6), Child and Adolescent Psychiatrists (4), Family Therapists (4), Other Therapists (4), and Social workers (2).
Of the 54 referrals, 4 did not meet inclusion criteria, 3 we were unable to contact, 2 dropped out of CAMHS before we could obtain consent and 1 declined to participate. A total of 44 young people completed baseline assessments with 40 (90.9%) completing post familiarisation interviews and entering the BlueIce use phase. Of these, 33 (82.5%) completed post-use assessments (Figure 1).

Figure 1: Participant flow





b) Demographics and Baseline Assessments

Baseline data is summarised in Table 1.

Table 1: Characteristics of participants and young person report baseline symptomatology

Characteristic		
Male : Female, (number)	4 : 40	
Age, (number) 12 13 14 15 16 17	 1 5 3 9 15 11	
Self-harmed at least once in past 4 weeks (number, %)	30 (68.2%)	
	Child report	Parent report
Mood and Feelings Questionnaire (MFQ) Total MFQ, Mean (SD)	 43.57 (9.58)	 N/A
Revised Child Anxiety and depression Scale (RCADS) Total RCADS, Mean (SD)	 81.00 (21.88)	 75.35 (26.93)
Strengths and Difficulties Questionnaire (SDQ) Total SDQ, Mean (SD)	 21.36 (3.28)	 23.82 (6.30)
SDQ Impact on life Definite or severe problem Problem present longer than 12 months Causes medium – great deal of distress Effect on home life (medium – great deal) Effect on friendships (medium – great deal) Effect on ability to learn (medium – great deal)	 33/39 (84.6%) 33/39 (84.6%) 31/39 (79.5%) 23/38 (60.5%) 31/39 (79.6%) 28/37 (75.7%)	 17/18 (94.4%) 17/18 (94.4%) 18/18 (100%) 14/18 (77.8%) 16/18 (88.9%) 11/18 (61.1%)

Effect on leisure (medium – great deal)	29/38 (73.3%)	14/18 (77.8%)
Burden on you and family (quite a lot – great deal)	31/39 (79.5%)	15/18 (83.3%)

The group was predominantly girls (40; 90.9%) with an average age of 15.98 years (sd= 1.37; range 12.70 -17.80). Data summarised in Table 1 indicates that both young people (YP) and parents (P) identified significant problems (YP=84.6%; P=94.4%) which had been present for longer than 6 months (YP=84.6%; P=94.4%) and caused significant distress (YP=79.5%; P=100%).

(i). Self-report

Using recommended cut-offs, 42 young people (95.5%) scored 29 or more on the MFQ suggesting probable depression. Using age and gender adjusted cut-offs on the RCADS 37 (84.1%) screened positive for one or more probable anxiety disorders and 37 (84.1%) scored above cut-offs on the SDQ for a probable emotional disorder.

(ii) Parent-report

On the RCADS, 16/17 (94.1%) parents rated their child above the cut-off for depression and 16/18 parents (88.9%) scored their child above the cut-off on the SDQ for significant emotional problems.

c) BlueIce acceptability, helpfulness and use.

Two weeks after installing BlueIce 40 (90.1%) of those who consented completed post-familiarisation interviews. Initial views about use, possible unintentional harm and helpfulness were assessed (Table 2). No safety issues were identified. BlueIce did not crash and no-one thought that it would make them harm more. Of these 40 young people, 37 (92.5%) elected to use BlueIce for the 12 week trial.

Table 2: Post familiarisation feedback

Post Familiarisation (2 weeks)	No	Maybe	Not sure	Think so	Definitely
Would you be able to use BlueIce if you had thoughts of self harm?	2	2	3	20	13
Do you think BlueIce might make you harm more	32	4	4	0	0
Do you think BlueIce would help you to stop harming	2	6	8	15	9
Post-Use (12 weeks)			x (sd)		
How easy was it to use BlueIce (1 not at all -10 very easy)			8.86 (1.22)		
How helpful did you find BlueIce (1 very unhelpful – 10 very helpful)			6.58 (2.15)		
Would you recommend BlueIce to a friend (1 no – 10 definitely)			8.60 (1.64)		

Post-use assessments were complete with 33/37 (89.2%) of those who elected to use BlueIce. Participants were asked to rate ease of use, helpfulness and whether they would recommend BlueIce on a 10 point scale (higher score = more positive endorsement). Results suggest that BlueIce was intuitive and easy to use and that nearly all young people would recommend it to a friend. Ratings of usefulness were again high with 29 (88%) wanting to keep BlueIce at the end of 12 weeks.

Of those who didn't want it, 1 no longer felt she needed it, 2 were not ready to stop self-harming and 1 felt it was too much of a chore to use.

d) Post-use psychological outcomes

Paired t tests were undertaken to compare baseline and post-use ratings on the standardised measures of depression (MFQ), anxiety (RCADS) and behaviour (SDQ). The results are presented in table 3.

(i). Self-report

There was a statistically significant mean difference of 4.91 (95%CI, 0.17 to 9.64, t (31) = 2.11, p<.043) on post-use symptoms of depression (MFQ), of 13.53 on symptoms of anxiety (RCADS) (95%CI, 6.17 to 20.90, t(30) = 3.76, p<.001) which was evident across all sub-scales. There was no change in behaviour (SDQ) other than a statistically significant mean difference of 0.84 on the emotional sub-scale (95%CI, .25 to 1.44, t(29)=2.90, p<.007).

The analysis was repeated comparing those who reported no change in self-harm (n=7) vs those who had not harmed or did so at a reduced rate (n=26). There were no post use changes on any measure for those who self harmed at the same rate. For those who had not harmed or did so at a reduced rate, there was a 7.48 post use reduction on mean MFQ (95%CI, 1.94 to 13.03, t(24)=2.78, p<.010); 16 point mean reduction on the RCADS (95%CI, 7.63 to 24.37, t(24)=3.95, p<.001) and 1.0 mean reduction on the emotional subscale of the SDQ (95%CI, .27 to 1.73, t(24)=2.81, p<.010).

(ii). Parent-report

18 parents of children younger than 16 completed baseline measures with 13 completing post use questionnaires. There were no significant differences on the parent completed RCADS. However, on the SDQ, there was a statistically significant post-use mean difference of 0.92 on the emotional sub-scale (95%CI, .083 to 1.75, t(11) = 2.42, p<.034), 2.61 on the peer relationship sub scale (95%CI, .334 to 4.90, t(12) = 2.50, p<.028) and 4.08 on the total score (95%CI, 2.16 to 6.01, t(11) = 4.67, p<.001).

Table 3: Paired baseline and follow-up scores on standardised measures

Self-report (n=30-32)	Baseline x (sd)	Follow-up x (sd)	Significance
Mood and Feelings Questionnaire (MFQ)			
Total MFQ	42.75 (10.73)	37.84 (15.44)	p=.043
Revised Child Anxiety & Depression Scale (RCADS)			
Panic disorder	14.00 (7.31)	11.20 (6.40)	t=2.90, df=29, p.007
Separation anxiety disorder	8.90 (4.20)	7.37 (4.97)	t=2.77, df=28, p=.010
Generalised anxiety disorder	11.27 (3.50)	9.50 (4.05)	t= 2.72, df=29, p=.011
Social Anxiety disorder	19.67 (5.65)	16.60 (6.33)	t=3.58, df=29, p=.001
OCD	6.97 (4.21)	5.70 (4.74)	t=2.64, df=29, p=.013
Depression	19.16 (5.13)	16.58 (6.62)	t=2.40, df=30, p=.023
Total RCADS	80.33 (23.75)	66.80 (28.46)	t=3.76, df=29, p=.001
Strength & Difficulties Questionnaire (SDQ)			
Hyperactivity scale	5.44 (1.63)	5.22 (1.83)	t=0.62, df=31, p=.543
Emotional symptoms scale	7.91 (1.51)	7.06 (2.17)	t=2.90, df=31, p=.007
Peer problems scale	4.91 (1.55)	5.25 (1.61)	t=-1.36, df=31,p=.183

Prosocial scale	7.34 (2.24)	7.63 (1.56)	t=-1.01, df=31, p=.319
Conduct problems scale	2.91 (1.23)	2.75 (1.05)	t=0.67, df=31, p=.510
Total SDQ	21.16 (3.35)	20.28 (4.47)	t=1.16, df=31, p=.255
Parent-report (n=10-13)	Baseline x (sd)	Follow-up x (sd)	Significance
Revised Child Anxiety & Depression Scale (RCADS)			
Panic disorder	13.70 (6.36)	12.10 (4.04)	t=1.50, df=9, p=.168
Separation anxiety disorder	10.73 (5.29)	9.91 (4.74)	t=1.22, df=10, p=.251
Generalised anxiety disorder	11.55 (4.74)	10.00 (2.93)	t=1.76, df=10, p=.109
Social Anxiety disorder	18.64 (5.56)	17.64 (6.14)	t=1.08, df=10, p=.305
OCD	9.10 (5.86)	9.50 (5.15)	t=.557, df=9,p=.591
Depression	17.91 (6.49)	17.64 (6.35)	t=.273, df=10, p=.791
Total RCADS	80.90 (30.49)	77.70 (23.21)	t=1.027, df=9, p=.331
Strength & Difficulties Questionnaire (SDQ)			
Hyperactivity scale	4.31 (1.65)	4.15 (1.91)	t=.413, df=12, p=.687
Emotional symptoms scale	8.17 (2.37)	7.25 (2.60)	t=2.42, df=11, p=.034
Peer problems scale	8.38 (3.82)	5.77 (1.79)	t=2.50, df=12, p=.028
Prosocial scale	7.23 (1.64)	6.54 (1.85)	t=1.03, df=12, p=.324
Conduct problems scale	2.92 (1.12)	3.23 (1.83)	t=.716, df=12, p=.487
Total SDQ	24.58 (6.95)	20.50 (6.25)	t=4.67, df=11, p=.001

Numbers were too small to compare parental reported changes in symptoms for young people who reported changes in self herm vs those who were self-harming at the same rate.

e) Changes in self-harm

Self-report changes in self harm were assessed during post-use interviews. We are aware that this may be subject to various biases but self-report is the only way we can quantify self-harming urges that are not acted upon. All of those who reported not self-harming in the 4 weeks before baseline assessment maintained their status and had not self-harmed over the course of the 12 week trial. Of those who had self-harmed at baseline, 4 (15.4%) had completely stopped with a further 15 (57.7%) reporting less frequent acts of self-harm. There were a small group of young people (7, 26.9%) who reported no reductions in their self-harming behaviour over the 12 week trial.

Baseline self harm status	Number	Post use (12 week) self-harm status	Number
Not self-harmed in 4 weeks before baseline assessment	7	Not self-harmed at follow-up Self-harmed during follow-up	7 0
Self harmed in 4 weeks before baseline assessment	26	Not self-harmed during follow-up Self-harmed during follow-up at a reduced rate Self-harmed during follow-up at same rate	4 15 7

We calculated the number of self-harm acts prevented in two ways. Firstly, we obtained data on baseline rates of self-harm for 4 young people who had stopped self-harming at follow-up. We used this to estimate the number of self-harm events that were prevented, if they continued to self-harm at the same rate, during the 12 week study. Secondly, for the 14 who continued to self-harm but at a reduced rate we assessed during post-use interviews how many episodes BlueIce had prevented. These calculations suggest that a total of 308 incidents of self-harm were prevented during the course of this study.

f) Potential cost savings

The majority of self-harming incidents will not result in a hospital attendance. Nonetheless we can make some assumptions about the number that may have resulted in A&E attendance to examine the potential range of costs savings that BlueIce has accumulated.

Cost of the Intervention: The initial development costs of BlueIce were £16,000 which, for the 40 young people involved in this project, equates to £400 per person. A mental health (Band 4) worker helped young people to download and personalise BlueIce (1 hour at approximately £20 per hour plus travel £5). The total cost of delivering BlueIce in this project was £17,000 or £425 per person.

Potential savings: Department of Health reference costs for 2015, indicate that the cost of an A&E attendance is £132 and a specialist mental health contact £230, a total of £362 per episode. The figures in the table below show the range of potential savings based on a series of assumptions about how many of these 308 episodes would have resulted in A&E attendance and a mental health assessment (total cost= £362 per episode).

Ratio of hospital attendance to self-harming episodes	Number of hospital attendances prevented	Potential savings at £362 per attendance
1: 8	38	£13,756
1:15	20	£7,240
1:50	6	£2,172
1: 100	3	£1,086

The majority of the costs associated with BlueIce are fixed (development of the app) and will significantly reduce with more users. Our results suggest that at scale, BlueIce offers significant potential cumulative savings to the NHS in terms of reduced hospital attendance.

Limitations

Whilst our results are promising we are aware of a number of limitations of this project.

- **Comparison group:** This study reports on a convenience sample of young people who have used BlueIce. We do not know how representative these are of the wider group of young people who self-harm. .
- **Usual care or BlueIce?** BlueIce has been offered to young people receiving face to face CAMHS interventions. The improvements we note may be due to the face to face care, rather than BlueIce. A more robust research design is required to determine the additional benefits of BlueIce.
- **Objective data:** We have relied extensively on self-report to assess changes in self-harm. Within the resources available we were unable to validate these reports through exploration of hospital records of A&E attendances. Similarly, a detailed cost-analysis was not an aim of this project which was concerned with establishing safety, use and acceptability.

- **Retrospective assessment:** We assessed self-harm at fixed points of time and therefore relied on retrospective recall. This can be subject to recall bias and demand characteristics (e.g. pleasing the assessor). A more accurate way of assessing self-harm could be via prospective dairies. However, given the early stage nature of this work we consider our approach was appropriate.
- **Economic analysis:** We are aware that the cost effectiveness analysis we have outlined is speculative. We have nonetheless included this as a way of identifying a range of potential savings that might result from BlueIce.

Conclusions

- **Safety:** No young people rated BlueIce as potentially increasing their self harming. No functionality issues were reported and BlueIce did not crash. Post-use interviews highlighted that no young person reported increased rates of self-harm after using BlueIce.
- **Acceptability:** All professional groups within the service engaged with this project suggesting that BlueIce is acceptable to clinicians as an adjunct to face to face meetings. Of those young people who were familiarised with BlueIce, 92.5% elected to use the app. Young people gave high ratings in response to the question about whether they would recommend BlueIce to a friend.
- **Use:** Young people thought that BlueIce was intuitive and easy to use. 82.5% thought they would be able to use BlueIce if they had thoughts pf self-harm. Post-use feedback suggests that on some occasions the distress was too intense for the young people to resist.
- **Outcomes:** There were significant reductions on standardised measures of mood and anxiety after using BlueIce. All young people who had not recently self-harmed before using BlueIce maintained their non-harming status at follow-up. Of those who had recently self-harmed, 75% were either no longer harming or doing so at a reduced rate.
- **Cost benefits:** Our findings suggest that 308 episodes of self-harm have been prevented. Based on a range of assumptions about the ratio of self-harming events that might result in a hospital presentation these findings suggest that BlueIce offers considerable savings to the NHS.

Acknowledgement

This work was funded by grants from the Health Foundation and NHS England (Digital Labs)

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