An early economic evaluation of Kooth, a web-based mental health platform for children and young people with emerging mental health needs

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ARTICLE INFO

ABSTRACT

Background: "Kooth" is a web-based mental health platform commissioned by the National Health Service (NHS), local authorities, charities, and businesses in the UK. The platform gives children and young people (CYP) access to an online community of peers and a team of counsellors. This study reports an early economic evaluation of the potential benefits of Kooth in the UK.

Methods: An early evidence cost calculator was built to estimate the potential costs and savings of implementing Kooth from a UK NHS and crime sector perspective. A decision tree structure was used to track the progress of CYP with emerging mental health needs (EMHN), comparing CYP with access to Kooth to CYP without access to Kooth. The model implemented a 12-month time horizon and followed a typical Kooth contract in relation to costing, engagement, and CYP demographics.

Results: The base case results followed a cohort of 2160 CYP. The results of the cost calculator estimated that engagement with Kooth is associated with a cost saving of £469,237 to the NHS across a 12-month time horizon, or £236.15 per CYP with an EMHN. From a combined NHS and UK crime sector perspective, the cost savings increased to £489,897, or £246.54 per CYP with an EMHN. The largest cost savings were provided by an estimated reduction of 5346 GP appointments and 298 antidepressant prescriptions. For this cohort, the model predicted that engagement with Kooth averted 6 hospitalisations due to suicidal ideation and 13 hospitalisations due to self-harm. Furthermore, the number of smokers and binge drinkers was reduced by 20 and 24, respectively. When a crime sector perspective was taken, 3 crimes were averted.

Discussion: This early model demonstrates that Kooth has the potential to be a cost-saving intervention from both an NHS and a combined NHS and UK crime sector perspective. Cost savings were provided through aversion in clinical and social outcomes. The model used a conservative approach to balance the uncertainty around assumptions of the intermediate outcomes (GP and medication use). However, it is limited by a paucity of costing data and published evidence relating to the impact of digital mental health platforms.

1. Background

Mental illnesses, or mental health disorders, describe a range of conditions that affect how a person thinks, feels, or interacts with other people. In the UK, mental ill health in children and young people (CYP) is on the rise. In 2023, one in five CYP had a probable mental health disorder (NHS Digital, 2023) – almost double that recorded in 2017 (NHS Digital, 2020). Failing to address mental health disorders in CYP can have profound consequences into adulthood. For example, it is

associated with high-risk behaviours, such as smoking, drug misuse and alcohol abuse, and a greater risk of physical and mental health disorders in later life (Egan et al., 2015). Psychological distress may also negatively impact a young person's educational achievements and labour market prospectives, which may confer an added economic impact (Egan et al., 2015).

In the UK National Health Service (NHS), support for CYP with emotional, behavioural, or mental health difficulties is available through Child and Adolescent Mental Health Services (CAMHS). These

services are supported by teams of nurses, therapists, psychologists, support workers, and other professionals in an individual's local area. In recent years, these services have come under increasing pressure; from 2016 to 2022, there was a three-fold increase in the number of people in contact with CAMHS (NHS Digital, n.d.). The economic burden of these services is also substantial. When inflated to 2020 levels, the average annual cost of CAMHS is £1521 per CYP aged 5 to 15 (Stevens et al., 2022). The importance of investing in mental health services is recognised in the NHS Long Term Plan (NHS, 2019). However, even if the NHS achieves the 2023/24 CAMHS access targets, this would only equate to around two-fifths of eligible CYP with a diagnosable mental health disorder accessing appropriate services (Garratt et al., 2024). This leaves a substantial unmet need.

Digital peer-support interventions are an alternative to traditional mental healthcare and have been associated with improvements in biomedical and psychosocial outcomes in people with mental health disorders (Fortuna et al., 2020). Kooth.com ("Kooth") is a web-based service that gives CYP aged 11 to 19 access to an online community of peers and a team of experienced counsellors. The service has been providing counselling and mental health support to the NHS for over 20 years and is accessed 1.3 million times per year in the UK (Kooth, n.d.). A key value proposition of Kooth is that no formal referral from a healthcare practitioner is needed and that access is free to the end users.

Evidence suggests that engagement with Kooth is associated with reductions in psychological distress, suicidal ideation, loneliness, and reported self-harm (Stevens et al., 2022). Notably, the observed benefits were similar between users who only used the community/peer-support functionality of Kooth and for those who engaged with Kooth's counsellors (Stevens et al., 2022). However, the study was limited by the absence of a control group and only evaluated the impact after one month of use. The cost-impact of Kooth is also yet to be quantified. As such, there is limited evidence ascertaining the effectiveness of the service.

1.1. Aims of the study

This study aimed to generate early economic evidence of the potential benefits of implementing Kooth in the UK NHS. This was achieved by estimating the potential impact on a range of immediate and intermediate outcomes for CYP and then calculating the subsequent incremental costs and savings to the UK NHS and crime sector. The results of the study provide an early assessment of the potential cost-effectiveness of Kooth. However, they will need to be supplemented following the publication of more robust data evaluating the impact of the platform on primary measures of mental health in CYP.

2. Methods

Economic modelling was undertaken to estimate the costs associated with mental ill health to public services for CYP registered with the Kooth platform, compared with a population that did not. To measure the impact of Kooth, we calculated outcomes such as the number of hospitalisations due to suicidal ideation and self-harm, crimes committed, smoking status, binge drinking, the number of GP appointments attended, and antidepressant prescriptions. The model was created from the perspective of the UK public services, focusing on the healthcare and crime sector. However, results have also been reported from the perspective of the UK NHS only. All costs are reported in GPB (£) for the 2021/22 cost year. The model implemented a one-year time horizon. As such, no discounting was introduced.

2.1. Population

The study population of interest was CYP with emerging mental health needs (EMHN) in the UK. A cohort of 2160 people was used as the model population. This was based on a current contract between Kooth

and a local authority in England. Retrospective ethics approval of the study was granted by the University of Kent School of Psychology (Ethics ID: 202216601257977878).

2.2. Model structure and data analytic procedures

The Young Person's Clinical Outcomes in Routine Evaluation (YP-CORE) questionnaire was used to determine the proportion of CYP with an EMHN. The YP-CORE is a measure of psychological distress and is widely used in mental health and school counselling services (Twigg et al., 2009). Users could choose to participate in the survey upon registration for Kooth.

The model structure was separated into two parts. Firstly, for the intervention (Kooth) arm of the model, a decision tree was used to determine the proportion of the registered population with an EMHN and the proportion engaging with the Kooth platform (Fig. 1). A score of 15 (moderate level) or greater on the YP-CORE was used as a proxy for the EMHN population. Lower levels of psychological distress were not included, with the aim to take a conservative approach in this early model. Data provided by Kooth showed that 92.0 % of registrants ($n = 2160$) were defined as having an EMHN. "Engaged" users were defined as those with an EMHN who completed an activity on Kooth within one month of creating an account. From October 2019 to June 2021, the engagement rate of the model population ($n = 1987$) was 76.5 %. This was extracted from data provided by Kooth.

Immediate changes to mental health-related outcomes in CYP following engagement with Kooth were extracted from a study published by the London School of Economics (LSE) in 2021 (Stevens et al., 2021). The study used online surveys to assess the mental health and wellbeing of Kooth registrants at baseline and at one-month follow-up. The outcomes evaluated in the LSE study (and the evaluation method for each outcome) that were used within this economic model were as follows:

- Suicidal ideation (Suicidal Ideation Attributes Scale [SIDAS]).
- Self-harm (A2-item questionnaire) (Moran et al., 2012).
- Perceived impact of difficulties (Strengths and Difficulties Questionnaire [SDQ]) (Goodman et al., 1998).

These outcomes were selected because they were associated with more robust data availability. Other outcomes from the LSE study were excluded if the associated costs were uncertain or difficult to ascertain. This decision was made to ensure the modelling approach remained conservative and to limit the amount of uncertainty introduced. In the model, the selected outcomes were termed "immediate outcomes". Baseline scores (i.e. survey scores recorded prior to engagement) were used to represent the outcomes of CYP who do not have access to Kooth. The scores recorded at the one-month follow-up were used to represent the outcomes of CYP engaging with the service.

A key modelling assumption was that engagement with Kooth can only impact the immediate outcomes of a CYP if they had previously presented with these outcomes to a Kooth practitioner (i.e. the user had displayed one of the immediate outcomes as a "presenting issue" during interaction with Kooth). This could have been either via a one-to-one therapeutic chat, or interaction with the moderated Kooth community. This conservative assumption ensures that the model is focused on outcomes that are of primary concern to the users upon registration. The presenting issues were collected by Kooth and mapped to the immediate outcomes of the LSE study via a categorisation exercise workshop. The workshop was attended by Kooth and three of Kooth's internal clinical experts. The frequency of presenting issues was as follows: 25.3 % of users presented with suicidal ideation, 26.2 % presented with self-harm, and 71.2 % presented with perceived impact of difficulties.

The second part of the model structure linked a change in immediate outcomes to a set of intermediate outcomes (Fig. 2). Intermediate outcomes consisted of a combination of healthcare and social events
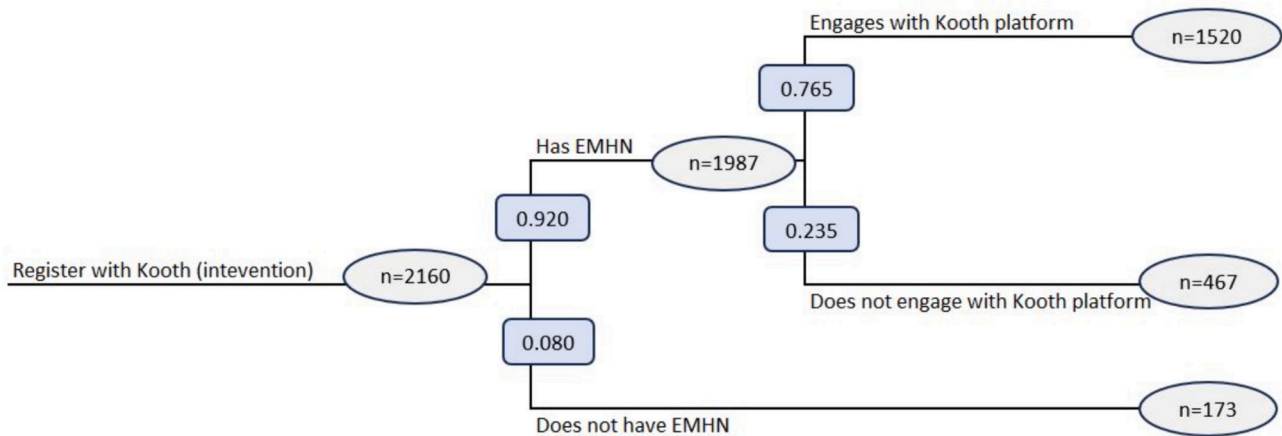
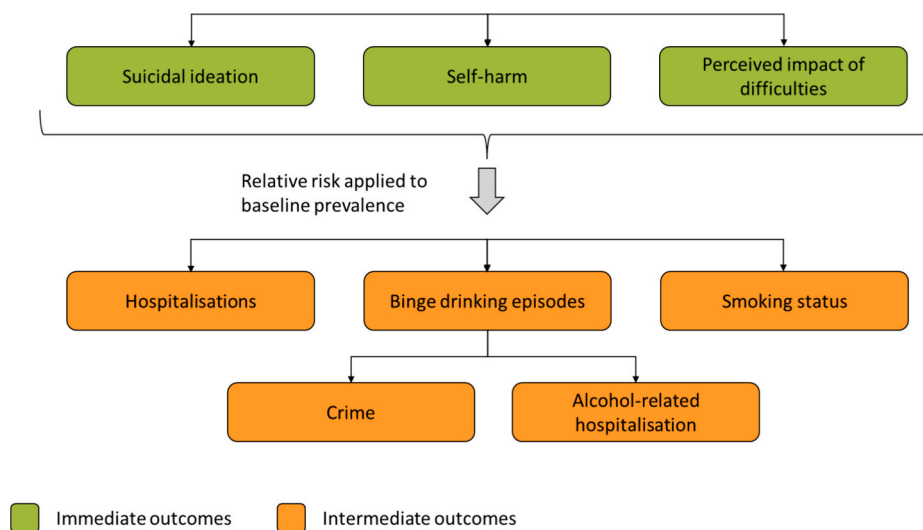**Fig. 1.** Decision tree of the economic model.

Fig. 2. Structure of the economic model.

associated with EMHNs in which a cost per event can be calculated. These outcomes included the number of hospitalisations due to suicidal ideation and self-harm, crimes committed, smoking status, binge drinking, the number of GP appointments, and antidepressant prescribing. The difference in the number of intermediate outcome events, with and without the availability of Kooth, is calculated as a model outcome. Immediate outcomes were linked to intermediate outcomes using odds ratios (OR) and relative risks (RR) that were extracted from the literature. Table 1 outlines the OR and RR used, as well as the baseline prevalence of the intermediate outcomes in CYP.

In the population of CYP with EMHN that does not have access to Kooth, it was assumed that 75 % visit their GP at the beginning of the model. Additional GP resources use was informed by the Kooth LSE study; the LSE study reported that 16.9 % of CYP with an EMHN visited a GP in the month prior to using Kooth and 14.6 % of CYP with an EMHN visited a GP in the subsequent month. For both of these values, the average number of GP visits per person attending was 1.7. Therefore, it was assumed that 16.9 % of CYP with access to Kooth received 1.7 GP appointments at the beginning of the model (prior to the adoption of Kooth). Subsequent GP resource use was also applied. 16.9 % of CYP with EMHN who do not have access to/do not engage with Kooth receive 1.7 GP appointments per month for the remainder of the model time horizon (equivalent to an average of 0.29 GP appointments per month per participant not using Kooth). 14.6 % of CYP with EMHN who did

engage with Kooth receive 1.7 GP appointments (equivalent to an average of 0.25 GP appointments per month per participant not using Kooth) for one subsequent month, which was followed by no further GP appointments for the remainder of the model time horizon. All GP resource use assumptions were either set out or validated by clinical experts who commission Kooth, in addition to other services.

The total number of hospitalisations due to a suicide attempt and the total number of hospitalisations due to self-harm were calculated by multiplying the risk of being hospitalised due to a suicide attempt/self-harm (which was higher for those with suicidal ideation/who had previously self-harmed than for the rest of the population) by the number of people in the model. The model calculated that the proportion of people with suicidal ideation reduced when Kooth was used; therefore, this was reflected when calculating the number of hospitalisations with/without Kooth engagement. Similarly, the total number of smokers and the total number of binge drinkers was calculated by multiplying the probability of being a smoker/binge drinker (which was higher for those who had either previously self-harmed or had a higher SDQ score than the rest of the population) by the number of people in the model. This method was also applied for the total number of crimes committed, where the probability of committing a crime was higher for those who had previously self-harmed than the rest of the population.

The number of antidepressant prescriptions in the comparator arm of the model was calculated by multiplying the proportion of CYP who see

Table 1
Model inputs.

Difference in scores between baseline and follow-up	
Suicidal ideation (SIDAS)	−8.8 % (Stevens et al., 2021)
Self-harm	−19.2 % (Stevens et al., 2021)
Perceived impact of difficulties (SDQ)	−2.2 % (Stevens et al., 2021)
Population	
Kooth engagement rate	76.5 %
Proportion of Kooth users with an EMHN	92.0 %
Presenting issues of Kooth users	
Suicidal ideation	25.3 %
Self-harm	26.2 %
Perceived impact of difficulties	71.2 %
OR/RR linking immediate and intermediate outcomes	
Suicidal ideation to hospitalisation OR	3.75 (Harmer et al., 2020)
Self-harm to crime OR	3.5 (Richmond-Rakerd et al., 2019)
Self-harm to smoking RR	2.21 (Moran et al., 2015)
Self-harm to binge drinking RR	2.13 (Moran et al., 2015)
Perceived impact of difficulties to smoking OR	1.14 (Goodman, 2010)
Perceived impact of difficulties to binge drinking OR	2.18 (Huang et al., 2016)
Baseline prevalence of intermediate outcomes	
SA resulting in hospitalisation	8.46 % (McManus et al., 2016; Bilsen, 2018)
Arrests	2.11 % (Ministry of Justice, 2020)
Regular smokers (aged 11–15 years)	2.0 % (National Statistics, 2018)
Regular smokers (aged 16–24 years, male)	23.0 % (NHS Digital N, 2021)
Regular smokers (aged 16–24 years, female)	19.0 % (NHS Digital N, 2021)
Binge drinkers	28.0 % (Oldham et al., 2018)
Percentage of people with an EMHN initially visiting a GP (as a replacement for initial Kooth contact)	75.0 %[a]
Monthly percentage of people with an EMHN who visit a GP (when Kooth is not in use)	16.9 % (Stevens et al., 2021)
Monthly percentage of people with an EMHN who visit a GP (when Kooth is in use)	14.6 % (Stevens et al., 2021)
Average number of appointments (per month) for those who visit the GP (when Kooth is not in use)	1.7 (Stevens et al., 2021)
Average number of appointments (per month) for those who visit the GP (when Kooth is in use)	1.7 (Stevens et al., 2021)
Costs	
Hospitalised (SA population)	£917[b] (Tsiachristas et al., 2017)
Arrests	£1096[b] (Heeks et al., 2018)
Regular smokers 12–24 years	£270[c]
Binge drinkers[d]	£737[c]
Example cost of a Kooth contract	£140,000
Cost per GP appointment	£41.00 (*Unit Costs of Health and Social Care* 2020, 2020)
Cost of 1 year of Fluoxetine	£751.56 (NICE, n.d.-b)

CYP, children and young people; EMHN, emerging mental health needs; OR, odds ratio; GP, general practitioner; RR, relative risk; SA, suicide attempt; SDQ, Strengths and Difficulties Questionnaire; SIDAS, Suicidal Ideation Attributes Scale.
[a] Assumption validated from clinical experts.
[b] Inflated to 201/22 prices.
[c] For full calculation details see Supplementary data.
[d] This cost decreases to £117 when the UK NHS only perspective is selected.

a GP by the proportion who are subsequently prescribed antidepressants. As highlighted above, it was assumed that CYP with access to Kooth are not prescribed antidepressants.

Participants who do not engage are assumed to have an average of 0.29 GP appointments (number without Kooth). These values were extrapolated and applied for the one-year time horizon. All of the above assumptions were clinically validated by independent clinical experts.

Pharmaceutical treatment of depression in CYP is only recommended for those with moderate to severe depression. It is anticipated that use of Kooth will prevent the severity of depression escalating from mild to moderate or severe. Therefore, it was assumed that CYP with access to Kooth are not prescribed antidepressants. The model was built to include functionality for this assumption to be included or excluded, and we have conducted scenario analysis whereby this assumption was removed. Furthermore, it was assumed that fluoxetine is the only anti-depressant prescribed to CYP as it is the first line of care recommended by the National Institute for Health and Care Excellence (NICE) (NICE, n.d.-a). This was to prevent the introduction of additional uncertainty into the model.

2.3. Costs

Costs used in the model are detailed in Table 1 and were obtained from a targeted literature search. All costs were reported for the 2021/22 cost year and are reported in GBP. We followed published guidance to account for inflation (*Unit Costs of Health and Social Care* 2020, 2020).

The annual cost for medication was calculated by scaling up the monthly cost of a 10 mg daily prescription of fluoxetine by a factor of 12 (NICE, n.d.-b). The Electronic Medicines Compendium reports that the starting dose of fluoxetine is usually given as 2.5 ml of Fluoxetine Oral Solution daily or as one 20 mg capsule on alternate days, increased to 20 mg after 1 to 2 weeks if necessary (EMC, 2021). Most people report improvement in symptoms following the use of fluoxetine for at least 6 to 12 months (Young Minds, 2021) and this model assumes the use of fluoxetine for the full one-year time horizon. Costs and dosing information were acquired from the British National Formulary (NICE, n.d.-c).

The cost of a GP appointment was sourced from the Personal Social Service Research Unit (PSSRU) Unit Costs of Health and Social Care (2022) (PSSRU, n.d.).

The cost of Kooth service provision varies depending on the geographical area and number of users. A value of £140,000 was used in the base case; this was taken from a previous Kooth contract for a local area of 2160 CYP in England.

2.4. Sensitivity analysis

Deterministic sensitivity analysis (DSA) was undertaken to evaluate the key drivers of uncertainty within the model. In DSA, input values were individually varied between a lower and upper bound of its confidence intervals. Where these values were not reported in the literature, they were estimated through clinical consultation, or assumed to be ±20 % of the baseline value. The upper and lower values of the contract cost were taken from costs provided by Kooth. All confidence intervals and DSA results are reported in the Supplementary Materials.

A probabilistic sensitivity analysis (PSA) was also conducted to assess how robust the results are and to provide more information about the likely distribution of outcomes. In the PSA, 10,000 model simulations were run, and the average cost difference and probability of the intervention being cost saving was recorded. For each of these 10,000 model iterations, input parameters were randomly sampled from standard error (SE) values. It was not possible to find SE values for most of the parameters; when not reported, these were assumed to be ±20 % of the baseline values. The number of model iterations in the PSA was determined by analysing the convergence over an initial PSA consisting of 15,000 simulations. This determined that stabilisation of the model results (measured by the cumulative average incremental cost by iteration) occurred after approximately 7000 iterations. All analyses were conducted using Microsoft Excel. We followed published guidance on the reporting of economic evaluations (Husereau et al., 2022).

2.5. Findings

The base case results follow a cohort of 2160 CYP with EMHN. Results were evaluated from an NHS and crime sector perspective, and an NHS-only perspective in the base case. Implementation of Kooth was associated with cost savings, regardless of the model perspective (Table 2). From a UK NHS and crime sector perspective, Kooth was associated with a total cost difference of -£349,237 across a 12-month time horizon, or -£247 per CYP with EMHN. From a UK NHS perspective only, implementation of Kooth was associated with a cost difference of -£329,237. This was largely driven by a reduction in the number of antidepressant prescriptions, which provided a cost saving of £223,966, and a reduction in the number of GP appointments, which provided a cost saving of £219,178. The cost impact of the other intermediate outcomes is detailed in Table 3. The service cost of Kooth per person with EMHN was £70.

2.6. Scenario analysis

A scenario analysis was conducted to test the assumption that Kooth prevents the severity of an EMHN escalating and requiring pharmaceutical treatment. In this scenario, the cost of antidepressant prescriptions was omitted from the analysis to estimate the economic impact of Kooth, excluding any Kooth-associated prescription cost savings. From an NHS and crime sector perspective, the use of Kooth was associated with a total cost difference of -£125,931 for the cohort, or -£63 per person with EMHN. When a UK NHS-only perspective was taken, the cost differences per cohort and per person with an EMHN were -£105,272 and -£53 respectively (Table 4).

2.7. Sensitivity analysis

DSA was conducted to highlight which parameters are the key drivers of uncertainty in the model. For all parameters and across both considered perspectives, the cost difference remained between -£100 and -£250 per person. The DSA results also show that the parameter most affecting the cost difference is the proportion of CYP who receive follow-up GP appointments and are subsequently prescribed antidepressants. This is likely driven by the base case assumption that people with an EMHN will not require pharmaceutical intervention. The impact of not including this assumption has been tested in a scenario analysis. Other key drivers of uncertainty include the monthly number of GP appointments when Kooth is not being used, and the Kooth contract cost. For all input value variations, Kooth remained cost saving. Figs. 3 and 4 display the results of the DSA as tornado charts.

PSA was also conducted to analyse the uncertainty associated with the model (Table 5). The results of the PSA indicate that the use of Kooth is associated with a 100.0 % chance of being cost saving in both perspectives; the average cost difference was -£353,528 from the combined UK NHS and crime sector perspective, and -£331,571 from the UK NHS-only perspective. When prescription costs were not included, the probability of Kooth being cost saving was 99.8 % from the NHS-only

perspective, and 100 % when the crime sector was also considered.

3. Discussion

The results of this early analysis suggest that Kooth has the potential to be a cost-saving digital intervention for CYP with EMHN. The early economic model demonstrates a potential cost saving to the UK NHS of £236.15 per person with an EMHN over a 1-year time horizon. This increases to £246.54 when the NHS + crime sector perspective is taken. Engagement with Kooth could result in a reduction of 'high-risk behaviour', as assessed by the number of hospitalisations, crimes committed, smokers, and binge drinkers. Clinical experts validated the assumption that engaging with a mental health platform, such as Kooth, may also result in a reduction in GP attendances and antidepressant prescriptions. The impact of these assumptions was individually explored through DSA, which suggested that Kooth remained cost saving. This was further explored through a PSA, which suggested that there was a high level of certainty associated with the results.

Throughout the development of the economic model, the authors identified a lack of published evidence that evaluates the impact of mental health digital platforms on CYP. A systematic review conducted in 2020 identified eleven randomised control trials exploring the impact of mental health apps on CYP (Leech et al., 2021). All of the included studies looked at the immediate-term impact of the intervention, with the longest follow-up period being six months (Hides et al., 2019). NICE has published guidelines on behaviour change through digital and mobile health interventions (NICE, 2020). These guidelines emphasised the need for evidence-based behaviour change techniques and the benefits of digital health interventions as a supplement to existing services. Therefore, it is hoped that the findings of this study will contribute to, and encourage, a wider body of published literature in this direction.

In 2013, Clayton and Illback published a paper that aimed to economically justify Jigsaw, a mental health service for CYP in Ireland, by evaluating the cost impact of early intervention and prevention (Clayton and Illback, 2013). The analysis assumed a 5 % reduction in psychiatric medication prescriptions in all youth and a 20 % reduction in the cost attributable to GP and primary care mental health services, as a result of Jigsaw; the study estimated €3 million in cost savings. Although these figures are based on assumptions, they can be used to support our findings that providing digital mental health support for CYP could reduce the demand on primary services and reliance on medication.

The impact of poor mental health on educational attainment was explored in the model. However, a monetary value was not attached to this outcome given of uncertainty beyond a one-year time horizon. It should be noted that the development of depression and self-harm during primary and secondary education has previously been linked to a decline in future educational attainment of CYP (Rahman et al., 2018).

Furthermore, the impact of digital mental health platforms could help to reduce burden on existing face-to-face health services. Digital access may overcome some of the barriers in attending in-person GP sessions during working hours and with regards to equitable access of GPs, promoting wider access to mental health support (Hui et al., 2020).

3.1. Strengths and limitations

EMHN was determined through the YP-CORE scores of Kooth users at the time of registration. The YP-CORE score falls into different thresholds: healthy (0–5), low (6–10), mild (11–14), moderate (15–19), moderate-to-severe (20–24), and severe (25 and above) (Twigg et al., 2009). Scores above the moderate threshold were used as a proxy for EMHN. However, online mental health platforms could also impact those with a low score on the YP-CORE. These CYP were not captured in the model.

The model focused on a one-year time horizon. The short time horizon was chosen because the LSE study only published short-term data, collected over a period of one month (Stevens et al., 2021). Extending

Table 2
The base case results of the cost calculator associated with implementation of Kooth at a service cost of £140,000.

Perspective of the economic model	Overview	Total impact	Cost impact per CYP with EMHN
UK NHS + crime sector	Cost saving	£489,897	£246.54
	Cost difference	−£349,897	−£176.09
UK NHS perspective	Cost saving	£469,237	£236.15
	Cost difference	−£329,237	−£165.69

CYP, children and young people; NHS, National Health Service, UK, United Kingdom.

Table 3

Resource use associated with implementation of Kooth at a service cost of £140,000.

Associated perspective	Intermediate outcome	Number of outcomes without Kooth engagement	Number of outcomes following Kooth engagement	Number of outcomes averted	Cost savings per CYP engaged with Kooth
UK NHS	Hospitalisations due to suicidal ideation	255	249	6	£5503
	Hospitalisations due to self-harm	258	245	13	£11,924
	Smokers	576	556	20	£5398
	Binge drinkers	721	697	24	£19,618
	GP appointments	7700	2424	5346	£219,178
	Antidepressant prescriptions	298	0	298	£223,966
UK crime	Crimes	67	64	3	£3287

CYP, children and young people; GP, general practitioner; NHS, National Health Service; UK, United Kingdom.

Table 4

Model results of the scenario analysis, when the impact of prescription costs is excluded.

Perspective of the economic model	Overview	Total impact	Cost impact per person with EMHN
UK NHS + crime sector	Cost saving	£265,931	£133.83
	Cost difference	−£125,931	−£63.38
UK NHS perspective	Cost saving	£245,272	£123.43
	Cost difference	−£105,272	−£52.98

the time horizon of the model beyond one year would introduce further uncertainty in the analysis. However, the model in its current form will likely underestimate the true cost savings if the changes in immediate outcomes were to remain beyond one-year.

Due to a lack of evidence linking immediate to intermediate outcomes for CYP in the published literature, this economic model focused on the impact of Kooth on suicidal ideation, self-harm, and perceived impact of difficulties. However, Kooth may also have a positive impact on other factors, including worries about COVID-19, psychological distress, hope, arguments with parents, closeness to parents, and loneliness (Stevens et al., 2021). Therefore, it is likely that the results of this model are conservative and that Kooth could provide additional cost savings through outcomes that have not been explored in this study.

Furthermore, generating inputs for early economic models requires a large number of assumptions. The inputs of the model were clinically validated by two clinical practitioners external to the service, who specialise in mental health for CYP. DSA and PSA were also conducted to explore the uncertainties associated with the assumptions. This identified that Kooth remained cost saving for all input value variations and that there is greater than a 99.8 % chance that Kooth provides cost-savings, respectively. However, the use of PSA in early modelling should be caveated. It was not possible to acquire uncertainty estimates for a significant proportion of the inputs; hence, the SE was assumed to be equal to ±20 %. By randomly sampling input values from assumed SEs, the model results are associated with a substantial level of uncertainty and are a limitation of this study. This introduces a risk of over or undervaluing the certainty of the model results, which may negatively impact subsequent decision making.

In the model, it is important to note that the impact of Kooth on mental health cannot be isolated from the impact of any additional services used by CYP. For example, CAMHS, school counsellors, or general practitioners. Furthermore, it was assumed that changes in immediate outcomes are only shown in CYP who identified the immediate outcome as a 'presenting issue' upon Kooth registration.

Finally, the model primarily evaluated quantitative published evidence and is, therefore, not able to capture all decision-making discussion points. Patient choice should always be qualitatively considered, this being in line with the emphasis on patient empowerment from the NHS long term plan (National Health Service, n.d.). Evidence was not available to apply utility values and quality-adjusted life years to the immediate mental health outcomes.
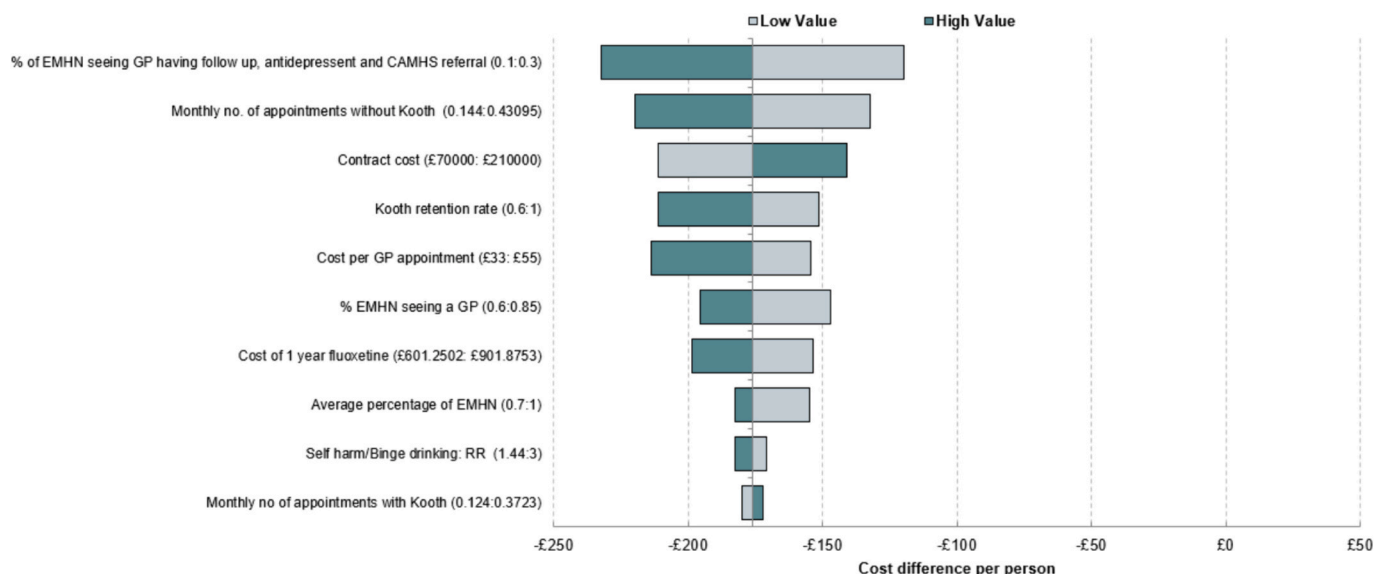
Fig. 3. Results of the DSA, from a UK NHS plus crime sector perspective.
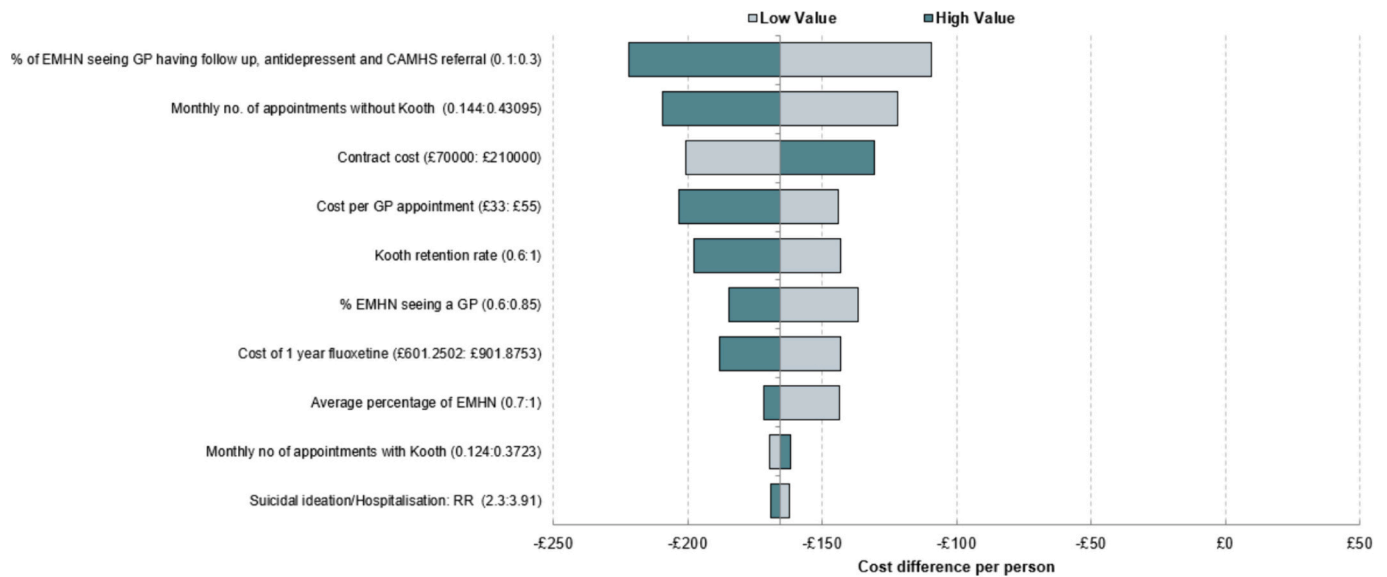
Fig. 4. Results of the DSA, from a UK NHS perspective.

Table 5
Results of the PSA.

Perspective	Scenario	Cost difference	Cost saving per person with EMHN	Probability of being cost saving
UK NHS + crime sector	Base-case	−£353,528	−£178	100.0 %
	Medication costs not included	−£129,327	−£65	100.0 %
UK NHS perspective	Base case	−£331,571	−£167	100.0 %
	Medication costs not included	−£107,229	−£54	99.8 %

4. Conclusion

The economic case for online mental health platforms, such as Kooth, as an additional resource alongside traditional mental health services should be given further consideration. This early economic study found a one-year cost saving to the UK government of £225 per engaged user when Kooth is made available to CYP. As such, it is plausible that Kooth is a cost-effective intervention. Further investigation of the impact of digital mental health services on CYP is recommended to reduce current uncertainties and assumptions.

CRediT authorship contribution statement

Laura Coote and Luc Curtis-Gretton were major contributors in conducting the data analysis and developing the model. All authors contributed to the original research and development of the manuscript, with the final version approved by all authors.

Ethical approval information

Approval was granted by the School of Psychology, University of Kent Ethics ID: 202216601257977878.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: There are no competing interests for Laura Coote, Laura Kelly, Luc Curtis-Gretton, Charlotte Graham, Maisie Green, or Hayden Holmes. Louisa Salhi, Santiago de Ossorno Garcia and Aaron Sefi are all employees of Kooth Plc and receive honorarium from the organisation.

Data sharing statement

Data that are publicly available have been cited in the reference list.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.invent.2024.100748.

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