NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

Medical technology consultation document

Sleepio to treat insomnia symptoms

How medical technology guidance supports innovation

NICE medical technologies guidance addresses specific technologies notified to NICE by companies. The 'case for adoption' is based on the claimed advantages of introducing the specific technology compared with current management of the condition. This case is reviewed against the evidence submitted and expert advice.

If the case for adopting the technology is supported, the specific recommendations are not intended to limit use of other relevant technologies that may offer similar advantages. If the technology is recommended for use in research, the recommendations are not intended to preclude the use of the technology but to identify further evidence which, after evaluation, could support a recommendation for wider adoption.

1 Recommendations

1.1 Sleepio shows promise for treating insomnia symptoms in primary care for people who would have usual treatment (sleep hygiene or sleeping pills). But there is uncertainty about whether it will be cost saving for the NHS.

1.2 Clinical evidence shows that Sleepio reduces insomnia symptoms compared with usual treatment. But cost models show that Sleepio is £16 more expensive than usual treatment at 1 year. This could result in a high total cost to the NHS. But Sleepio could be cost saving over a 3-year period if the longer-term benefits of using the technology can be shown.

1.3 Real-world evidence collection is recommended to show that the patient benefits and resource savings observed at 65 weeks also apply at 3 years. Find out more in the section on further research.

1.4 Sleepio is not recommended for people with insomnia symptoms who would be eligible for face-to-face cognitive behavioural therapy for insomnia (CBT-I) in primary care. This is because there is not enough clinical evidence to show how effective Sleepio is compared with face-to-face CBT-I.

Why the committee made these recommendations

Usual treatment for insomnia symptoms is sleep hygiene and sleeping pills. People with insomnia that persists after usual treatment are referred for face-to-face CBT-I.

Sleepio is a digital self-help programme that includes CBT-I. It could increase patient access to CBT-I. It also increases the options available to primary care practitioners when treating insomnia.

Clinical evidence shows that Sleepio reduces insomnia symptoms compared with usual treatment. But because there is no direct evidence about its effectiveness compared with CBT-I, it is not supported for people who would be eligible for CBT-I.

Cost modelling shows reduced healthcare costs at 65 weeks, mostly because of reduced GP appointments and sleeping pills prescribed. But there is an overall cost to the NHS at this point because of the price of the technology. To be cost saving, Sleepio would need to reduce healthcare costs for at least 3 years. So, evidence collection for at least 3 years is recommended.

2 The technology

Technology

2.1 Sleepio (Big Health) is a self-help sleep improvement programme based on cognitive behavioural therapy for insomnia (CBT-I). It is accessed through a website or an app for iOS mobile devices and can link to a compatible wearable fitness tracker to monitor sleep (currently Fitbit and any other device that uses Apple's HealthKit).

2.2 The programme is structured around a sleep test, weekly interactive CBT-I sessions and regular sleep diary entries. The sessions focus on

identifying thoughts, feelings and behaviours that contribute to the symptoms of insomnia. Cognitive interventions aim to improve the way a person thinks about sleep and behavioural interventions aim to promote a healthy sleep routine. Although the programme can be completed in 6 weeks, people can use the programme for 12 months from registration. They can also access electronic library articles, online tools and the online Sleepio user community. A daily sleep diary helps users track their progress and the programme tailors advice to individuals. Users can fill in the diary manually or the data can be automatically uploaded from a compatible wearable tracking device.

2.3 People can get Sleepio via self referral on the product website or through referral by a healthcare professional in regions of the NHS where it is commissioned. For patients with mental health conditions managed in routine care, use of Sleepio may benefit from the involvement of a healthcare professional.

Care pathway

2.4 The British Association of Psychopharmacology (BAP) consensus statement on insomnia describes treatment options for adults with poor sleep, which depend on how long they have had insomnia for. People are first offered advice about sleep hygiene. If this does not work and they are severely impaired during the day, and it is causing significant distress, they can be offered a 3 to 7 day course of a non-benzodiazepine hypnotic medication. Hypnotic medication should only be considered if symptoms are likely to resolve soon (for example because of a short-term stressor). If not, they should be offered face-to-face or digital CBT-I. Currently, face-to-face CBT-I is not routinely available in the NHS for most people with insomnia. A short-term course of hypnotic medication can be offered in addition to CBT-I but should not be offered routinely. People should be offered follow-up consultations every 2 to 4 weeks to review their symptoms.

2.5 NICE's clinical knowledge summary on insomnia summarises the latest evidence on managing insomnia in primary care, based on whether it is short term (less than 3 months) or long term (more than 3 months). For both the advice is to consider referral to a sleep clinic or neurology if the person has symptoms of another sleep disorder, and to address whatever might be causing the insomnia. It also advises making sure comorbidities such as anxiety and depression are managed. It gives the same advice on sleep hygiene, hypnotic medication and CBT-I as BAP.

2.6 People with insomnia often also have a mental health problem. NICE's clinical guideline on common mental health problems recommends assessing people using the improving access to psychological therapies (IAPT) screening tools and validated scales. Treatment depends on symptom severity and includes education, monitoring, CBT and medication.

Innovative aspects

2.7 Sleepio uses an artificial intelligence (AI) algorithm to provide people with tailored digital CBT-I. There is also support available from a Sleepio community, which includes clinical experts and other people with insomnia.

Intended use

2.8 Sleepio is primarily intended as an alternative to usual treatment, which includes sleep hygiene education and hypnotic medication. People can get Sleepio through self referral, or through primary care or IAPT services.

Training

2.9 The company offers primary care training on prescribing Sleepio, technical training and set up.

Costs

2.10 The cost of Sleepio depends on the number of adults in a region's healthcare system. It is £0.90 per person for regions with more than

1 million people. Cost increases for smaller regions, up to £1.00 per person for regions with 250,000 people or fewer. During the evaluation the company proposed a different cost model, see section 3.13 for further details.

For more details, see the website for Sleepio.

3 Evidence

NICE commissioned an external assessment centre (EAC) to review the evidence submitted by the company. This section summarises that review. Full details of all the evidence are in the project documents on the NICE website.

Clinical evidence

The clinical evidence comprises 28 studies, 12 of which are randomised controlled trials

3.1 The EAC assessed 25 full text publications, an unpublished study and 2 abstracts. Twelve of the studies were randomised controlled trials (including 6 secondary analyses of randomised controlled trials). Six were non-randomised studies and there was 1 abstract. Also, the company provided the EAC with 2 unpublished, real-world evidence studies. For full details of the clinical evidence, see section 3 of the assessment report.

The 12 randomised controlled trials are relevant to the decision problem and show that Sleepio reduces symptoms of insomnia

3.2 There is good quality evidence that Sleepio improves sleep in people with self-reported insomnia symptoms (according to DSM-5 [Diagnostic and Statistical Manual of Disorders 5], SCI [Sleep Condition Indicator] and ISI [Insomnia Severity Index] measures). The most robust evidence for Sleepio comprises 12 randomised controlled trials, 10 of which used intention to treat analyses to control for high drop-out rates. The studies are small relative to the potential reach of Sleepio but are adequately powered and well reported.

The UK population is well represented in the evidence for Sleepio

3.3 The UK population is well represented in the evidence base for Sleepio, which includes 7 UK studies and 4 multinational studies that included UK populations. Four of the studies done in the UK were randomised controlled trials (Espie et al. 2012, Freeman et al. 2017, Denis et al. 2020 [pilot study], Kyle et al. 2020); all concluded that Sleepio was more effective in reducing insomnia symptoms than the comparator (standard care, waiting list, placebo or attention control).

The evidence is heterogenous

3.4 The studies included in the assessment varied in design, population, outcome measures and comparators. Study participants included people with difficulty sleeping with or without medical and mental health comorbidities, and different durations of insomnia. The comparator differed between studies and often the description of standard care lacked clarity. It was unclear whether standard care included aspects of cognitive behavioural therapy for insomnia (CBT-I), the hypnotic medication prescription, or both, and there was little information about what was offered as sleep hygiene education.

There is no evidence comparing Sleepio with face-to-face CBT or other forms of digital CBT-I

3.5 The company acknowledged that the lack of evidence comparing Sleepio with face-to-face CBT or digital CBT-I was a limitation. It said that face-to-face CBT-I for insomnia is not routinely available on the NHS and is not scalable to the UK NHS population. There is an indirect meta-analysis (Soh et al. 2020) that indicated that digital CBT-I is non-inferior to face-to face CBT-I. There are currently no studies that compare Sleepio with other digital CBT-I technologies.

Cost evidence

The company used a single cohort spreadsheet model to compare the cost of Sleepio with treatment as usual and face-to-face CBT-I

3.6 The company submitted 12 economic studies relevant to the economic assessment. The EAC found 3 of them met the decision problem. The company's economic analysis modelled a population of adults with insomnia symptoms. The model compared Sleepio with 2 comparators: treatment as usual (which includes sleep hygiene and sleep medication), and face-to-face CBT-I. The company's analysis estimates the overall cost of providing Sleepio to a large population. The company assumed that:

- 24,000 people from a population of 2.4 million would start session 1 of Sleepio (1% uptake)
- the percentage uptake in year 1 would be maintained in year 2 and year 3.
- primary care resource from year 1 could be extrapolated to 3 years

3.7 The cost impact and proportion of patients using Sleepio are based on data from Sampson et al. 2021. The key costs were:

- Sleepio at £0.90 per adult in the population
- sleep hygiene at £0
- CBT at £492 (this was changed by the EAC to £542 to account for inflation) per adult
- primary care resource use per user in years 1, 2 and 3 at £49.52, £43.52 and £42.05 respectively.

For full details of the cost evidence, see section 4 of the assessment report.

The EAC made changes to the percentage uptake parameter

3.8 The EAC considered that the company's assumption that 1% of the population will start session 1 of Sleepio was an overestimate. The EAC

changed it to 0.58% (13,920 people in a population of 2.4 million) based on data for the Buckinghamshire region reported in Sampson et al. (2021). The company provided uptake data from the rollout of Sleepio in North Hampshire, where a 0.84% uptake rate was observed using the standard implementation model. New data from years 2 and 3 in Buckinghamshire suggest that the uptake rate is maintained in subsequent years, although the rate is significantly lower than the 1% assumed by the company.

The EAC's updates to the cost model make Sleepio cost incurring compared with treatment as usual but cost saving compared with face-to-face CBT-I

3.9 With the updated cost parameters, the EAC's base case shows that after 3 years:

- compared with treatment as usual, Sleepio is cost incurring by £20.09 per person
- compared with face-to-face CBT-I, Sleepio is cost saving by £386.83 per person

3.10 The EAC used sensitivity analyses to explore how the percentage uptake affects the cost of Sleepio compared with treatment as usual. These showed that cost savings fall as the proportion of users (uptake) reduces. The breakeven point for the first year cohort was an uptake percentage of 0.666%.

The EAC used sensitivity analyses to explore costs associated with subsequent cohorts being included in the modelling

3.11 The company modelled the costs associated with using Sleepio in a single cohort over a 3 year time horizon. The EAC did additional analyses to quantify the rolling cost of Sleepio considering subsequent cohorts of patients using it. The EAC modelled 2 scenarios. In both scenarios, the overall cost rises over time:

- In scenario 1, the uptake of Sleepio was maintained at 0.58% of the population per year. At year 5, the total cost of providing Sleepio up to this point was £2,775,500.
- In scenario 2, the uptake of Sleepio fell to 0.2% of the population for every year beyond the first year of rollout. At year 5, the total cost of providing Sleepio up to this point was £6,156,357.

The EAC concluded that the statistical analysis outlined in Sampson et al. (2021) is robust

3.12 The committee asked the EAC to review the statistical analysis described in Sampson et al. (2021) and explore if it was possible to link the NHS data with the data from Sleepio to better understand the outcomes associated with its use. Patient-level data was made available to the EAC, who replicated the multilevel generalised linear model described in the paper. It was not possible to link the NHS data to the data available from Sleepio users about usage and weekly sleep score. The EAC also investigated adding an individual patient level to the generalised linear model, the impact of seasonal adjustment, and relevant comorbidities. It found that the resource use saving results from the statistical model did not change significantly from those reported in the study (£6.64 compared with £5.53 per patient per year in the EAC model). It concluded that the Sampson et al. (2021) results are robust enough for use in the economic modelling for Sleepio.

The EAC re-ran the economic modelling using the company's alternative cost model

3.13 The company proposed an alternative Sleepio cost model (described as the Scotland cost model), which is tiered and based on the anticipated annual treatment volumes. Treatment reduces in cost as volume increases, from £80 per patient for 1 to 1,000 patients having treatment to £60 per patient for more than 10,000 patients having treatment. Using this costing approach, Sleepio's cost in the EAC's base case reduced from £155.17 to £66.11 per patient. With the Scotland costing model applied to

the data in Sampson et al. (2021), the EAC's base case showed that after 3 years:

- compared with treatment as usual, Sleepio is cost saving by £68.97
- compared with face-to-face CBT-I Sleepio is cost saving by £475.89.

4 Committee discussion

Treatment pathway

Sleepio can be used to treat symptoms of insomnia

4.1 The evaluation considered Sleepio as a treatment for the symptoms of insomnia. The proposed patient population included people with symptoms or a diagnosis of insomnia. The committee accepted that this broad population was relevant and understood people could either be referred to this technology by their GP, or choose to self-refer if they live in a region where Sleepio is available. The committee accepted that insomnia symptoms are a common problem and that Sleepio has the potential to benefit many people.

The most relevant comparator is treatment as usual including sleep hygiene advice and short-term medication

4.2 Sleepio provides a sleep improvement programme based on cognitive behavioural therapy for insomnia (CBT-I) for people with insomnia or symptoms of insomnia. Clinical experts explained that the gold standard treatment for insomnia is face-to-face CBT-I but its availability is very limited in the NHS. Instead, they agreed with the company that the most relevant comparator is 'treatment as usual', which includes sleep hygiene education and hypnotic medication. There are several other digital technologies that provide CBT-I or other support for people with insomnia symptoms, but the uptake and use of these technologies is limited. The committee concluded that the appropriate comparator for Sleepio is treatment as usual consisting of sleep hygiene advice and short-term medication.

Sleepio could provide another CBT-I option, the gold standard treatment for insomnia

4.3 Clinical experts explained that digital CBT-I, such as Sleepio and other digital CBT-I technologies, increases the options available to primary and secondary care practitioners when treating insomnia. They explained that the gold standard treatment for insomnia is face-to-face CBT-I but its availability is very limited in the NHS. Although face-to-face CBT-I has some advantages in solving specific patient needs, they thought that difital and face-to-face CBT-I are likely to be similar. The committee considered that there is space in the care pathway for Sleepio. It concluded that Sleepio would provide another option for people to access CBT-I.

Clinical-effectiveness overview

Sleepio is effective at reducing insomnia symptoms compared with treatment as usual

4.4 The committee noted the large evidence base for Sleepio, and that the 28 studies in the evidence base included a range of patients who had a diagnosis or symptoms of insomnia. The EAC explained that changes in lifestyle are expected as part of treatment as usual, but it is unclear whether there was any explicit control for these factors in the evidence. The committee concluded that the evidence shows that Sleepio is more effective than treatment as usual in reducing symptoms of insomnia in adults.

There is no direct evidence comparing Sleepio with face-to-face CBT-I or with other digitally facilitated CBT-I

4.5 The EAC explained that no studies were identified in the literature that compared Sleepio with other methods of delivering CBT-I directly, such as face-to-face CBT-I or digital CBT-I. Clinical experts confirmed that other digital devices are available that also deliver digital CBT-I. They considered that the clinical effectiveness of Sleepio is likely to be comparable to other digital devices delivering CBT-I as well as face-to-face CBT-I, but also recognised that there are some advantages to the

latter. The committee recognised the lack of comparative evidence between different delivery methods of CBT-I was a limitation in the evidence.

Drop-out rates

There are high drop-out rates with Sleepio, but these are thought to be consistent with face-to-face CBT-I

4.6 The evidence shows a high drop-out rate for people using Sleepio, from 11.2% (Luik et al. 2017) up to 61.6% (Freeman et al. 2017). High drop-out rates were also observed from the rollout of Sleepio in Buckinghamshire, these occurred throughout the programme from session 1 through to session 5. The committee noted that the meta-analysis (Soh et al. 2020) that compared digital CBT-I (including Sleepio) and face-to-face CBT-I reported similar levels of engagement and completion in both arms. Clinical experts explained that in some cases people's insomnia symptoms can resolve after sleep hygiene advice. Since Sleepio sessions 2 and 3 include sleep hygiene advice, it is possible some people's symptoms may resolve before completing all 6 sessions of the programme. However, the reason for drop-outs was not recorded so people may have left the programme because they did not experience any improvement in symptoms. The committee concluded the direction of bias as a result of high drop-out rates with Sleepio is unclear, but it recognised that high drop-out rates are common with CBT-I in general and not specific to Sleepio.

Other patient benefits or issues

Following the Sleepio programme can be challenging but the Sleepio community provides support

4.7 The patient expert described the sleep restriction component and quarter hour rule as particularly challenging aspects of the Sleepio programme that were difficult to implement, especially in the beginning. These challenges were also reported by people who responded to the patient

survey. The patient expert said the support from the Sleepio website community was particularly helpful during this time. The company said that the community is monitored by volunteers with experience of using Sleepio. It also said that Sleepio users can have a weekly session with a clinical psychologist if needed and 24-hour customer service is available. The committee noted the importance of the Sleepio community and its role in supporting people using Sleepio.

Sleepio may be difficult to use for some people

4.8 Sleepio requires access to a computer and the internet and some people do not have a computer or the internet at home. The patient expert said that it was possible to use Sleepio by accessing the internet occasionally (for example, at a public library) and keeping a paper sleep diary, but that this was more difficult. Some users of Sleepio may find it difficult to use a computer, such as people with a visual or cognitive impairment, limited manual dexterity, or hearing impairment. The patient expert said that using Sleepio was relatively straightforward and that people with minimal computer skills could use it. But they agreed that some skill in using a computer is needed. They added that the Sleepio community can help people who need it. Also, Sleepio may be difficult to use for people who have limited English language skills. The company noted that the programme is being restructured so it can be translated into other languages. The committee accepted that Sleepio would be harder to use for some people.

Training

Patient selection and the implementation model used for introducing Sleepio might affect patient uptake and engagement

4.9 The company said that during the roll out of Sleepio they noticed that the different levels of training it provided for referring services (such as GP practices) affected the uptake of Sleepio. It said that training and support varies depending on the implementation model used to introduce it. In the 9 GP practices in the Buckinghamshire region, which used a

comprehensive implementation model, the estimated uptake was 0.94%. Regions that did not have this implementation model had an uptake of 0.54% to 0.55% (Sampson et al. 2021). Clinical experts said patient selection was important to improve the chances of people using Sleepio properly and benefiting from it. They also said it would be helpful to give feedback to referrers, such as GPs, about how many people registered to use Sleepio, and how many were in remission. This would help understand outcomes and inform referral and training. The committee agreed that the training and support for referrers has an important effect on patient uptake and engagement.

Side effects and adverse events

Adverse events are rare in people using Sleepio

4.10 The EAC explained that very few adverse events were reported in the literature, and no serious adverse events were related to using Sleepio. Sleepio has been available in some regions of the NHS since 2013 and unpublished real-world evidence reports that over 100,000 people have used Sleepio in the UK. For full information about adverse events in the studies, see section 6 of the EAC's assessment report.

Sleepio is unlikely to harm people who have other sleeping disorders

4.11 Clinical experts said that some people who present with symptoms of insomnia might have underlying conditions causing their symptoms. They explained that using Sleepio in this population may delay them having more appropriate treatment but is unlikely to cause harm. The company said that it has procedures in place for managing risk and adverse events but that they are uncommon. The committee concluded that Sleepio is unlikely to harm people who experience sleeping difficulties because of an underlying condition.

Cost modelling overview

The economic model is uncertain because of limitations in the data available

4.12 The statistical analysis in Sampson et al. (2021) assumed that all changes in resource use over the study duration were because of the introduction of Sleepio. The committee had concerns about whether the variables included in the generalised linear model adequately captured all the important parameters, such as seasonal affect and comorbidities. The EAC reviewed the statistical analysis described in the study and confirmed that it was appropriate, and that it gave similar results to its own preferred statistical model. Despite some reassurance on the statistical analysis, the committee understood it was only possible to adjust for known confounders, and the quasi-experimental nature of the study means some uncertainty remains. The EAC also reported that it was not possible to link individual patient data from Sleepio with NHS resource use data. So, in the NHS data it is unclear which patients used Sleepio, if their symptoms improved with use, and what the associated resource impact was. This meant it was not possible to include remission status in the economic modelling. The committee accepted that the data available was limited, particularly around linking user data to NHS system data, and understood that this resulted in uncertainties in the economic modelling.

Using resource use data at 65 weeks to model how Sleepio affects primary care costs over 3 years is uncertain

4.13 The EAC accepted that resource use savings are likely to continue beyond the 65-week follow-up reported in Sampson et al. (2021) but was not confident that the data can be extrapolated to 3 years. The EAC reported that the study used to justify the extrapolation of the data to 3 years (Blom et al. 2016) was on another intervention and may not be generalisable to Sleepio. The committee agreed that it was not certain about the suitability of using data reported at 65 weeks to project resource use savings up to 3 years. It concluded that more evidence was needed to support the extrapolation.

Potential for cost savings

Sleepio is cost incurring at 3 years compared with treatment as usual using the population-based cost model

4.14 Using the population-based cost model and reducing the uptake rate from 1% to 0.58%, increased the cost of Sleepio from £90 to £155.17 per user. The EAC base case found Sleepio was cost incurring compared with treatment as usual after 1 year and 3 years. The committee understood there were uncertainties in the modelling associated with the uptake rate and the extrapolation, but it concluded that Sleepio is unlikely to be cost saving if the population-based cost model isused.

The Scotland cost model is more likely to lead to cost savings with Sleepio

4.15 The company proposed an alternative cost model for Sleepio based on the number of people who register for Sleepio treatment (the Scotland cost model, see section 3.13). The committee discussed the EAC's cost comparison analysis based on this cost model and the population-based model described in the submission. It agreed that the Scotland cost model is more likely to lead to cost savings. However, it noted that the results using either costing model show that the technology is cost incurring after 1 year. The committee considered that, ideally for adoption, the technology should be cost saving based on the 1 year resource use data without extrapolation. The committee concluded that while the Scotland cost model is more likely to lead to cost savings, the choice of costing models gives commissioners flexibility to adopt the strategy that most closely meets their requirements.

Main cost drivers

Uptake is the main cost driver for the economic analysis

4.16 The uptake of Sleepio is estimated in the Thames Valley study (Sampson et al. 2021) as between 0.54% and 0.94%. The EAC explained that the economic model with population-based costing shows Sleepio to be cost incurring if the uptake is lower than 0.666%. The company had explained

that the variation in uptake can be partly explained by the effectiveness of the implementation model. The company also suggested that, with the population-based cost model, it can agree a minimum uptake rate and apply a rebate if it is not met. The committee concluded that the uptake of Sleepio is a key driver of the economic modelling and that it needs to be more than 0.666% for the technology to be cost saving with the population-based cost model.

Further research

Real-world economic data collection is needed for at least 3 years to capture the cost savings associated with Sleepio

4.17 The committee agreed that the case for adopting Sleepio is plausible if the resource use savings can be evidenced over 3 years, rather than relying on extrapolated data. It therefore agreed that with the current costing models, more economic data collection is needed to validate the resource use savings extrapolated in the statistical analysis. This could be done by using data from regions in England where Sleepio is already being used, to generate resource use savings at 3 years. The company could attempt to link patient outcome data with NHS resource use data to allow costs to be stratified based on remission status.

5 Committee members and NICE project team

Committee members

This topic was considered by NICE's medical technologies advisory committee, which is a standing advisory committee of NICE.

Committee members are asked to declare any interests in the technology to be appraised. If it is considered there is a conflict of interest, the member is excluded from participating further in that evaluation.

The minutes of the medical technologies advisory committee, which include the names of the members who attended and their declarations of interests, are posted on the NICE website.

NICE project team

Each medical technologies guidance topic is assigned to a team consisting of 1 or more health technology assessment analysts (who act as technical leads for the topic), a health technology assessment adviser and a project manager.

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