The impact of a digital sleep-improvement program on health care costs

OHE
Chris Sampson
Amanda Cole
Grace Hampson
OXFORD AHSN
James Rose
BIG HEALTH
Richard Stott

CONTACT
Chris Sampson
csampson@ohe.org

ohe.org

Background

Access to **non-pharmacological interventions** for sleep improvement is limited.

Digital cognitive behavioural therapy for insomnia (**dCBT-I**) has been shown to be effective.

By reducing the need for face-to-face services, dCBT-I has the potential to **reduce health care costs**.

Sleepio™ is an app and online dCBT-I programme that improves sleep quality.

There is little **real-world evidence** available on the possible cost impacts of Sleepio.

Aim

- To identify whether providing access to Sleepio can reduce health care costs.
- To test for a change in the trend of primary care costs including GP attendances and prescriptions.
- To explore the methodological implications for a full-term analysis.

Methods

- Before and after quasi-experimental design alongside population rollout of Sleepio in a region of England.
- Segmented regression analysis of interrupted time series data.
- Interim analysis at 6-month follow-up.

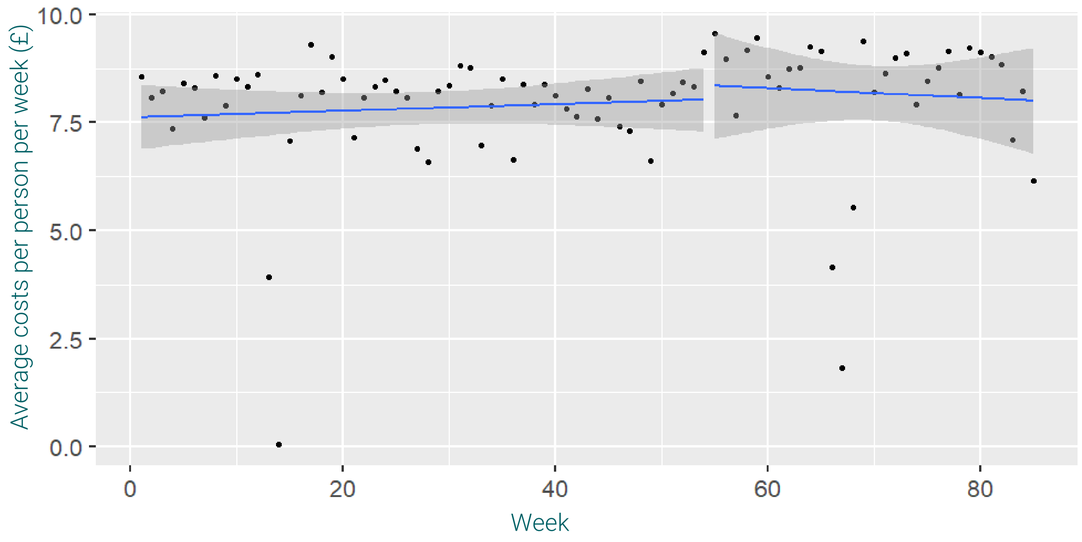
Results

Data / outcomes

- The data included 852,798 observations over 89 weeks, from October 2017 to May 2019.
- Sleepio rollout began in October 2018, with 6,472 individuals using the Sleepio service.
  - 78% of health care referrals were within a clinical range (Sleep Condition Indicator score ≤ 2.5).
  - 36% converted to a first session of dCBT-I, gaining **30 minutes extra sleep per night**, on average.

Primary care costs

- Total primary care costs were relatively stable over the period.
  - The figure shows pre- and post-rollout trends for the full sample, with very low outliers in the final four weeks excluded. Trends were similar for key subgroups.



Segmented regression analysis

- A hierarchical generalised linear model controlled for seasonal effects, patient characteristics, and variation at GP practice level.

$$Y_{tp} = \beta_0 + \beta_1 time_{tp} + \beta_2 intervention_{tp} + \beta_3 post_{tp} + \beta_4 X_{tp} + u_p + e_{tp}$$

Coefficient	Estimate	Std. Error	P-value
Intercept (β_0)	£2.32	0.08	0.000
Week (β_1)	£0.00	0.00	0.000
Pre/post (β_2)	£0.23	0.01	0.000
Weeks post-intervention (β_3)	-£0.00	0.00	0.000

- The week immediately following the rollout of Sleepio was associated with a statistically significant increase in primary care costs (of £0.23 per person).
- After Sleepio rollout, there was a change in trend, from a slightly increasing trend to a slightly decreasing trend.
  - If the current trend continues, the full sample would have **reduced costs within 58 weeks**.
- The model was also run on key subgroups: people with an anxiety or depression diagnosis, people with an insomnia diagnosis, and people recorded as being referred to Sleepio by their GP.
  - Only the **depression group showed savings at 31 weeks** follow-up (within the timeframe of the interim analysis).

	Sample size	Difference in mean weekly costs at 31 weeks	Projected number of weeks after which savings are incurred
Full sample	9,582	£0.12	58
Diagnosis of anxiety or depression	4,471	-£0.03	28
Diagnosis of insomnia	1,397	£0.18	65
Referral to Sleepio	710	£0.17	63

Discussion

Main findings

- Clinical trials have shown Sleepio to be effective in improving sleep quality.
  - Real-world data from this study supports its effectiveness on the Sleep Condition Indicator.
- The rollout of Sleepio could reduce population-level primary care costs associated with GP attendances and relevant prescriptions.
- The dataset and methods used for the analysis are robust and suitable for a full-term analysis.

Strengths

- Segmented regression analysis of interrupted time series data is a strong methodology for the identification of effects in a quasi-experimental design.
- Our study uses a large sample from a selection of primary care practices, with individual-level data recorded weekly, providing a high level of variation and the power to identify small effects.
- The selection criteria for our study, based on diagnoses and prescriptions that suggest people are more likely to use Sleepio, reduces the noise in the data.

Limitations

- Our interim analysis is not able to fully account for seasonal effects, as a full year of post-rollout data is not yet available.
- Recording of GP referral was not reliable, making it difficult to identify a clean effect of Sleepio use.
- Sleepio rollout could use a variety of implementation models, which we did not evaluate separately.

Implications

- The findings from our study will inform commissioners about the expected cost-effectiveness and budget impact of implementing Sleepio at the local or national level.
- Whole population rollout of digital interventions can be evaluated using routinely collected primary care data in combination with data collected through the intervention's digital platform.

Conclusions

- Both clinical trial and real-world evidence show that Sleepio is effective in improving sleep quality.
- The real-world data used in this analysis demonstrate the potential for Sleepio to reduce primary care costs in the UK setting.
- It is likely that Sleepio rollout would reduce primary care costs for the population with a diagnosis of anxiety or depression within 7 months.
- Sleepio rollout was associated with a temporary increase in costs, though this finding may be due to the study's selection criteria
- Given the subtle but statistically significant changes observed, long-term follow-up data will be valuable.

This study was commissioned by Oxford AHSN.