YHEC
York Health Economics Consortium

NHS INNOVATION ACCELERATOR

Economic Impact Case Study: Little Journey

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Summary

Anxiety before surgery or other medical procedure can have negative consequences for children and their families, both in the short and long term. These can have an impact on healthcare resources, as a result of on-the-day cancellations; increased induction time; increased perioperative medication; slower recovery readiness and discharge; and increased unplanned admissions after surgery. Little Journey aims to address this by providing age-appropriate information for children, including virtual reality tours, information, relaxation exercises, and therapeutic games. An economic evaluation carried out in 2019 indicated net healthcare resource use reduction over five years of £586,200, in total, across five hospitals that took part in a pilot. Extrapolated to all paediatric hospital departments in the NHS in England, this would be £11.8 million, including societal benefits from reduced time off work for parents or carers. The return on investment would be 4.89. These results are uncertain as they are based on a small sample size in an observational study. A randomised controlled trial is currently under way, which may produce sufficient data for a more robust economic analysis in the future.

1. BACKGROUND

It is common for children to have anxiety before an operation or other healthcare procedure. This can lead to various additional healthcare resource-related costs. Some of these costs are the immediate consequence of a child's anxiety, such as cancellations on the day of surgery; longer time spent in pre-operative induction; additional medication or sedation costs; additional post-operative recovery time.

There is evidence that even non-invasive healthcare procedures can result in distress for children.[1] Pre-operative anxiety has been associated with adverse effects in children, such as delirium, increased postoperative pain and maladaptive behavioural changes, including nightmares, nocturnal enuresis (bed-wetting) and separation anxiety.[2] In one study of children who underwent general anaesthesia and elective surgery, 54% showed negative behavioural responses two weeks after the surgery.[3] Negative behavioural changes were present at six months in 20% of the children and persisted at one year in 7.3% of the children.

Beyond the immediate costs to the healthcare system, there may be negative societal impacts arising from days off school for children and off work for parents, as well as a poor health service experience for patients and their families and carers. In addition, there may be other, long-term costs related to poor early experiences of healthcare, which can potentially lead to the development of poor health-related behaviours.

Little Journey is a system developed to improve healthcare experiences and health outcomes by psychologically preparing and supporting children and their parents or carers in their healthcare interactions. The system has been developed by the company Little Journey. The system consists of a smartphone app which is used to access information about the procedure a child is about to undergo. It uses interactive, age-appropriate virtual reality (VR) animations to prepare children and families for the healthcare procedure, in the form of virtual reality tours, information articles, relaxation exercises and therapeutic games for children.

The VR content can be configured to individual hospitals, to reflect the details of their pathways and procedures. The aim is to familiarise children with the hospital environment and procedures in an age-appropriate way, which will desensitise them to the unfamiliar situation. Presented as a 'tour' of the hospital, each section or room in the tour is narrated, explaining to the child what happens there and who the staff they will meet are. Information is also provided to parents and carers about the procedure at appropriate times, to promote understanding and information retention.

A list of the proposed benefits for the Little Journey system includes:

- Decreased on-the-day cancellations.
- Reduction in pre-medication.
- Reduced anxiety and improved patient experience.
- Decreased pre-procedure fasting time.
- Faster recovery time.
- Improved compliance with post-procedure care, including medications.
- Reduced unplanned admissions.

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1 Carmichael N, et al. "Is it Going to Hurt?": The Impact of the Diagnostic Odyssey on Children and Their Families. J Genet Counsel, 2015, 24: 325-335. https://doi.org/10.1007/s10897-014-9773-9

2 Kain Z, et al. Preoperative anxiety and emergence delirium and postoperative maladaptive behaviors. Anesthesia & Analgesia. 2004, Volume 99, pp. 1648-1654.

3 Kain ZN, et al. Preoperative anxiety in children. Predictors and outcomes. Arch Pediatr Adolesc Med. 1996 Dec;150(12):1238-45. doi: 10.1001/archpedi.1996.02170370016002. PMID: 8953995.

- Reduction in number of days of school/work missed.
- Promotion of positive health behaviour development, reducing poor adherence to medication and late presentation when unwell in the future.

As of August 2021, Little Journey was being used for surgery preparation and support in 22 Hospitals in the UK, with a further 12 in the set-up phase, prior to full use. A multi-centre randomised controlled trial (RCT) of the system is currently under way, with publication of results expected at the end of 2023. However, an economic evaluation of Little Journey was produced in 2019, using data from early trials.[4] As the new data are not yet available upon which to base a new analysis, this case study summarises the methods and results from the 2019 economic evaluation. The values shown are taken directly from the evaluation report and a *de novo* analysis has not been conducted by YHEC.

The case study was prepared in Summer 2022 based on the evidence available. The limitations of the case study include:

- The economic evaluation was based on a small set of data from a study of early implementations of Little Journey. No control group was used for the evaluation and counterfactual evidence was obtained from clinical opinion. A more robust evaluation could be undertaken using a larger data set from the current RCT.
- The evidence is taken from an economic evaluation undertaken by Kent Surrey Sussex Academic Health Science Network (AHSN) and YHEC has not undertaken any independent analysis.
- Only a small sub-set of the proposed benefits of Little Journey could be included in the economic evaluation carried out by the AHSN which, as a result, may underestimate the full impact of the system.
- There was no assessment of patient outcomes in the AHSN study, only on the use of healthcare resources.
- The economic evaluation was based on data from five hospitals participating in a pilot study. The impacts and costs could be different for children undergoing different types of surgical or non-surgical intervention and in hospitals with different peri-operative processes.

2. METHODS OF THE ECONOMIC EVALUATION

2.1 General Methods

The data for the AHSN economic evaluation was obtained during an implementation in NHS hospitals in England in 2019. The data on the impact of Little Journey was taken from five of those hospitals, which were using the system as part of a pilot study, with results extrapolated to a larger group of hospitals. The sample size for the estimation of the impact of Little Journey was 181 patients, of which 81 provided post implementation data.

[4] Kent Surrey Sussex Academic Health Science Network. Evaluation report of the Little Journey mobile application. October 2019.

The counterfactual scenario for comparison, was the standard of care in a hospital without the use of Little Journey. Typically, a child and their parents or carers will attend a pre-operative assessment, as a face-to face appointment. They may also be sent written information on what to expect along with a surgery invitation letter. This information may be offered in a child-friendly manner, with the information tailored to the patient age group and with use of tools such as illustrated books or videos. The resource requirements of the comparator for the evaluation were ascertained by means of questionnaires, which were completed by ten sites participating in the implementation.

The AHSN evaluation considered the costs and impacts of Little Journey over a five-year period, with a weighting applied to later years to account for the possibility that, in future years, the benefits will diminish as the 'momentum' of using the system lessens. The resource consequences of Little Journey and the comparator were based on the data and questionnaire responses received by the researchers, using research evidence and other published sources to estimate appropriate economic values.

The AHSN researchers used an 'optimism bias' to counteract the fact that commissioners and practitioners are often overly positive about the benefits that will result from a new project or programme. This varied between a 5% to a 40% 'correction' depending on the source of evidence. So, for example, costs or benefits derived from RCTs or local contract delivery costs were corrected by 5%, whilst costs or benefits derived from uncorroborated expert opinion were corrected by 40%.

The benefits for the use of Little Journey were calculated for the five hospitals which provided usage data. These results were extrapolated to estimate the total benefits for 29 hospitals that had implemented the system at that time. Furthermore, the results were extrapolated to estimate the benefits that would be obtained if the system were rolled out to all paediatric hospital departments in England.

All economic values were reported as net present value. This discounts the value of future costs and benefits (by 3.5% per year, in line with HM Treasury guidance) and then subtracts the discounted costs from the discounted benefits to give the net present value.

2.2 Costs of Using Little Journey

The economic evaluation considered the following categories of costs related to the use of Little Journey:

- Service agreement costs for the use of Little Journey.
- Consumables: cardboard headsets for viewing the VR content and printed cards with QR codes which access the specific pathway for each hospital.
- Camera postage costs: for the camera sent from Little Sparks Hospital to permit filming the environment at an individual hospital site.
- Staff time costs for adopting the system: estimated to be six hours, shared between a Band 5 nurse and a consultant anaesthetist at each site, spent on training and administrative tasks.

From this, a total cost per hospital was calculated (Section 3).

2.3 Benefits of Using Little Journey

Due to limitations in scope, it was not possible for the AHSN economic evaluation to include all the potential benefits of Little Journey, as listed in the Background section, above. The specific resource use reduction benefits that were measured and costed were as follows:

- On-the-day cancellations of surgery: these interrupt the flow of patients through pathways and decrease the throughput of operating theatres, which results in wasted resources. Little Journey aims to address this by messaging parents to check that their child is fit and ready for surgery, if they have been unwell recently, or have had any change in their condition since the last time they were seen by the surgeon. A reminder is also sent about the age-appropriate fasting guidelines relevant to the child's procedure.
- Induction time and method: whether gas, intravenous (IV) or other (e.g. oral or sub-cutaneous). Gas induction is lower cost than IV induction, but each has its own risks for inducing anxiety in patients which can affect the time needed to administer it. These differences were assessed in the evaluation.
- Perioperative medication: the use of various types of sedative premedication in order to reduce crying and the need for restraint for induction of anaesthesia.
- Recovery readiness and discharge times, divided into three phases: first stage recovery or recovery readiness, which is until the patient is awake, protective reflexes have returned and pain is controlled; second stage recovery or discharge, which is until the patient is ready for discharge from hospital; late recovery, which is until the patient has made a full physiological and psychological recovery from the procedure.
- Unplanned admissions after surgery, which may be due to shortcomings in one or more of the above aspects of the care pathway.

The assumption which the AHSN evaluation tested is that Little Journey can have a resource use reducing impact on each of these elements of the patient pathway, with a corresponding impact on costs. In addition, other benefits were noted, to which no economic value was ascribed:

- Reduced pre-operative fasting times for both liquids and solids.
- Improved reputation of the hospital.

3. RESULTS OF THE AHSN ECONOMIC EVALUATION

The most detailed results reported in the AHSN economic evaluation related to the five hospitals who had provided data on usage of Little Journey (the results were not reported for the individual hospitals). For this group, the costs reported over five years were as shown in Table 3.1, at net present value for 2019.

Table 3.1: Costs over five years for five hospitals using Little Journey at net present value for 2019

Cost type	Year 1	Year 2	Year 3	Year 4	Year 5	Total cost
Service agreement cost	£300	£1,400	£1,300	£1,300	£1,300	£5,600
Consumables	£0	£10,100	£13,900	£17,800	£22,000	£63,800
Camera postage cost	£70	£0	£0	£0	£0	£70
Staff time cost	£2,600	£2,600	£2,500	£2,500	£2,400	£12,600
Total	**£2,970**	**£14,100**	**£17,700**	**£21,600**	**£25,700**	**£82,070**

Note: due to rounding in the original AHSN report, the numbers do not sum precisely

The resource use reduction benefits for the same five hospitals, over five years, at net present value for 2019, were as shown in Table 3.2. These only relate to the benefits for the NHS, specifically the hospitals using Little Journey themselves, rather than wider benefits for the NHS as a whole.

Table 3.2: Resource use reduction benefits over five years for five hospitals using Little Journey at net present value for 2019

Benefit type	Year 1	Year 2	Year 3	Year 4	Year 5	Total benefit
On-the-day cancellations	£49,900	£49,900	£43,200	£37,700	£32,300	£213,000
Induction time	-£1,220	-£1,320	-£1,220	-£1,120	-£1,020	-£5,900
Perioperative medication	£900	£1,000	£900	£800	£700	£4,300
Recovery readiness and discharge times	£7,000	£7,200	£6,700	£6,100	£5,500	£32,500
Unplanned admissions after surgery	£1,100	£1,200	£1,100	£1,000	£1,000	£5,400
Total	**£57,680**	**£57,980**	**£50,680**	**£44,480**	**£38,480**	**£249,300**

Note: due to rounding in the original AHSN report, the numbers do not sum precisely

For induction time, there was an increase rather than a reduction in cost from using Little Journey in three of the five hospitals that provided data, leading to an overall net cost increase across the sample. No reason was suggested for this in the study, but it was noted that there were very few cases where this metric was reported.

For on-the-day cancellations, it was estimated by the AHSN that there is a societal benefit, in addition to savings for the hospitals, due to family members not having to miss an additional work day because of the cancelled operation. The societal benefit was calculated using median gross weekly earnings from the Annual Survey of Hours and Earnings published by the Office for National Statistics.[5] The results were as shown in Table 3.3.

Table 3.3: Societal benefits over five years related to five hospitals using Little Journey at net present value for 2019

Benefit type	Year 1	Year 2	Year 3	Year 4	Year 5	Total benefit
On-the-day cancellations	£101,300	£98,000	£85,200	£73,200	£62,000	£419,700

Note: due to rounding in the original AHSN report, the numbers do not sum precisely

Table 3.4 combines the total costs (Table 3.1) and benefits reported by the AHSN (Tables 3.2 and 3.3), to show the net present value for the five hospitals that provided data. The same result was extrapolated to the level of all hospitals performing paediatric surgery in the NHS in England: a total of 145 sites. This includes both the resource use reduction benefits to the NHS and the wider societal benefits for the incremental change in on-the-day cancellations.

[5] https://www.ons.gov.uk/surveys/informationforbusinesses/businesssurveys/annualsurveyofhoursandearningsashe

Table 3.4: Benefits over five years for hospitals using Little Journey at net present value for 2019 (£000)

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
For five hospitals in the pilot						
Total benefits	£159.1	£155.0	£135.9	£117.7	£100.4	£668.2
Total costs	£3.0	£14.0	£17.7	£21.6	£25.7	£82.0
Net present value	£156.1	£141.0	£118.2	£96.2	£74.7	£586.2
For all paediatric hospital departments in the NHS in England (n=145)						
Total benefits	£1,651.2	£3,334.9	£3,367.5	£3,059.5	£2,746.3	£14,159.4
Total costs	£201.6	£404.6	£498.8	£597.4	£699.9	£2,402.3
Net present value	£1,449.7	£2,930.3	£2,868.7	£2,462.1	£2,046.4	£11,757.1

Notes:
Data are taken directly from the original AHSN evaluation report. Extrapolated results are from the AHSN analysis and are not simply extrapolated from the results for the five pilot hospitals.
Due to rounding, the numbers do not sum precisely.

Using these figures, a return on investment (ROI) can be calculated using the formula:

$$\frac{\sum \text{Total discounted benefits} - \sum \text{discounted costs}}{\sum \text{Total discounted costs}}$$

Over five years, at a national level and including societal benefits, the ROI is: 4.89.[6] With the societal benefits excluded, the ROI is: 2.04.

4. CONCLUSION

The results calculated in the economic evaluation carried out by Kent Surrey Sussex AHSN show a net present value, over five years of using Little Journey, of £586,930 for five hospitals included in the analysis. When extrapolated up to all paediatric hospitals, assuming the same potential for incremental benefit, this value increase to £11,757,100. To be conservative, this calculation incorporates a correction for optimism bias as described in Section 2.1. Furthermore, it does not include all the possible benefits of the system. In particular, it was not possible to capture many of the longer-term benefits of improved health behaviours in the evaluation. In addition, the evaluation did not consider the incremental changes in patient outcomes as a result of the intervention. Coupled with the limitations in the methods employed in the evaluation, there is significant uncertainty in these results.

The societal benefits estimated from on-the-day cancellations, as shown in Table 3.3 (£419,700 over five years) are greater than the total benefits to the NHS over the same period, as shown in Table 3.2 (£249,300 over five years). However, with the societal benefits excluded, the NHS benefits would still outweigh the total costs, with an ROI of 2.04, in this scenario, compared to 4.89 with societal benefits included.

[6] Note that this is a slightly lower value than that for the social return on investment given in the AHSN report (5.89), which uses a slightly different formula of: net present benefits/net present costs.

It should be noted that not all benefits reported are cash-releasing. Many benefits are in terms of opportunity costs, which means that they free up resources for other uses but will not have an impact on the budget of the hospital or department using Little Journey. Of the total savings of the system to the NHS, the AHSN report estimates that about 0.5% are cash releasing.

The estimation of benefits at a national level assumes similar costs and benefits in all paediatric hospital departments. This is unlikely to be the case, as their will be variations in procedures, such as patient pathways, baseline logistical and infrastructure systems. It is not possible to estimate the impact these will have on the results, although there may be some averaging out of hospitals with higher costs or benefits and hospitals with lower costs or benefits.

The multi-centre RCT which is currently underway is likely to produce a larger and more detailed data set, which can be used to provide a more robust evaluation of the efficacy of Little Journey and its economic impact.