York Health Economics Consortium

LITTLE JOURNEY

Economic Analysis of Little Journey in Addressing Pre-Operative Anxiety in Children

Draft Report

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Executive Summary

1. INTRODUCTION

Pre-procedure anxiety (PPA) is a common issue that is estimated to affect 40% to 60% of children attending hospital for a surgical or diagnostic procedure [1, 2]. PPA is associated with increased risk of adverse events such as emergence delirium, postoperative behavioural changes [3], and a longer postoperative recovery.

Little Journey has developed a mobile application that aims to reduce PPA, which allows children who are preparing for a procedure to visit the hospital rooms and interact with the staff and equipment that they will come across on the day. This allows children the time to process their thoughts and feelings and prepare for clinical experiences, with the aim of reducing their fear.

YHEC developed and populated an early health economic model to consider the economic impact of Little Journey, including the implication for carbon emissions, using data collected from two hospitals. The objective of this work was to produce a cost-consequence model that generated estimates of the cost impact and benefits of using the Little Journey app to reduce PPA.

2. DECISION PROBLEM

The economic analysis compared using the Little Journey app in a population of children aged 3 to 12 who are undergoing hospital general surgery and magnetic resonance imaging (MRI) scans, compared with current standard of care. The economic outcomes of interest were incremental costs, changes in productivity, and incremental carbon emissions, over a one-year time horizon.

3. ECONOMIC MODELLING

The cost-consequence model took a decision-tree structure. The model cohort entered the decision tree when they were informed that they would undergo a procedure (general surgery or MRI). Patients who were provided with Little Journey would either use or not use the application. When undergoing their procedure, children would either be anaesthetised using inhalational or intravenous induction, be sedated by a nurse or anaesthetist, or be awake. They may also never undergo the procedure. Model inputs were sourced from the data from the hospital service evaluations, and from academic literature and official databases. The model had a one-year time horizon.

Deterministic sensitivity analysis (DSA) was conducted to test the impact of uncertainty in the model by varying each input individually by +/-15% to see the change in the model results. Scenario analyses were also conducted where data quality was poor or multiple sources were available for an input.

4. RESULTS: SURGERY POPULATION

Using a surgery population of 100 people, Little Journey was estimated to generate a cost saving of £12.56 per person, or £1,296 per cohort. This saving was driven by a reduction in unplanned admissions. Little Journey was also estimated to reduce emissions by 2.68kgCO_2e per person, or 268.34kgCO_2e per cohort. After accounting for emissions produced from redirecting saved resources to the rest of the service, Little Journey was estimated to have net emissions savings of 76.35kgCO_2e for the cohort.

According to the DSA, the parameter that was the main driver of the model results was time to induction in the Little Journey arm. Varying any parameter by +/-15% still resulted in cost savings. The difference in number of patients taking analgesia, number of unplanned admissions, and the number of bed days per unplanned admission between each study arm were found to be statistically significant.

5. RESULTS: MRI POPULATION

Using an MRI population of 100 people, Little Journey was estimated to generate a cost saving of £2.40 per person, or £240 per cohort. This saving was driven by a reduction in unplanned admissions and repeat scans. Little Journey was also estimated to reduce emissions by 2.48kgCO_2e per person, or 247.54kgCO_2e per cohort. After accounting for emissions produced from redirecting saved resources to the rest of the service, Little Journey was estimated to have net emissions savings of 211.96kgCO_2e for the cohort.

According to the DSA, the parameter that was the main driver of the model results was time in the MRI scanner, as this affects the amount of anaesthetist time required. Varying certain inputs by +/-15% resulted in some scenarios being cost incurring. Only the difference in number of repeat scans in each study arm was found to be statistically significant (and only at the 10% level).

6. DISCUSSION

Overall, the model estimated that Little Journey would generate a cost saving and positive environmental impact in paediatric surgery and MRI, compared with standard care. The main limitations of the research were data quality, a study design that did not use controls, and the size of the study population. It is recommended that these limitations are addressed in future research.

Abbreviations

ADHD	Attention deficit/hyperactivity disorder
ASD	Autistic spectrum disorder
BNF	British National Formulary
DSA	Deterministic sensitivity analysis
IV	Intravenous
LCH	Leeds Children's Hospital
MRI	Magnetic resonance imaging
ODP	Operating department practitioner
PHBQ	Post-Hospitalization Behaviour Questionnaire
PPA	Pre-procedure anxiety
RCT	Randomised controlled trial
SBRI	Small Business and Research Initiative
UHP	University Hospitals Plymouth NHS Trust
YHEC	York Health Economics Consortium

1 Introduction

1.1 Background

Pre-procedure anxiety (PPA) is a common issue that is estimated to affect 40% to 60% of children attending hospital for a surgical or diagnostic procedure [1, 2]. PPA is associated with increased risk of adverse events such as emergence delirium, postoperative behavioural changes [3], and a longer postoperative recovery, although further evidence is needed to demonstrate that this is a cause-effect relationship [4]. Anxiety disorders are also particularly prevalent in neurodiverse individuals, with around 40% to 50% of people with autistic spectrum disorder (ASD) receiving a clinical diagnosis for anxiety [5] and a comorbidity rate of 35% for attention deficit/hyperactivity disorder (ADHD) [6]. This group can therefore often be more prone to PPA [7].

Little Journey has developed a mobile application that aims to reduce PPA by offering virtual hospital tours, information articles, and distraction and soothing activities to help children cope with their emotions. It allows children who are preparing for a procedure to visit the hospital rooms and interact with the staff and equipment that they will come across on the day. This allows children the time to process their thoughts and feelings and prepare for clinical experiences, with the aim of reducing their fear.

Little Journey was a awarded a grant through the Small Business and Research Initiative (SBRI) Phase 2 award. The funding has been used to conduct a service evaluation of the app at Leeds Children's Hospital (LCH), where it is being tested and refined by observing its usage and impact on children, particularly those who are neurodiverse. Data from this evaluation has been used to assess clinical, economic, and environmental impact. Data has also been made available from a deployment in University Hospital Plymouth NHS Trust (UHP). The evaluation included before and after quantitative analysis in surgery and MRI departments using Little Journey.

A requirement of the SBRI funding was that Little Journey needed to undertake a health economic analysis as part of the service evaluation. York Health Economics Consortium (YHEC) has developed a health economic model to conduct this analysis.

1.2 Objectives

YHEC developed and populated an early health economic model to consider the economic impact of Little Journey, including the implication for carbon emissions, using data collected through the service evaluation at LCH and data from UHP. The objective of this work was to produce a cost-consequence model that generated estimates of the cost impact and the benefits of using the Little Journey app to reduce PPA. The purpose of this technical report is to provide details of the modelling approach, structure, inputs, and key results of the model.

2 Decision Problem

The decision problem outlines the population, intervention, comparator, outcomes, time horizon, and perspective of the modelling approach, and is summarised in Table 2.1. The economic analysis compared using the Little Journey app in a population of children aged 3 to 12 who are undergoing hospital general surgery or magnetic resonance imaging (MRI) scans, compared with current standard of care. The economic outcomes of interest were incremental costs, changes in productivity, and incremental carbon emissions, over a one-year time horizon.

Table 2.1: Summary of the decision problem

Population	Children aged 3-12 undergoing hospital general surgery or MRI scans.
Intervention	Little Journey – mobile application to prepare children for their procedure.
Comparator	Standard care – care in the absence of Little Journey.
Outcomes	Economic outcomes: ▪ Incremental costs. ▪ Incremental carbon emissions.
Time horizon	One year.
Perspective	UK NHS and societal and environmental impacts.

MRI, magnetic resonance imaging; NHS, National Health Service.

The early economic model is suitable for making internal decisions, identifying key parameters and areas for further research, and demonstrating to NHS trusts the potential costs and consequences of using Little Journey in their hospitals.

3 Economic Modelling

3.1 Modelling Approach

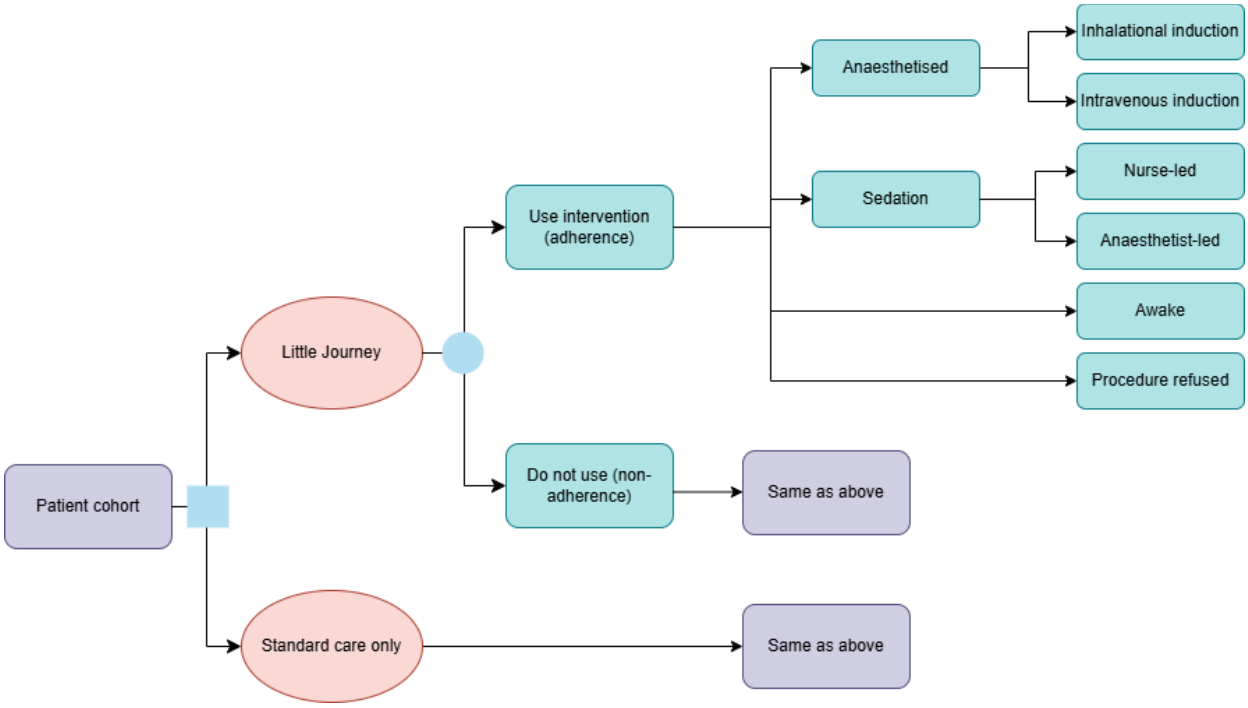
The cost-consequence model was built was built using Microsoft Excel and designed in a flexible, user-friendly format whereby the user could access a full range of input sheets and run various scenarios, by choosing from the options provided in an initial set-up sheet. The model was built to allow all major inputs to be easily changed by the user, including but not limited to, number of on-the-day cancellations, medication use, staff time, costs of resources, and carbon dioxide emissions. The functionality to choose which data sources to use was included, to add further flexibility to the model.

The model had a decision-tree structure, which is illustrated in Figure 3.1. The model cohort entered the decision tree when they were informed that they would undergo a procedure (general surgery or MRI). Patients who were provided with Little Journey would either use or not use the application. When undergoing their procedure, children would either be anaesthetised using inhalational or intravenous induction, be sedated by a nurse or anaesthetist, or be awake. They may also never undergo the procedure. Data on how cohorts were split were taken from service evaluation data.

Costs and resource use were taken into account for each arm of the decision tree for medication use, cancellations, post-discharge follow-ups, unscheduled admissions, and repeat scans. Each arm also considered the carbon dioxide emissions ($kgCO_2e$) for additional travel due to unscheduled appointments or on-the-day cancellations, equipment waste and disposal, bed days from unplanned admissions, and the method of anaesthesia used.

The model had a time horizon of one year and totalled the costs, additional resources, and environmental impact that occurred in this period.

Figure 3.1: Decision tree



3.2 Population

The model population was children aged 3 to 12 undergoing hospital general surgery or MRI scans. It considered the population undergoing each of these procedures independently, using different clinical, cost, and resource use parameters.

A model cohort of 100 children was used as a base case for this report. However, the model can run any cohort size and so can be applied to specific NHS trusts should this be required. Table 3.1 and Table 3.2 show the cohort sizes for the surgery and MRI study cohorts at the hospitals in Leeds and Plymouth.

Table 3.1: Surgery cohort sizes

	Pre-Little Journey (standard care)	Post-Little Journey (intervention)
Leeds	50	50
Plymouth	70	54
Combined	**120**	**104**

Table 3.2: MRI cohort sizes

	Pre-Little Journey (standard care)	Post-Little Journey (intervention)
Leeds	50	31
Plymouth	29	25
Combined	**79**	**56**

The populations were stratified by age band and average weights for each band were measured. These data were used to calculate the weighted average weight of the cohort going through the model, which would affect the environmental impact of anaesthetic induction. Calculations of weight for the combined cohorts from Leeds and Plymouth are shown in Table 3.3 and Table 3.4.

Table 3.3: Weighted average cohort weight for surgery

Age band	Proportion	Average weight (kg)
3 to 5 years	34.4%	17.09
6 to 7 years	14.7%	23.58
8 to 9 years	12.1%	29.89
10 to 12 years	38.8%	40.09
Weighted average cohort weight (kg)		**28.52**

Table 3.4: Weighted average cohort weight for MRI

Age band	Proportion	Average weight (kg)
3 to 5 years	24.2%	17.97
6 to 7 years	21.2%	25.18
8 to 9 years	17.4%	31.83
10 to 12 years	37.1%	44.02
Weighted average cohort weight (kg)		**31.58**

3.3 Clinical Parameters

Clinical parameters were mostly taken from primary data collection from Leeds and Plymouth. Both MRI and surgery cohorts included data on time to induction, time in the recovery room, time on the ward, and proportion receiving intravenous (IV) versus inhalational induction. The MRI cohort included additional data on the proportion having the scan under anaesthesia, sedation, or awake. However, the proportion undergoing each was determined by the hospital independent of whether a child was using Little Journey. Therefore, scenarios were also considered which included only general anaesthesia, only general anaesthesia and sedation, and only awake populations, as detailed in Section 3.8.2. Data were intended to be collected on time spent in the MRI scanner, but this was only reported for one study arm at each hospital, so it was assumed that the time spent in the MRI scanner was the same for both study arms.

Inputs for the number of staff required at each stage of a procedure were taken from literature. The number of operating department practitioners (ODPs)/nurses in the anaesthesia room was taken from the Royal College of Anaesthetists [8]. The number of nurses in the recovery room was taken from the British Anaesthetic and Recovery Nurses Association [9]. The number of nurses per patient on the ward was taken from the Royal College of Nursing [10].

Data were not collected on patients who refused a procedure when offered it. Additionally, no data were collected on which staff were administering sedation for MRI. Therefore, it was assumed that all sedation was anaesthetist-led.

Parameters for the surgery population are shown in Table 3.5. Parameters for the MRI population are shown in Table 3.6.

Table 3.5: Clinical parameters for surgery population

Parameter	Little Journey arm	Standard care arm
Time to induction (hours) average per patient	0.30	0.23
Nurses and ODPs (combined) per patient in anaesthesia room	1.00	1.00
Time in recovery room (hours) average per patient	1.37	1.45
Nurses per patient in recovery room	0.50	0.50
Time from recovery room to discharge (hours) average per patient	0.22	0.43
Nurses per patient on the ward	0.22	0.22
Proportion where actual method of induction is intravenous	53.4%	66.1%
Proportion of IV induction, where inhalational was planned	0.0%	3.8%
Proportion of inhalational induction, where IV was planned	16.4%	20.0%

IV – intravenous; ODP – operating department practitioner.

Table 3.6: Clinical parameters for MRI population

Parameter	Little Journey arm	Standard care arm
Proportion anaesthetised	33.9%	30.4%
Time to induction (hours) average per patient	0.30	0.28
Nurses and ODPs (combined) per patient in anaesthesia room	1.00	1.00
Time in MRI scanner (hours) average per patient	0.87	0.87
Time in recovery room (hours) average per patient	0.93	0.87
Nurses per patient in recovery room	0.50	0.50
Proportion where actual method of induction is intravenous	50.0%	17.4%
Proportion of general anaesthetic, where sedation was planned	5.3%	4.3%
Proportion of IV induction, where inhalational was planned	0.0%	0.0%
Proportion of inhalational induction, where IV was planned	0.0%	5.3%
Proportion sedated	1.8%	2.5%
Proportion of sedation where awake was planned	0.0%	0.0%
Time for staff leading sedation (hours) average per patient	0.30	0.28
Proportion of sedation being nurse-led	0.0%	0.0%
Proportion awake for procedure	64.3%	67.1%
Time on main ward (hours) average per patient	2.28	2.35
Nurses per patient on the ward	0.22	0.22
Probability of repeating MRI scan	3.9%	13.9%

IV – intravenous; MRI – magnetic resonance imaging; ODP – operating department practitioner.

3.4 Resource Use

Resource use parameters were taken from the study data collected by Little Journey at Leeds and Plymouth. This included the proportion of patients requiring anxiolytic, analgesic, and antiemetic medication, the number of cancellations, the number of unplanned admissions, and the number of bed days per unplanned admission. It was assumed that the adherence to using Little Journey was 100% in the absence of data for this input. Data on follow-up appointments were not collected and so these were not considered in the analysis.

Data quality for cancellations was poor. For several patients, the reason for a delay in the planned procedure was not recorded. Where the reason for postponement was recorded, it was not clear if this cancellation was on-the-day, which would imply the slot could not be filled by another patient, or in advance. Due to this uncertainty, and uncertainty around their costs, cancellations were only incorporated in scenario analysis, detailed in Section 3.8.2, and are set to zero in the base case. Commonly reported reasons were 'cancellation by hospital', and 'cancellation by family'.

3.4.1 Surgery

In the Little Journey cohort, the number of bed days for an unplanned admission only used Plymouth data as no admissions were reported in Leeds, and so no data on average bed days was available from there.

Table 3.7: Resource use parameters for surgery population

Parameter	Little Journey arm	Standard care arm
Adherence to Little Journey	100%	NA
Proportion where perioperative anxiolytic medication used	10.6%	14.2%
Proportion where post-operative analgesia used	27.2%	42.9%
Proportion where post-operative antiemetic used	19.6%	16.8%
Proportion of procedures with on-the-day cancellation	(0.0%)	(0.0%)
Proportion of cases with unplanned pre-discharge admission	1.9%	6.7%
Average bed days per unplanned admission	1.00	1.38

3.4.2 MRI

Data on antiemetic use was missing in the Little Journey cohort of the Leeds data. Therefore, it was assumed that the data for Plymouth also applied to the Leeds cohort. Additionally, there were no unplanned admission in the Little Journey cohort at either hospital. Therefore, the average number of bed days was set to zero as a placeholder. No unplanned admissions were reported in the standard care cohort in Leeds either. Therefore, only the Plymouth data were used to populate this input.

Table 3.8: Resource use parameters for MRI population

Parameter	Little Journey arm	Standard care arm
Adherence to Little Journey	100%	NA
Proportion where perioperative anxiolytic medication used	12.0%	12.5%
Proportion where post-operative analgesia used	0.0%	0.0%
Proportion where post-operative antiemetic used	0.0%	10.5%
Proportion of procedures with on-the-day cancellation	(0.0%)	(0.0%)
Proportion of cases with unplanned pre-discharge admission	0.0%	2.5%
Average bed days per unplanned admission	0.00	0.50

3.5 Costs

The service cost of the intervention was provided by Little Journey. This cost covered one pathway using Little Journey. The cost used in the base case assumed that this was the first pathway using Little Journey. The cost of additional pathways is much lower so a scenario where this ran as an additional pathway was analysed, described in Section 3.8.2.

Staff costs were taken from the PSSRU 2023 [11]. It was assumed that the cost of an ODP was a Band 5 hospital-based scientific and professional staff. This cost did not include qualification costs in the PSSRU, so it was assumed that the same proportion of the cost attributed to qualifications for a Band 5 nurse applied to the ODP cost. This cost was applied regardless of if an ODP or anaesthetic nurse were in the anaesthetic room.

The cost of IV induction was calculated from the paediatric British National Formulary (BNF) [12]. It was assumed that single-use vials of propofol were used. Therefore, one vial would cover a weight range of up to 153kg which covered the weight range of the study cohort.

The cost of inhalational induction required several calculations. The ratio of nitrous oxide to oxygen was 2:1, using one litre every ten seconds, and one percent of sevoflurane increasing to eight percent in one-percent intervals every ten seconds i.e. 70 seconds to induction. This information was taken from Dave 2019 [13]. The conversion of sevoflurane fluid agent to volatile agent vapour volume was taken from Biro 2014 [14] with 1.52ml of liquid required. The cost of sevoflurane was taken from the BNF [12]. The cost of oxygen and nitrous oxide were taken from the BOC Healthcare Medical Gases Price List 2025, and assumed the largest canister of each gas was used [15].

The cost of sedative, anxiolytic, analgesic, and antiemetic medications were calculated using costs from the BNF (paediatric and regular where paediatric costs were unavailable), and the NHS drug tariff where drugs were a special-order item [12, 16, 17]. Medication in the Plymouth and Leeds data was costed based on the drug and dose administered for each patient and an average cost per patient taking the medication was calculated. Where vials were required, it was assumed that these were single-use vials.

The cost of an excess bed day was taken from the National Schedule of NHS costs 2017/18 as this was the last dataset to publish this cost [18]. The cost was then inflated to 2022/23 prices using the PSSRU inflation index [11].

The cost of a repeat MRI scan was calculated as a weighted average of the following currency codes from the National Schedule of NHS costs 2023/24 (outpatient imaging only): RD01B, RD01C, RD02B, and RD02C [19].

Due to the poor data quality for on-the-day cancellations, as discussed in Section 3.4 and Section 3.7, and the multiple sources available for the cost of this, as discussed in Section 3.8.2, the cost of on-the-day cancellations is set to £0 in the base case and varied in the scenario analysis.

Table 3.9: Cost parameters

Parameter	Value
Service cost of Little Journey for one pathway	£1,020.00
Cost of nurse per hour	£48.00
Cost of operating department practitioner per hour	£44.57
Cost of anaesthetist per hour	£143.00
Cost of intravenous induction per patient	£12.06
Cost of inhalational induction per patient	£0.91
Cost of sedative per patient	£19.08
Cost of anxiolytic per patient	£8.13
Cost of analgesic per patient	£1.16
Cost of antiemetic per patient	£0.90
Excess bed day cost per day	£403.99
Cost of repeat scan (MRI only)	£162.36
Cost of on-the-day cancellation	(£0.00)

3.6 Environmental Parameters

Data for the environmental impact of anaesthetic induction were taken from unpublished NAP7 survey data and associated emissions data, after liaising with Hrishi Narayanan, the lead author of a 2022 paper modelling the carbon footprint of paediatric anaesthesia [20]. Weighted average emissions were calculated for each method of induction (a weighted average was required because the value changes dependent on the method of maintenance). The value altered dependent on whether the average weight of the cohort was above or below 30kg. The inputs listed in Table 3.10 are those associated with the average weights used in the base-case scenarios, as reported in Table 3.3 and Table 3.4.

Table 3.10: Parameters for environmental impact of anaesthetic induction

Parameter	Surgery	MRI
Intravenous induction (per patient)	1.44 kgCO_2e	2.16 kgCO_2e
Inhalational induction (per patient)	2.14 kgCO_2e	3.45 kgCO_2e

The environmental impact values associated with additional travel and on-the-day cancellations were taken from a SusQI project report for a study conducted at The Christie NHS Foundation Trust [21]. Travel emissions were only associated with additional follow-up appointments in this model as it was assumed that the family would ring the hospital to cancel a procedure rather than travel there. Therefore, this parameter does not currently impact the model results as data on follow-up appointments was not available. The overall environmental impact of using Little Journey is, therefore, likely to be understated.

The environmental impact of one additional bed day was sourced from a publication by the Sustainable Healthcare Coalition [22]. It was assumed that all bed days would be low-intensity inpatient bed days to provide a conservative estimate of emissions.

The environmental impact of an MRI scan was taken from Martin et al. 2018 [23]. This source analysed the impact of abdominal imaging specifically. However, the National Schedule of NHS costs combine all MRI imaging under scanning one or multiple parts of the body, implying the same resource use for scanning another body part. Therefore, it was assumed that the environmental impacts of scanning any one part of the body were equivalent.

The environmental impact parameters used in the base case are displayed in Table 3.11.

Table 3.11: Other parameters for environmental impacts

Parameter	Value
Travel emissions per additional appointment	13.67 $kgCO_2e$
Waste, consumables, set-up and staff travel per cancellation	47.42 $kgCO_2e$
Emissions per additional bed day	37.9 $kgCO_2e$
Emissions per MRI scan	19.72 $kgCO_2e$

If an intervention is cost saving to the NHS, it is assumed that the resources saved would be redistributed elsewhere in the service. Therefore, an additional analysis was conducted to estimate the impact of the average emissions associated with this redistribution of resources, by calculating the emission per £1 spent by the NHS. This was deducted from the incremental environmental impact of the intervention to produce a net environmental impact.

The NHS annual budget was taken from the NHS England 2023/24 business plan [24]. The annual CO_2 emissions from the NHS were taken from Tennison et al. 2021 [25]. This figure reflected emissions from 2019 with no more recent value available, and it was assumed that this value also reflected total emissions in 2024/25. Given that the NHS is currently working towards a goal of net-zero, the actual emissions may be lower than this. Table 3.12 shows the calculation results.

Table 3.12: Parameters for environmental impact of cost savings

Parameter	Value
NHS total annual budget	£168,800,000,000
NHS total annual CO_2 emissions ($kgCO_2e$)	25,000,000,000
NHS CO_2 emissions per £1 spent ($kgCO_2e$)	**0.15**

3.7 Assumptions

It was assumed that the model outcomes of the decision tree represented the most common possible outcomes and would be based on averages. This was because it would not be practical to model every possible outcome.

Assumptions were also made about the parameters used/excluded in the model, as discussed briefly above. First, on-the-day cancellations were excluded in the base case. This was due to the quality of data on which cancellations occurred on the day versus in advance. In the scenario analysis, the proportion of on-the-day cancellations was equal to the proportion where cancellations were made by the family (rather than by the hospital). This used the logic that, if the hospital arranged the cancellation, they would also make a decision about reallocating resources when making this decision, whereas cancellations made by the family would be unexpected.

Additionally, data were not available for the number of follow-up appointments required, adherence to using Little Journey, and the number of patients/family refusing a procedure when offered it. Therefore, whilst the model has the functionality to include these inputs, they were assumed not to affect the results of the model.

Data on the time spent in the MRI scanner was poor quality. Therefore, the time in the scanner was assumed to be the same in both treatment arms.

3.8 Sensitivity Analyses

3.8.1 Deterministic sensitivity analysis

Input parameters were tested in deterministic sensitivity analysis (DSA). DSA involves altering the value used for individual parameters one at a time, within realistic ranges, to determine the impact on the model results. The main output from the DSA is a tornado diagram, which summarises the impact of changing each parameter on the model results and ranks the size of the individual impact from top to bottom. This enables the user to quickly identify the parameters that have the largest impact on the results when varied independently. The purpose of this is to analyse what impact any uncertainty in the input parameter values has on the results of the modelling. Where there is a larger impact on the results, it is more important to collect additional information to inform the parameter value, to reduce the uncertainty.

Model input parameters included in the DSA were varied by +/-15% around the point estimate that was applied in the base-case analysis. This percentage variability can be altered by the user, but +/-15% was deemed a reasonable level of variation for all parameters in the base case. The incremental cost per person was calculated for each of the high and lower value ranges. All input parameters were included in the DSA except for the proportion having a procedure under anaesthesia, sedation, or awake as varying these individually would mean that the total proportions no longer summed to 100%.

3.8.2 Scenario analysis

Scenario analysis was conducted on the cost of an on-the-day cancellation. This was done to address the multiple sources available which reported different costs. Each source had limitations, meaning that one was not preferred over the other. Additionally, the quality of data on cancellations from Leeds and Plymouth was poor as discussed in Section 3.7. Therefore, the base case attributed no costs to on-the-day cancellations, to provide a conservative estimate of costs. In the scenario analysis, it was assumed that data entries reporting 'cancellation by the family' were on-the-day cancellations, whereas reports of 'cancellation by the hospital' or 'intercurrent illness' were not. This assumed that those appointments cancelled by the family were a result of a family member phoning up on the day to cancel, in the absence of more robust evidence. Each cancellation cost was then applied to this cohort. The proportion of the study cohort reporting 'cancellation by family' is reported in Table 3.13.

Two sources were explored for the costs. The first was a SusQI report from Maestreania et al. 2022 [21]. This included a larger cost which incorporated multiple potential contributors to cost, such as wasted materials. The second cost used from this source was a more conservative estimate which only considered the cost of wasted staff time. This source was limited in that it considered all types of surgery. The other source was from Turunen et al. 2018. This had a much larger cost but was specific to paediatric surgery [26]. The limitation of this source was that it was from a Finnish setting which may attribute different costs to healthcare resources or have different medical practices/structures. No source could be found for the cost of a cancelled MRI scan. Therefore, scenarios were only run for the surgery cohort. The costs are shown in Table 3.14.

Table 3.13: Population reporting cancellations

	Little Journey	Standard care
Surgery population	0.0%	2.5%
MRI population	5.4%	4.0%

Table 3.14: Scenario on-the-day cancellation costs

Source	Cost
Maestreania et al. 2022 – total cost	£406.96
Maestreania et al. 2022 – staff cost only	£297.50
Turunen et al. 2018	£1,136.51

In the MRI population, scenario analysis was conducted which considered a population only undergoing anaesthesia, only undergoing a general anaesthetic or sedation, and a scenario which considered a population who only had an MRI scan awake. This is because the hospital determined if a child received anaesthesia/sedation independent of whether a child was using Little Journey. Therefore, any differences in proportions should not be statistically significant and should be the same if a larger population were included in the study. However, this does further shrink the study populations and so these results should be analysed with caution. Anaesthesia and sedation were combined as only two children were sedated and one planned sedation was changed to a general anaesthetic.

A scenario was also conducted where the population was from an additional pathway using Little Journey i.e. not the first pathway commissioned by the hospital. This reduced the service agreement cost from £1,020 to £300 for the whole pathway.

3.8.3 Significance tests

Significance tests were conducted on the combined data collected by Leeds and Plymouth to analyse if the differences between study arms were significant. This included both categorical and continuous variables. Chi-square tests were performed on categorical variables. Where data included a cell count that was less than five, the Fisher's exact test was used.

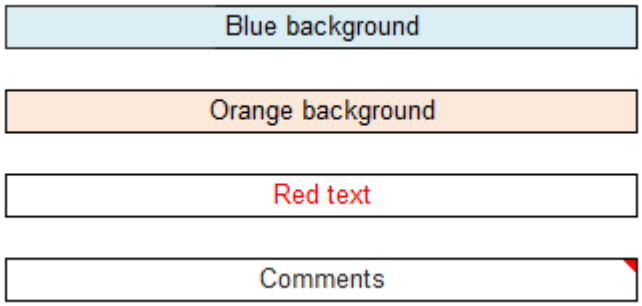
One-tailed, two-sample t-tests were performed on continuous data. Variances were calculated to determine whether the test used would be homoscedastic (equal variance) or heteroscedastic (unequal variance). Variances were considered unequal if one was at least twice as large as the other. The type of test performed for each variable is specified in the results sections.

3.9 Updating the Model

Figure 3.2 displays the model key to help users understand how to use the model and update any input parameters to run different scenarios. The following description explains what the different cell formats within the model mean:

- A blue background indicates input cells. These can be changed as appropriate to your requirements. Many user-defined columns are represented with a blue background.
- An orange background indicates input cells where placeholder data or substantial assumptions have been used. These should be updated as and when data become available.
- Red text indicates a formula cell. These are dependent upon other cells and should not be changed.
- A red mark in the corner of a cell indicates a comment. To view a comment, hover the pointer over the cell. This does not impact whether a cell can or cannot be changed and may be used in combination with the other format styles.

Figure 3.2: Model key



Changes to input cells (blue and orange backgrounds) are useful for routine testing or for running scenarios. To toggle the source of data used in the overall model, a drop-down menu has been provided in the Set-Up sheet that has access to data from each source in the data library. The data library indicates the input source, and any calculations made to arrive at the input (blue background) or based on assumption (orange background). Any changes to source data made within the data library will automatically feed through to the rest of the model.

4 Results: Surgery Population

4.1 Interpreting Results

The total and incremental costs per person were generated as primary outcomes in each arm of the model and the difference between arms was calculated. These costs were also broken down into individual elements of resource use and associated costs in each arm. The model also considered additional environmental outcomes for both the intervention and standard care arms.

Incremental results are included for each of these outcomes to demonstrate the difference in key outcomes when Little Journey is used in addition to standard care. A negative incremental cost indicates that Little Journey results in lower total costs than standard care alone. When incremental costs are zero, it indicates that Little Journey is neither more nor less costly than standard care. Finally, if the incremental cost is positive, it indicates that Little Journey is more costly than standard care.

Cost savings are not necessarily cash releasing. Rather they represent opportunity cost savings and may represent efficiency gains within the healthcare system such as staff time freed up for other purposes.

4.2 Base Case

4.2.1 Costs and resources

Using a surgery population of 100 people, Little Journey was estimated to generate a cost saving of £12.96 per person, or £1,296 per cohort. This saving was driven by a reduction in unplanned admissions, which outweighed the intervention cost and the increased cost of procedures from longer times spent in the anaesthesia and recovery room. Cost savings were also generated from the reduced use of anxiolytic and analgesic medication. A breakdown of the costs and savings is shown in Table 4.1. The change in resource use is reported in Table 4.2.

Table 4.1: Breakdown of cost results for surgery population

	Little Journey	Standard care	Incremental cost
Intervention cost	£1,020.00	£0.00	£1,020.00
Procedure costs	£9,819.60	£9,136.83	£682.78
Anxiolytic medication costs	£86.18	£115.45	-£29.27
Antiemetic medication costs	£17.64	£15.12	£2.52
Analgesic medication costs	£31.55	£49.76	-£18.21
(On-the-day cancellations)	(£0.00)	(£0.00)	(£0.00)
Unplanned hospital admissions	£767.58	£3,721.876	-£2,954.18
Annual cost per cohort	**£11,743**	**£13,039**	**-£1,296**
Cost per person	**£117.43**	**£130.39**	**-£12.96**

Table 4.2: Breakdown of resource use for surgery population

	Little Journey	Standard care	Incremental resource use
Anxiolytic medication use	11	14	-4
Antiemetic medication use	20	17	3
Analgesic medication use	27	43	-16
(On-the-day cancellations)	0	0	0
Unplanned hospital admissions	2	7	-5
Nurse/ODP time (hours)	103.04	105.25	-2.21
Anaesthetist time (hours)	30.00	23.33	6.67

ODP – operating department practitioner.

4.2.2 Additional results

Using Little Journey in the surgery population decreased emissions by 2.68kgCO_2e per person, or 268.34kgCO_2e per cohort. This was driven solely by a reduction in bed days resulting from unplanned admissions which outweighed the increase in the number of inhalation induction methods of anaesthesia. It should also be noted that the Little Journey arm saw a smaller number of changes in the planned method of anaesthetic induction. This suggests that the decrease in IV inductions with Little Journey was a result of the preferences of the surgeon rather than being driven by use of the intervention. There may be additional resource use and environmental factors which could not be captured from these last-minute changes which could affect costs and emissions further in favour of the intervention arm. The environmental results are shown in Table 4.3. The unplanned changes in induction are shown in Table 4.4.

Due to the cost saving of Little Journey, incorporating the annual emissions attributed to resources being reallocated to other parts of the service reduced the net total emission savings associated with using Little Journey with net emission reduction totalling 76.35kgCO_2e per cohort, or 0.76kgCO_2e per person. This calculation is shown in Table 4.5.

Table 4.3: Environmental impact of Little Journey on surgery population

	Little Journey	Standard care	Incremental emissions
Annual emissions per cohort	248.55kgCO_2e	516.90kgCO_2e	-268.34kgCO_2e
Annual emissions per person	2.49kgCO_2e	5.17kgCO_2e	-2.68kgCO_2e

Table 4.4: Number of changes in planned induction method in surgery population

	Little Journey	Standard care	Incremental changes
IV planned changed to inhalational	16	20	-4
Inhalation planned changed to IV	0	4	-4
Total unplanned changes*	**16**	**24**	**-7**

*Totals may differ due to rounding.

Table 4.5: Net incremental emissions of Little Journey for surgery population

Annual NHS emissions per pound spent	0.15kgCO_2e
Funds redirected to rest of NHS	£1,296
Annual emissions attributed to redirected funds	192.00kgCO_2e
Net incremental emissions of Little Journey	**-76.35kgCO_2e**

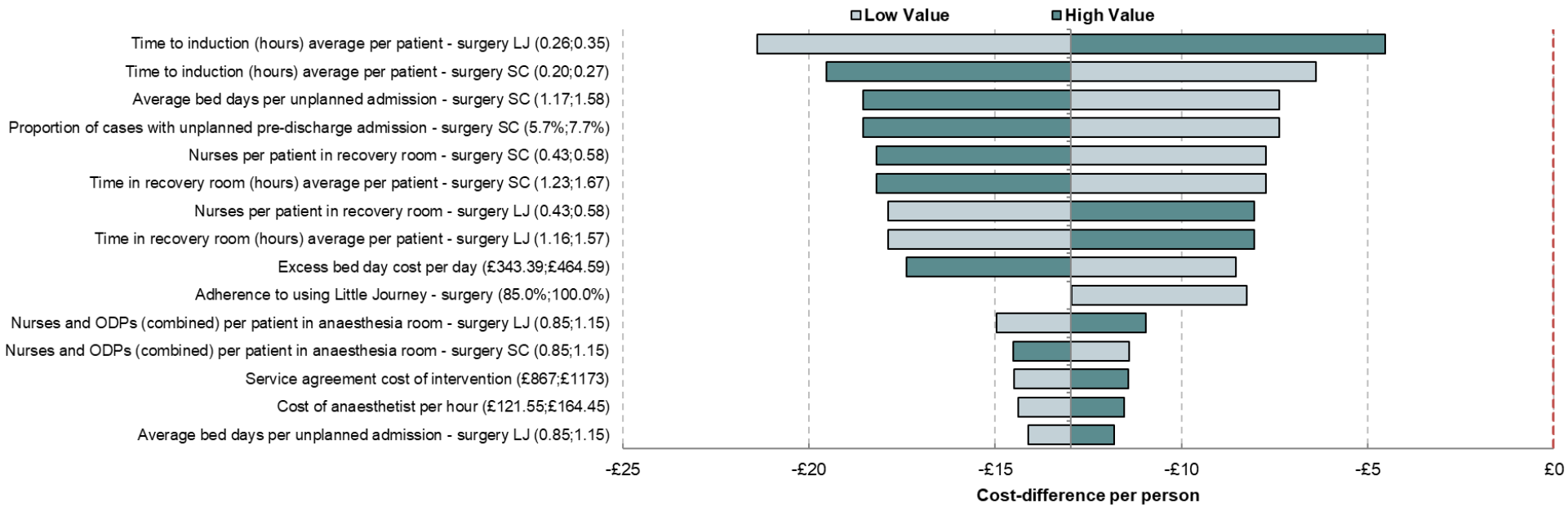
4.3 Sensitivity Analysis

4.3.1 Deterministic sensitivity analysis

The impact on the results of adjusting each model parameter value by +/-15% are summarised in a tornado diagram in Figure 4.1. It presents the cost-difference per person results, with the parameters that have the largest individual impact listed at the top of the y-axis.

The parameter that was the main driver of the model results was time to induction using Little Journey. Other key drivers were time to induction under standard care, average bed days per unplanned admission under standard care, number of unplanned admissions under standard care, number of nurses in the recovery room, and time spent in the recovery room. Varying these results by a range of +/-15% still resulted in cost savings.

Figure 4.1: Surgery population tornado diagram



LJ – Little Journey; ODP – operating department practitioner; SC – standard care.

4.3.2 Scenario analysis

Calculating the on-the-day cancellation proportion produced 0.0% cancelled in the Little Journey cohort and 2.5% cancelled in the standard care cohort. Using these figures the model estimated reductions in environmental emissions of 3.87kgCO_2e per person, with a net reduction in emissions, including the cost savings from the base case of 194.90kgCO_2e for the cohort of 100 people. These results are shown in Table 4.6.

Table 4.6: Environmental impact of Little Journey for surgery population including cancellations

	Little Journey	Standard care	Incremental
Annual emissions per cohort	248.55kgCO_2e	635.45kgCO_2e	-386.89kgCO2e
Annual emissions per person	2.49kgCO_2e	6.35kgCO_2e	-3.87kgCO_2e
Annual emissions attributed to redirected funds			192.00kgCO_2e
Net incremental emissions of Little Journey			**-194.90**kgCO_2e

Varying the cost of on-the-day cancellations using the different cost sources resulted in further cost savings between £20.40 and £41.38 per person. However, due to the increase in cost saving, the net incremental emissions increased, ranging from -84.75kgCO_2e (a reduction) to 225.91kgCO_2e (an incurrence) per cohort. These results are shown in Table 4.7.

Table 4.7: Scenario analysis of different cancellation costs on surgery population

Scenario	Scenario cancellation cost	Incremental cost per person	Net emissions per cohort
Base case	£0.00	-£12.96	-194.90kgCO_2e
Maestreania et al. 2022: total cost	£406.96	-£23.14	-44.22kgCO_2e
Maestreania et al. 2022: staff costs only	£297.50	-£20.40	-84.75kgCO_2e
Turunen et al. 2018 cost	£1,136.51	-£41.38	225.91kgCO_2e

The results from using the ‘additional pathway’ cost with a service agreement cost of £300 (and excluding cancellations are shown in Table 4.8 and Table 4.9. Using this cost estimated are larger cost saving of £20.16 per person. However, they generated a net emissions incurrence for the cohort of 30.29kgCO_2e due to further funds being redistributed to the rest of the health service.

Table 4.8: Cost results for surgery population as an additional pathway

	Little Journey	Standard care	Incremental cost
Annual cost per cohort	£11,023	£13,039	-£2,016
Annual cost per person	£110.23	£130.39	-£20.16

Table 4.9: Environmental results for surgery population as an additional pathway

Annual NHS emissions per pound spent	0.15kgCO_2e
Funds redirected to rest of NHS	£2,016
Annual emissions attributed to redirected funds	298.63kgCO_2e
Annual emissions per cohort	-268.34kgCO_2e
Net incremental emissions of Little Journey	**30.29kgCO_2e**

4.3.3 Significance tests

The difference in two variables was found to be significant at the 5% level. These were the number of patients using analgesia and the number of bed days per unplanned admission. The number of unplanned admissions was found to be significant at the 10% level. Given that unplanned admissions are the biggest contributor to cost savings, it is encouraging to find that the difference between Little Journey and standard care is unlikely to be due to chance.

Table 4.10: Significance tests for surgery population

Variable	Statistical test	p-value
Number of procedures cancelled by family	Fisher's exact test	0.152
Number of patients using anxiolytics	Chi-square test	0.418
Number of patients who had a different induction method than planned	Chi-square test	0.896
Number of patients using analgesia	Chi-square test	0.024**
Number of patients using antiemetics	Chi-square test	0.597
Number of patients with an unplanned admission	Fisher's exact test	0.078*
Number of bed days per unplanned admission	One-tailed, two-sample, heteroscedastic t-test	0.040**
Time in the anaesthetic room	One-tailed, two-sample, heteroscedastic t-test	0.216
Time in the recovery room	One-tailed, two-sample, homoscedastic t-test	0.331
Time on the ward	One-tailed, two-sample, heteroscedastic t-test	0.167

*p < 0.1; **p < 0.05.

5 Results: MRI Population

5.1 Base Case

5.1.1 Costs and resources

Using an MRI population of 100 people, Little Journey is estimated to generate a cost saving of £2.40 per person, or £240 per cohort. This saving was driven by a reduction in unplanned admissions and repeat scans, which outweighed the intervention cost and increased staff time. Anxiolytic and antiemetic use also decreased. Procedure costs were higher in the Little Journey arm by £875.52. This is because more children underwent a general anaesthetic for their MRI scan, which required anaesthetist time, in the Little Journey arm. However, it should be noted that the number receiving general anaesthetic, sedation, or awake was determined by the hospital independent of whether a child was using Little Journey. Therefore, there may be additional cost savings if it is assumed that the number of general anaesthetics is the same in both study arms, which may not have been picked up given the smaller sample of MRI patients. This is explored in Section 5.2.2. A breakdown of the costs and savings is shown in Table 5.1. The change in resource use is reported in Table 5.2.

Table 5.1: Breakdown of cost results for MRI population

	Little Journey	Standard care	Incremental cost
Intervention cost	£1,020.00	£0.00	£1,020.00
Procedure costs	£9,578.82	£8,703.31	£875.52
Anxiolytic medication costs	£97.56	£101.63	-£4.07
Antiemetic medication costs	£0.00	£3.11	-£3.11
Analgesic medication costs	£0.00	£0.00	£0.00
(On-the-day cancellations)	£0.00	£0.00	£0.00
Unplanned hospital admissions	£0.00	£504.99	-£504.99
Repeat scans	£633.20	£0.00	-£1,623.60
Annual cost per cohort	**£11,330**	**£11,570**	**-£240**
Cost per person	**£113.30**	**£115.70**	**-£2.40**

Table 5.2: Breakdown of resource use for MRI population

	Little Journey	Standard care	Incremental resource use
Number anaesthetised	34	30	4
Number sedated	2	3	-1
Number awake	64	67	-3
Anxiolytic medication use	12	13	-1
Antiemetic medication use	0	3	-3
Analgesic medication use	0	0	0
(On-the-day cancellations)	0	0	0
Unplanned hospital admissions	0	3	-3
Repeat scans	4	14	-10
Nurse/ODP time (hours)	75.56	72.87	2.68
Anaesthetist time (hours)	40.09	35.67	4.42

5.1.2 Additional results

Using Little Journey in the MRI population reduced emissions by 2.48kgCO_2e per person, or 247.54kgCO_2e per cohort. This was driven by a decrease in repeat scans, a decrease in the number of inhalation induction methods of anaesthesia and a decrease in bed days from unplanned admissions. The Little Journey cohort also had a smaller number of changes in anaesthetic induction method. There may be additional resource use and environmental factors which could not be captured from last-minute changes which could reduce costs and emissions further in the Little Journey arm. The environmental results are shown in Table 5.3. The unplanned changes in induction/sedation are shown in Table 5.4.

Due to the cost saving potential of Little Journey, incorporating the annual emissions attributed to resources being reallocated to other parts of the service reduced the net total emission savings associated with using Little Journey with net emission reduction totalling 211.96kgCO_2e per cohort, or 2.12kgCO_2e per person. This calculation is shown in Table 5.5.

Table 5.3: Environmental impact of Little Journey on MRI population

	Little Journey	Standard care	Incremental emissions
Annual emissions per cohort	172.10kgCO_2e	419.64kgCO_2e	-247.54kgCO_2e
Annual emissions per person	1.72kgCO_2e	4.20kgCO_2e	-2.48kgCO_2e

Table 5.4: Number of changes in planned induction method in MRI population

	Little Journey	Standard care	Incremental changes
IV planned changed to inhalational	0	2	-2
Inhalation planned changed to IV	0	2	-2
Sedation changed to anaesthetic	2	1	1
Awake changed to sedation	0	0	0
Total unplanned changes	**2**	**5**	**-3**

Table 5.5: Net incremental emissions of Little Journey for MRI population

Annual NHS emissions per pound spent	0.15kgCO_2e
Funds redirected to rest of NHS	£240
Annual emissions attributed to redirected funds	35.58kgCO_2e
Net incremental emissions of Little Journey	**-211.96kgCO_2e**

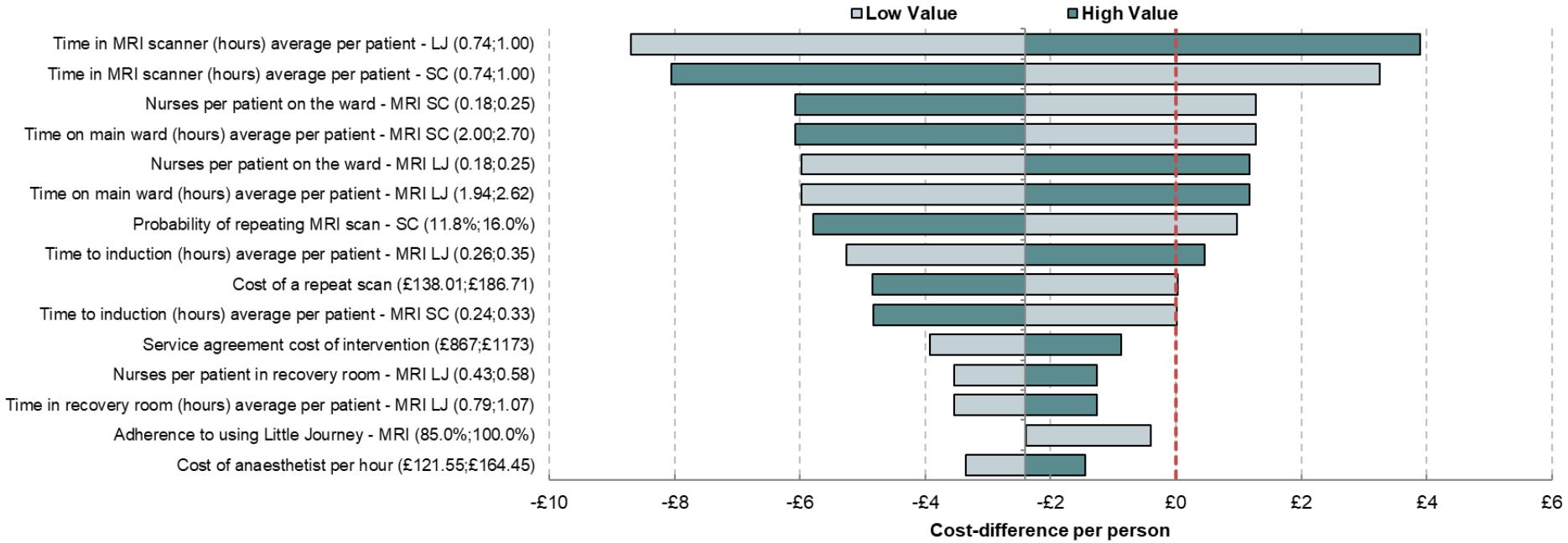
5.2 Sensitivity Analysis

5.2.1 Deterministic sensitivity analysis

The impact on the results of adjusting each model parameter value by +/-15% are summarised in a tornado diagram in Figure 5.1. It presents the cost-difference per person results, with the parameters that have the largest individual impact listed at the top of the y-axis.

The parameter that was the main driver of the model results was time in the MRI scanner, as this affects the amount of anaesthetist time required. Other key drivers were time spent on the ward, number of nurses per patient on the ward, and probability of a repeat scan. The direction of the results is sensitive to variation of +/-15% in these parameters, shown in Figure 5.1.

Figure 5.1: MRI population tornado diagram



LJ – Little Journey; MRI – magnetic resonance imaging; SC – standard care.

5.2.2 Scenario analysis

Little Journey saw a slight increase in the number of on-the-day cancellations (5.4% compared with 4.0%). However, since a robust cost for this parameter could not be sourced, it was not possible to analyse the impact on the model results.

The results from using the 'additional pathway' cost with a service agreement cost of £300 (and excluding cancellations) are shown in Table 5.6 and Table 5.7. Using this cost estimated a larger cost saving of £9.60 per person, compared with the base case. This generated a net emissions reduction for the cohort of 105.33kgCO_2e after accounting for cost savings generated from use of the intervention being redistributed to the rest of the health service.

Table 5.6: Cost results for MRI population as an additional pathway

	Little Journey	Standard care	Incremental cost
Annual cost per cohort	£10,610	£11,570	-£960
Annual cost per person	£106.10	£115.70	-£9.60

Table 5.7: Environmental results for MRI population as an additional pathway

Annual NHS emissions per pound spent	0.15kgCO_2e
Funds redirected to rest of NHS	£960
Annual emissions attributed to redirected funds	142.22kgCO_2e
Annual emissions per cohort	-247.54kgCO_2e
Net incremental emissions of Little Journey	**-105.33kgCO_2e**

The results from considering a cohort of 100 people who all received a general anaesthetic are shown in Table 5.8 and Table 5.9. This estimated a cost saving of £3.59 per person. A net emissions reduction of 233.49kgCO_2e for the cohort was also estimated. The cost saving increased, but the Little Journey still resulted in higher procedure costs. This is because, whilst the number receiving anaesthesia is equal across study arms in this scenario, people in the Little Journey arm still spend longer in the anaesthetic room and recovery room.

Table 5.8: Cost results for MRI population all undergoing general anaesthetic

	Little Journey	Standard care	Incremental cost
Annual cost per cohort	£25,039	£25,398	-£359
Annual cost per person	£250.39	£253.98	-£3.59

Table 5.9: Environmental results for MRI population all undergoing general anaesthetic

Annual NHS emissions per pound spent	0.15kgCO_2e
Funds redirected to rest of NHS	£359
Annual emissions attributed to redirected funds	53.18kgCO_2e
Annual emissions per cohort	-286.66kgCO_2e
Net incremental emissions of Little Journey	**-233.49kgCO_2e**

The results from considering a cohort of 100 people who all received a general anaesthetic or sedation are shown in Table 5.10 and Table 5.11. This estimated a reduced cost saving of £0.22 per person. A net emissions reduction of 272.91kgCO_2e for the cohort was also estimated. The reduction in cost saving was driven by an increase in procedure costs. This is because the small difference in the number receiving sedation now has a larger impact on the results when scaled up.

Table 5.10: Cost results for MRI population all undergoing either general anaesthetic or sedation

	Little Journey	Standard care	Incremental cost
Annual cost per cohort	£24,303	£24,325	-£22
Annual cost per person	£243.03	£243.25	-£0.22

Table 5.11: Environmental results for MRI population all undergoing either general anaesthetic or sedation

Annual NHS emissions per pound spent	0.15kgCO_2e
Funds redirected to rest of NHS	£22
Annual emissions attributed to redirected funds	3.26kgCO_2e
Annual emissions per cohort	-276.17kgCO_2e
Net incremental emissions of Little Journey	**-272.91kgCO_2e**

The results from considering a cohort of 100 people who were all awake for their MRI scan are shown in Table 5.12 and Table 5.13. This estimated a cost saving of £11.86 per person. A net emissions reduction of 68.97kgCO_2e for the cohort was also estimated. The increase in cost saving was driven by a reduction in procedure costs on top of the reduction in repeat scans and unplanned admissions that were already present.

Table 5.12: Cost results for MRI population who are all awake for the scan

	Little Journey	Standard care	Incremental cost
Annual cost per cohort	£4,130	£5,316	-£1,186
Annual cost per person	£41.30	£53.16	-£11.86

Table 5.13: Environmental results for MRI population who are all awake for the scan

Annual NHS emissions per pound spent	0.15kgCO_2e
Funds redirected to rest of NHS	£1,186
Annual emissions attributed to redirected funds	175.61kgCO_2e
Annual emissions per cohort	-244.58kgCO_2e
Net incremental emissions of Little Journey	**-68.97kgCO_2e**

5.2.3 Significance tests

Only the number of repeat scans was found to be statistically significant at the 10% level. No variables were found to be significant at the 5% level. The lack of significant results is likely due to the small population for the MRI data. Many of these variables are specific to people who had a general anaesthetic which was only 23 in the standard care arm and 19 in the Little Journey arm.

However, given that the number of repeat scans is the main contributor to cost savings in the model, it is encouraging to see that the difference between study arms is statistically significant.

A significance test could not be performed for patients using analgesia as none were taken in either study arm. A test could also not be performed for bed days per unplanned admission as one study had no unplanned admissions and therefore no data for this variable. A test was not performed for time in the MRI scanner either as it was assumed that this length of time was the same in both study arms due to poor data quality.

Table 5.14: Significance tests for MRI population

Variable	Statistical test	p-value
Number of procedures cancelled by family	Fisher's exact test	0.554
Anaesthesia vs sedation vs awake	Fisher's exact test	0.818
Number of patients using anxiolytics	Fisher's exact test	0.585
Number of patients who had a different induction method (or sedation) than planned	Fisher's exact test	0.627
Number of patients using analgesia	NA	NA
Number of patients using antiemetics	Fisher's exact test	0.324
Number of patients with an unplanned admission	Fisher's exact test	0.362
Number of patients requiring a repeat scan	Fisher's exact test	0.055*
Number of bed days per unplanned admission	NA	NA
Time in the anaesthetic room	One-tailed, two-sample, heteroscedastic t-test	0.385
Time in the MRI scanner	NA	NA
Time in the recovery room	One-tailed, two-sample, homoscedastic t-test	0.377
Time on the ward	One-tailed, two-sample, heteroscedastic t-test	0.448

*p < 0.1; **p < 0.05.

6 Discussion

6.1 Results Discussion

The results of the model for the surgery population estimate that Little Journey is cost saving compared with standard care. The model estimates a cost saving of £12.96 per person. This saving is driven by a reduction in unplanned admissions, and the number of bed days per unplanned admission.

Little Journey is also estimated to have a positive impact on the environment when looking exclusively at the paediatric surgery pathway, reducing emissions by 2.68kgCO_2e per person. This impact is reduced but remains positive when considering the impact of redistributing resources saved to the wider service, reducing emissions by 0.76kgCO_2e per person. Applying this reduction to a cohort of 100 people, this reduction in emissions is equivalent to the emissions of two low-intensity inpatient bed days or 13 GP appointments [22, 27].

These results do not consider the impact of on-the-day cancellations. Using 'cancellation by family' as a proxy for on-the-day cancellations, there could be increased savings of between £20.40 and £41.38 per person using Little Journey, compared with £12.96 in the base case. These savings would affect net emissions, with the largest potential saving resulting in a negative impact on the environment due to the redistribution of funds to other areas of the health service, increasing emissions in those areas.

DSA shows time to induction to be the main driver of the model. Therefore, it is important to ensure that uncertainty in this parameter is minimised through robust data collection. Other drivers include number of unplanned admissions and bed days per unplanned admission, and time and number of nurses in the recovery room per patient.

The results of the model for the MRI population also estimate that Little Journey is cost saving compared with standard care. The model estimates a cost saving of £2.40 per person. This saving is driven by a reduction in unplanned admissions and a reduction in repeat scans.

Little Journey is also estimated to have a positive impact on the environment when looking exclusively at the paediatric MRI pathway, reducing emissions by 2.48kgCO_2e per person. This impact is reduced but remains positive when considering the impact of redistributing resources saved to the wider service, reducing emissions by 2.12kgCO_2e per person. Applying this reduction to a cohort of 100 people, this reduction in emissions is equivalent to the emissions of 6 low-intensity inpatient bed days or 35 GP appointments [22, 27].

These results do not consider the impact of on-the-day cancellations. However, it was not possible to source a cost associated with on-the-day cancellations for MRI scans. This may affect the cost-saving element of the results given that there was a slight (but not statistically significant) increase in the number of on-the-day cancellations in the Little Journey study arm.

DSA shows time in the MRI scanner to be the main driver of the model, as this is affected by the number of people undergoing anaesthesia. Therefore, it is important to ensure that uncertainty in this parameter is minimised through robust data collection. It is likely that this parameter is currently subject to a large amount of uncertainty due to the small population size of the MRI cohort. Therefore, additional data collection with a larger cohort is recommended. Other drivers include number of nurses and time on the ward, and probability of requiring a repeat scan. The direction of the results is sensitive to variation of +/-15% in the parameters which reduces the level of confidence in the results. It is important that future data collection prioritises these parameters so that there is greater certainty around the input values.

When considering each population as an additional pathway, this results in further cost savings. Therefore, paying for Little Journey for both pathways, one as the first pathway and one as an additional pathway, would provide the best value for money for hospitals.

6.2 Limitations

This research has several limitations. The primary limitation is the quality of the data used to inform some of the input parameters. This is especially important for the number of on-the-day cancellations given that, if Little Journey successfully reduces peri-operative anxiety, this could result in fewer on-the-day cancellations if a child exhibits fewer physical or behavioural symptoms that affect the suitability to go ahead with the procedure. In future research, it is recommended that more information about the reason and timing of a cancellation is collected. Other inputs where there was high data missingness were time spent in various places during the hospital visit, and planned method of anaesthetic induction.

Data were not collected for adherence to Little Journey, number of follow-up appointments, and refusal of a procedure. These are inputs which may have impacted the model results and so it is recommended that this data is collected in future research. The model also facilitates additional results from changes in parent days of work missed, child days of school missed, and Post-Hospitalization Behaviour Questionnaire (PHBQ) scores. Whilst these do not impact the incremental costs and emissions reported in the model results, they would be useful to include to explore potential additional benefits of using Little Journey.

Another limitation is that this model uses data from a before-and-after study in the form of a service evaluation. This could mean that there are unobserved variables that have affected the results such as events occurring in one time period but not the other, or a difference in populations between study groups. It is therefore recommended that future research controls for these factors.

The study populations, particularly for MRI, were small which increases the risk of outliers having a large effect on the results. Whilst some of the differences in input parameters were statistically significant, there may be additional statistically significant differences shown in a larger study population. We initially intended to analyse a sub-population exploring the specific impacts on neurodivergent children. However, due to the small populations, the number who were neurodivergent was even smaller and so data quality was too poor to conduct this analysis.

6.3 Conclusions

The base case results of this cost-consequence model indicate that Little Journey is potentially cost saving and has the potential to reduce emissions for NHS hospitals if introduced into paediatric surgery and MRI pathways. It is recommended that larger studies are conducted to provide a greater level of confidence in the results, and to realise the full potential economic impact of introducing Little Journey in the UK health system.

7 References

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