Rhinology Online

ORIGINAL CONTRIBUTION

OPEN ACCESS

# A cost analysis of local anaesthetic nose and sinus surgery for the treatment of chronic rhinosinusitis*

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**Rhinology Online, Vol 5:** 62 - 69, 2022

http://doi.org/10.4193/RHINOL/21.050

***Received for publication:**

October 15, 2021

**Accepted:** March 8, 2022

**Published**: April 19, 2022

## Abstract

**Background**: People with chronic rhinosinusitis may be referred for endoscopic sinus surgery (ESS), a procedure commonly performed under general anaesthesia, once maximal medical therapy has failed. A new pathway of care is emerging: Local Anaesthetic Nose & Sinus Surgery (LANSS). With LANSS the patient is not placed under general anaesthesia, but instead the procedure is performed under a local anaesthetic.

**Methodology**: A decision analytic model was developed from the perspective of the UK National Health Service (NHS) to assess the potential cost impact of LANSS versus current standard care pathway for ESS.

**Results**: Modelling indicated that the introduction of LANSS would generate substantial savings of around £84,500 per year if introduced to a typical NHS trust with a large otolaryngology department undertaking 300 ESS procedures per year. These savings are generated as a proportion of the ESS procedures no longer need to be completed in an operating theatre, which reduces operational costs (saving around £64,500 per year), plus the use of local anaesthetic instead of general anaesthetic and a reduction in the time a patient spends as an inpatient.

**Conclusions**: The uptake of LANSS could generate cost-savings of around £84,500 per year to a typical NHS trust in the UK.

**Key words**: chronic rhinosinusitis, cost analysis, endoscopic sinus surgery, nasal polyposis

## Introduction

Chronic rhinosinusitis (CRS) is a group of disorders defined by inflammation of the paranasal sinuses and the nasal passages that persists for at least 12 weeks [(1)]. The condition affects up to 10% of the UK population and can have a significant impact on quality of life, leading to absenteeism and presenteeism [(2)]. If CRS is diagnosed and medical treatments have been exhausted, with an unsuccessful outcome, the patient may be referred for a surgical opinion [(3)]. The surgical procedure, endoscopic sinus surgery (ESS), aims to open the sinuses via the removal of inflamed mucosa or polypoid tissue. Alternatively, surgeons may use balloon dilation techniques to open up the sinus drainage pathways. With the sinuses open and draining subsequent topical medical therapy is therefore also more effective.

In the UK, in order to facilitate surgery patients typically receive a general anaesthetic as standard of care (SoC) [(4)]. There is evidence that use of a general anaesthetic for ESS procedures leads to an increase in both total operative time and recovery time for patients [(5)]. Furthermore, the prospect of general anaesthesia may cause patients' anxiety and accordingly they may be reluctant to undergo surgery or refuse it altogether [(6)]. Despite these limitations, sinonasal surgeries are currently rarely undertaken using a local anaesthetic. However, patient requests for the use of a local anaesthetic are increasing due to a greater understanding of the options and traditional inpatient theatre capacity, which is required for a procedure completed under a general anaesthetic, is becoming a scarce and expensive resource in many

healthcare settings with this issue exacerbated by the COVID pandemic.

To this end, a novel treatment approach has emerged, entitled Local Anaesthetic Nose & Sinus Surgery (LANSS), which is an amended version of the current standard care pathway under which a proportion of nasal and sinus procedures (e.g. polypectomy, limited ethmoid dissection and revision sinus surgery) are performed following administration of a local anaesthetic. Given the use of local anaesthesia, patients may be more willing to undergo the surgery and it also enables the option of the procedures to be undertaken in a treatment room rather than an operating theatre. It is expected that this, in turn, will free up space and resources for other surgeries, thus reducing overall waiting times and costs for hospitals. A pilot study has recently been completed at the Newcastle upon Tyne Hospitals NHS Foundation Trust (Freeman hospital) in which 22 patients completed an ESS procedure under local anaesthesia in a treatment room and patients reported favourable outcomes following the procedure [7].

Additionally, it is hoped that the use of LANSS will lead to streamlining of the patient pathway for ESS procedures (e.g. shorter time for anaesthesia, reduced requirement for post-operative care on a ward), which should facilitate additional general anaesthesia theatre time for other patients within the same time period. If LANSS does enable more ESS procedures in the same period it may assist hospitals to meet the national waiting time targets and avoid incurring financial penalties associated with missing those targets.

The aim of this analysis was to estimate the current costs associated with ESS procedures in the UK and the potential impact following the introduction of LANSS.

## Methods

First, a series of workshops were conducted with key opinion leaders to map out the structure of the current pathway and the potential impact on this pathway following the implementation of LANSS. This included a consideration of the resources required in each pathway to facilitate an estimation of the total cost impact of LANSS. Second, the information/data collected during the workshops were collated within an economic model to provide an evaluation framework for the costing analysis of LANSS.

### Workshops

One workshop took place at each of the following locations:

- Newcastle upon Tyne Hospitals NHS Foundation Trust (Freeman Hospital).
- University Hospitals Birmingham NHS Foundation Trust (Queen Elizabeth Hospital).
- Lewisham and Greenwich NHS Trust (University Hospital Lewisham).

Staff at all three hospitals had extensive experience of undertaking ESS procedures using the current SoC pathway and all of the surgeons had experience of completing ESS procedures using a local anaesthetic. Additionally, all staff had at least some knowledge of LANSS, either direct practical experience of the pathway or an understanding of the potential impact of its implementation due to discussions with other key opinion leaders. Therefore, they were able to provide detailed information about the structure of the current pathway and the likely changes that would be required following the introduction of LANSS. During 2019, a pilot of LANSS was completed at the Freeman Hospital allowing the attendees at that workshop to provide insights and data based on practical experience of the new pathway.

The workshops allowed the complete structure of the two pathways to be established by facilitating detailed discussions between clinicians and administration staff, including individuals with knowledge of NHS financing. The resourcing of the pathways was also discussed with the Freeman Hospital and Queen Elizabeth Hospital able to provide specific cost data based on internal reviews within their otolaryngology departments.

There were some minor variations across the three hospitals due to differences in local practices. However, it was possible to reconcile these differences and a unified pathway for SoC and LANSS was mapped. These pathways are described in more detail below and are judged to be appropriate generalisations for the UK.

### Pathways

There is a pre-surgery pathway for nasal and sinus surgery, which includes a series of diagnostic tests, anaesthetic preassessments and consultations with clinicians within the otolaryngology department. However, it was confirmed at the workshops that this pre-surgery pathway should not be impacted following the introduction of LANSS so it was not considered further.
The first divergence between the SoC and the LANSS pathways occur on the day of the ESS procedure and it is these differences that are the focus of the analysis. The SoC pathway typically involves admission to an otolaryngology ward, often in the morning (i.e. regardless of the time of surgery). As the allotted surgery time approaches, the patient is taken to the theatre complex where an anaesthetist will induce general anaesthetic in an anaesthetic room before the patient is transferred to the operating theatre for the procedure. Following the procedure, the patient is taken to a recovery area to wait for the effects of the general anaesthetic to wear off before they return to the ward where they will wait, sometimes overnight, until they are well enough to be discharged. At each stage in the pathway

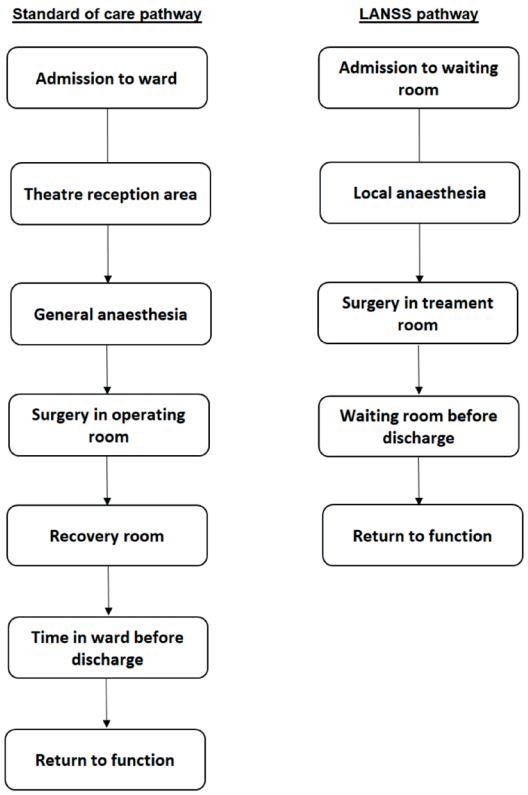


Figure 1. Summary of clinical pathway for standard care and LANSS.

there are inevitable periods of waiting and delay. The pathway is displayed in Figure 1.

With LANSS, patients wait in an outpatient room, rather than a ward, prior to the procedure and this admission can take place shortly before the local anaesthetic needs to be administered. Once the local anaesthetic is administered the patient is taken to a treatment room, instead of an operating theatre, where the surgery is performed. After the procedure the patient is returned to the waiting room before discharge. Altogether, there are four major differences between the two pathways:

1. No admission to a hospital ward is required with LANSS, unless any complications arise, so patients can return home the same day.
2. The LANSS procedure can be completed under a local anaesthetic.
3. The LANSS procedure can be completed within a treatment room (as opposed to an operating theatre).
4. Recovery is generally quicker in the absence of general anaesthesia, which means patient discharge can be expedited.

The pathway can be seen in Figure 1. It should be noted that it has been assumed the use of a local anaesthetic does not shorten the actual procedure time and, therefore, the equivalent number of procedures would be completed in the same time period regardless of the choice of anaesthesia.

### Economic model

The economic model was designed in Microsoft Excel from the perspective of the NHS, and was developed to estimate the total cost of the two pathways just described. This facilitated a direct comparison of LANSS to SoC. A distinction was made between any savings from LANSS that were cash releasing (e.g. the avoidance of drug treatment) and those which were opportunity cost savings (e.g. if the total time for the procedure is reduced then staff time is freed up for them to undertake other activities, such as additional surgical procedures).

LANSS will not be appropriate for all patients who currently receive ESS under a general anaesthetic. Firstly, a proportion may prefer to receive a general anaesthetic instead of a local anaesthetic and so would enter the SoC pathway. Secondly, the extent and nature of disease and anatomical variation or scarring may require a general anaesthetic. To this end, a parameter was included to define the proportion of the overall population that will continue to receive a general anaesthetic even following the introduction of LANSS. As a result, two separate populations were considered in the model. Firstly, all ESS eligible patients, including those who would not be appropriate for LANSS, named "All ESS procedures". The second was the sub-population that only included patients who were eligible for LANSS, referred to as the "LANSS eligible only" population.

In order to facilitate a comparison of the total cost of the two pathways, two different scenarios were modelled. Firstly, scenario one, in which all patients entered the standard care pathway, regardless of their eligibility for LANSS, to model hospitals in which LANSS is unavailable (described as "without LANSS" henceforth). Secondly, scenario two, in which LANSS is an option within a hospital such that patients were distributed between the standard care pathway and LANSS, depending on their preferences and eligibility (described as "with LANSS" henceforth). Therefore, for the "with LANSS" scenario a proportion of patients were modelled to still pass through the standard care pathway for ESS, to account for those would be ineligible for, or unwilling to undergo, a local anaesthetic procedure.

### Inputs – costs

The costs used in the model were primarily sourced from two hospitals: the Freeman Hospital and the Queen Elizabeth Hospital. These hospitals provided micro-costs based on an in-house financial investigation of the cost of ESS under the current standard pathway at each hospital. Additionally, both hospitals were able to provide micro- costs for LANSS. To account for minor differences between the costs an average of both was taken. Where possible, staff costs provided by the hospitals were

Table 1. Total cost of ESS with each pathway.

| Components | Unit per hour | Standard care (SoC) | | LANSS | |
|---|---|---|---|---|---|
| | | Units required | Sub-total | Units required | Sub-total |
| **Staff time** | | | | | |
| Anaesthetist | £109.00 | 1.29 | £140.79 | 0.00 | £0.00 |
| Nurse (Band 2/3) | £28.00 | 1.04 | £29.17 | 0.88 | £24.50 |
| Nurse (Band 5) | £38.00 | 1.04 | £39.58 | 0.88 | £33.25 |
| Nurse (Band 6) | £47.00 | 1.04 | £48.96 | 0.00 | £0.00 |
| Nurse (Band 7) | £55.00 | 1.04 | £57.29 | 0.00 | £0.00 |
| ODP (Band 5) | £38.00 | 1.04 | £39.58 | 0.00 | £0.00 |
| Pre-operative assessment (Band 5) | £38.00 | 1.00 | £38.00 | 1.00 | £38.00 |
| Surgical consultant | £109.00 | 1.04 | £113.54 | 1.00 | £109.00 |
| Specialist registrar | £108.00 | 0.67 | £72.00 | 0.50 | £54.00 |
| **Facilities** | | | | | |
| Treatment room | £100.00 | 0.00 | £0.00 | 1.00 | £100.00 |
| Operating theatre | £1,075 | 1.00 | £1,075 | 0.00 | £0.00 |
| Ward time | £245.00 | 0.25 | £61.25 | 0.02 | £4.90 |
| Other | - | - | £183.91 | - | £191.32 |
| **Consumables** | | | | | |
| Anaesthetic consumables | £37.67 | 1 | £37.67 | 0.61 | £22.96 |
| Belucci sucker | £0.08 | 1 | £0.08 | 1 | £0.08 |
| Camera drape | £5.99 | 1 | £5.99 | 1 | £5.99 |
| Cannulation pack | £4.86 | 1 | £4.86 | 1 | £4.86 |
| Dr Fogg demister | £1.15 | 1 | £1.15 | 1 | £1.15 |
| Endoscrub Cover | £31.00 | 1 | £31.00 | 0 | £0.00 |
| Frazier sucker | £0.10 | 1 | £0.10 | 1 | £0.10 |
| Gallipots | £0.12 | 1 | £0.12 | 1 | £0.12 |
| Minor Pack | £3.02 | 1 | £3.02 | 0 | £0.00 |
| Otrivine spray | £8.91 | 1 | £8.91 | 0 | £0.00 |
| Patties | £7.20 | 1 | £7.20 | 1 | £7.20 |
| Sterile gauze | £0.30 | 1 | £0.30 | 1 | £0.30 |
| Sterile gloves | £3.18 | 1 | £3.18 | 1 | £3.18 |
| Sterile hand towels | £0.20 | 1 | £0.20 | 1 | £0.20 |
| Suction tubing | £0.59 | 1 | £0.59 | 0 | £0.00 |
| Syringe & needle | £0.06 | 1 | £0.06 | 1 | £0.06 |
| Trays TSSU | £20.00 | 1 | £20.00 | 1 | £20.00 |
| Tricut blade | £94.00 | 1 | £94.00 | 0 | £0.00 |
| Yankuer sucker | £0.28 | 1 | £0.28 | 0 | £0.00 |
| Adrenaline and cocaine | £0.63 | 1 | £0.63 | 0 | £0.00 |
| Nasal bolster | £0.19 | 0 | £0.00 | 1 | £0.19 |
| Paediatric tricut blade | £87.30 | 0 | £0.00 | 1 | £87.30 |
| Suction tubing & canister liner | £1.64 | 0 | £0.00 | 1 | £1.64 |
| | | **Total** | **£2,118** | **Total** | **£710** |

updated to 2019 values using information from the Personal Social Services Research Unit [8].

Within the model, the costs were separated into two distinct categories. Firstly, costs related to staff and room use, which are resources that would be continuously reused within the hospital. For example, staff required for ESS will attend multiple patients

Table 2. Base case results for the 'ALL ESS procedures' population (i.e. 300 patients).

| | Before LANSS | After LANSS | Incremental (amount) | Incremental (%) |
|---|---|---|---|---|
| Total annual costs | £635,524 | £551,036 | -£84,487 | 13% |
| Cost per procedure | £2,118 | £1,837 | -£282 | |

Table 3. Base case results for the 'LANSS eligible only' population (i.e. 60 patients).

| | Before LANSS | After LANSS | Incremental (amount) | Incremental (%) |
|---|---|---|---|---|
| Total annual costs | £127,105 | £42,617 | -£84,487 | 66% |
| Cost per procedure | £2,118 | £710 | -£1,408 | |

each day. Table 1 shows the list of resources that fall under this category, the unit cost per hour and units required with both the SoC pathway and LANSS. Secondly, surgical consumables, which were assumed to be single-use consumables so a new set would be required for each patient undergoing ESS and are also presented in Table 1.

Additionally, the cost of an operating theatre room was included in the model. The cost of a half-day list (i.e. four hours of theatre room time) was estimated as being £4,200 and £4,400 by the Newcastle Freeman Hospital and Queen Elizabeth hospital, respectively. Therefore, a mean value of £4,300 was applied. Previously, an approximate cost of £1,200 per hour (so £4,800 per half-day list) has been reported at a national level, so the cost applied in the model is largely consistent with the national value [9]. It is understood that the time a patient spends in theatre will vary depending on a variety of factors, such as their characteristics and the setup of the hospital. However, staff at both the Freeman hospital and the Queen Elizabeth hospital agreed that, on average, each patient will spend 60 minutes in the theatre when ESS is completed under a general anaesthetic. Therefore, a figure of 60 minutes was applied in the model (i.e. £1,075 per patient). All costs are presented in Table 1.

A base case analysis was undertaken using a hypothetical cohort of 300 patients undertaking ESS procedures in one year, with 20% of these surgeries being performed using LANSS after the new method is introduced. The cohort size was chosen to reflect the typical number of procedures that would be undertaken annually in an NHS trust with a large ENT department. For example, 359 procedures were undertaken in the Newcastle Upon Tyne Hospitals NHS Foundation Trust in 2018, which is where the Freeman Hospital is located. There are currently no data on the exact number of patients who would undergo LANSS, rather than SoC, so the figure of 20% was applied as a conservative working assumption.

The following assumptions were made for the base case:

- 2% of LANSS patients required a general ward bed for one night.
- 25% of SoC patients required a general ward bed for one night.
- The otolaryngology department paid for theatre use associated with SoC procedures.

It has been assumed that 25% of SoC patients require an overnight stay following an ESS procedure based on national hospital episode statistics (HES) data for England [10]. These data indicate that from April 2019 to March 2020, 75% of ESS procedures within England were completed as a day case procedure and, therefore, an overnight stay would not have been required. The remaining 25% of patients, therefore, did require an overnight stay following the procedure.

It has been postulated that the introduction of LANSS may also reduce financial penalties associated with waiting time targets. However, no data were available to facilitate an assessment of the potential impact of LANSS so this was excluded from the base case analysis. However, an exploratory analysis was included as a scenario analysis and financial penalties were assumed to be issued to a hospital if a patient's waiting time exceeds 18-weeks and 52-weeks. University Hospital Lewisham provided the cost of a 52-week penalty, but assumptions were used for the cost of an 18-week penalty and for the percentage of patients treated within the target time with both the SoC and LANSS pathways. In the model, in the absence of any data, it was conservatively assumed that the use of LANSS would lead to a small improvement of 2% of patients treated within the 18-week time frame and of 10% of patients treated within the 52-week time frame, which was employed due to the potentially faster procedure times with LANSS allowing for extra patients to be treated each day.

## Results

The model compares two scenarios (i.e. 'without LANSS' vs 'with LANSS') in both of the populations outlined previously (i.e. 'All ESS procedures' and 'LANSS eligible only') whereby the cost of

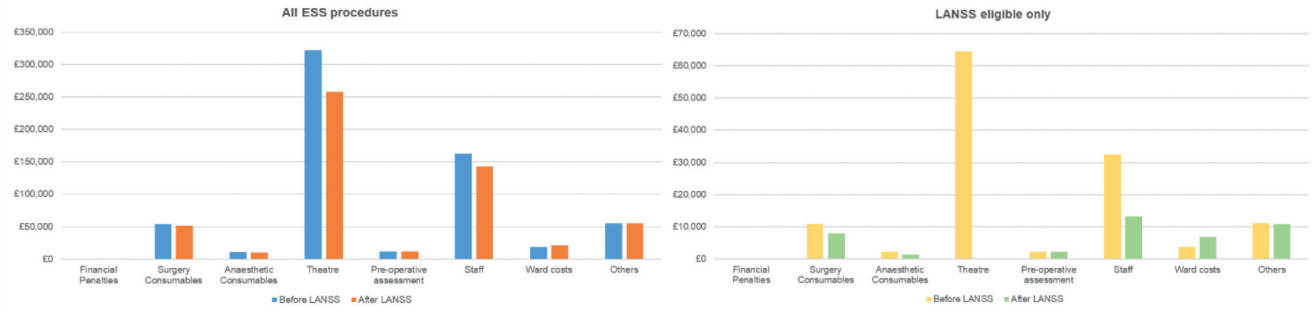


Figure 2. Breakdown of total costs by resource category.

treating a hypothetical cohort of 300 patients was calculated. The patients in the 'without LANSS' scenario only had one choice of pathway: standard care. Therefore, all 300 patients underwent general anaesthetic and were treated under standard care pathway. The costs of SoC were applied to the 300 patients in this pathway allowing an estimation of total costs for SoC to be calculated.

As described previously, there were two pathway options for the 300 patients in the 'with LANSS' scenario, either the standard care pathway or LANSS. It has been assumed that 20% of patients will receive LANSS. Therefore, the remaining 80% of the population (240 patients), passed through the SoC pathway. SoC specific costs were applied to these 240 and LANSS specific costs were applied to the remaining 20% (60 patients). These values were summed to generate the total costs for this scenario. The two scenario costs were then compared to demonstrate the cost impact of introducing LANSS as an option into the patient treatment pathway.

The base case results show that, in the 'All ESS procedures' population, the total cost for 300 ESS procedures would have been £635,524. In the same population, after the introduction of LANSS where 20% of the population received the new approach, the total costs would be £551,036. This equated to a total cost saving of £84,487 after the introduction of LANSS, which equates to a reduction in costs of 13.29%.

The 'LANSS eligible only' population scenario compares the costs and resource use between the 60 patients who underwent LANSS in the first scenario (i.e. 20% of the 300 'All ESS procedures' population), to a sample of 60 patients who underwent SoC treatment. SoC specific costs were applied to the 60 patients in this pathway and LANSS specific costs were applied to the 60 patients who underwent LANSS. This allowed a direct comparison between the cost of treating patients under SoC and the cost of treating patients with LANSS. For the 60 people eligible for LANSS, the total cost was £127,105 with the SoC pathway and £42,617 with LANSS. This equates to a total cost saving of £84,487 after the introduction of LANSS, which correspond to the total cost saving in the 'All ESS procedures' population. The percentage reduction in costs for this scenario was 66.47%.
A summary of the annual base case cost saving results for LANSS vs SoC in the 'All ESS procedures' population are presented in Table 2. The annual base case cost saving results for LANSS vs SoC in the 'LANSS eligible only' are presented in Table 3.

The total annual costs are broken down into the cost saving per average ESS procedure and also into cash saving or opportunity cost saving. A breakdown of annual costs and a graph to show this diagrammatically are presented in Figure 2 for both the 'All ESS procedures' and the 'LANSS eligible only' populations.

A scenario analysis was also undertaken in which a reduction in financial penalties following the introduction of LANSS was modelled. The results of this scenario were similar to the base case, with a small increase in the incremental cost savings associated with LANSS shown. This equated to incremental savings of £117,487 and £91,087 with the 'All ESS procedures' and 'LANSS eligible only' populations respectively.

### Sensitivity analysis

The sensitivity analysis undertaken within the model is presented via a tornado plot (Figure 3) which was included to summarise the impact of changes to each parameter on the overall results (i.e. incremental cost). For all parameters included in the tornado plot a range of values were applied around the point estimate, to highlight the parameters that the model results were most sensitive to. The sensitivity results were equivalent for both populations and, therefore, only one diagram is presented. The length of time in theatre for ESS procedures under a general anaesthetic was the primary driver of the cost savings when all else remained constant at a base case setting.

## Discussion

The results of the current analysis indicate that the adoption of

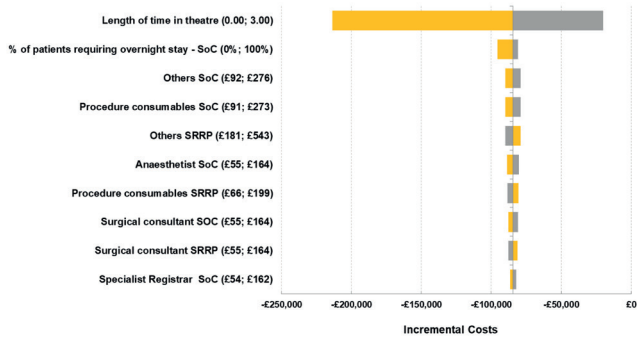


Figure 3. Tornado diagram summary of the deterministic sensitivity analysis.

LANSS could generate substantial savings, around £84,500 per year, to a typical NHS trust. Those savings are generated due to a number of changes within the pathway, in particular the reduced operating theatre usage (saving around £64,500 per year); also, the reduced staff time (saving £19,210 per year) and use of a local anaesthetic instead of a general anaesthetic (saving £883 year), (Figure 2). Overall, it is expected that more widespread adoption of LANSS could lead to savings in otolaryngology departments across the UK.

The costings within the model were largely based on micro-costing data provided by two large and active otolaryngology departments in the UK. It is therefore expected that the cost of the SoC pathway has been accurately captured within the model. However, only two of the three hospitals we spoke to had limited practical experience of LANSS so it is not entirely clear how generalisable the costs will be when it is rolled out to other hospitals in the UK, including smaller district hospitals. For example, there may be specific practical barriers within individual hospitals, such as equipping the LANSS treatment room, and these would require additional investment in order to be overcome. These practical impediments, and their potential cost, have not been considered. Additionally, the analysis indicates the largest savings to the otolaryngology department would likely be due to a reduction in operating theatre costs. However, in certain hospitals there may be no direct charge for the use of these rooms, in which case the overall cost savings would reduce significantly to £19,987 per year.

Within this analysis, the focus has been exclusively on the cost impact of LANSS; its potential impact on clinical outcomes has not been considered. This assumes that the main surgical procedure (i.e. ESS) is unchanged across the two pathways. In reality, there might be small differences between patient outcomes such as improvements due to the use of local rather than general anaesthetic [7].

Other consequences of implementing LANSS are not captured in the model given the focus on the direct cost impact of the new approach. For example, if there are issues relating to the operating theatre capacity within individual hospitals, LANSS should allow extra capacity to be freed up by moving procedures to a separate treatment room in an outpatient setting. This may lead to numerous benefits, such as a reduction in waiting lists for other procedures and an improvement in patient outcomes if these procedures were to be completed more quickly as it allows patients to return to normal health sooner. Use of LANSS may also lead to lower staff requirements to complete ESS procedures. These improvements in capacity will be particularly pertinent in hospitals with ongoing capacity issues, which often leads to the cancellation of elective lists during busy periods when staff and theatres are required to respond to urgent requests from other surgical specialties. In order to explore the scope of these consequences, and others like them, the analysis would need to be expanded.

It is important to note that a local anaesthetic will not be suitable in all patients requiring sinonasal surgery. The findings from this analysis should only be considered applicable in patients for whom the individual clinician and patient agree the use of a local anaesthetic is appropriate. In the absence of defined guidelines on selection criteria for local anaesthetic, nasal and sinus procedures with general anaesthesia remains a highly relevant and important consideration for this patient population.

## Conclusion

The uptake of LANSS, when used appropriately for patients requiring sinonasal surgery, could generate cost-savings of around £84,500 per year to a typical NHS trust in the UK.

## Acknowledgments

Thanks goes to Anastasia Rachmanidou who provided insights into ESS procedures from the perspective of Lewisham and Greenwich NHS Trust. Additionally, thanks goes to Catherine Bowe who provided medical writing support and also Marina Grifi and Stephanie Hoewekamp who provided guidance throughout the project.

## Authorship contribution

WG and EB have been involved in model design and construction and also drafting and editing the manuscript. SC and SA have been involved in the workshops, providing the data for use in the model and editing the manuscript. FG and JS were actively involved in all stages of the project, including: model development, workshop completion and the drafting of the manuscript.

## Funding

This study was funded by Medtronic.

## Ethics approval and consent to participate

Not applicable.

## Consent for publication

Not applicable.

## Availability of data and materials

Not applicable.

## Conflict of interest

SA has received an unrestricted educational grant from Medtronic. SC has undertaken paid advisory work for Medtronic and Olympus. WG and EB were employees of YHEC who received a consultancy fee for the analysis. JS and FG were employees of Medtronic.

## References


1. National Institute for Health and Care Excellence. Managing chronic rhinosinusitis in adults. 2016. London, UK.
2. Royal College of Surgeons. Commissioning guide: Chronic Rhinosinusitis. 2016. London, UK.
3. Baguley C, Brownlow A, Yeung K, Pratt E, Sacks R, Harvey R. The fate of chronic rhinosinusitis sufferers after maximal medical therapy. Int Forum Allergy Rhinol 2014; 4(7):525-32.
4. National Institute for Health and Care Excellence. XprESS multi sinus dilation system for treating chronic sinusitis. Medical Technologies Guidance [MTG30]. 2016. London, UK.
5. Fedok FG, Ferraro RE, Kingslet CP, Fornadely JA. Operative times, postanesthesia recovery times, and complications during sinonasal surgery using general anesthesia and local anesthesia with sedation. Otolaryngol Head Neck Surg 2000; 122(4):560-6.
6. Mitchell M. General anaesthesia and day-case patient anxiety. J Adv Nurs. 2010; 66(5):1059-71.
7. Coates ML, Mayer A, Carrie S. Developing an innovative office-based UK rhinology service-Experience and outcomes in 22 patients undergoing office-based local anaesthetic nasal polypectomy. Clin Otolaryngol 2020; 45(2):268-273.
8. Curtis L, Burns A. Unit Costs of Health and Social Care 2019. Personal Social Services Research Unit, University of Kent, Canterbury, UK.
9. Fletcher D, Edwards D, Tolchard S, Baker R, Berstock J. Improving theatre turnaround time. BMJ Qual Improv Rep 2017; 6(1):u219831.
10. NHS Digital. Hospital Episode Statistics (HES). Available online: https://digital.nhs.uk/data-and-information/data-tools-and-services/data-services/hospital-episode-statistics [accessed 29/06/2020].



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