SUSQI PROJECT REPORT

Project Title: Financial and environmental from transitioning from MLB under GA to TNO biopsies under LA in ENT

Start date of Project: September 2025

Date of Report: January 2026

Team Members:

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Background:

The increasing demand on ENT services has intensified the need to adopt more efficient, sustainable, and patient-centred diagnostic pathways. Traditionally, microlaryngoscopy and biopsy (MLB) under general anaesthetic (GA) has been the standard approach for the assessment of suspicious laryngeal and pharyngeal lesions. However, advances in endoscopic technology now allow many biopsies to be safely and effectively performed using local anaesthetic transnasal oesophagoscopy (LA TNO) in an outpatient setting, reducing reliance on theatre-based procedures and general anaesthesia (Scottish Health Technologies Group [SHTG], 2023).

Transitioning from GA MLB to LA TNO biopsies offers significant financial advantages for healthcare systems. LA TNO procedures avoid the costs associated with operating theatre use, anaesthetic staffing, inpatient recovery, and peri-operative bed occupancy, while also improving procedural throughput and reducing waiting times. Published service evaluations and cost

analyses, demonstrate substantial per-patient cost savings when biopsies are performed under local anaesthetic compared with general anaesthetic MLB (Little *et al*., 2025).

In addition to financial savings, LA TNO biopsies contribute to meaningful reductions in healthcare-related carbon emissions. General anaesthesia is associated with a high environmental footprint due to energy-intensive operating theatres and the use of volatile anaesthetic agents, which have a high global warming potential. Anaesthetic gases are recognised as a significant contributor to the NHS carbon footprint, and national initiatives have demonstrated that reducing or avoiding their use can lead to substantial emissions reductions (NHS England, 2022).

Overall, the adoption of LA TNO biopsies represents an important step toward delivering high-value, environmentally responsible ENT care. By reducing both financial expenditure and carbon emissions while maintaining diagnostic effectiveness, this shift supports sustainable service transformation and aligns with wider NHS efficiency and net-zero ambitions (SHTG, 2023; NHS England, 2022).

The change is taking place within a busy NHS ENT service providing care to a diverse adult population. Including a high volume of patients referred under urgent suspected cancer pathways for assessment of laryngeal and pharyngeal lesions. Diagnostic MLB under general anaesthetic is resource-intensive, requiring access to shared operating theatres and a large multidisciplinary team. This includes an anaesthetist, operating department practitioner, scrub and circulating theatre staff and recovery personnel in addition to the operating ENT surgeon.

This dependence on theatre infrastructure and specialist staffing limits procedural capacity and contributes to delays in diagnostic pathways, in the context of increasing referral volumes and competing surgical demands. In contrast, TNO with biopsy under local anaesthetic can be delivered safely by the ENT surgeon with minimal additional staffing, avoiding the need for anaesthetic input, theatre admission or postoperative recovery facilities.

The ENT team, including the operating surgeon and resident doctors, led this project. With engagement from anaesthetic and theatre colleagues, we were particularly well suited to delivering this change due to the routine involvement in both general anaesthetic and local anaesthetic diagnostic procedures. Having oversight of patient pathways across clinic and theatre settings, provided the ability to directly compare clinical, operational and sustainability impacts of

the two approaches within the same service.

Specific Aims:

The aim of this project is to calculate financial and environmental saving from transitioning from microlaryngoscopy and biopsy under general anaesthetic to local anaesthetic transnasal oesophagoscope, for suspected laryngeal lesions when appropriate.

Methods:

This project evaluated an existing service change rather than introducing a new intervention. From 2022 onwards, the ENT service had begun transitioning selected diagnostic biopsies from MLB under GA to TNO with biopsy under LA. From 2022 to 2025 roughly 300 MBL under GA were converted to TNO biopsy under LA. Giving an average of 100 cases per year. The aim of this project was to formally study, quantify, and evaluate the clinical, financial, environmental, and patient experience impacts of this change.

The primary change evaluated was the substitution of general anaesthetic MLB with local anaesthetic TNO biopsy for appropriate patients with laryngeal and pharyngeal lesions. Case selection was based on clinical suitability, lesion accessibility, and patient tolerance, with procedures such as laser treatment and filler injections used as comparator cases to ensure consistency of procedural complexity. The evaluation period spanned from 2022 to 2025, allowing sufficient time to assess outcomes across a representative number of cases and to account for service maturation and staff familiarity with the pathway. This transition was put into place due to ongoing extended waiting list times, available literature evidence proving safety and tolerability and existing infrastructure.

Data collection focused on comparing the two diagnostic pathways, including staffing requirements, use of theatre resources, consumables, costs, carbon emissions, and patient-reported outcomes. Patient experience data was collected prospectively using a structured feedback form following local anaesthetic procedures. Financial and environmental data was derived from NHS reference costs, local procurement data, published literature, and sustainability guidance, enabling reproducible estimates of cost and carbon footprint for each pathway.

As this was an evaluation of an established service model, no formal pilot testing was required; however, early in the service transition, some patients initially listed for general anaesthetic were

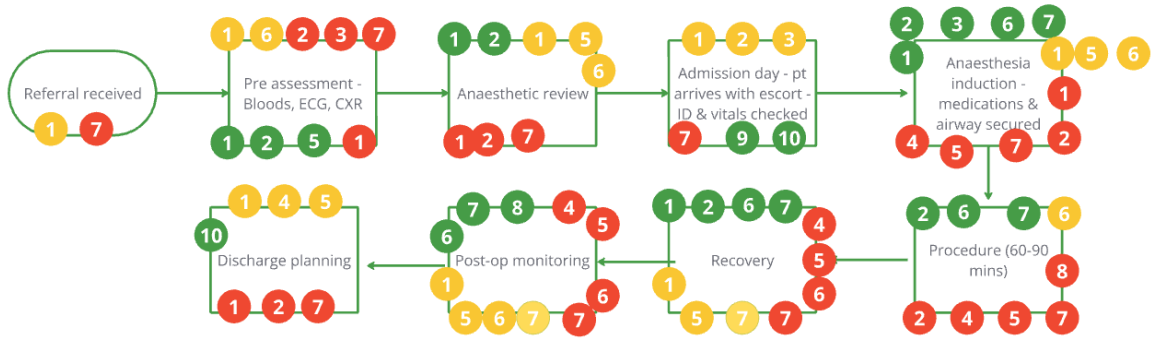
found to be unsuitable for local anaesthetic biopsy due to anxiety or limited tolerance, reinforcing the importance of careful patient selection and pre-procedure counselling. These experiences informed refinement of selection criteria and patient information processes.

Key stakeholders involved included the operating ENT surgeons, junior doctors, anaesthetic colleagues, theatre staff, and sustainability leads. Engagement occurred through regular departmental meetings and informal discussions, ensuring shared understanding of the project aims and facilitating access to data across clinic and theatre settings.

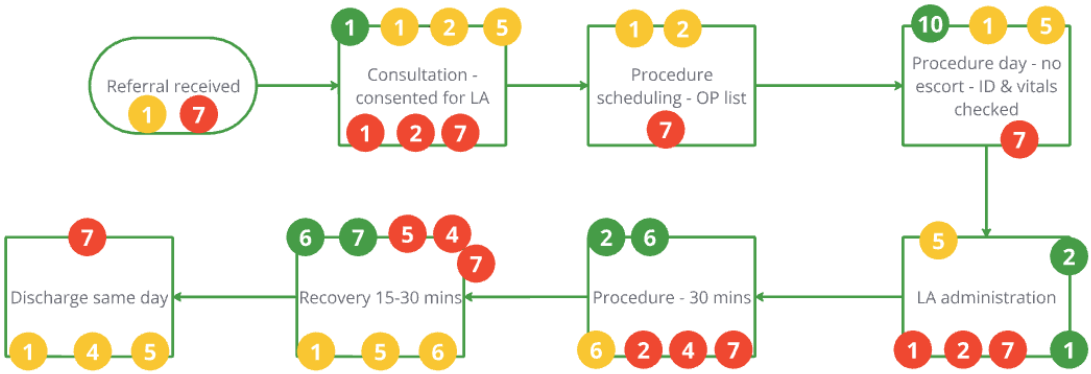
No additional capital investment was required, as reusable transnasal oesophagoscopes and biopsy forceps were already available within the department. Financial resources were limited to staff time for data collection and analysis, which was supported within existing departmental activity. This approach ensured that the project was feasible, low-cost, and easily reproducible in other ENT services with access to transnasal endoscopic equipment.

Process maps of GA & LA procedures including staff involvement:

GA process map:



LA process map:



Resource Key:

RESOURCE USE KEY

Environmental resources	Social resources/impacts	Financial resources
1 Medications	1 Patient/carer time	1 Medications
2 Medical supplies	2 Patient/carer satisfaction	2 Medical supplies
3 Anaesthetic gases/nitrous oxide	3 Patient/carer relationships	3 Non-medical supplies
4 Propellant inhaler (MDI)	4 £ cost to patient/carer	4 Energy use
5 Non-medical supplies	5 Patient/carer wellbeing	5 Waste disposal
6 Energy use	6 Staff satisfaction	6 Water use
7 Waste disposal	7 Staff wellbeing	7 Staff time
8 Water use	8 Community impacts	8 Contracted services (e.g. cleaning, laundry)
9 Staff travel	9 Supply chain worker wellbeing	
10 Patient travel		

See below for typical staff numbers and time spent per case for MBL under GA and TNO biopsy under LA:

The MBL under GA team typically involves:

- Consultant Surgeon – 1
- SHO/Registrar – 1
- Anaesthetist – 1
- ODP – 1
- Scrub Nurses – 2
- HCA (runner) – 1
- Recovery/Ward pooled staff – equivalent of 2 hours per case

This totals 7 staff members per GA case. The combined staff time per case is approximately 9.32 hours (Consultant 1.33h + SHO/Registrar 1.33h + Anaesthetist 1.33h + ODP 1.33h + Scrub Nurses 2.67h combined + HCA 1.33h + Recovery 2h pooled fraction).

Staff for TNO biopsy under LA cases are:

- Consultant ENT – 1
- SHO/Registrar – 1
- Endoscopist/Nurse – 1
- HCA – 1

This totals 4 staff members per LA case, with a combined staff time of approximately 2.3 hours.

Staffing assumptions are based on a typical NHS GA theatre list delivering six cases, with costings derived from PSSRU 2023 data.

Measurement:

Patient outcomes:

The transition from GA MLB to LA TNO biopsies delivers substantial clinical, operational, and patient-centred benefits. One of the most significant outcomes is improved access to timely diagnosis. We were unable to measure the actual change in pathway duration or waiting time during the project, evidence has been discussed in the results to suggest how patient outcomes may have improved. Swapping to LA has the potential to reduce patient risks associated with GA, but again it was beyond the scope of this project to measure it.

Population outcomes:

We were unable to formally measure population outcomes during the project window, such as improved access to diagnostic procedures for vulnerable population groups. Presumptions have been explained in the results of how population changes could occur, based on evidence.

Environmental sustainability:

We collected data on the medical instruments and pharmaceuticals required to perform procedures under both GA (using Sevoflurane as the anaesthetic gas), and LA from the ENT supplies team. All the materials and equipment which were similar in both practices were excluded from the environmental impact calculations. Tables 1 and 2 below presents the list of items that were considered for the study.

Table 1. List of items carbon footprinted for General Anaesthesia procedure

	Item	**Number of items per procedure**
Anaesthetic gas	Sevoflurane - 60 minutes	1
GA Drugs/ medication	Dexamethasone 3.3 mg vials	2
	Ondansetron 4mg vial	1
	Diclofenac 75 mg	1
	Metaraminol 2.5 mg	1
Anaesthetic equipment	20ml syringe	1
	5ml syringe	2
	2ml syringe	2
	1 x 2ml syringe for Disclofenac	1
	Angle piece & HME filter	1
	Anaesthetic face mask	1
	ECG dots	4
	Tape for eyes	2
	Cannula 20g (pink)	1
	Cannula dressing	1
	Ted stockings	1
	Optilube	1
	Anaesthetic circuit (changed every 24h)	0.1
	Capnography line	1.0
	Soda lime (filed at start of the day)	0.1
	Microlaryngoscopy tube (Size 5)	1
Equipment	Hopkins rod	1
	Forceps Set	1
	Anterior Commisure Laryngoscope (Rigid)	1
	Reusable Video Rhino laryngoscope	1
PPE	Non-sterile gloves (pairs)	10
	Mask	3
	Disposable gown	2
Electricity	Electricity (kWh per 90 minutes)	15
Staff Commute	Staff travel per emissions procedure	-

A cradle-to-grave hybrid carbon footprint approach was used to estimate all the items' GHG apart from medication, tape for eyes, cannula dressing, optilube, microlaryngoscopy tube, Hopkins rod for GA, biopsy forceps set and reusable video endoscope for LA. These were carbon footprinted based on cost using the Environmentally Extended Input Output Analysis (EEIOA). The analysis included GHG emissions associated with primary materials production, transport, and disposal. The carbon footprint for 20 ml syringe, 5ml syringe, 2ml syringe, angle piece & HME filter, anaesthetic face mask, ECG dots and PPEs were obtained from previous CSH projects and publications. Under LA, as summarised in table 2, Chlorhexidine, blunt fill needle with filter, green needle, and vomit bowl carbon footprint were obtained from previous CSH projects. Tristel wipe-3 stage cleaning for the reusable video laryngoscope under LA carbon footprint, was obtained from the manufacturer's life cycle analysis for single episode. Non-sterile gloves and autoclaving carbon footprint were drawn from academic publication.

Table 2. List of items carbon footprinted under LA procedure

	Item	Number of items per procedure
LA drugs/medication	**Xylocaine 10mg Spray**	1
	4% Lignocaine - 2mls	1
Equipment	Chlorhexidine wipe	1
	Blunt fill needle w/ filter	1
	Green needle	1
	Disposable dressings pack	1
	Autoclaving of Biopsy forceps	1
	Forceps- manufacturing	1
	Non sterile gloves (pair)	2
	Tristel wiped - 3 stage	1
	Reusable Video endoscope	1
	Vomit bowl - Cardboard	1
Electricity	Electricity (kWh per 50 minutes)	8.3
Staff Commute	Staff travel per emissions procedure	

In case of the items carbon footprinted using a process-based method, the material composition for each consumable was analysed through a process-based approach. It was converted into GHG emissions using carbon conversion factors from the 2025 UK Government Greenhouse Gas Conversion Factors database UK DESNZ Database. For end-of-life treatment, disposable equipment was assumed to be disposed of as clinical waste, while the packaging waste was assumed to be dry mixed recyclable with the corresponding emission factors taken from Rizan et al., 2020. The emission factor for autoclaving was obtained from Rizan *et al* 2022 study.
The emissions savings were translated into equivalent miles driven in an average car with unknown fuel using a factor of 0.3399 kgCO_2e per mile, as published by the UK Government

Greenhouse gas reporting: conversion factors 2025. This factor is inclusive of fuel and well-to-tank emissions.

Economic sustainability:

Financial data for this project was obtained from multiple sources to ensure robust and reproducible cost estimates. These included NHS reference costs and procurement pricing from several NHS sites, data from previous local and national quality improvement projects (including CSH project's) and published economic evaluations relevant to ENT procedures. Where detailed product-level data was required, cost information was supplemented using environmentally extended input–output analysis (EEIOA) and manufacturer-provided pricing for consumables and reusable equipment.

Additional cost data was drawn from relevant peer-reviewed publications and NHS sustainability resources. No additional financial investment was required to implement the service change, as both general anaesthetic microlaryngoscopy and local anaesthetic transnasal oesophagoscopy were already established within the service. The necessary equipment and staff expertise were in place prior to the evaluation period.

As a result, there were no one-off implementation costs or new ongoing maintenance costs; instead, the project evaluated the financial impact of substituting a theatre-based general anaesthetic procedure with a lower-cost outpatient local anaesthetic alternative.

Social sustainability:

Patient reported experience was assessed for patients who underwent TNO biopsies under LA in the ENT department, using a structured post-procedure feedback form. These included procedural convenience, comfort during the procedure, overall satisfaction, staff approachability, and willingness to undergo the procedure again. Convenience and overall satisfaction were measured using 10-point Likert scales (1 = very inconvenient, 10 = very convenient)., while comfort and staff interaction were assessed using binary yes/no responses, allowing both quantitative and qualitative evaluation of patient experience.

Results:

Patient outcomes:

By removing dependence on operating theatre availability and anaesthetic staffing, LA TNO

biopsies can be delivered rapidly in outpatient settings, resulting in shorter waiting times for investigation. Earlier biopsy facilitates faster diagnosis and, where malignancy is identified, earlier initiation of treatment (Vakharia and Dwivedi, 2025). This is a key determinant of outcomes in head and neck cancer pathways and contributes to improved compliance with national waiting time targets.

From a diagnostic perspective, population studies demonstrate that outpatient LA biopsies provide a high diagnostic yield for suspicious upper aerodigestive tract lesions (Waldron *et al.*, 1992). While a small proportion of patients may still require repeat or confirmatory biopsy under general anaesthesia, the majority receive a definitive histological diagnosis from the initial outpatient procedure. This reduces the overall number of invasive procedures performed across the population and minimises exposure to the risks associated with general anaesthesia, particularly in older patients and those with significant comorbidities.

Safety and tolerability outcomes further support this shift in practice. LA TNO biopsies are associated with low complication rates. Avoidance of general anaesthesia reduces peri-operative morbidity and eliminates risks such as airway complications, cardiovascular events, and post-operative nausea, which disproportionately affect vulnerable patient groups (Mozzanica *et al., 2020)* At a population level, this contributes to safer care delivery and reduced post-procedure healthcare utilisation, including unplanned admissions and recovery-related delays.

Population outcomes:
Formal evaluation of population level outcomes was not feasible within the project time window; however, no negative effects were identified, and multiple benefits are likely. The transition from GA MLB to LA TNO biopsies, represents a substantial advancement for both population health and health equity. By moving biopsies into the outpatient setting under LA, the service has reduced hospital attendances, shortened procedures, improved theatre and inpatient resource utilisation, and contributed to shorter wait list times. These efficiency gains increase diagnostic throughput within existing resources, helping reduce backlogs and variation in access to ENT diagnostics. This scalability enables more consistent delivery across regions and preserves theatre capacity for patients who truly require operative intervention. The shift to LA TNO biopsies also supports earlier detection of laryngeal and pharyngeal pathology, including malignancy, which is associated with improved treatment options, better functional outcomes, and reduced disease burden (Lim et al., 2023). Earlier access to investigation is particularly important for older, frail, and

multimorbid patients who face increased risks or barriers associated with GA. LA avoids preoperative assessments, fasting, inpatient admission, and postanaesthetic recovery, thereby reducing the likelihood of delayed or deferred diagnosis. Socioeconomically disadvantaged groups also benefit, as outpatient LA procedures reduce time off work, travel costs, and reliance on carers, helping lower indirect barriers to care. At a system level, increasing outpatient diagnostic capacity and reducing reliance on theatres support more timely investigation for all patients while narrowing disparities in access to specialist diagnostics (House of Commons Committee of Public Accounts, 2022). Collectively, these improvements contribute to earlier disease detection, reduced procedural risk, fairer access to care, better patient experience, and more resilient ENT services capable of meeting rising demand.

Environmental sustainability:

The environmental impact of this project was evaluated by comparing the carbon footprint of diagnostic procedures performed under GA and LA at baseline and following the quality improvement intervention. Per-procedure carbon emissions were calculated as 24.31 $kgCO_2e$ for GA and 8.91 $kgCO_2e$ for LA. Representing a reduction of 15.39 $kgCO_2e$ per procedure when a GA procedure is replaced with a LA alternative as summarised in tables 3 and 4.

Table 3. GA procedure carbon footprint

	Item	Number of items per procedure	Cost per items (£)	Cost per procedure (£)	Carbon footprint per item (kgCO2e)	Carbon footprint per procedure (kgCO2e)
Anaesthetic gas	Sevoflurane - 60 minutes	1	4.30	4.30	5.472	5.472
GA Drugs/ medication	Dexamethasone 3.3 mg vials	2	0.20	0.40	0.048	0.096
	Ondansetron 4mg vial	1	0.52	0.52	0.125	0.125
	Diclofenac 75 mg	1	3.15	3.15	0.756	0.756
	Metaraminol 2.5 mg	1	0.90	0.90	0.216	0.216
Anaesthetic equipment	20ml syringe	1	0.12	0.12	0.051	0.051
	5ml syringe	2	0.10	0.20	0.033	0.066
	2ml syringe	2	0.02	0.04	0.024	0.048
	1 x 2ml syringe for Diclofenac	1	0.02	0.02	0.024	0.024
	Angle piece & HME filter	1	0.96	0.96	0.123	0.123
	Anaesthetic face mask	1	0.78	0.78	0.221	0.221
	ECG dots	4	0.08	0.32	0.055	0.221
	Tape for eyes	2	0.23	0.46	0.162	0.324
	Cannula 20g (pink)	1	0.47	0.47	0.041	0.041
	Cannula dressing	1	0.12	0.12	0.084	0.084
	Ted stockings	1	1.38	1.38	0.221	0.221
	Optilube	1	0.04	0.04	0.010	0.010

	Anaesthetic circuit (changed every 24h)	0.1	4.50	0.64	0.176	0.025
	Capnography line	1.0	1.60	1.60	0.094	0.094
	Soda lime (filed at start of the day)	0.1	14.95	2.14	1.200	0.171
	Micralaryngoscopy tube (Size 5)	1	5.00	5.00	3.520	3.520
Equipment	Hopkins rod	1	1.00	1.00	0.704	0.704
	Forceps Set	1	5.00	5.00	0.002	0.002
	Anterior Commisure Laryngoscope (Rigid)	1	5.00	5.00	0.053	0.053
	Reusable Video Rhino laryngoscope	1	0.50	0.50	0.061	0.061
PPE	Non-sterile gloves (pairs)	10	0.10	1.00	0.052	0.520
	Mask	3	0.30	0.90	0.020	0.060
	Disposable gown	2	2.50	5.00	0.905	1.810
Electricity	Electricity (kWh per 90 minutes)	15	0.27	4.04	3.68	4.035
Staff Commute	Staff travel per emissions procedure	-	-	5.09	-	5.099
Total				**45.99**		**24.31**

Table 4. LA procedure carbon footprint

	Item	Number of items per procedure	Cost per items (£)	Cost per procedure (£)	Carbon footprint per item (kgCO2e)	Carbon footprint per procedure (kgCO2e)
LA drugs/medication	**Xylocaine 10mg Spray**	1	0.30	0.30	0.07	0.07
	4% Lignocaine - 2mls	1	2.00	2.00	0.48	0.48
Equipment	Chlorhexidine wipe	1	0.33	0.33	0.0206	0.02
	Blunt fill needle w/ filter	1	0.03	0.03	0.017	0.02
	Green needle	1	0.05	0.05	0.017	0.02
	Disposable dressings pack	1	0.47	0.47	0.33	0.33
	Autoclaving of Biopsy forceps	1	0.00	0.00	0.05	0.05
	Forceps-manufacturing	1	0.30	0.30	0.21	0.21
	Non sterile gloves (pair)	2	0.10	0.20	0.8	1.60
	Tristell wiped - 3 stage	1	8.00	8.00	0.07	0.07
	Reusable Video endoscope	1	0.50	0.50	0.35	0.35
	Vomit bowl - Cardboard	1	0.14	0.14	0.006	0.01
Electricity	Electricity (kWh per 50 minutes)	8.3	0.27	2.23	2.05	2.05
Staff Commute	Staff travel per emissions procedure	-		-	-	3.64
				14.55		**8.91**

These reductions are attributed to decreased operating theatre utilisation, lower energy demand from theatre ventilation and lighting, avoidance of volatile anaesthetic agents, reduced sterile

processing and consumable use, and elimination of postoperative recovery and ward-based resource requirements.

At project baseline, the service delivered 100 GA procedures and 10 LA procedures per annum. Following the quality improvement project, activity shifted towards increased use of LA procedures, with 10 GA procedures and 100 LA procedures per annum as demonstrated in table 5 below. This change is associated with a substantial reduction in overall carbon emissions from the diagnostic pathway. Based on these figures, transitioning to 100 LA cases per year corresponds to an estimated annual carbon saving of 1539.44 $kgCO_2e$. Partial transitions were also modelled to demonstrate the scale of impact, showing annual savings of 1154.58 $kgCO_2e$ with a 75% transition.

Table 5: Environmental and Financial consumable and drug savings achieved by switching from GA to LA

Parameters	**Per procedure ($kgCO_2e$)**	**Baseline**	**Post QI**
		GA 300 case per annum LA 30 cases per annum	**GA 60 case per annum LA 270 cases per annum**
General anaesthesia (GA)	24.31	100	10
Local Anaesthesia (LA)	8.91	10	1000
Average Carbon savings from switching from GA to LA per procedure ($kgCO_2e$)		15.39	
Annual savings with 100% switching from GA to LA ($kgCO_2e$)		1539.44	
Annual savings with 90% switching from GA to LA ($kgCO_2e$)		1385.50	
Annual savings with 75% switching from GA to LA ($kgCO_2e$)		£1154.58	
Average Financial savings from switching from GA to LA per procedure (£)		£31.44	
Annual financial savings with 100% switching from GA to LA (£)		£3,144.09	
Annual financial savings with 90% switching from GA to LA (£)		£2,829.68	
Annual financial savings with 75% switching from GA to LA (£)		£2,358.07	

Expressed in more tangible terms, an annual reduction of approximately 1.5 tonnes of CO_2e represents a meaningful environmental benefit, comparable to driving 4,529 miles in an average car of unknown fuel. Overall, these findings demonstrate that shifting from general anaesthetic microlaryngoscopy to local anaesthetic transnasal procedures for appropriate patients delivers significant reductions in healthcare-related carbon emissions, supporting NHS net-zero ambitions while maintaining high-quality diagnostic care.

Economic sustainability:

Switching from MLB under GA to TNO biopsies under LA delivers a substantial reduction in per-

case cost, driven primarily by staffing intensity, theatre utilisation, peri-operative assessment requirements, and post-operative recovery needs. Importantly, this transition required no capital investment, as it utilised existing outpatient and endoscopy infrastructure. The financial savings purely from consumables and drugs/anaesthetic gases are demonstrated above in table 5. The cost for consumables and drugs for a single GA procedure is £45.99, the cost for the equivalent under LA is £14.55. Table 5 demonstrate there is a financial saving of £31 per procedure when swapping from GA to LA.

In addition to the cost of consumables there are other costs associated with performing procedures, such as staffing costs, pre-operative assessments, post-operative ward stay and admission/discharge processing.

For MLB under GA, excluding the outpatient consultation cost common to both pathways (£25), the total cost per case is approximately £1160.65 This includes pre-assessment (£50), anaesthetic review (£30), day-of-admission processing (£15), theatre staffing costs (£754.66), equipment and medication including autoclaving (£45.99), post-operative ward stay (£250), and discharge processing (£15).

In contrast, TNO biopsy under LA has a total per-case cost of approximately £317.55, comprising lower staffing costs (£288), minimal equipment and medication costs (£14.55), and same-day discharge with brief recovery (£15).

The direct saving per case when transitioning from GA to LA is therefore approximately £880.80. Additionally, each case saves 7.02 staff-hours (9.32h GA – 2.3h LA). When projected across a conservative activity level of 100 TNO cases per year, this equates to an annual financial saving of £75,879 and a total staff-time saving of 702 hours per year, achieved without additional investment, increased staffing establishment, or new facilities. Beyond the financial and staffing efficiencies, LA-based TNO biopsies also reduce theatre pressure, improve patient throughput and avoid GA-related risks.

The direct saving per case when transitioning from GA to LA is approximately £843. Additionally, each case saves 7.02 staff-hours (9.32h GA – 2.3h LA). Table 6 shows the pre and post project yearly overall costs based on theatre activity and models a £75,879 yearly saving based on actual procurement savings and modelled financial efficiencies from 701 hours of staff time saving. This

has been achieved without additional investment, increased staffing establishment, or new facilities. Beyond the financial and staffing efficiencies, LA-based TNO biopsies also reduce theatre pressure, improve patient throughput, and avoid GA-related risks.

Table 6. Financial comparison of total local and general anaesthetic costs and yearly savings

	Per procedure cost	Pre project numbers	Post project numbers	Pre project yearly cost	Post project yearly cost	Saving
GA	£1,160.65	100	10	£116,065.00	£11,606.50	
LA	£317.55	10	100	£3,175.50	£31,755.00	
Total		110	110	£119,240.50	£43,361.50	£75,879.00

Social sustainability:

Analysis demonstrated consistently high levels of patient satisfaction, with convenience and overall experience most frequently rated at 9 or 10 out of 10. Most patients reported feeling comfortable throughout the procedure and described staff as friendly and approachable. Qualitative comments reinforced these findings, with patients noting that staff were “so friendly,” that they “felt very safe,” and describing the team as “great” and “highly professional.” Many also emphasised the speed and efficiency of the procedure, viewing this as a key advantage of the local anaesthetic pathway. These results strongly support the project’s aim of introducing a more efficient and sustainable diagnostic model. Maintaining a positive patient experience is particularly important, given evidence that positive experience is associated with improved quality of care, safety, and clinical outcomes (Doyle et al., 2013).

Quantitative feedback further demonstrated the high level of convenience afforded by the pathway. Of the 30 patients surveyed, 23 (77%) rated convenience as 10 out of 10, 4 (13%) rated it 9 out of 10, and 2 (7%) rated it 8 out of 10. Only one patient (3%) provided a lower rating of 3 out of 10. Overall, 29 of 30 patients (97%) scored the procedure 8 or above, indicating an overwhelmingly positive perception of convenience. These findings align with the project’s goal of improving efficiency and patient-centred care by delivering diagnostic biopsies in an outpatient, local anaesthetic setting with minimal disruption to patients. High satisfaction scores, perceptions of efficiency, and qualitative descriptions of staff as friendly, professional, and reassuring suggest that the redesigned pathway also enhanced the social experience of care.

Staff time savings were also evaluated, using list structures and staffing models reflective of real-world ENT theatre and clinic practice. A GA MLB list required approximately 68 staff hours per list, involving a large multidisciplinary team including anaesthetic, theatre, and recovery staff. In contrast, a local anaesthetic transnasal oesophagoscopy (LA TNO) list required 40 staff hours per list, delivered by a smaller ENT-led team without the need for anaesthetic or recovery support. This reduction reflects a lower workforce intensity and decreased reliance on highly specialised peri-operative staff, enabling improved rota flexibility, reduced staff burden, and greater service resilience.

Collectively, these findings demonstrate that the LA TNO pathway provides strong social sustainability benefits by simultaneously improving workload balance, patient experience, and access to care, all while maintaining clinical quality.

Discussion:

This project has demonstrated annual carbon savings of 1539.44kgCO_2e by swapping from 100 GA's and 100 LA's per year. This is the equivalent to driving 4529 miles in an average car of unknown fuel. The financial savings associated with reduced consumables, medications and waste, combined with financial staff efficiencies are modelled at £75,879 per year.
This project demonstrates that transitioning appropriate diagnostic laryngeal and pharyngeal biopsies from GA to LA delivers meaningful financial, environmental, and social benefits without compromising patient experience or clinical effectiveness. By reducing reliance on operating theatres, anaesthetic staffing, and peri-operative recovery, the LA pathway supports a more efficient and sustainable diagnostic model while maintaining high patient satisfaction and diagnostic yield.

Interpretation of the findings suggests that LA TNO is a high-value alternative to GA MLB for selected patients. The outpatient model enables more timely access to biopsy, reducing diagnostic delays and exposure to the risks associated with general anaesthesia. Reduced theatre utilisation and staffing intensity improve service resilience and allow reallocation of limited resources to patients requiring operative intervention, aligning with NHS efficiency and net-zero priorities. Interestingly the staff travel is responsible for almost 50% of the carbon emissions. The reduction in the number of staff in the theatre for LA cases and their associated travel is one of the biggest contributors for carbon emissions savings. By aligning with the NHS net zero travel and transport strategy. Further savings in carbon emissions could be made by using salary sacrifice schemes for

zero emission vehicles making them affordable for staff members. Furthermore, the promotion of low carbon methods of transport such as active travel (walking and cycling) as well as public transport to would also have a huge impact on carbon emissions due to staff travel.
This approach has clear potential for transfer across multiple medical specialties. Particularly for procedures that are low risk and suitable for local anaesthesia. Adopting similar models more broadly could improve system efficiency, expand procedural capacity, and deliver comparable benefits in patient experience and access to care across the health service.

Several challenges were identified during the service transition. Early in implementation, a small number of patients were unable to tolerate LA biopsy due to anxiety or discomfort, necessitating re-listing under GA. This highlighted the importance of careful patient selection and effective pre-procedure counselling, which were refined over time. Staff engagement and confidence were also key considerations; although ENT clinicians were familiar with transnasal endoscopy, expanding its use for biopsy required reassurance regarding safety, diagnostic adequacy, and patient acceptability. These challenges were addressed through shared learning, discussion of published evidence, and gradual scaling of the service.

Limitations of this evaluation include its observational design and the absence of direct patient-reported outcome data for GA procedures, limiting direct comparison of satisfaction between pathways. Additionally, GA MLB remains necessary for a subset of patients due to anatomical, clinical, or tolerance factors. Financial and environmental estimates were based on standardised costings and emissions factors, which may vary between organisations, although the methodology is reproducible across NHS settings.

Overall, this project highlights the feasibility and impact of shifting diagnostic ENT care from theatre-based GA procedures to outpatient LA pathways. The model is highly transferable to other ENT services with access to transnasal endoscopy and could be scaled through standardised patient selection criteria, staff training, and incorporation into urgent suspected cancer pathways. Wider adoption has the potential to improve access to care, reduce healthcare emissions, and deliver sustained system-level efficiencies across the NHS.

Conclusions:

This project demonstrates that replacing general anaesthetic microlaryngoscopy with local anaesthetic transnasal oesophagoscopy for appropriate diagnostic biopsies is a valuable and sustainable service improvement. The work shows that high-quality diagnostic care can be delivered with reduced cost, lower carbon emissions, and improved efficiency, without compromising patient experience or safety.

Key factors underpinning success included strong ENT clinical leadership, careful patient selection, and the use of existing equipment and staffing models, allowing implementation without additional financial investment. Patient-reported experience data confirmed high acceptability, supporting the project's aim of delivering more patient-centred care alongside operational and environmental benefits.

Challenges encountered, particularly related to patient tolerance of local anaesthetic procedures, highlighted the importance of pre-procedure counselling and clear selection criteria. These lessons reinforced that general anaesthesia remains necessary for a small subset of patients and informed refinement of the pathway.

The local anaesthetic TNO pathway is now embedded within routine practice, supporting sustained change. The organisation intends to build on this work by expanding outpatient diagnostic capacity and sharing learning within the department, with potential for wider adoption across ENT services as part of ongoing efficiency and sustainability initiatives.

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Appendices

Critical success factors Please select one or two of the below factors that you believe were most essential to ensure the success of your project changes.			
People	**Process**	**Resources**	**Context**
☐ Patient involvement and/or appropriate information for patients - to raise awareness and understanding of intervention ☐ Staff engagement ☐ MDT / Cross-department communication ☐ Skills and capability of staff ☐ Team/service agreement that there is a problem and changes are suitable to trial (Knowledge and understanding of the issue) ☐ Support from senior organisational or system leaders	☐ clear guidance / evidence / policy to support the intervention. ☐ Incentivisation of the strategy – e.g., QOF in general practice ☐ systematic and coordinated approach ☐ clear, measurable targets ☒ long-term strategy for sustaining and embedding change developed in planning phase ☐ integrating the intervention into the natural workflow, team functions, technology systems, and incentive structures of the team/service/organisation	☐ Dedicated time ☐ QI training / information resources and organisation process / support ☐ Infrastructure capable of providing teams with information, data and equipment needed ☐ Research / evidence of change successfully implemented elsewhere ☐ Financial investment	☒ aims aligned with wider service, organisational or system goals. ☒ Links to patient benefits / clinical outcomes ☐ Links to staff benefits ☐ 'Permission' given through the organisational context, capacity and positive change culture.

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Template References

- SQUIRE | SQUIRE 2.0 Guidelines (squire-statement.org)
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