



## SusQI project report: Back to the Future: Bringing back “old practices” for a sustainable future.



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### Date of Report:

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## Abstract:

### Aims:

Aim 1 for Inguinal hernia repair (IHR) project:

- To convert as many IHR from general anaesthesia (GA) to local anaesthesia (LA) as clinically appropriate and in line with the wishes of the patient.

Aim 2 for reusable gown project:

- To replace single-use disposable surgical gowns with reusable surgical gowns in the Imperial Surgical Innovation Centre.

### Method and measurement:

We engaged teams to understand current practice and suggest suitable alternatives relevant to our aims. We completed audits of current practice and literature reviews. We implemented educational campaigns via meetings and posters. Resource use was compared from patient induction of anaesthesia to discharge for both GA vs LA pathways, with resources measured to calculate financial and environmental savings.

### Results:

Inguinal hernia project: Our literature review, audit and study suggest IHR under LA appears to be quicker, safer, and likely to improve surgical flow. We found lower risk of complications and reduced length of stay by 53.2% (4 hours, 9 minutes) with LA vs GA, with no obvious post surgical differences between patients. For the 10 cases in the study period, 102 KgCO<sub>2</sub>e and at least £699.97 was saved. As the literature suggests up to 64% of cases via LA is achievable, 138 cases yearly could be switched to LA in our trust, which could save 2005.14 KgCO<sub>2</sub>e and £15,984.54/year.

Reusable gown project: Moving to reusable gowns saved £118.52 and 1025.05 kgCO<sub>2</sub>e across our 8 week trial. If reusable gowns were introduced across our trust, we estimate a saving of 234,660.92 kgCO<sub>2</sub>e and £27,131.69/year. 91% staff reported positively following clinical use of the gowns.

### Conclusion:

Our interventions demonstrated significant clinical, social, environmental and financial savings and align with the values highlighted in the trust's new 'Green Plan'. This project served as a catalyst in education and has supported further pilot sustainability programmes within other departments in the trust





## Background:

Surgical activity is a significant producer of carbon emissions. 42% of this is attributable to anaesthetic gases, 32% to procurement of consumables and 58% to energy use. As surgeons, we work within the multidisciplinary theatre team, constantly interacting with theatre managers, department managers, clinical leads, as well as commercial suppliers, and are thus well positioned to understand existing systems and gather support to help us identify and effectively overcome barriers to establish lasting change within our specialty.

We identified Inguinal hernia repair (IHR) surgery under General Anaesthesia (GA) as a common operation that would be amenable to Local Anaesthesia (LA) +/- sedation. Moving away from GA would allow us to tackle one of the carbon hotspots of surgery and deliver benefits to patients, healthcare workers and the NHS across the triple bottom line of sustainable healthcare. Numerous studies demonstrate that IHR performed under LA leads to improved patient outcomes, reduced financial costs, as well as faster return to work. Associated reduced theatre utilisation and decreased length of stay (LOS) is especially useful when dealing with the backlog of waiting lists.

Similarly, switching from disposable to reusable sterile surgical gowns would allow us to introduce a relatively small intervention that can however be scaled up across the whole NHS and that will help put a dent into the massive NHS carbon footprint that is caused by procurement.

## Specific Aims:

To reduce the carbon footprint of our surgical department whilst achieving the triple bottom line of environmental, financial and social benefits by bringing back pre-existing practices that could be seamlessly adopted by our clinical team.

- 1) To convert as many IHR from General Anesthesia (GA) to Local Anaesthesia with/without sedation (referred to simply as LA from hereon for brevity) as are clinically appropriate and in line with the wishes of the patient.
- 2) To replace single-use disposable surgical gowns with reusable surgical gowns in the Imperial Surgical Innovation Centre (theatres 1 & 2).

## Methods:

We built a process map (Appendix 1) of a patient's journey when undergoing elective IHR. A second process map (Appendix 2) was developed to focus specifically on the perioperative period.

Aim 1: We used text-messaging based surveys and interview-style discussions to understand anaesthetic practices and preferences for IHR within our staff group. Having determined suitability criteria for LA IHR using national guidelines, we presented our project at departmental meetings and consulted our surgical and anesthetic colleagues to adapt these for our practice.





Aim 2: We researched available options for reusable surgical gowns and discussed feasibility and costs with prospective suppliers. We conducted face-to-face surveys of surgeons, anaesthetists and nurses with samples of the reusable gowns. 97.4% of 76 surveyed healthcare workers were happy to trial reusable gowns during surgical operation.

Feedback from colleagues allowed us to dynamically adapt and incorporate suggestions into our aims and change ideas, ultimately providing strong engagement and support from our wider team. We recruited motivated and dedicated colleagues as well as effective senior leaders to join our team. We conducted regular online meetings to discuss progress and plan required actions; meeting minutes and relevant documents were shared on an online drive.

We talked to relevant stakeholders to harness expertise, understand barriers and find acceptable and effective interventions, including: general theatre manager, existing linen contractors, linen delivery staff, facilities managers, infection control, Clinical Procurement Lead Nurse, anaesthetic and surgical clinical leads, QI team and patient engagement team. Having established feasible interventions, we secured necessary permissions (e.g. from Infection control for reusable gowns). Our work was registered with the Audit and Quality Improvement Department locally.

With approval to proceed with our proposed changes from our heads of department, we presented our analysis and proposals at the monthly departmental meeting and disseminated information via emails and poster campaigns in relevant areas. Posters containing reminders to consider use of LA for IHR were placed in clinic rooms as some surgeons suggested that they would prefer to give patients anaesthetic options at their first consultation. We also asked surgeons to review the inclusion criteria for LA and included these in the clinic posters. Posters on reusable gowns were adapted to include gown replacement cost in response to feedback to increase staff motivation to care for them. All posters can be viewed in Appendix 3.

## Measurements:

### Environmental and financial impact:

Aim 1: We compared resource use from patient induction of anaesthesia to discharge for both GA vs LA pathways, including: energy use (in anaesthetic rooms, operating theatres, recovery and on wards), consumables and drugs including anaesthetic gases.

- Baseline data was collected via a staff survey, audit of 2019 IHR cases (data provided by Business Intelligence Analysts), and electronic medical records. This gave us information on consumables and anaesthetic gas use, and average anaesthetic room, theatre room, recovery, ward times and length of stay (LOS). A 2019 Estates Returns Information Collection report determined our hospital's total energy and gas use per m<sup>2</sup>.
- The cost of medical equipment was identified with the help of theatre managers, procurement team and commercial suppliers. We obtained the cost of each medication from the Pharmacy department or from the British National Formulary website.





- Financial analysts estimated a cost of £400 per one unplanned overnight stay in an elective surgical bed.
- The carbon footprint of individual items was determined via weight or product specification data from suppliers. CO<sub>2</sub>e factors from the Inventory of Carbon Energy v3.0 were used. If weight wasn't available, we used GHG emissions factor for NHS spend for medical equipment (0.3kgCo<sub>2</sub>/£). The carbon footprint of medications was calculated using the GHG emissions factor for NHS financial spend on pharmaceuticals (0.155kgCo<sub>2</sub>/£).
- Carbon emissions factors from Rizan et al (2021) were used for waste disposal (for autoclave sterilization and high temperature incineration),
- We also estimated savings if the proportion of LA cases were increased to 64%, the highest proportion of cases performed under LA within an NHS trust in published literature (Sanjay et al, 2007).

#### Aim 2:

- A literature review identified comparative studies of reusable vs disposable gowns environmental impact. Vozzola et al's study (2020) was deemed the most up to date and applicable to our project.
- Disposable gowns: Through our trust procurement data, we calculated the average cost for a disposable gown, including waste disposal and waste transport, as £1.41. We used 217,840 gowns per year, costing £290,075.88.
- Reusable gowns: Synergy, who own the reusable gowns, provided costing for their loan service (which includes delivery, usage, collection, washing, sterilisation and packaging), equating to £1.29 per gown.
- We collated the total number of gowns used over the study period.

#### Social impact

We collected data from patients regarding the amount of time taken off work by themselves and their carer following IHR, any additional loss of income incurred as a result and any impacts on Activities of daily living (ADLs).

We collected feedback from staff after using the reusable gowns. To assess engagement and beliefs in regard to the climate emergency, we asked staff about previous behavioural changes as well as intentions for future climate action subsequent to our intervention.

#### Results:

##### Aim 1:

We screened all 85 patients on our elective open IHR waiting list with 40 (47%) deemed suitable for repair under LA. Patients were offered the option of LA repair preoperatively if their surgical consultant was willing to perform the procedure. All 14 patients who were offered LA agreed to it, however final anaesthetic decision was based on clinical suitability and patient choice on the day of operation. Of 20 cases booked during our initial study period, 10 (50%) were performed under LA. The reason behind the anaesthetic choice was not recorded, however allowed a natural control group of patients who had been screened as suitable, but not booked on participant consultants lists.







*Social sustainability, Clinical and Health outcomes:*

Our retrospective audit of 2019 IHR cases identified that 27.7%, or 105/379 elective day-case open IHRs were performed under LA. There was a higher incidence of unexpected overnight stays in the GA group (11%, n=30) compared to LA (2.8%, n=3). LOS was reduced by 33.9% (4 hours 45 minutes) with LA.

In our study sample, we found lower risk of complications and increased length of stay (10%) with LA compared to GA (40%) LOS was reduced by 53.2% (4 hours, 9 minutes) with LA. Our literature review, audit and study suggest IHR under LA appears to be quicker, safer and likely to improve surgical flow. We surmise that the poorer outcomes and longer LOS could lead to poorer quality of life for both patients and carers. A change to LA also reduces exposure to risks associated with GA, and COVID exposure risk for Aerosol Generating Procedures (AGP).

We conducted two surveys for each patient included in our project: one immediately postoperatively and the other 7 days later. There was no obvious difference between patients in terms of pain, post-operative symptoms, return to work and ADLs, although we recognise that our numbers are small and follow-up time was short. All patients who underwent IHR under LA were happy with their choice and would not have changed it retrospectively.

Aim 2:

The introduction of reusable gowns offers significant reductions in environmental impacts which translates to an overall healthier environment and healthier population, directly benefiting the health of staff, patients and the wider community. As a trust, moving to reusable gowns aligns with the values highlighted in the trust's new 'Green Plan' and those of many of our staff. Theatre staff surveys at the initiation of the project demonstrated 96% were willing to try the gowns, whereas 91% scored positively after using them clinically.

*Environmental sustainability*

Aim 1:

The estimated difference for IHR under LA vs GA is 10.2 kgCO<sub>2</sub>e/case, or 102 KgCO<sub>2</sub>e for the 10 cases in our intervention period. Based on our trust's 2019 LOS data an additional 14.53kgCO<sub>2</sub>e/case can be saved. As the literature suggests up to 64% of cases via LA is achievable, 138 cases yearly could be switched to LA in our trust, which could save 2005.14 KgCO<sub>2</sub>e.

Aim 2:

950 reusable gowns were used in two participating theatres over our 8 week project, with a resulting total reduction of 1025.05 kgCO<sub>2</sub>e. If reusable gowns were introduced across the entire trust, this would allow carbon emission savings of 234,660.92 kgCO<sub>2</sub>e. This is equivalent to driving a car around the earth's equator 23.6 times, or the annual carbon footprint of 18 UK adults.

As per Vozzola et al, further reductions were demonstrated in blue water, solid waste and natural resource energy (NRE) (Table 1).





Table 1 - Environmental Sustainability from introducing Reusable Gowns

Environmental Resource	Reduction during 10-week trial	Reductions if introduced across trust
GWP (tonnesCO2e)	1.025	234.66
Blue Water (Kg)	866.4	198,341.76
Solid Waste (Kg)	210.52	48,193.57
NRE (MJ)	1,6048.35	3,673,889.64

**Economic sustainability**

Aim 1: According to our analysis, just the 10 cases performed under LA in our intervention period saved the trust at least £699.97. If we consider the LOS from 2019, savings increase to £1158.3. Delivering 64% of IHR in our trust under LA, could lead to an additional saving of £15,984.54/year.

Aim 2: During our 8-week trial we saved £118.52 by switching to re-usable gowns. If reusable gowns were introduced across our trust, we estimate a saving of £27,131.69/year.

**Barriers encountered:**

Aim 1: The most significant barrier encountered was a lack of familiarity with LA technique. This was overcome by asking more experienced surgeons to discuss their techniques and tips with colleagues. We also recorded a video of the technique to show in our next departmental meeting.

Our project was limited in scope by COVID19 restrictions in OPD attendances and its short timespan, which did not allow us to effectively measure uptake of LA in clinics, to assess long-term outcomes after IHR or to set up LA technique training.

Aim 2: We had 1 incident which arose when a major 4-hour laparotomy was performed using the reusable single-ply gowns and a strike-through occurred. As a result, we have sourced double-ply (re-reinforced) gowns to the theatres for major laparotomy cases. We have also had discussion with our Clinical Procurement Leads to ensure gown selection criteria are clearly signposted in all theatres as this will also have significant repercussions for environmental and financial savings.

**Conclusions:**

Our interventions offer significant carbon and financial savings to our surgical department, as well as offering social and clinical benefits to IHR patients. The project served as a catalyst in educating ourselves, healthcare staff and patients about the environmental benefits of reusable gowns and of LA. It also stimulated important conversations with staff who were previously unaware of our carbon footprint, and created networks of concerned, engaged and enthusiastic staff members.





We plan to disseminate the results to our local departmental meeting and explore other potential barriers in continuing the project. Moving forward, we aim to investigate the use of local and regional anaesthesia options for other surgical procedures in various specialties and to audit anaesthetic considerations and surgical consenting practices. Alongside the trust's "Green Plan" developers, we have set up an Green Anaesthesia and Surgery Taskforce to streamline and reduce volatile use (Desflurane and Nitrous oxide in particular) and have secured an Innovation Grant to fund a trial of volatile capture devices volatile agents. We have also invited Sustainability QI projects from surgical juniors and are supporting them in the delivery of SusQI projects. We have been invited to present our projects at trust-wide as well as national surgical events.

The beneficial findings we established for the use of reusable gowns have led to 5 trials in orthopaedics, urology, vascular, maternity and neonatal intensive care. and in a private wing (with multiple specialties) in April-July 2022. Unfortunately, some negative feedback has been received from orthopaedics and vascular as the forced double ply gowns are heavy and therefore difficult to wear in long surgeries when staff may also be wearing lead gowns. In all other departments feedback has been positive.

As a result of our project, the trust's Green team is exploring reusable options and working with procurement to establish a long term contract for reusable gowns across the whole trust. This demonstrates the lasting change instigated by our projects. We will continue to raise awareness on the issue of sustainability in surgery to achieve cultural change, but most importantly, we will strive to effect lasting changes wherever possible to embed cultural action.

The team were highly commended at the Green Surgery Conference 2021, and used their prize money to buy reusable theatre hats for the team involved in the projects.

Imperial College  
London

BY USING RE-USABLE GOWNS ACROSS THE  
TRUST WE ESTIMATE WE WILL BE ABLE TO SAVE  
**234661 kgCO<sub>2</sub>e/year**

EQUIVALENT TO DRIVING A CAR  
AROUND THE EARTH'S EQUATOR  
**23.6 times**

CENTRE for  
SUSTAINABLE  
HEALTHCARE  
Imperial College London

GREEN SURGERY  
CHALLENGE

Imperial College Healthcare  
**NHS**  
NHS Trust







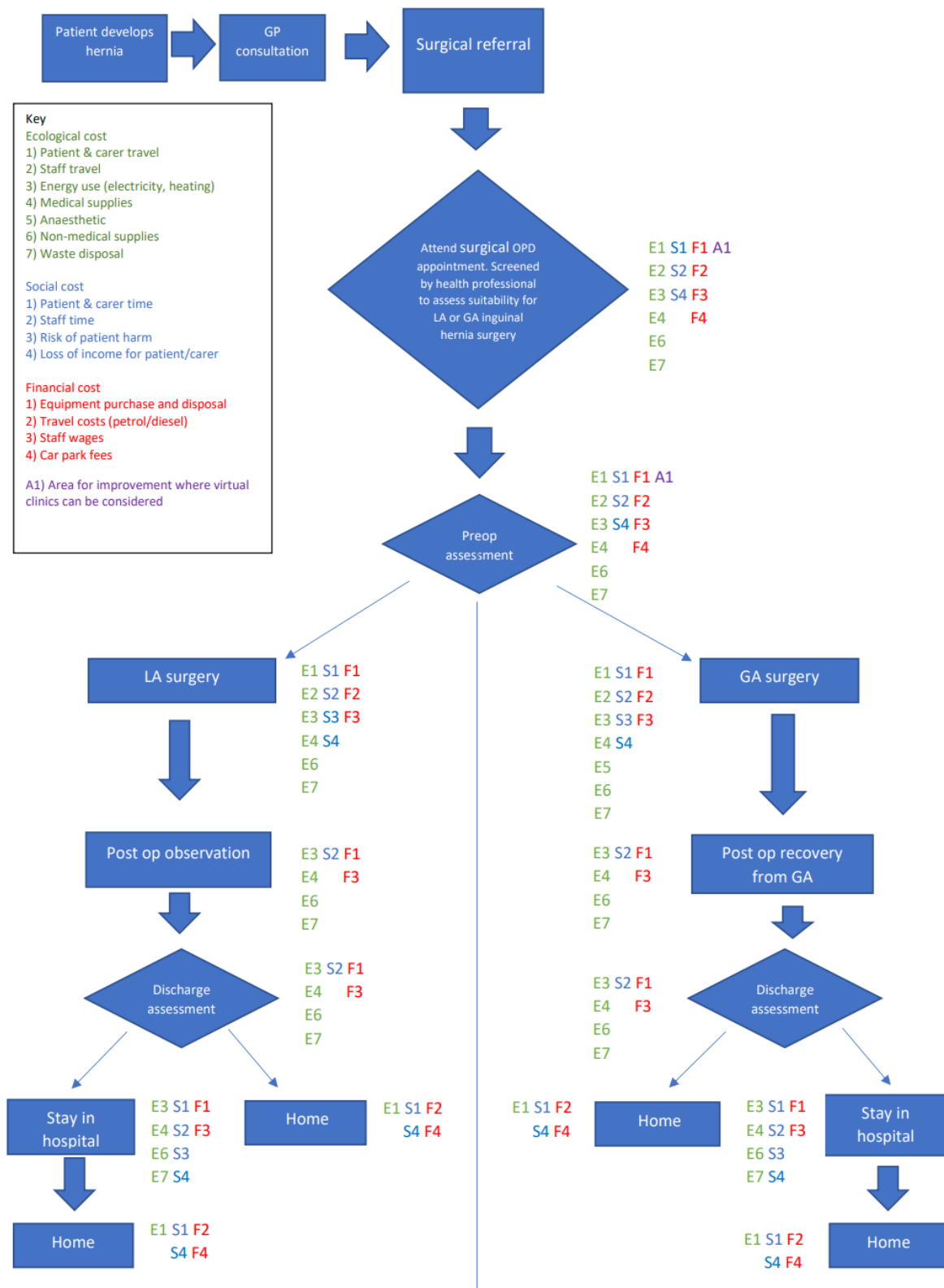
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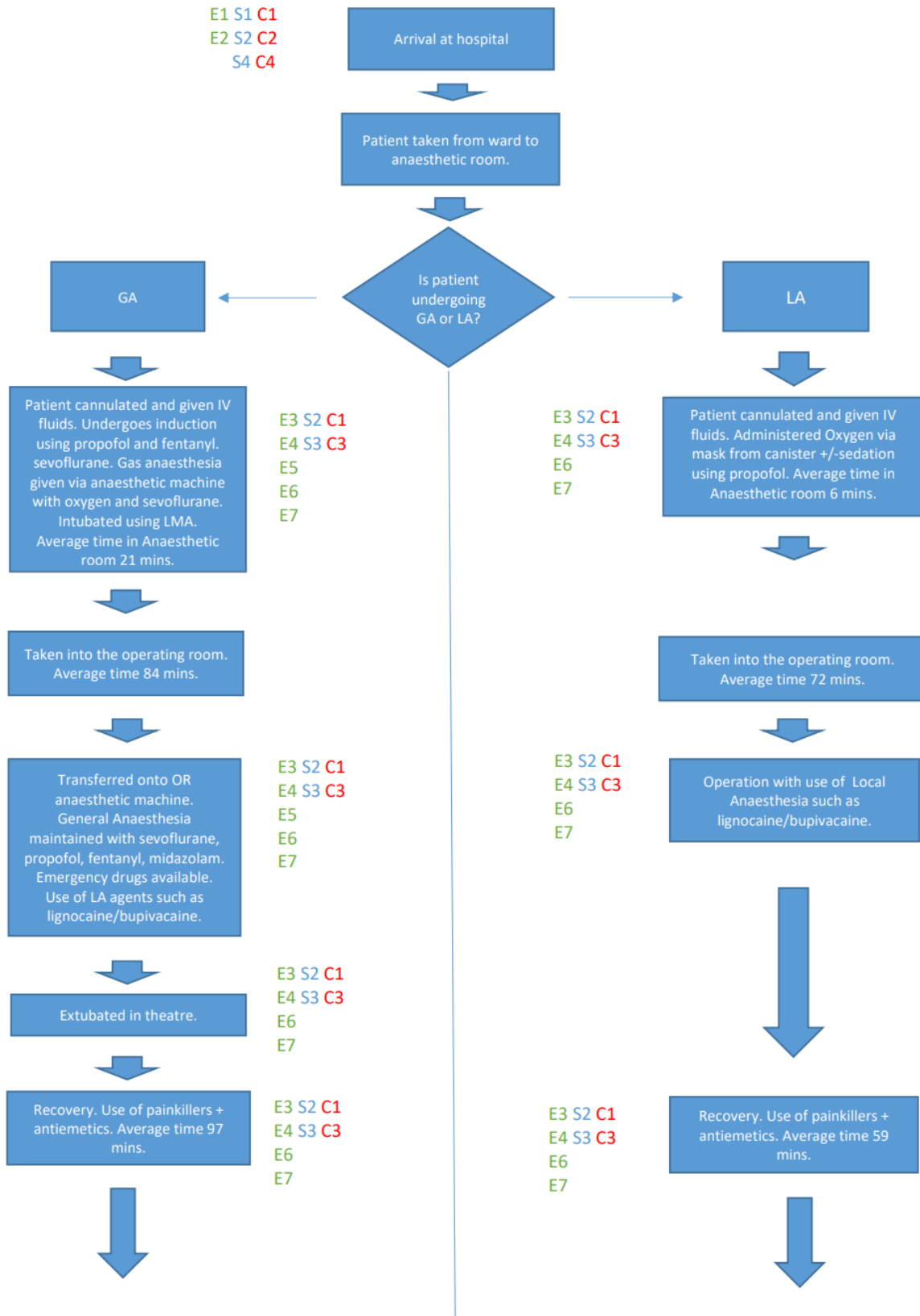


## Appendix 1: Process Map 1: Patient Journey





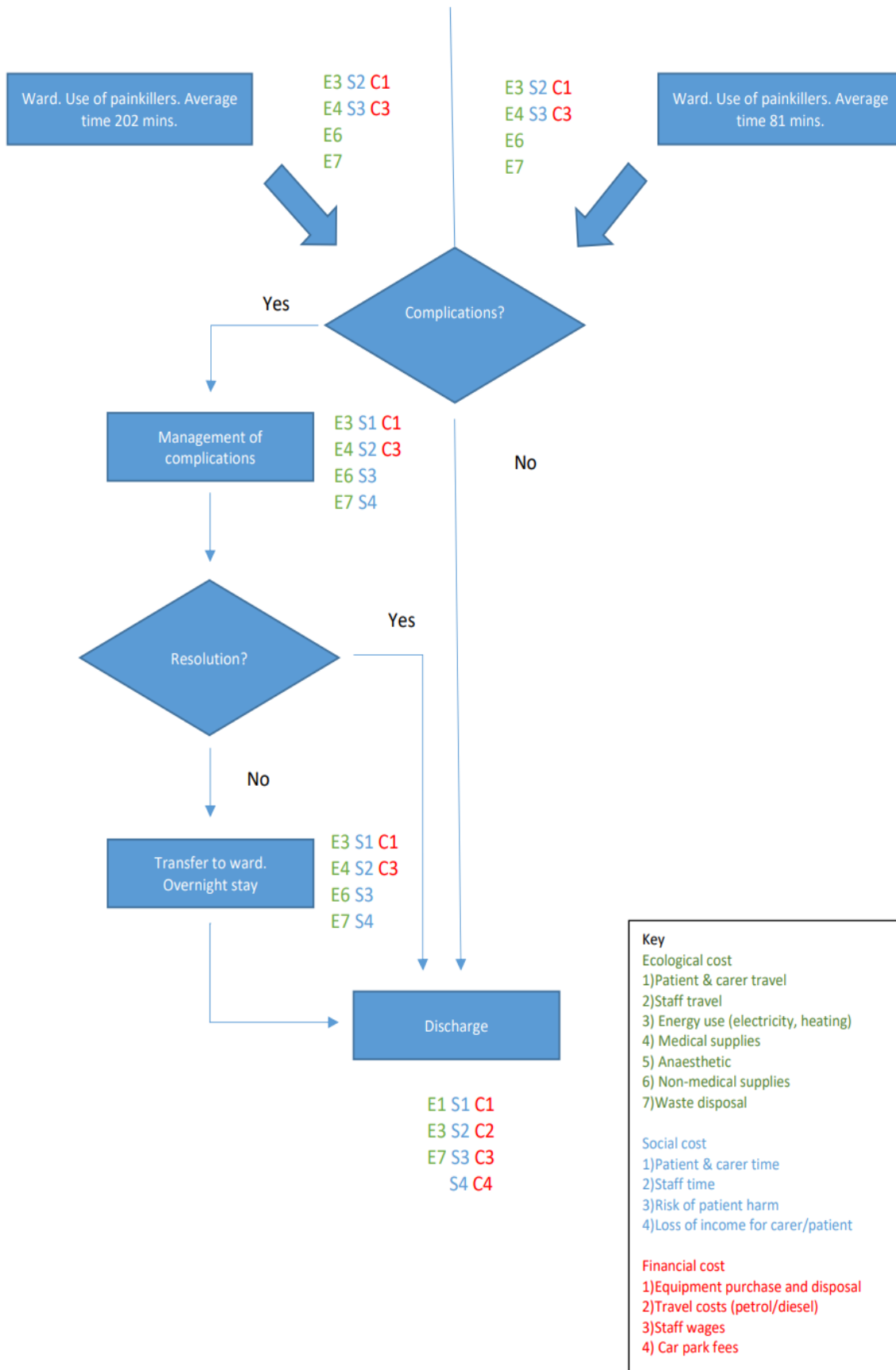
Appendix 2: Process map - Perioperative Process



Continued below.



The Centre for Sustainable Healthcare would like to acknowledge the Green Surgery Challenge gold sponsors NIHR11 Surgical MedTech Co-operative and Elemental Healthcare; as well as our partners NIHR Surgical MedTech Co-operative, Royal College of Surgeons of England, Royal College of Surgeons of Edinburgh, Sustainable Healthcare Coalition, Association for Perioperative Practice and Brighton and Sussex Medical School.





### Appendix 3: Posters

- 1) OPD poster of inclusion and exclusion criteria for IHR under LA.
- 2) Operating theatre reminder of correct reusable gown disposal.
- 3) Operating theatre reminder of correct reusable gown disposal.
- 4) QR code for gown usage satisfaction survey.

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## GREEN SURGERY CHALLENGE 2021

Please remember to offer Inguinal Hernia repair under LA & help your department be more sustainable!

**1) IDENTIFY APPROPRIATE PATIENTS USING OUR CRITERIA**

**2) DISCUSS OPTION OF INGUINAL HERNIA REPAIR UNDER LA**

**3) KEEP US INFORMED BY COMPLETING THE UPTAKE SURVEY AT THE END OF CLINIC**

INCLUSION	EXCLUSION
<ul style="list-style-type: none"> <li>Primary hernia</li> <li>Unilateral</li> <li>Reducible</li> <li>Small hernia</li> <li>Male</li> <li>Female (if not planning to perform laparoscopically)</li> </ul>	<ul style="list-style-type: none"> <li>Recurrent hernia</li> <li>Bilateral</li> <li>Non reducible</li> <li>High BMI (&gt;30)</li> <li>Chronic Pain</li> <li>Very muscular pt</li> <li>Inguinal-scrotal hernia</li> <li>Hyperkinetic movement disorder</li> <li>Massive hernia</li> <li>Anxiety</li> <li>Needle Phobia</li> <li>Patient choice</li> <li>Anticoagulation</li> </ul>

THANK YOU!  
IMPERIAL GREEN SURGERY TEAM

1)

Imperial College Healthcare NHS Trust

## YOU ARE WEARING A NEW REUSABLE GOWN TODAY!

REMEMBER: Don't throw your gown away after the operation but please: put it in the **BLUE** laundry bag.

10 GOWNS X BAG

EACH GOWN COST £10.40 TO REPLACE!!!

Thank you for helping your department be more **SUSTAINABLE!**

IMPERIAL GREEN SURGERY TEAM

2)

Imperial College Healthcare NHS Trust

## YOU ARE WEARING A NEW REUSABLE GOWN TODAY!

## REMEMBER TO PUT YOUR REUSABLE GOWN IN THE BLUE LAUNDRY BAG.

THANK YOU!

EACH GOWN COST £10.40 TO REPLACE!!!

IMPERIAL GREEN SURGERY TEAM

3)

Imperial College Healthcare NHS Trust

## Tell us your thoughts on the reusable gowns!

Scan the QR code.  
Takes less than 30 seconds to complete.

THANK YOU!

IMPERIAL GREEN SURGERY TEAM

4)

