Variable	*Methodology*
Patient variables	
Procedure type (immediate vs delayed, bipedicled vs unipedicled) Postcode	Direct data collection from Electronic Patient Records
Preoperative consultation variables	
Number of in person consultations before DIEP (plastic surgery clinic appointments, preoperative assessments) Number and type of preoperative imaging Length of time for one abdominal CT scan	Direct data collection from Electronic Patient Records
Number and type of staff present Clinic durations	Through observation
Staff travel	Staff travel surveys (Supplementary File 2)
Electricity, gas, oil and water used	Annual hospital consumption provided by estates
Preoperative variables	
Time in anaesthetic room	Direct data collection from the World Health Organisation Intraoperative Record, available on Electronic Patient Records
Equipment used	Through observation and discussion with consultant anaesthetists

Anaesthetic induction agent used	Direct data collection from anaesthesia records, available on Electronic Patient Records and discussion with consultant anaesthetists
Number and type of staff present	Through observation
Staff travel	Staff travel surveys (Supplementary File 2)
Electricity, gas, oil and water used	Annual hospital consumption provided by estates
Room sizes	Provided upon request by estates
Equipment transport	Suppliers for equipment and postcodes provided by estates Weight of equipment taken from supplier information sheets
Intraoperative variables	
Operative time Number and type of staff present during DIEP Instruments used	Direct data collection from the World Health Organisation Intraoperative Record, available on Electronic Patient Records
Staff travel	Staff travel surveys (Supplementary File 2)
Electricity, gas, oil and water used	Annual hospital consumption provided by estates
Anaesthetic gases used	Direct data collection from anaesthesia records, available on Electronic Patient Records and discussion with consultant anaesthetists
Room sizes	Provided upon request by estates
Equipment transport	Suppliers for equipment and postcodes provided by estates
Sterilization water and electricity consumption	Provided upon request by the central sterilization department
Weight of waste	Raw data collection through physical weighing of all constituent bags for different waste streams Weight of sharps bin before and after procedure

Waste management	Provided upon request by the waste management department
Equipment transport	Suppliers for equipment and postcodes provided by estates Weight of equipment taken from supplier information sheets
Immediate postoperative variables	
Number and type of staff present Time in recovery	Through observation
Staff travel	Staff travel surveys (Supplementary File 2)
Electricity, gas, oil and water used	Annual hospital consumption provided by estates
Anaesthetic gases used	Direct data collection from anaesthesia records, available on Electronic Patient Records and discussion with consultant anaesthetists
Room sizes	Provided upon request by estates

SDC 1: Methodology used to collect data variables. Abbreviations: DIEP- Deep Inferior Epigastric Perforator, CT- Computerised Tomography

Variable	Methodology and source
Computerised Tomography (CT) angiogram	Emissions from running CT scanner for abdominal CT(27)
Electricity, gas, oil and water consumption	Number of minutes spent in relevant clinical area*proportion of hospital occupied by area*total hospital consumption in one minute (in kWh for electricity, gas and oil and m^3 for water)*conversion factor from government report(28) Electricity, gas and oil calculated for time in CT room, clinic, anaesthetic room, theatre Water supply was considered negligible apart from intraoperatively. Emissions from water supply was calculated separately as part of the scrubbing procedure preoperatively. Intraoperative usage is assumed to be a resource intensive setting so all usage values were doubled.
Patient travel	Average distance from patient postcode to our hospital by land transport (km) calculated using the website free map tools(29)*conversion factor for car transport(30) Return journeys calculated for all journeys prior to the day of surgery, single route calculated for the day of surgery.
Staff transport	Average distance from staff postcode to our hospital by land transport (km) calculated using the website free map tools(3)*conversion factor for most populous type of

	transport for that type of staff member(30). Divided by the number of patients responsible for that day. Return journeys calculated for all journeys prior to the day of surgery, single route calculated for the day of surgery.
Induction of anaesthesia	Emissions from remifentanil and propofol TIVA induction calculated for the average weight of patients and operative length(31)
Maintenance of anaesthesia (including anaesthetic gases)	Kg CO2eq per hour for the % N_2O *L/min from the Association of Anaesthetists anaesthetic impact calculator(32)*operative time (hours)
Production and usage of anaesthetic equipment	Lifecycle assessments provided by external supplier (Supplementary File 1)
Production of surgical equipment and scrubs	Values taken from study by Rizan et.al (33)
Equipment transport	Average distance from supplier postcode to our hospital by land transport (miles) calculated using the website free map tools(29)*total equipment weight (ton)* average freight truck emissions per ton-mile(34) Calculated separately for equipment required in the preoperative and intraoperative period.
Sterilisation of reusable instruments	Electricity(in kWh) and water(in m^3) consumption for the sterilisation of one instrument tray was provided by the Central Sterilisation Unit.

	Electricity/water consumption*average number of instrument trays used per operation*conversion factor from government report(28)
Waste management	Weight of waste stream (non-infectious offensive , dry mixed recyclable or sharps)*kg CO2 per kg waste in each respective stream for study by Rizan.et al(33)
Surgical scrubbing	Number of minutes spent scrubbing(35)*water used in one scrub(m^3)(10)*total hospital water consumption in one minute (m^3)*conversion factor from government report(28)* average number of scrubs per procedure
Laundry of scrubs	Presumed one load of washing per procedure laundered at 60 degrees(36), kgCO2eq. from Shahmohammadi et.al(37)

SDC 2: Methodology used to calculate carbon dioxide equivalents (kgCO2eq.) for each sector. Abbreviations: DIEP- Deep Inferior Epigastric Perforator, CT- Computerised Tomography, TIVA- Total Intravenous Anaesthetic

Equipment	Mean number used
Raytec 4*3 swabs	49
Suture needles	34
Liga clip cartridge	22
Red ties	17
Cotton buds	15
10*7.5 swabs	15
Tonsil swabs	14
Single clamps	12
Abdominal packs	12
Double clamps	10
Arrows	9
Hypodermic needles	7
Blade	7
Lahey	6
45*45 swabs	6
Lone star	4
Marking pens	3
Diathermy tip	3
Sloops	2
Slings	2
Screws	2
Background	2

Rulers	1
P77 coupler set trays	1
P53 free flap trays	1
P5 liga clip trays	1
P27 retractor set trays	1
P1 plastic trays	1
Monopolar forceps	1
Microscope	1
Micro wipes	1
Implant GEM couplers	1
B31a breast extra trays	1
B31 breast trays	1
30*30 swabs	1

SDC3: Average number of surgical equipment for the 42 patients undergoing DIEP flap surgery.

Life Cycle Assessment (LCA) Comparison of non-PVC and PVC Anaesthetic Masks, 2010111, 22mm Flextube Silver Knight™ anti-microbial breathing system for use with Aisys®, Avance® and Aespire® Carestation® with 2L bag, and limb, ≥1.6m and 2196000 – IS Can, Spherasorb disposable CO2 absorber.

LCAs calculated using Simapro V8.3.1, Ecoinvent V3 according to ISO 14040 and 14044:2006. Methodology Ecoindicator 99 (E) v2.10.

Background

A life cycle assessment (LCA) is a method used to evaluate the environmental impact of a product throughout its life cycle. Results can be presented to show the overall impact score, encompassing the products entire lifecycle or focus on specific lifecycle stages. LCAs are commonly used to compare one product to another, as is the case in this study. LCAs can also be utilised to assess the impact of proposed sustainable changes to a given product. Changes can be modelled to determine how they will affect the products environmental impact.

Method

Data is collected on the product under investigation detailing its materials, their weights, the manufacturing processes used, assembly, sterilisation step (if applicable), transportation and the disposal method. This is used to guide selection throughout LCA creation.

The following LCAs have been calculated using Simapro version 8, 3.1. The software contains a database of inventory data, in this case, Ecoinvent V3. This is an extensive database of materials with an assigned environmental impact score. The given score takes into consideration, the raw material's extraction, processing as well as its effects on a range of environments/habits which fall under the following categories - human health, ecotoxicity and resources. Ecoinvent V3 is continuously updated by a team of specialists to provide the most accurate assessment of a given material. This ensures compliance to ISO 14040/44 and EU requirements.

Materials can be tailored to best represent those of the product. Using flexible PVC as an example, the plasticiser used (phthalate or non-phthalate based) and its exact percentage can be selected to ensure accuracy.

The manufacturing method is tailored in a similar way. Ecoinvent V3 contains an extensive database of manufacturing processes (injection moulding, blow moulding, tube extrusion, film extrusion etc) which can be selected and further adjusted (e.g. the tonnage/size of IM machines, cycle time) to that used. The environmental impact of the energy and water usage as well as any bi-products are considered when assigning a score.

Although excluded from the following LCAs, transportation from manufacturing site to subsidiaries, distribution centres or customers can be included. A score is assigned based on the environmental impact of the method of transport (exact vehicle emissions) and distance travelled.

The end-of-life of the product is also assessed, via determination of the disposal method, incineration or landfill.

Output can be in the form of a single environmental impact score, given in milli-eco-points (mPt) or further divided into individual impact categories, each with their own relevant units. These categories are explored in more detail below.

Products

Clearlite Anaesthetic Face Mask

Product code: 7294000
Description: Adult Size 4, green seal, 22F Face mask
Manufacturing process: two shot injection moulding
End of life disposal: Incineration
Sterilisation: N/A
Transportation: N/A

Material data:

Component	Material	Weight (g)
Shell	PP	8.4
Cushion	Colour Masterbatch	0.131
	TPE	8.7
Hook ring	PP	1.48

Economy Anaesthetic Face Mask

Product code: 1515000
Description: Medium adult size 4, 22F Face mask
Manufacturing process: two shot injection moulding
End of life disposal: Incineration
Sterilisation: N/A
Transportation: N/A

Material data:

Component	Material	Weight (g)
Cushion	PVC	9.51
Shell	PVC	24.2
Hook ring	PE	1.844

Methodology

Once the inventory data has be inputted into the LCA software, environmental impact data can be calculated. This stage is called the Life Cycle Impact Assessment (LCIA). The results are separated into 'impact categories' which show how the product affects different environmental components. Common impact categories include Global Warming, Ozone Depletion, Acidification, Human Toxicity, etc. Each impact category is quantified using different units (e.g., Global warming is measure in Kg CO_2 eq as Global warming potential is most commonly referred to relative to the emissions of CO_2). Higher results for each impact category therefore indicate a greater environmental impact as a higher reference unit of emissions is said to have entered the environment.

Certain reference units may have a more substantial impact on the overall environment than others which is why you are not able to solely compare figures from one category to another but can compare different LCA results for each category.

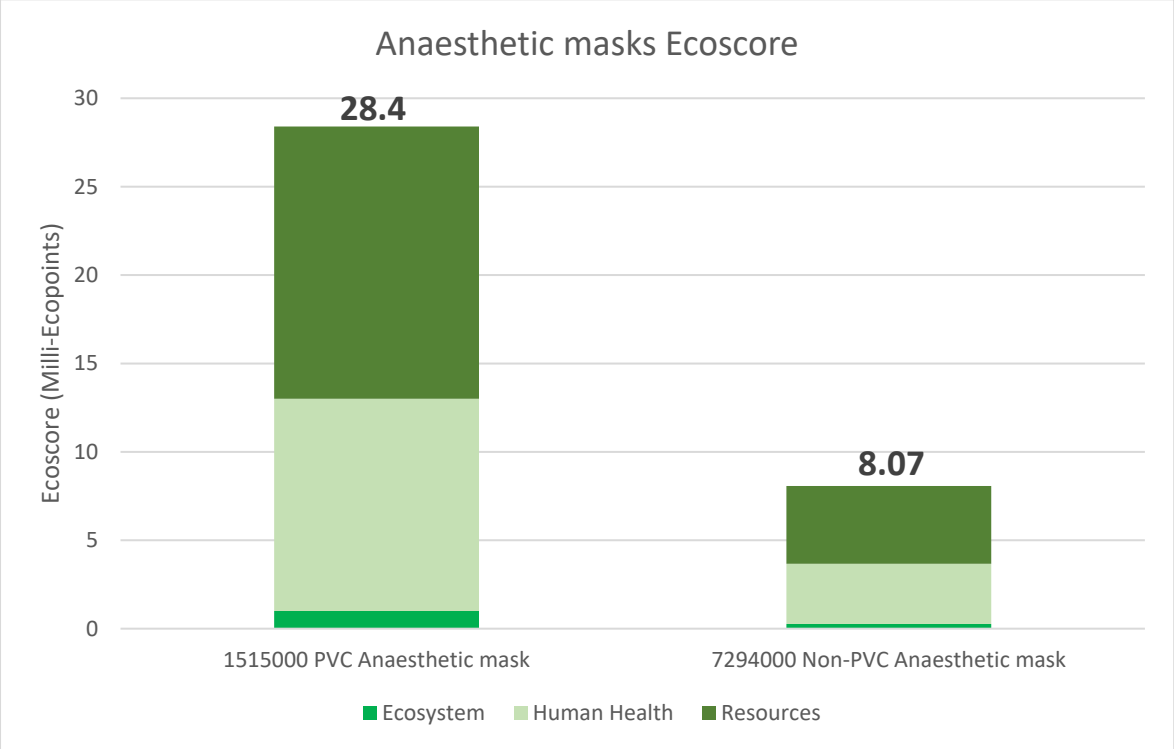
In order to get an overall comparison of products (i.e., an 'EcoScore') the relative impact of each impact category can be multiplied by its 'weighting factor'. How impactful each of the

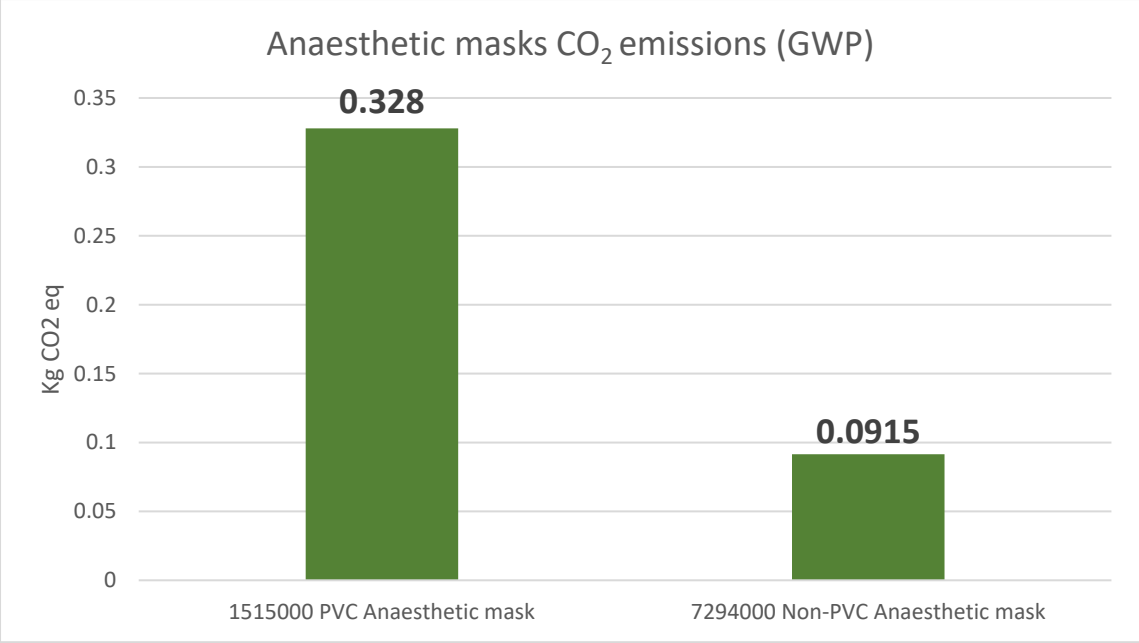
categories are, is determined by environmental governing agencies and scientific research groups which is then collectively agreed on by overseeing bodies and followed according to international standards (for example the ISO). Each methodology may have slightly different agreed weighting based on what impact the LCA is intended to be focused on. The main universally agreed upon methodologies at the moment include TRACI, CML, EcoIndicator, EDIP, ILCD, and ReCiPe. For this study, EcoIndicator and CML were chosen. EcoIndicator provides a 'single score' function which generates an overall EcoScore allowing a quick and simple comparison between the two masks. CML was used for the more thorough breakdown of each impact category to see where further comparisons can be made.

LCA Results

Overall EcoScore for 7294000 (non-PVC) - **8.07mPt**
CO_2 emissions (GWP) - **0.0915 Kg CO_2 eq**

Overall EcoScore for 1515000 (PVC) - **28.4mPt**
CO_2 emissions (GWP) - **0.328 Kg CO_2 eq**



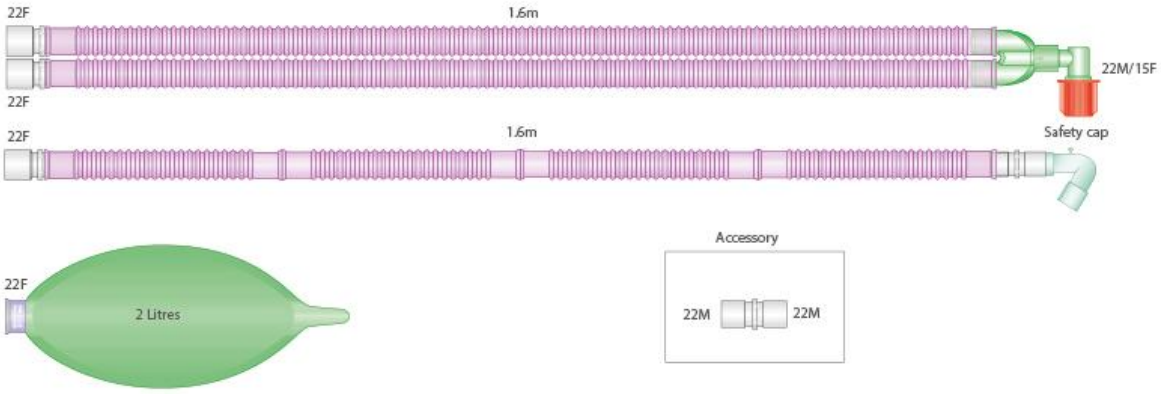


Packaging

Packaging is excluded from the above scores. LCAs have been carried out on the LDPE packaging films. The EcoScore for both packs is **3.3mPt, CO_2 emissions (GWP) 0.033Kg CO_2 eq.**

Product

22mm Flextube Silver Knight™ anti-microbial breathing system for use with Aisys®, Avance® and Aespire® Carestation® with 2L bag, and limb, ≥1.6m 22mm Eco Smoothbore breathing system ≥ 1.6m



Product code: 2010111
Manufacturing process: tubing – extrusion, reservoir bag – blow moulding, connectors, Y-piece, cap, elbow – injection moulding
End of life disposal: Incineration
Sterilisation: N/A
Transportation: N/A

Material data:

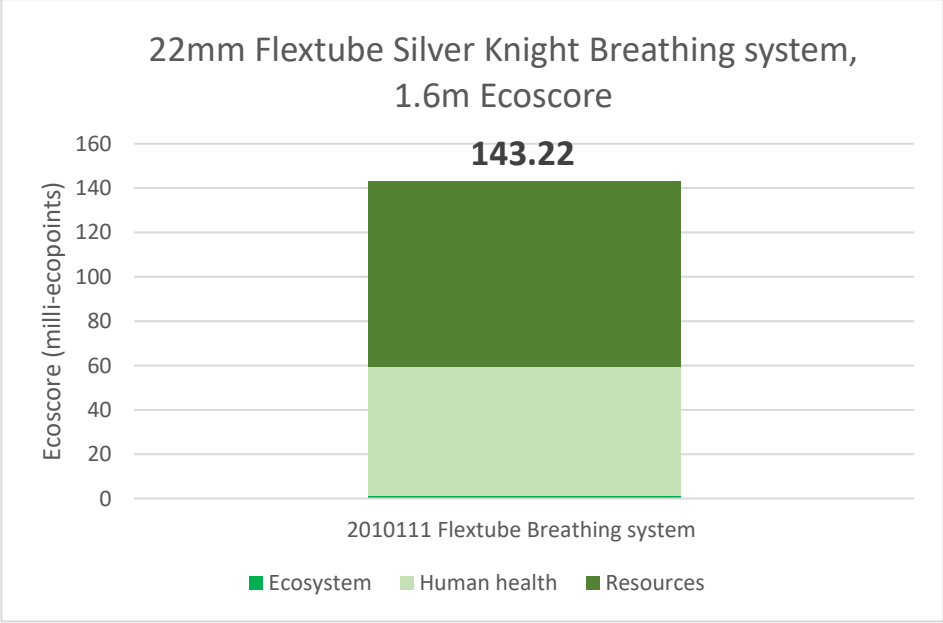
Component	Subassembly	Material	Weight (g)
Flextube	Y piece (0612)	PP + LDPE	12.97

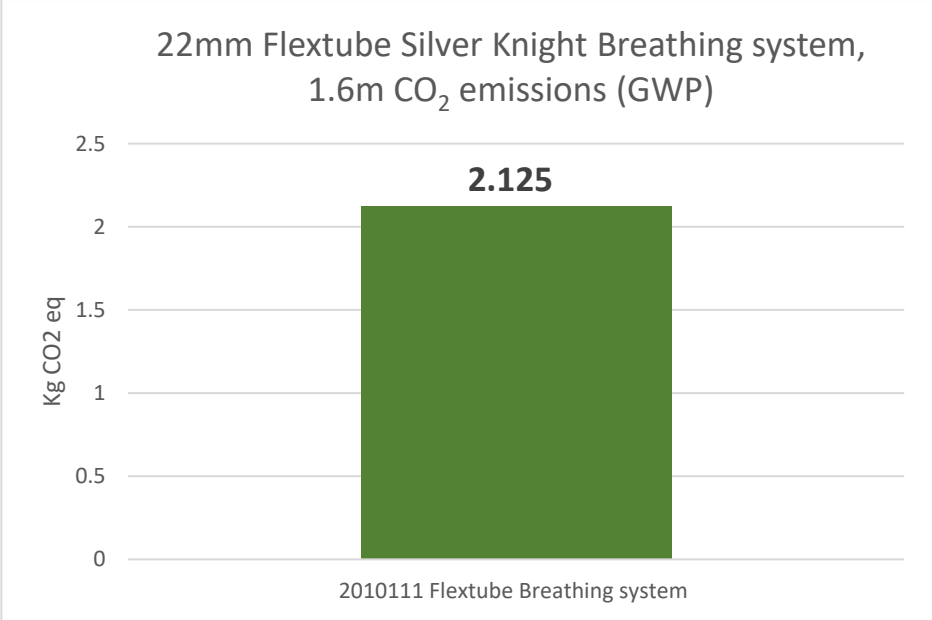
	22M-22M Connectors (6252)	PP	6.16
	22M-22F Connectors (7285)	PP	16.72
	Tubing	LDPE	163.2
	Safety Cap (0370)	HDPE	4.26
2L Reservoir Bag 2420506	Reservoir Bag (5646)	TPE	44.99
	Bag mount connector (6199)	PP	5.64
Elbow	15M-15M Elbow (0360)	SB	6.77
1.6m Extra Limb 2002505	Tubing	LDPE	88.09
	Connectors (7285)	PP	16.72

LCA Results

Overall Ecoscore - **143.22 mPt**

CO_2 emissions (GWP) - **2.125 kg CO_2**





SDC 4: An example of life cycle assessments performed for individual anaesthetic equipment

Operative Phase	DIEP kgCO2eq	Implant kgCO2eq.
Overall	233.96	48.80
Preoperative consultation total	15.46	6.12
Preoperative total	25.68	13.67
Intraoperative total	192.61	28.58
Immediate postoperative total	0.21	0.43

SDC 5: Variation between DIEP and implant-based reconstruction by operative phase