ELECTRONIC SUPPLEMENTARY MATERIAL

Environmental impact of single use and reusable items in central venous catheter insertion kits - a life cycle assessment

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Method

Life Cycle Assessment methodology is a quantitative method which compare environmental impacts throughout a product's entire life, from extraction of raw material to disposal based on four steps (i) goal and scope, (ii) inventory of material and processes, (iii) impact assessment, and (iv) interpretation of results including sensitivity and uncertainty analyses [1].

Goal and Scope

We compared three different kits containing items used for central venous catheter (CVC) insertions, using input data from Helsingborg Hospital in southern Sweden. In clinical practice, several additional items are used for CVC insertion but for the purpose of this analysis we only included items for which both single use and reusable alternatives were available (Table S1). The functional unit for comparison was set to 1 CVC insertion. The existing infrastructure was not included in the analysis. This means that, for example, the environmental effects of transport by lorry were included in the analysis but the environmental effects of the production of the lorry was outside the system boundaries. The lifespan of reusable metal items was based on information provided by the staff at Helsingborg Hospital. The reusable metal bowl included in the set is virtually indestructible but for the purposes of the analysis it was assumed to have the same life span as the other reusable metal objects. The lifespan of the reusable sterile surgical gown and reusable sterile surgical drape were assumed to have a life span of 70 cycles based on information from the laundry facility. The primary analysis was based on 300 reuses for the metal items and 70 reuses for the textile items.

Life cycle inventory

The life cycle analysis was performed using the software SimaPro version 9.2.0.2. The Ecoinvent 3.6 database [6] was used for data concerning the environmental impact of materials, processes, and transports. The weight of all single use components and the reusable metal items was established using a scale with a precision of ± 1 g. Transport distances were estimated using Google Maps, assuming the shortest way. For the final disposal, the waste treatment was modelled as average Swedish municipal waste by incineration.

The single use items were modelled based on information provided by the supplier. Following production, the single use products were transported from their country of origin to Denmark for packaging. The complete single use kits were then transported to the national distributor in Kungsbacka, Sweden, before being transported to Helsingborg Hospital. The products were transported to the local waste disposal facility for incineration after use (Table S2).

The reusable metal items were modelled based on information provided by the suppliers. Transport included the distance between country of origin to the national distributors in Alingsås or Partille before being transported to Helsingborg Hospital. As Helsingborg Hospital does not use any sterile reusable textiles, the model was based on information collected from the laundry facility in the neighbouring county, Region Västra Götaland. After use, the reusable needle holder, scissor, metal bowl and haemostatic forceps were assumed to be prewashed and transported to the sterile technical unit for subsequent sterilization. Energy and water consumption in the sterilization process was based on information provided by the manufacturer of the autoclave and washer disinfector. The energy mix used in the primary analysis is specific for the distribution in Sweden and consist of approximately 40% nuclear power, 40% hydro power, 10% wind power, and 10% thermal power [7]. The reusable items used for 1 central venous insertion takes up to 1.7% of the space in the autoclave and up to

6.7% of the space in the washer disinfector. Data concerning the energy and water consumption in the laundry process was obtained from the closest laundry capable of washing and sterilizing textiles, located in Alingsås, Sweden. Transport between the laundry facility and back to Helsingborg Hospital was included in the analysis (Table S3).

Life cycle impact assessment

The environmental impact of the three kits were assessed using the life cycle impact assessment method IMPACT 2002 +. With this method, the environmental impact was assessed for 15 midpoint categories and the collective downstream effect on four endpoints was then estimated. The four endpoints are resources (MJ Primary), referring to the total amount of extracted non-renewable energy; Climate change (kg CO_2eq), referring to the climate effect of carbon dioxide equivalents emitted into the air over 100 years; Ecosystem quality (PDF*m^2*yr), referring to potentially disappeared fraction of species per square meter during a year and; Human health (DALY/person/yr), referring to disability adjusted life years per person and year [8, 9].

Life Cycle Costing

Life Cycle Costing (LCC) was performed to assess the direct financial costs of each system. The financial comparison, like the environmental assessment, only included the items that differ between the three kits (Table S1). Costs for purchase and disposal of the items were included in the analysis. For the reusable items costs of laundry and sterilization was included. Repair costs for reusable items were not included in the analysis since it occurs after approximately 100-750 cycles and thus assumed to be negligible [2,4]. Assumptions and sources of information is specified in Table S4.

Sensitivity analyses

As single use scissors made from metal has previously been suggested to have a higher impact than comparable single use scissors made from plastic [2], we performed a sensitivity analysis to test the results robustness when using a single use scissor and needle holder made from plastic instead of metal (Table S2). To test the model's sensitivity to the choice of electricity mix in the sterilization and laundry process of the reusable metal items and reusable textiles, two sensitivity analyses were performed. One with a fossil intensive electricity mix exemplified by country specific data for Poland (76% hard coal and lignite, 14% renewable, 8% thermal gas, 2% nuclear) and one with a European average electricity mix (39% fossil fuel, 35% renewable energy, 26% nuclear) [10]. We performed a sensitivity analysis where the reusable metal items were sterilized at a remote location, using the same distance as for the transportation of textiles to the laundry facility, 520km. We performed a sensitivity analysis in which we increased the allocation of water and electricity used in the sterilization process by 50% to simulate a model which includes standby time and accessory loads [11]. We performed a sensitivity analysis where the reusable surgical textiles were modelled using a 50/50 cotton-polyester blend as this is an alternative to the 100% polyester used in our primary model. In previous life cycle assessments possible reuses of reusable metal instruments have varied between 300 and 3500 reuses [2-4] and possible reuses of surgical textiles can vary between 50-127 reuses [5], we therefor performed two sensitivity analyses, one analysis with 3500 reuses of the metal instruments and 127 reuses of the surgical textiles, and one analysis with 100 reuses of the metal instruments and 25 reuses of the surgical textiles for a scenario where items get misplaced. For these scenarios sensitivity analyses was performed also for the LCC analyses. Finally, we performed a sensitivity analysis to test the LCC results robustness regarding fluctuations in electricity prices, increasing the price per kWh 5-fold.

Statistics, uncertainty analysis

The Ecoinvent 3.6 database provides either an uncertainty range for each data point based on variation in sample data or, uncertainties based on a simplified standard procedure built into the database [12]. As previously described, Monte Carlo simulation was used to produce simulated 95% intervals between the 2.5th and 97.5th percentiles for each of the analysed kits on each impact category (n =1000) [13, 14]. Monte Carlo simulations were further used for dependent (paired) simulation to assess differences between the different kits [14, 15]. Differences are presented as median difference with a range between the 2.5th and the 97.5th percentiles (n =1000). As suggested previously, differences between the systems for which the 2.5th-97.5th percentile range did not cross 0 were considered to reflect true differences [16].

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Supplementary tables

Table S1 The components of the respective kits. Green cells contain reusable metal instruments and the textiles**.** The orange cells contain single use items. The grey cells contain single use items used for CVC insertions at Helsingborg Hospital which were not included in the analysis.

Kit with reusable instruments and reusable textiles (RR)	**Kit with reusable instruments and single use textiles (RS)**	**Kit with single use items (SS)**
Scissor, Mayo, 15 cm Needle holder, Hegar Haemostatic forceps, 18 cm Metal bowl, B6	Scissor, Mayo, 15 cm Needle holder, Hegar Haemostatic forceps, 18 cm Metal bowl, B6	Scissor, Mayo, 14.5 cm (metal) Needle holder, Mayo-Hegar, 12 cm (metal) Haemostatic forceps, 19 cm (plastic) Bowl, 250 ml (plastic)
Sterile drape 80x230cm Sterile gown	Sterile drape, non-woven 100x150 cm Sterile gown XL, non-woven 150 cm	Sterile drape, non-woven 100x150 cm Sterile gown XL, non-woven 150 cm
Adhesive drape with aperture Dispension cannula Injection needle Syringe 10 ml Syringe 20 ml 10 Cotton balls Dressing Suture material Product packaging	Adhesive drape with aperture Dispension cannula Injection needle Syringe 10 ml Syringe 20 ml 10 Cotton balls Dressing Suture material Product packaging	Adhesive drape with aperture Dispension cannula Injection needle Syringe 10 ml Syringe 20 ml 10 Cotton balls Dressing Suture material Product packaging

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Table S2 Details of input data for the single use items used at Helsingborg Hospital. Material and process information for items in the original model was gathered from the manufacturer, Codan Triplus. Information on material for the plastic scissor and needle holder which was assessed in a sensitivity analysis was gathered from the manufacturers website, B Braun. Corresponding data from the ecoinvent 3.6 database was used as input in the software SimaPro for all material and processes.

Product	Material	Weight	Lifetime	Processes	Transportation	Assumptions
Single use items						
Scissor	Stainless steel	44 g	1	Metalworking	Euro5-lorry: 30 kg.km Ferry: 0.82 kg.km	Place of origin = Lenshan, Germany
Needle holder	Stainless steel	22 g	1	Metalworking	Euro5-lorry: 15 kg.km Ferry: 0.41 kg.km	Place of origin = Lenshan, Germany
Haemostatic forceps	Polypropylene (70 %) and glass fibre (30 %)	17 g	1	Injection moulding	Euro5-lorry: 12 kg.km Ferry: 0.32 kg.km	Place of origin = Lenshan, Germany
Bowl	Polypropylene	11 g	1	Injection moulding	Euro5-lorry: 7.6 kg.km Ferry: 0.21 kg.km	Place of origin = Lenshan, Germany
Perioperative drape, non-woven 100x150 cm	Polyethylene and viscose	84 g	1	Extrusion of plastic sheets	Euro5-lorry: 58 kg.km Ferry: 1.57 kg.km	Assumed to contain 70 % polyethylene and 30 % viscose. Place of origin = Lenshan, Germany
Perioperative gown, non-woven 150 cm	Polyester reinforced with Cellulose	209 g	1	Extrusion of plastic sheets	Euro5-lorry: 145 kg.km Ferry: 3.91 kg.km	Assumed to contain 100% polyester due to lack of data for cellulose. Place of origin = Lenshan, Germany
Scissor	Nylon (93%) and stainless steel (7%)	15 g	1	Injection moulding	Euro5-lorry: 9.69 kg.km Ferry: 0.26 kg.km	Used for sensitivity analysis. Material and weight adjusted but place of origin remained.
Needle holder	Nylon (93%) and stainless steel (7%)	15 g	1	Injection moulding	Euro5-lorry: 9.69 kg.km Ferry: 0.26 kg.km	Used for sensitivity analysis. Material and weight adjusted but place of origin remained.

Table S3 Details of input data for the reusable items and sterilization and laundry processes. Reusable instruments at Helsingborg Hospital used for central venous insertions. Material and process information for the reusable metal items was gathered from the manufacturer, Rudolf Medical. Material for the reusable textiles was based on information from the laundry facility in the neighbouring county, Region Västra Götaland. Corresponding data from the ecoinvent 3.6 database was used as input in the software SimaPro for all material and processes.

Products	Material	Weight	Lifetime	Processes	Transportation	Assumptions
Reusable items						
Scissor	Stainless steel	26 g	300-3500	Metalworking, sterilization	Euro5-lorry: 42 kg.km Ferry: 0.49 kg.km	Place of origin = Fridingen, Germany
Needle holder	Stainless steel	49 g	300-3500	Metalworking, sterilization	Euro5-lorry: 80 kg.km Ferry: 0.92 kg.km	Place of origin = Fridingen, Germany
Haemostatic forceps	Stainless steel	42 g	300-3500	Metalworking, sterilization	Euro5-lorry: 68 kg.km Ferry: 0.79 kg.km	Place of origin = Fridingen, Germany
Metal bowl	Stainless steel	105 g	300-3500	Metalworking, sterilization	Euro5-lorry: 171 kg.km Ferry: 1.96 kg.km	Place of origin = Fridingen, Germany
Perioperative drape	Polyester	295 g	50-127	Weaving synthetic fibre, laundry	Euro5-lorry: 412 kg.km Ship: 4120 kg.km or Euro5-lorry: 412 kg.km	Material and weight are based on information from Region Västra Götaland and Place of origin = China.
Perioperative gown	Polyester	310 g	50-127	Weaving synthetic fibre, laundry	Euro5-lorry: 826 kg.km Ship: 8260 kg.km or Euro5-lorry: 826 kg.km	Material and weight are based on information from Region Västra Götaland. Place of origin = China.
Perioperative drape	Polyester (50%) Cotton (50%)	295 g	50-127	Weaving synthetic fibre, laundry	Euro5-lorry: 412 kg.km Ship: 4120 kg.km or Euro5-lorry: 412 kg.km	Material and weight are based on information from Region Västra Götaland and Place of origin = China.
Perioperative gown	Polyester (50%) Cotton (50%)	310 g	50-127	Weaving synthetic fibre, laundry	Euro5-lorry: 826 kg.km Ship: 8260 kg.km or Euro5-lorry: 826 kg.km	Material and weight are based on information from Region Västra Götaland. Place of origin = China.
Cleaning						
Sterilization (autoclave + washer-disinfector)	Tap water	4.4 kg + 7.3 kg				Wastewater treated as European (without Switzerland) average
	Deionised water	0.29 kg + 2 kg				Wastewater treated as European (without Switzerland) average
	Processes			Electricity 0.2 + 0.43 kWh		Medium voltage Swedish electricity mix
Laundry	Deionised water	8047 g				Input for laundry of 1 drape and 1 gown. Wastewater treated as European average
	Processes			Electricity 1.51 kWh	Euro5-lorry: 315 kg.km	Input for laundry of 1 drape and 1 gown. Medium voltage Swedish electricity mix. Transport is between Helsingborg hospital and laundry facility in Alingsås.

Table S4. Specification of total cost calculation. The costs included in the respective product systems, purchase prices and price for sterilization (if applicable). The total cost is based on the functional unit of 1 procedure. Prices for each item were acquired from Helsingborg hospital together with information on average salary for the staff which handles the instruments. Prices for water and electricity was based on the annual average in Sweden for the year of 2020. Conversion of the prices in Swedish krona to Sterling Pound, Euro, and US dollar was based on exchange rates on the 30th of mars 2022 (1sek = €0.097, £0.082, $0.11).

Single use kit (SS)					
Product/service	**Unit**	**Unit price, € (£/$)**	**Amount**	**Allocation**	**Cost, € (£/$)**
Scissor, Mayo 14.5 cm	/piece	1.15 (0.97/1.3)	1	100%	1.2 (1.01/1.15)
Needle holder, Mayo-Hegar 12 cm	/piece	1.56 (1.3/1.77)	1	100%	1.6 (1.35/1.53)
Haemostatic forceps, 19 cm	/piece	0.34 (0.29/0.39)	1	100%	0.3 (0.25/0.34)
Bowl, 250 ml	/piece	0.20 (0.17/0.23)	1	100%	0.2 (0.17/0.23)
Surgical gown	/piece	4.61 (3.9/5.23)	1	100%	4.6 (3.89/5.22)
Surgical drape	/piece	0.89 (0.75/1.01)	1	100%	0.9 (0.76/1.02)
Waste management	/kg	1.13 (0.96/1.28)	0.387	100%	0.44 (0.37/0.50)
Transport [a]	-	-	-	-	-
Total cost					€9.2 (£7.8/$10.4)
Kit with reusable metal items and single use textiles (RS)					
Product/service	**Unit**	**Unit price, € (£/$)**	**Amount**	**Allocation**	**Cost, € (£/$)**
Scissor, Mayo 15 cm	/piece	7.8 (6.6/8.8)	1	0.3%	0.02 (0.02/0.02)
Needle holder, Hegar	/piece	90 (76/102)	1	0.3%	0.27 (0.23/0.31)
Haemostatic forceps, 18 cm	/piece	51 (43/58)	1	0.3%	0.15 (0.13/0.17)
Bowl, B6	/piece	4.6 (3.9/5.2)	1	0.3%	0.01 (0.01/0.01)
Surgical gown, single use	/piece	4.6 (3.9/5.2)	1	100%	4.6 (3.9/5.2)
Surgical drape, single use	/piece	0.9 (0.8/1.0)	1	100%	0.9 (0.8/1.0)
Autoclave purchase and service	/cycle	19 (16/21.5)	1	1.7%	0.31 (0.26/0.35)
Tap water autoclave	/litre	0.004 (0.003/0.005)	262	1.7%	0.02 (0.02/0.02)
RO water autoclave	/litre	0.25 (0.21/0.28)	17.5	1.7%	0.07 (0.06/0.08)
Electricity autoclave	/kWh	0.09 (0.08/0.1)	12.3	1.7%	0.02 (0.02/0.02)
Washer-disinfector purchase	/cycle	8.4 (7.1/9.5)	1	6.7%	0.56 (0.47/0.64)
Tap water washer-disinfector	/litre	0.004 (0.003/0.005)	110	6.7%	0.03 (0.03/0.03)
RO water washer-disinfector	/litre	0.25 (0.21/0.28)	30	6.7%	0.47 (0.4/0.53)
Electricity washer-disinfector	/kWh	0.09 (0.08/0.1)	6.5	6.7%	0.04 (0.03/0.05)
Labour cost sterilization process	/minute	0.48 (0.41/0.54)	2	100%	0.97 (0.82/1.1)
Treatment biological waste	/kg	1.13 (0.96/1.28)	0.515	100%	0.58 (0.49/0.66)
Transport [a]	-	-	-	-	-

Total cost					€9.1 (£7.7/$10.3)
Kit with reusable metal items and reusable textiles (RR)					
Product/service	**Unit**	**Unit price, € (£/$)**	**Amount**	**Allocation**	**Cost, € (£/$)**
Scissor, Mayo 15 cm	/piece	7.8 (6.6/8.8)	1	0.3%	0.02 (0.02/0.02
Needle holder, Hegar	/piece	90 (76/102)	1	0.3%	0.27 (0.23/0.31)
Haemostatic forceps, 18 cm	/piece	51 (43/58)	1	0.3%	0.15 (0.13/0.17)
Bowl, B6	/piece	4.6 (3.9/5.2)	1	0.3%	0.01 (0.01/0.01)
Surgical gown	/piece	19 (16/21.5)	1	2%	0.38 (0.32/0.43)
Surgical drape	/piece	19 (16/21.5)	1	2%	0.38 (0.32/0.43)
Autoclave purchase and service	/cycle	19 (16/21.5)	1	1.7%	0.31 (0.36/0.35)
Tap water autoclave	/litre	0.004 (0.003/0.005)	262	1.7%	0.02 (0.02/0.02)
RO water autoclave	/litre	0.25 (0.21/0.28)	17.5	1.7%	0.07 (0.06/0.08)
Electricity autoclave	/kWh	0.09 (0.08/0.1)	12.3	1.7%	0.02 (0.02/0.02)
Washer-disinfector purchase	/cycle	8.4 (7.1/9.5)	1	6.7%	0.56 (0.47/0.64)
Tap water washer-disinfector	/litre	0.004 (0.003/0.005)	110	6.7%	0.03 (0.03/0.03)
RO water washer-disinfector	/litre	0.25 (0.21/0.28)	30	6.7%	0.47 (0.4/0.53)
Electricity washer-disinfector	/kWh	0.09 (0.08/0.1)	6.5	6.7%	0.04 (0.03/0.05)
Labour cost sterilization process	/minute	0.48 (0.41/0.54)	2	100%	0.97 (0.82/1.1)
Laundry cost	/kg textile	0.13 (0.11/0.15)	1	61%	0.08 (0.07/0.09)
Detergent [a]	-	-	-	-	-
Softener [a]	-	-	-	-	-
Labour cost laundry	/minute	0.48 (0.41/0.54)	2	100%	0.97 (0.82/1.1)
Treatment biological waste	/kg	1.13 (0.96/1.28)	0.841	100%	0.95 (0.8/1.08)
Transport [a]	-	-	-	-	-
Total cost					€5.7 (£4.8/$6.5)

[a] Cost for transport, detergent, and softener were excluded for all systems as the total cost were close to zero.

Table S5 Cost comparison. Total cost for each of the kits for the original model and sensitivity analyses. Conversion of the prices in Swedish krona to Sterling Pound, Euro, and US dollar was based on exchange rates on the 30th of mars 2022 (1sek = €0.097, £0.082, $0.11).

	Single use kit, € (£/$)	Kit with reusable metal items and single use items, € (£/$)	Kit with reusable metal items and reusable textiles, € (£/$)
Original model	€9.2 (£7.8/$10.4)	€9.1 (£7.7/$10.3)	€5.7 (£4.8/$6.5)
100 and 25 reuses of reusable metal items and textiles	€9.2 (£7.8/$10.4)	€10.1 (£8.5/11.4)	€6.7 (£5.7/$7.6)
3500 and 127 reuses of reusable metal items and textiles	€9.2 (£7.8/$10.4)	€8.6 (£7.3/$9.6)	€5.2 (£4.4/$59)
5-fold electricity price	€9.2 (£7.8/$10.4)	€9.3 (£7.6/$10.5)	€6.1 (£5.1/$6.9)

Table S6. Midpoint category results on fifteen midpoint categories. The median environmental impacts of single use instruments and single use textiles (SS), reusable instruments and reusable textiles (RR), and reusable instruments and single use textiles (RS). Presented as median with 2.5th to 97.5th percentiles in parentheses. In the shaded columns, the median differences between two alternatives are presented with 2.5th to 97.5th percentiles. A true difference was assumed between two alternatives if the 2.5th to 97.5th percentile range is located either above or below 0. Difference is represented by green shaded cells, no difference by orange shaded cells.

Impact category unit	**SS**	**RR**	**RS**	**SS minus RR**	**SS minus RS**	**RS minus RR**
Mineral extraction MJ surplus	1.1 (0.8-1.4)	0.023 (0.019-0.028)	0.06 (0.03-0.1)	1.05 (0.8-1.4)	1 (0.8-1-3)	0.03 (0.02-0.08)
Non-renewable energy MJ primary	40 (36-45)	14 (9-22)	34 (31-40)	26 (18-31)	6 (3-7)	20 (14-25)
Global warming kg CO2 eq	2.3 (2.1-2.7)	0.24 (0.22-0.26)	1.7 (1.5-2.1)	2.1 (1.9-2.5)	0.63 (0.56-0.71)	1.5 (1.3-1.9)
Aquatic eutrophication kg PO4 P-lim	$4x10^{-4}$ ($2.8x10^{-4}$-$7.7x10^{-4}$)	$1.2x10^{-4}$ (9.4E-5-$1.7x10^{-4}$)	$2.9x10^{-4}$ ($2.1x10^{-4}$-$5.5x10^{-4}$)	$2.8x10^{-4}$ ($1.7x10^{-4}$-$6.1x10^{-4}$)	$1.2x10x^{-4}$ ($5.6x10^{-5}$-$2.4x10^{-4}$)	0.000168 (0.0001-0.0004)
Aquatic acidification kg SO2 eq	0.07 (0.05-0.09)	0.0018 (0.0016-0.0021)	0.008 (0.007-0.011)	0.065 (0.051-0.086)	0.06 (0.04-0.08)	0.006 (0.005-0.01)
Land occupation m2org.arable	1.28 (0.7-2.5)	0.13 (0.11-0.16)	0.22 (0.16-0.35)	1.2 (0.6-2.1)	1 (0.5-2.2)	0.1 (0.04-0.23)
Terrestrial acid-/nutrification kg SO2 eq	0.11 (0.09-0.14)	0.006 (0.005-0.007)	0.03 (0.02-0.05)	0.10 (0.08-0.13)	0.08 (0.06-0.1)	0.03 (0.02-0.05)
Terrestrial ecotoxicity kg TEG soil	233 (82-390)	49 (19-93)	79 (30-147)	180 (46-316)	149 (46-257)	30 (-0.685-72)
Aquatic ecotoxicity kg TEG water	682 (430-1000)	283 (193-448)	302 (209-466)	390 (129-703)	378 (177-614)	13.6 (-69-116)
Respiratory organics kg C2H4 eq	0.002 (0.0016-0.0023)	$1.21x10^{-4}$ ($1x10^{-4}$-$1.5x10^{-4}$)	0.0016 (0.0013-0.0019)	0.0018 (0.0015-0.0021)	$3.7x10^{-4}$ ($2.9x10^{-4}$-$5x10^{-4}$)	0.0014 (0.0012-0.0018)
Ozone layer dep. kg CFC-11 eq	$1.4x10^{-7}$ ($1.1x10^{-7}$-$2.3x10^{-7}$)	$1.2x10^{-7}$ ($8.5x10^{-08}$-$1.6x10^{-7}$)	$1.3x10^{-7}$ ($9.8x10^{-8}$-$2x10^{-7}$)	$3x10^{-8}$ ($-1.9x10^{-8}$-$1x10^{-7}$)	$1.4x10^{-8}$ ($-9.9x10^{-10}$-$4x10^{-8}$)	$1.6x10^{-8}$ ($-1.6x10^{-8}$-$6.4x10^{-8}$)
Ionizing radiation Bq C-14 eq	14 (8-55)	67 (40-244)	29 (18-109)	-53 (-247-(-33))	-15 (-57-(-9))	-39 (-139-(-23))
Respiratory inorganics kg PM2.5 eq	0.008 (0.007-0.01)	$3.2x10^{-4}$ (2.8 $x10^{-4}$-$3.7x10^{-4}$)	0.0019 (0.0016-0.0025)	0.0076 (0.0063-0.0095)	0.006 (0.005-0.008)	0.0015 (0.0013-0.0022)
Non-carcinogens kg C2H3Cl eq	0.09 (0.05-0.16)	0.02 (0.012-0.038)	0.05 (0.03-0.1)	0.07 (0.04-0.14)	0.04 (0.02-0.08)	0.03 (0.02-0.07)
Carcinogens kg C2H3Cl eq	0.1 (0.08-0.13)	0.005 (0.004-0.008)	0.05 (0.04-0.08)	0.09 (0.08-0.12)	0.04 (0.03-0.05)	0.05 (0.04-0.07)

MJ Surplus = MJ additional energy needed for future extraction; MJ Primary = MJ total primary non-renewable energy extracted; kg CO2eq = kg carbon dioxide into air; kg PO4 P-lim = kg orthophosphate as phosphorus into water; kg SO2 eq = kg sulphur dioxide into air; m2org.arable = m2 organic arable land; kg TEG soil = kg triethylene glycol into soil; kg TEG water = kg triethylene glycol into water; kg C2H4 = kg ethylene into air; kg CFC-11 = kg nitrous oxide into air; Bq C-14 = Bq radiocarbon/ carbon-14 into air; kg PM2.5 = kg particles with Ø > 2.5 µm; kg C2H3Cl = kg chloroethylene into air. Unit description adopted from Jolliet et al. (2003)

Supplementary figures

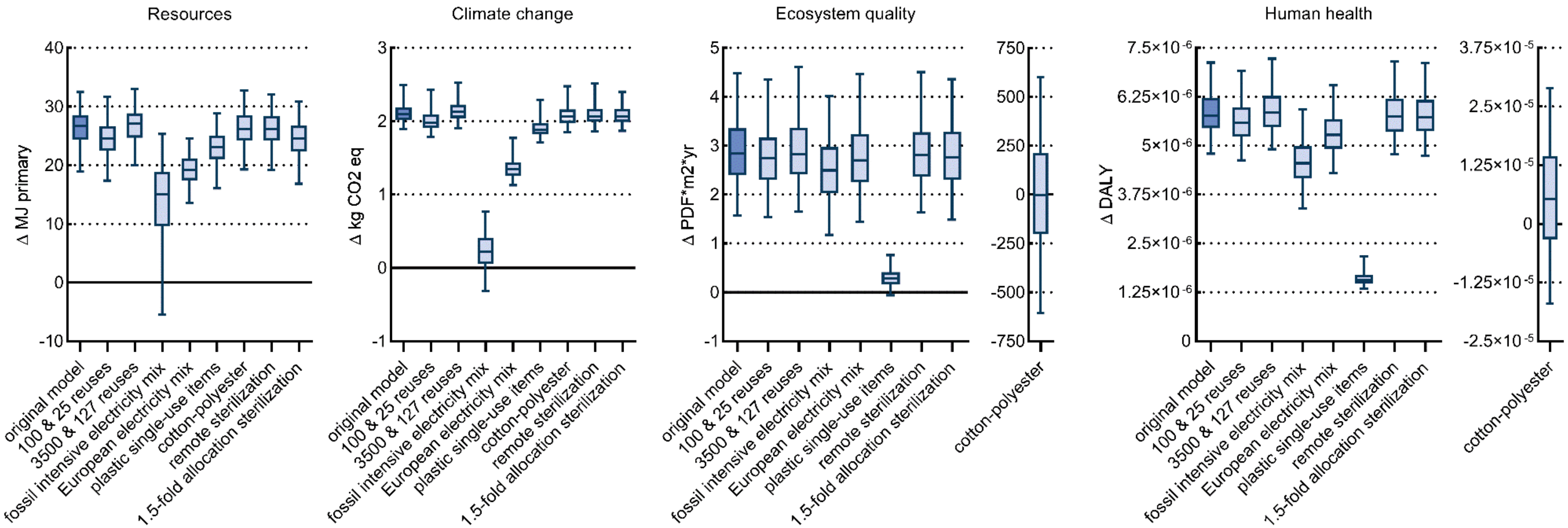

Fig S1. Difference between the single use kit and the kit containing reusable metal items and reusable textiles in the sensitivity analyses. The results of the primary analysis (dark blue) and the sensitivity analyses (light blue) in which the number of possible reuses for reusable items (changing to 100 or 3000 reuses for metal items and 25 or 127 reuses for textiles), the electricity mix (changing to European average or fossil intensive), the material for the single use scissor and needle holder (changing to plastic), the sterilization location (remote sterilization of metal items), the allocation in the sterilization process (increase by 50%), and the material of the reusable textile (changing to a 50/50 polyester-cotton blend) were altered. MJ Primary = total amount of extracted non-renewable energy. kg CO_2eq = the climate effect of carbon dioxide equivalents emitted into the air over 100 years. PDF*m^2*yr = potentially disappeared fraction of species per square meter during and year. DALY/person/yr = disability adjusted life years per person and year. Data are presented as median and the 2.5th to 97.5th percentiles. There is a difference between the two alternatives if the 2.5th percentile is ≥ 0 or the 97.5th percentile is ≤ 0. A positive value indicates that the single use kit had a higher impact.

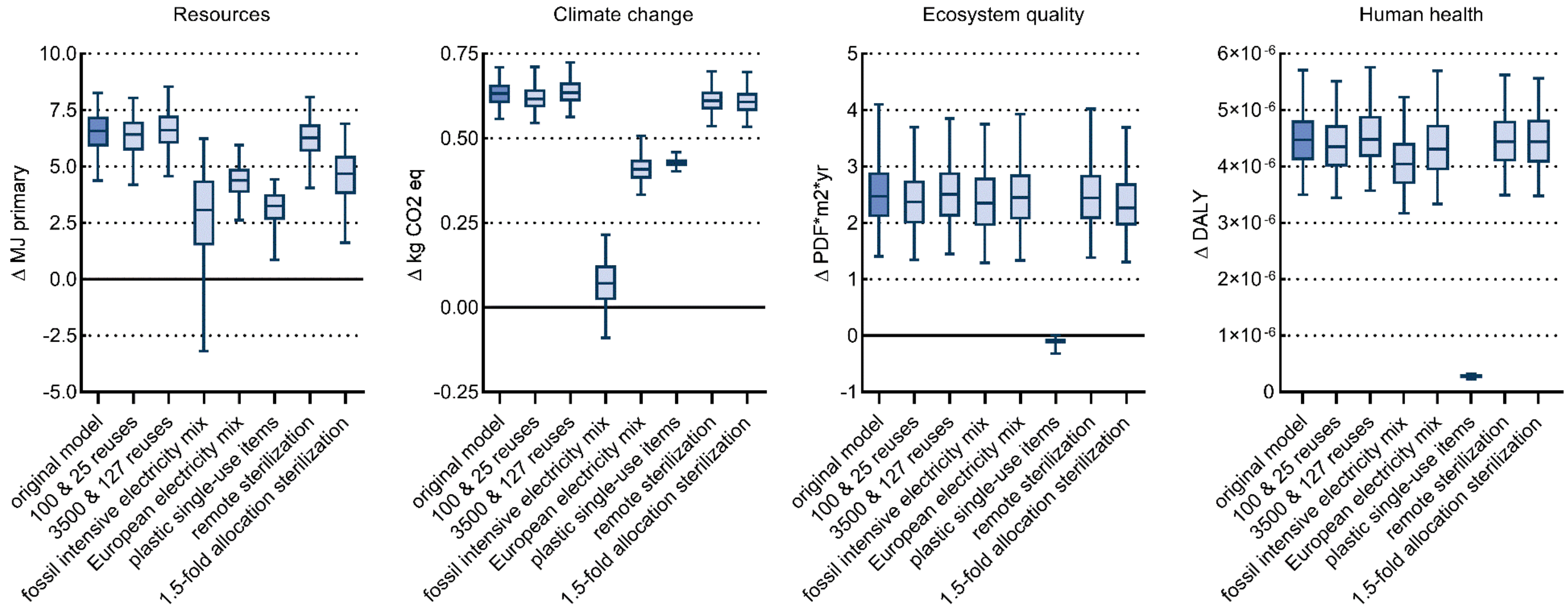

Fig S2. Difference between the single use kit and the kit containing reusable metal items and single use textiles in the sensitivity analyses. The results of the primary analysis (dark blue) and the sensitivity analyses (light blue) in which the number of possible reuses for reusable items (changing to 100 or 3000 reuses for metal items and 25 or 127 reuses for textiles), the electricity mix (changing to European average or fossil intensive), the material for the single use scissor and needle holder (changing to plastic), the sterilization location (remote sterilization of metal items), and the allocation in the sterilization process (increase by 50%) were altered. MJ Primary = total amount of extracted non-renewable energy. kg CO_2eq = the climate effect of carbon dioxide equivalents emitted into the air over 100 years. PDF*m^2*yr = potentially disappeared fraction of species per square meter during and year. DALY/person/yr = disability adjusted life years per person and year. Data are presented as median and the 2.5th to 97.5th percentiles. There is a difference between the two alternatives if the 2.5th percentile is ≥ 0 or the 97.5th percentile is ≤ 0. A positive value indicates that the single use kit had a higher impact.

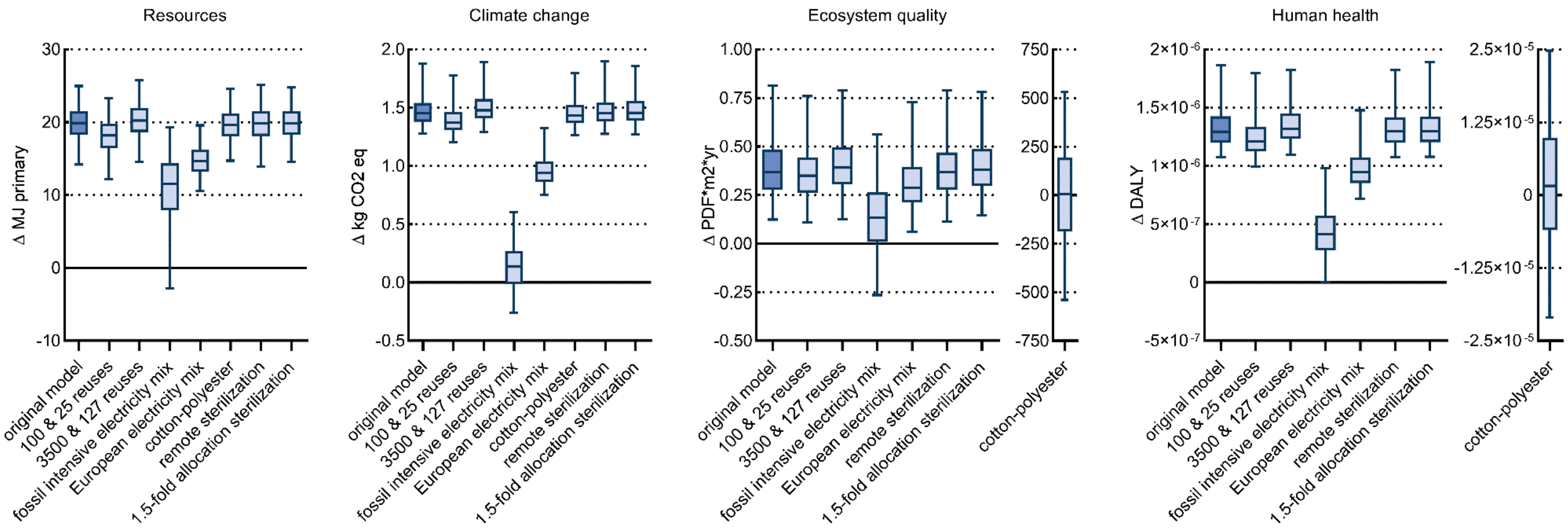

Fig S3. Difference between the kit containing reusable metal items and single use textiles and the kit containing reusable metal items and reusable textiles in the sensitivity analyses. The result of the primary analysis (dark blue) and the sensitivity analyses (light blue) in which the number of possible reuses for reusable items (changing to 100 or 3000 reuses for metal items and 25 or 127 reuses for textiles), the electricity mix (changing to European average or fossil intensive), the sterilization location (remote sterilization of metal items), the allocation in the sterilization process (increase by 50%), and the material of the reusable textile (changing to a 50/50 polyester-cotton blend) were altered. MJ Primary = total amount of extracted non-renewable energy. kg CO_2eq = the climate effect of carbon dioxide equivalents emitted into the air over 100 years. PDF*m^2*yr = potentially disappeared fraction of species per square meter during and year. DALY/person/yr = disability adjusted life years per person and year. Data are presented as median and the 2.5th to 97.5th percentiles. There is a difference between the two alternatives if the 2.5th percentile is ≥ 0 or the 97.5th percentile is ≤ 0. A positive value indicates that the kit with reusable metal items and single use textiles had a higher impact.

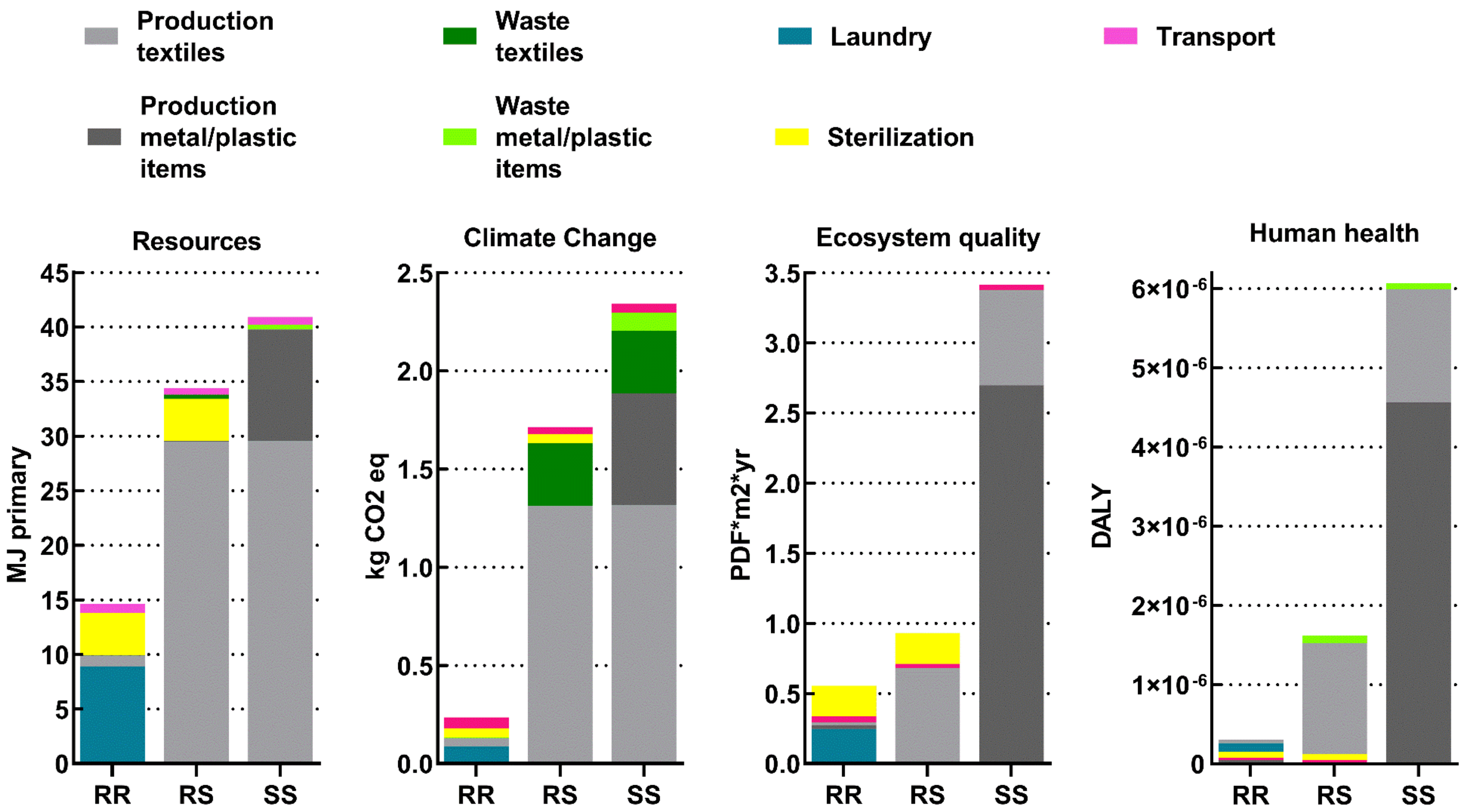

Fig S4. The contribution from production of instruments (dark grey), production of textiles (light grey), sterilization (yellow), laundry (blue), transport (pink), waste management metal/ plastic items (light green), and waste management textiles (dark green) to the impact on each endpoint category for the kit with reusable instruments and reusable textiles (RR), reusable instruments and single use textiles (RS), and the kit with single use instruments and single use textiles (SS). MJ Primary = total amount of extracted non-renewable energy. kg CO_2eq = the climate effect of carbon dioxide equivalents emitted into the air over 100 years. PDF*m^2*yr = potentially disappeared fraction of species per square meter during and year. DALY/person/yr = disability adjusted life years per person and year.