

Requirements for material logistics in a circular hospital

Design science research in academic hospitals Erasmus Medisch Centrum (Erasmus MC) & Leids Universitair Medisch Centrum (LUMC)

Data used: LCA studies, other management and academic literature, consultations with respondents (hospital employees from the two case hospitals, business offering solutions, experts by experience from some solutions), observations during consultations, archival documentation from the two case hospitals

SQ1: How can medical devices be captured in a typology based on what material logistics infrastructure elements are required when switching to a reusable version?

Types			Material logistics infrastructure elements and their requirements per type					
Reprocessing type	Internal/ external		Transport	Tracking and tracing	Reprocessing	Repair	Storage space	Point of collection space
T0	SU medical devices (no reprocessing)	-		Inventory levels, current location of unique medical devices, waste generated for separate streams	-	-	Central warehouse, decentral storage locations	Waste department for separate streams
T1	Light disinfection	Internal		-	Disinfection wipes, (enzyme bath), employees	-	Prolonged use (⇓⇓), reprocessing equipment (↑)	Prolonged use (⇓⇓), reprocessing equipment (↑)
T2	High-level disinfection	Internal		Unique medical device (and RER subparts) history: locations, #cycles	CSD, washing machines, PPE, packaging, employees	-	Reprocessing time (↑↑), reprocessing packaging (↑), other reprocessing equipment (↑)	More use cycles (⇓⇓), reprocessing equipment (↑)
T3		External		Unique medical device (and RER subparts) history: locations	-	-	Reprocessing time (↑↑↑)	More separate streams
T4	Steam sterilization	Internal		Unique medical device (and RER subparts) history: locations, #cycles, #repairs	CSD, washing machines, autoclaves, sterile packaging, PPE, employees	Repair equipment, employees	Reprocessing time (↑↑), sterile packaging: blue/tray wrap (↑) or sterile packaging: rigid sterilization containers (↑↑), other reprocessing equipment (↑)	More use cycles (⇓⇓), sterile packaging: rigid sterilization containers (⇓)
T5		External		Unique medical device (and RER subparts) history: locations	-	-	Reprocessing time (↑↑↑)	More separate streams
T6	Hydrogen peroxide sterilization	Internal		Unique medical device (and RER subparts) history: locations, #cycles, #repairs	CSD, washing machines, hydrogen peroxide gas plasma sterilizer, sterile packaging, PPE, employees	Repair equipment, employees	Reprocessing time (↑↑), sterile packaging (↑), other reprocessing equipment (↑)	More use cycles (⇓⇓)
T7		External		Unique medical device history: locations	-	-	Reprocessing time (↑↑↑)	More separate streams
T8	Reprocessing Scopes	Internal		Unique medical device (and RER subparts) history: locations, #cycles, #repairs	(CSD), scope reprocessor, scope drying machine, (hydrogen peroxide gas plasma sterilizer), (sterile) packaging, PPE, employees	Repair equipment, employees	Reprocessing time (↑↑), (sterile) packaging (↑), other reprocessing equipment (↑)	More use cycles (⇓⇓)
T9		External		Unique medical device history: locations	-	-	Reprocessing time (↑↑↑)	More separate streams
T10	Reprocessing medical textiles	External		Unique medical device history: locations	-	-	Reprocessing time (↑↑↑), thicker material (↑), prolonged use (⇓⇓)	More separate streams
T11	Reprocessing SU medical devices	External		Unique medical device history: locations	-	-	Reprocessing time (↑↑↑)	Lot more separate streams

Note. Material logistics requirements of elements from T1-T11 are compared to requirements of elements from T0. Additional requirements are explained with text, text in brackets = additional requirement might be needed. Expected changes in 'Storage space' and 'Point of collection space' requirements are indicated with arrows (⇓) and (↑), where more arrows indicate more space required, and the reason for the change is mentioned in text. When an element has no (additional) requirement, this is presented with -.

RQ: What are the alternative design solutions for the material logistics infrastructure in a circular hospital based on the typology?

#1. Tracking and tracing	#2. Storage space	#3. Reprocessing	#4 Transport
<p>Medical devices</p> <ul style="list-style-type: none"> Unique medical device barcodes (from GS1) for all medical devices in 2025 Use module to track unique medical device history (already exists inside ERP or Asset management system) More frequent scanning with every movement; use, reprocess, repair and/or RFID/BLE technology for automated tracking and tracing <p>Waste</p> <ul style="list-style-type: none"> Full-trackers on all waste bins to know what waste is created at what department 	<p>Not enough storage space/logistics employees?</p> <ul style="list-style-type: none"> Use a Warehouse Management System (together with solutions for tracking and tracing) change from manual 2-bin to automated order system for all medical devices optimize storage space pick medical devices that expire earlier first (avoid spillage) make sure everything fits in the racks (including alternatives) save on logistics employees 	<p>Not enough CSD employees?</p> <ul style="list-style-type: none"> Blue wrap packing robot R-Appit from R-solutions to save 1 FTE & 10% blue wrap RFID technology on sets/individual instrument to save on scanning <p>Not enough (CSD) space?</p> <ul style="list-style-type: none"> Switch from endoscope drying closets to endoscopic dryer Plasmabiotics from Plasmatyphoon to save space & time. Consider expanding the CSD or External reprocessing <p>Other savings on environmental impact</p> <ul style="list-style-type: none"> Switch from Blue wrap to Rigid sterilization containers or Reuse blue wrap before recycling 	<p>Not enough logistics employees?</p> <ul style="list-style-type: none"> Using AGV/AMR to save on employees is possible when: <ul style="list-style-type: none"> they can overtake each other they can communicate with elevators required movements on different times on the day are known (therefore first solutions for tracking and tracing)