



Final Project Submission Form

Health Service: Royal Children's Hospital

Title of project:

Rationalising the use of disposable pulse oximetry probes (d-POP) peri-operatively at the Royal Children's Hospital (RCH) – a sustainability quality improvement project

Department: Perioperative Department

Introduction

Provide a short introduction about yourself, your project, and why you were inspired to create sustainable environmental change in your department.

I am a PACU nurse within the Perioperative Department at the Royal Children's Hospital. In my role, I became increasingly aware of the significant volume of single-use equipment discarded daily, particularly disposable pulse oximetry probes.

Recognising that many perioperative practices have traditionally prioritised efficiency without fully considering environmental impact, I collaborated with multidisciplinary perioperative colleagues to develop a sustainable initiative aimed at reducing the environmental waste and financial burden associated with disposable pulse oximetry probes.

I was inspired to explore whether meaningful environmental change could be achieved in a practical, measurable way - without compromising patient safety or clinical standards. This project reflects my commitment to embedding sustainability into everyday perioperative practice while maintaining high-quality patient care.

What was the problem you tackled?

The frequent use and overuse of single-use disposable pulse oximetry probes in the operating theatre at RCH.

What was your SMART Goal?

To reduce disposable pulse oximetry probe usage in the Perioperative Department by 30% within one year without compromising patient safety or quality of monitoring.

What system factors contributed to the problem?

- Established clinical habits and culture.
- No consensus guideline on when to use disposable probes.

- No shared staff understanding of reasons to choose reusable versus disposable probes.
- Lack of environmental visibility.
- Procurement and supply systems.
- Limited staff education on sustainable practice.
- Workflow pressures in perioperative department.
- Absence of feedback or accountability measures.

Who were the key stakeholders?

Perioperative department:

- Pre-op and post-op nursing staff.
- Anaesthesia technicians / nurses.
- Anaesthetists.
- Perioperative Managers.
- Procurement / supply.

What was the intervention?

- Collected data on probe usage during the trial period through audits.
- Introduced education sessions.
- Trialled reusable probes in suitable patient cohorts.
- Monitored compliance and gathered staff feedback.
- Implemented revised probe selection guidelines.
- Developed an agreed guideline on which patients were suitable for a reusable probe.

What impacts/outcomes were measured? How did you measure them?

- Reviewed usage patterns and audited disposable probe usage prior to intervention and 6 months after implementation with a manual one-week snapshot audit of all perioperative patients.
- Estimated waste volumes generated by tracking procurement data and comparing usage against a baseline before the reduction initiative.
- Actual purchasing and associated costs were measured through liaison with the procurement team.
- Improved awareness was achieved through a combination of staff education sessions, informal discussions, in-service education and noticeboard communication.
- Staff feedback, both informal and through discussions during education sessions, provided insight into changes in decision-making and awareness.

What challenges did you face? What enablers facilitated the change? What were the learning points?

Challenges

- Cultural resistance to change.
- Habitual practice patterns – disposable probes had become routine. Shifting automatic behaviours required education, reminders and ongoing reinforcement.
- Data collection and measurement of d-POP usage required manual audit, as this information is not recorded in the electronic medical record (EMR). Compliance with completing the audit form proved challenging, largely due to decreased compliance / interest with audit. Embedding data collection within the EMR would likely improve accuracy, streamline the audit process and enhance compliance in future evaluations.

Enablers

- Multidisciplinary collaboration. Perioperative staff demonstrated strong enthusiasm for the change and quality improvement initiative through active participation in the education sessions, engagement in informal discussions and willingness to adopt new practices.
- Patient safety focus.
- Leadership support – support from perioperative leadership validated the initiative.
- Clear data and measurable outcomes.
- Alignment with organisational sustainability goals.

Learning points

- Small changes can have meaningful impact – significant waste and cost reduction.
- Sustainability and safety are not mutually exclusive – environmentally responsible practice can co-exist with high clinical standards.
- Engagement drives success – multidisciplinary team communication reduced resistance and fostered culture of shared responsibility.
- Nursing leadership matters – well positioned to identify inefficiencies and lead practical, system level improvements.
- Change requires persistence – ongoing reinforcement, auditing, and cultural normalisation.

What are the next steps with this project?

- Cost and waste savings of switching to reusable probes have been proven to be effective in the perioperative department, however we currently only stock adult sized reusable probes. Following a successful implementation of paediatric and infant reusable probes in the emergency department, there is interest in scaling this project to other areas of the hospital, including the perioperative department.
- Ongoing education to embed sustainable practice into routine care.
- Proposed broader hospital sustainability review of other single-use consumables.

Environmental sustainability: What were the carbon savings from your project? (Please include your raw data and calculations)

The carbon savings from this project are supported by multiple analyses. **Table 1: Life Cycle Analysis of Disposable Probes versus Reusable Probes** highlights that disposable probes have a higher environmental impact across most stages, including raw material use, packaging, transportation and waste generation. In contrast, reusable probes distribute their environmental cost over 300 - 500+ uses, significantly reducing per-use impact despite requiring cleaning and disinfection.

The difference is quantified in **Table 2: Carbon Footprint per use: Life Cycle Analysis Comparison of Disposable vs Reusable Pulse Oximetry Probes¹** which shows that a disposable probe generates approximately 0.15-0.16 kg CO₂e per use, compared to only 0.008-0.01 kg CO₂e per use for a reusable probe.

Building on this, **Table 3: Estimated Annual Reduction in Disposable Probe Use and Associated Carbon Emissions** at RCH demonstrates the overall impact of the project. With 19,500 anaesthetic procedures per year and a conservative 25% reduction in disposable probe use, approximately 4,875 probes are avoided annually. This corresponds to a total carbon saving of between 731 and 780 kg CO₂e per year.

Table 1: Life Cycle Analysis of Disposable Probes versus Reusable Probes

Life Cycle Stage	Disposable Probe	Reusable Probe
Raw material	Plastics, adhesive, LEDs	Durable Plastics, longer-life electronics
Resource Consumption	High per patient because probe discarded	Higher initial material input but spread across hundreds of uses
Manufacturing	Mass production	More durable construction
Packaging	Individually packaged	Minimal packaging after initial purchase
Transportation	Frequent deliveries required due to single-use turnover	Fewer shipments due to longer life span
Use Phase	No cleaning energy required	Cleaning / disinfection required after each patient
Chemical Use	None	Disinfectants, wipes
Labor	Minimal	Staff time required for cleaning
Lifespan	1 use per probe	Typically 300 - 500+ uses per probe
End-of Life	Medical waste (plastics & electronics) per patient	Waste only at end of device life
Waste Disposal	Regulated medical waste disposal	Occasional disposal after device damage

Table 2: Carbon Footprint per use : Life Cycle Analysis Comparison of Disposable vs Reusable Pulse Oximetry Probes¹

	Disposable Probe	Reusable Probe
Carbon Footprint per use	~0.15-0.16 kg CO ₂ e per disposable probe	~0.008-0.01 kg CO ₂ e per reusable probe
Daily hospital impact example	~23.4 kg CO ₂ e for 150 probes used in one day.	~3.9 -5.7 kg CO ₂ e per day depending on usage levels

Table 3: Estimated Annual Reduction in Disposable Probe Use and Associated Carbon Emissions at RCH

Category	Calculation	Result
Total anaesthetics / year	-	19,500
Reduction (%)	-	25%
Probes avoided / year	19,500 x 0.25	4,875
C02e per probe (low)	-	0.15 kg
C02e per probe (high)	-	0.16 kg
Carbon saved (low)	4,875 x 0.15	731.25 kg C02e
Carbon saved (high)	4,875 x 0.16	780 kg C02e
Midpoint estimate	-	~755 kg C02e / year saved

¹ Duffy, J., Slutzman, J. E, Thiel, C. L, & Landes, M. (2023). Sustainable Purchasing Practices: A Comparison of Single-use and Reusable Pulse Oximeters in the Emergency Department. *Western Journal of Emergency Medicine: Integrating Emergency Care with Population Health*, 24(6). <http://dx.doi.org/10.5811/westjem.58258> Retrieved from <https://escholarship.org/uc/item/7zx2q3td>

Environmental sustainability: What were the waste reductions? (If possible, please specify what waste stream – reduced clinical waste by diverting to recycling, reduced clinical waste by using reusable equipment etc.)

Waste reduction within the Perioperative Department was achieved through a targeted decrease in the utilisation of disposable pulse oximetry probes, resulting in measurable reduction in general waste generation. Observational assessment confirmed that most disposable probes and associated packaging were disposed of via the general waste stream, with very little segregation for recycling.

Procurement data, supported by two perioperative audits, demonstrated a substantial reduction in disposable probe utilisation across the period 2023 - 2025, which directly translates into reduced medical waste.

Table 4 below presents data from Procurement showing the reduction in the usage of disposable pulse oximetry probes within the Perioperative Department from 2023 – 2025. Each probe weighs approximately 15-20 grams, so the total waste generated can be estimated based on the number of probes used.

Table 4: Disposable Pulse Oximetry Probes – Probe Usage Reduction as per Procurement Data 2023 – 2025

Year	Type	Cost per unit	Total cost	No.units	Probe Usage Reduction (No.)	Probe Usage Reduction (%)	Approx. weight 15-20g
2023	InfantD-POP	\$13.54	\$83,013	6,131			
	Paediatric D-POP	\$17.71	\$90,979	5,137			
	Total		\$173,992	11,268	-	-	169kg-225kg
2024	InfantD-POP	\$13.54	\$79,435	5,867			
	Paediatric D-POP	\$17.71	\$47,125	2,661			
	Total		\$126,560	8,528	2740	24%	128kg-171kg
2025	InfantD-POP	\$13.54	\$72,394	3,930			
	Paediatric D-POP	\$17.71	\$35,721	1,416			
	Total		\$108,115	5,346	3182	37%	80kg-107kg



In 2023, which serves as the baseline year, a total of 11,268 probes were used, consisting of 6,131 infant disposable pulse oximetry probes and 5,137 paediatric disposable pulse oximetry probes. This equates to approximately 169 kg – 225 kg into general waste.

In 2024, total probe usage decreased to 8,528 units. This corresponds to 2,740 (24%) fewer probes entering the waste stream compared to 2023. The decrease was mainly driven by a reduction in the use of paediatric disposable pulse oximetry probes. This dropped significantly from 5,137 to 2,661 units. An approximate waste reduction of 41 kg to 54 kg, resulting in total estimated waste of 128 kg – 171 kg.

By 2025, both infant and paediatric probe usage continued to decrease. The perioperative department achieved a 37% reduction in probe usage and reduced estimated medical waste by nearly half compared to 2023.

Audit data further supports this trend, demonstrating a reduction in disposable probe use.

Table 5 below presents data collected from both audits. The proportion of cases using disposable pulse oximetry pulses fell from 48% to 25%, and for patients older than 1 year usage decreased from 44% to 21%. These findings indicate a successful transition toward the use of reusable alternatives and improved resource stewardship.

Table 5: Disposable Pulse Oximetry Probes – Probe Usage Reduction as per Audit 2023 – 2025

	Audit 1 (Dec 2023)	Audit 2 (July 2024)
No. of cases audited	250	218
Total Anaesthetic cases	378	345
% total cases audited	66%	63%
No. of d-POP's applied	119	55
% cases where d-POP applied	48%	25%
% cases age >1 where d-POP applied	44%	21%

* Both Audit 1 and Audit 2 were conducted over 1 week period Mon - Fri (Dec 2023 and July 2024)

Clinical outcomes: How did your project improve patient care? (include outcome data if available)

The reduction in landfill waste and lower costs allows the hospital to reallocate resources to other patient care services, thereby supporting improvements in overall patient care.

During the audit conducted in the Perioperative Department, an issue was identified with older reusable probes malfunctioning. A review conducted by the probe manufacturer found that many of the probes were beyond their recommended service life. Following the procurement of new reusable probes, probe reliability improved supporting more consistent monitoring. No pressure injuries were reported during the implementation of the project or with the increased use of functional reusable probes, further demonstrating the project's positive impact on patient care.

Financial sustainability: Have there been any financial savings? (please include your calculations)

Table 6 demonstrates the financial reduction achieved in the use of disposable pulse oximetry probes within the Perioperative Department between 2023 – 2025. In 2023, the total expenditure for disposable probes was \$172,992, with \$123,216 attributed to the Anaesthetic Department and \$50,775 to the Day of Surgery unit. This year serves as the baseline (0% reduction) for comparison.

By 2024, total expenditure decreased to \$126,560 representing a 27% reduction compared with 2023. This reduction reflects decreased usage and improved resource management across both perioperative areas.

In 2025, the total cost further decreased to \$108,115 resulting in an overall 38% reduction from the 2023 baseline. The continued decrease suggests sustained improvements in probe utilisation practices within the department.

Overall, the data demonstrates significant savings over the 3-year period, highlighting the effectiveness of initiatives aimed at reducing disposable probe usage while maintaining perioperative patient monitoring standards.

Table 6: Financial Reduction % (2023 – 2025) – Perioperative Department Summary

Year	Anaesthetic	Day of Surgery	Total	%age Reduction
2023	\$123,216	\$50,775	\$173,992	0%
2024	\$94,060	\$32,500	\$126,560	27%
2025	\$68,599	\$39,515	\$108,115	38%



Social sustainability: How did your project socially benefit patients, staff, or wider community?

Benefit to staff

This project fostered a sense of pride and engagement among the perioperative team by enabling them to actively contribute to environmental responsibility and uphold RCH organisational values. Staff involvement in reducing disposable probe usage strengthened their connection to sustainability initiatives, promoting a culture of shared accountability and professional satisfaction.

Benefit to patients

The project demonstrated that reducing the use of disposable probes did not compromise patient care. Evidence shows that reusable probes, which generate less carbon emissions, provide equivalent accuracy for oxygen saturation and pulse rate measurements, making them a safe and effective alternative. This approach reassures patients that environmentally sustainable practices are fully compatible with high-quality clinical care.

By aligning staff engagement and patient safety with environmental responsibility, the initiative delivers measurable social sustainability, strengthening both the hospital's culture and its contribution to broader sustainability goals.

Generalisability: Could this project be replicated in other areas of the hospital?

Yes – this project is highly replicable across other areas of the hospital, and the fact that the Emergency Department at the RCH has already implemented reusable probes provides a strong internal precedent.

A 25% reduction in disposable probe use in the Perioperative Department demonstrates both measurable carbon savings (~731 – 780 kg CO₂e annually) and likely cost reductions from decreased procurement and waste handling. These dual benefits make it a strong candidate for scale.

There may be an initial cost associated with purchasing reusable probes, however in the medium to long term, this is likely to result in overall cost savings alongside sustained reductions in carbon emissions.

Provided departments can safely substitute probes with reusable without compromising infection control or clinical quality replication is feasible.

Please attach some photos of you and your team undertaking this project



