



Final Project Submission Form

Health Service: Royal Children's Hospital

Title of project: The **PROACTIVE** (PReoperative Oral PAracetamol initiative) project to improve practice, cost, and sustainability at Royal Children's Hospital

Department:
Anaesthesia and Pain Management

Introduction

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

Our quality improvement project team included anaesthetists and nurses at the Royal Children's Hospital who are concerned about planetary health. We are motivated to make changes that maintain or improve patient care while reducing harm to the environment.

We identified that we had low rates of preoperative oral paracetamol administration, and that intravenous paracetamol was being administered intraoperatively by anaesthetists more often than was necessary. The aim of our project was to increase preoperative oral paracetamol administration. By reducing reliance on intraoperative intravenous paracetamol, and increasing overall paracetamol administration in our surgical patients, this change would have financial, environmental, and patient benefits.

What was the problem you tackled?

In 2023, our department was administering an average of 314 doses of intraoperative intravenous paracetamol per month. At the same time, low rates (4.18%) of surgical patients received preoperative oral paracetamol.

Evidence supports that preoperative paracetamol administration reduces intraoperative and postoperative opioid use, improving multimodal pain management and reducing postoperative nausea and vomiting.

When preoperative oral paracetamol is not given, intravenous (IV) administration is often used instead. The IV paracetamol formulation is significantly more expensive than oral, generates four or more times the environmental impact¹, and in 2024 a national shortage of IV paracetamol led to restrictions to its use in our hospital.

In response to this and our identified low preoperative administration rates at the Royal Children's Hospital (RCH) Melbourne, we embarked upon a quality improvement project at our quaternary paediatric centre entitled PROACTIVE.

What was your SMART Goal?

Our primary aim was to increase nurse-led administration of preoperative oral paracetamol to eligible surgical patients from 4.18% to 30%.

Our secondary aim was to reduce intraoperative IV paracetamol administration, with a resulting decrease in cost and environmental impact of paracetamol administration at RCH.

What system factors contributed to the problem?

While most surgical patients were eligible for and would benefit from preoperative oral paracetamol, multiple barriers were identified to this being able to be administered by staff. To administer preoperative paracetamol, nursing staff required an order to be placed by the anaesthetist in the electronic medical record (EMR). However, the anaesthetist could not place the order in the EMR until the patient had been admitted and a weight had been entered into the system.

Time pressures and multiple tasks required by both admitting nurse and anaesthetist to prepare the patient for theatre made giving preoperative paracetamol a low priority.

Who were the key stakeholders?

- Day of surgery nurses
- Anaesthetists
- Nursing quality and safety
- EMR build staff

What was the intervention?

A multidisciplinary working group was established in 2024 to design and implement a quality improvement (QI) project. Approval was obtained from RCH ethics as a low and negligible risk quality improvement project (DERP number 3993).

Key interventions included:

- In March 2024, in response to the national shortage, IV paracetamol was removed from anaesthesia drug trolleys. A key intervention in this QI project was the decision not to restock the anaesthesia drug trolleys when supply improved
- Nursing clinical guidelines were updated to authorize and prioritise preoperative oral 15mg/kg administration without a medical order
- a new preoperative nursing order set was created in the EMR to allow nurse-initiated administration of oral paracetamol to all eligible patients.
- To reduce inadvertent double dosing of paracetamol intraoperatively, a tile was created in the EMR anaesthesia workflow, which shows whether paracetamol has been administered in the 4 hours prior to the start of the intraoperative phase of care
- Education was delivered to nursing and anaesthetic staff regarding the new nurse-initiated orders
- Nurses were given the opportunity to trial the new EMR order prior to the go live. Following feedback from this trial, changes were made to improve the efficiency of workflow. The final order set went live in October 2024
- Regular feedback with reports of preoperative paracetamol administration rates was provided to nursing staff to encourage and maintain uptake of the new workflow

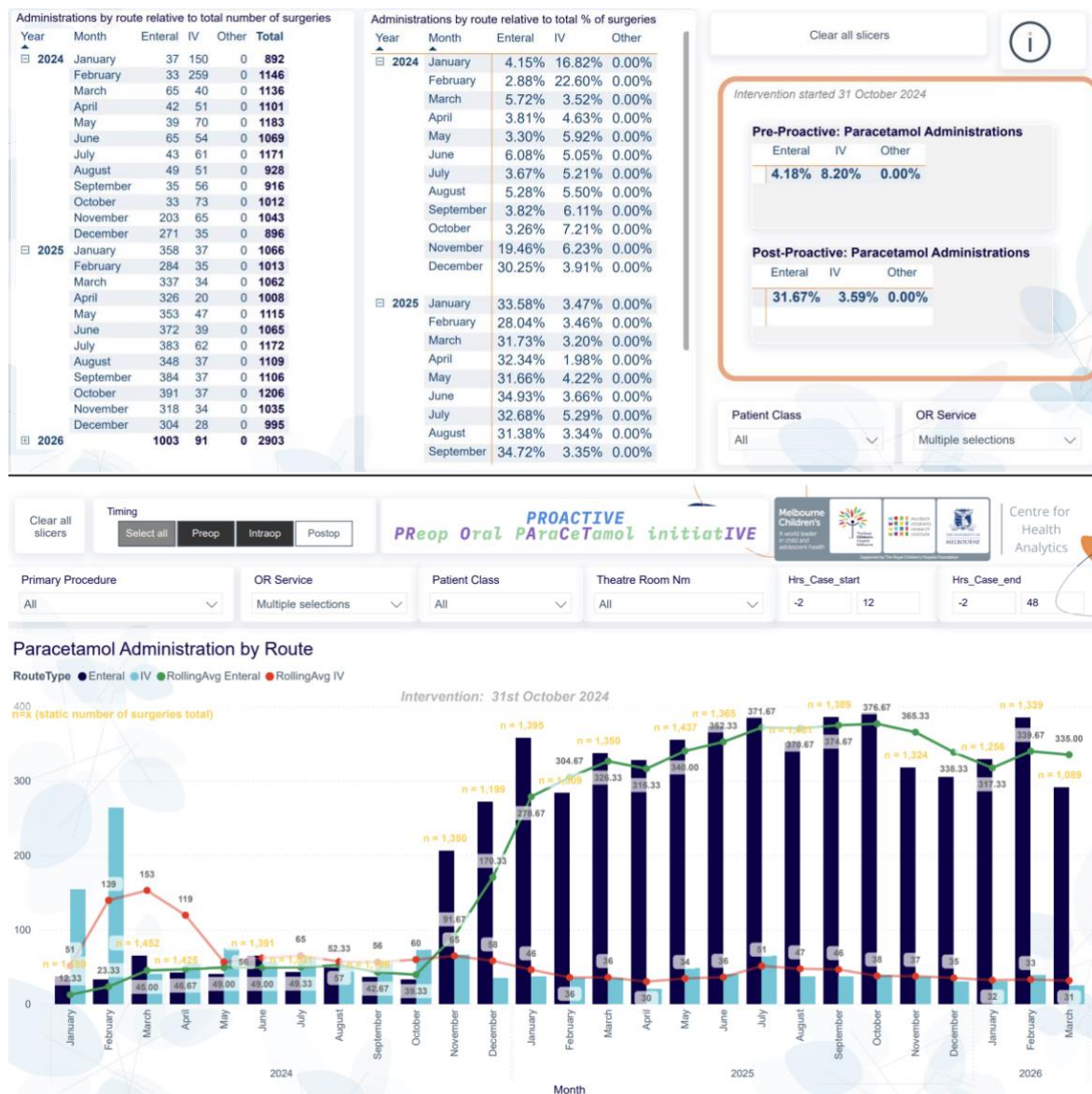
What impacts/outcomes were measured? How did you measure them?

Using data from the EMR, we measured

- Number of oral paracetamol doses administered by nurses using the new pre-op nursing order per month
- Number of intraoperative intravenous paracetamol doses administered by anaesthetists per month
- patient safety outcomes related to inadvertent double dosing of paracetamol. This was measured by tracking double dosing incidents, and liver function test results

We worked with the RCH Centre for Health Analytics (CHA) to build a data dashboard to track monthly paracetamol administrations, incidents of double dosing, and any harmful effects to patient liver function when double dosing occurred.

Results



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

Our anaesthetic department lacked experience in planning and running quality improvement projects. This project was identified as a useful test case for learning how to do quality improvement as a team, and there were many opportunities to learn during planning and implementation of the project.

Challenges faced:

- Difficulty meeting regularly as a team due to busy and unpredictable clinical workloads
- Nurse initiated order required approval from medication safety and nursing professional council
- Difficulty identifying valid and reliable data points from the EMR for data dashboard build. We identified that one of the EMR data points used in the initial dashboard build was unsuitable to be used because it was not reliably entered by clinical staff. The data dashboard was consequently showing inaccurate and misleading results. Feedback to the data analytics team and discussion with RCH EMR experts were needed to resolve this problem.

We learned many things as a team, including:

- The importance of designating roles and responsibilities to each member of the improvement team at the start of the project
- How to navigate relevant nursing policies and regulations to ensure we had support for the nurse-led paracetamol order
- How to work effectively with the EMR team to build the new nurse-initiated paracetamol order
- The importance of stakeholder engagement and feedback throughout the project
- the importance of regular meetings to review progress, problem solve, and plan next steps
- How to work effectively with data analysts at the Centre for Health Analytics to build the data dashboard for monitoring monthly progress and issues
- That when a multi-disciplinary team agrees on an improvement goal and commits time and resources to it, significant system change can occur which can be very rewarding.

What are the next steps with this project?

- We will continue to monitor our monthly use of the preoperative paracetamol nursing order set, and provide regular feedback to nursing staff to encourage ongoing support for the improvement
- We will continue to monitor for patient safety incidents using the data driven dashboard report
- We will continue to build our department's knowledge and experience by running further department supported quality improvement projects. We are particularly interested in learning more about how to effectively use data to monitor the effects of quality improvement cycles

Points will be awarded in the following categories:

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

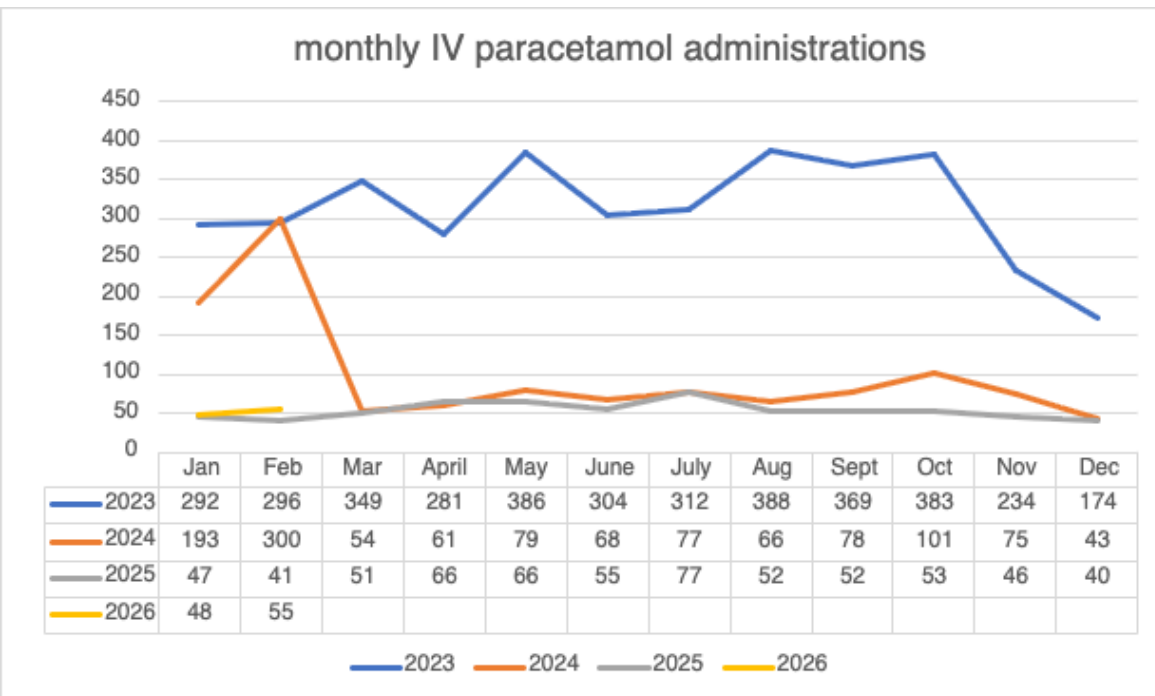
The total carbon saving over 2 years, arising from a significant reduction in intravenous paracetamol since March 2024, was 2,810kg CO₂e.

Carbon reduction from the 2023 baseline were 1552kg CO₂e in 2024, and 1258kg CO₂e in 2025.

Table 1: Total annual carbon emissions of pre- and intra-operative paracetamol administered at RCH (kg CO₂e)

Calculations are based on monthly numbers of administrations identified from the EMR (see charts below for numbers), and carbon calculations from the life cycle analysis listed in the references.

	intravenous	oral suspension	oral tablet	total
2023	2366.304	68.9164	7.4328	2442.6532
2024	750.46	125.6773	13.5546	889.6919
2025	405.688	721.35	57.708	1184.746



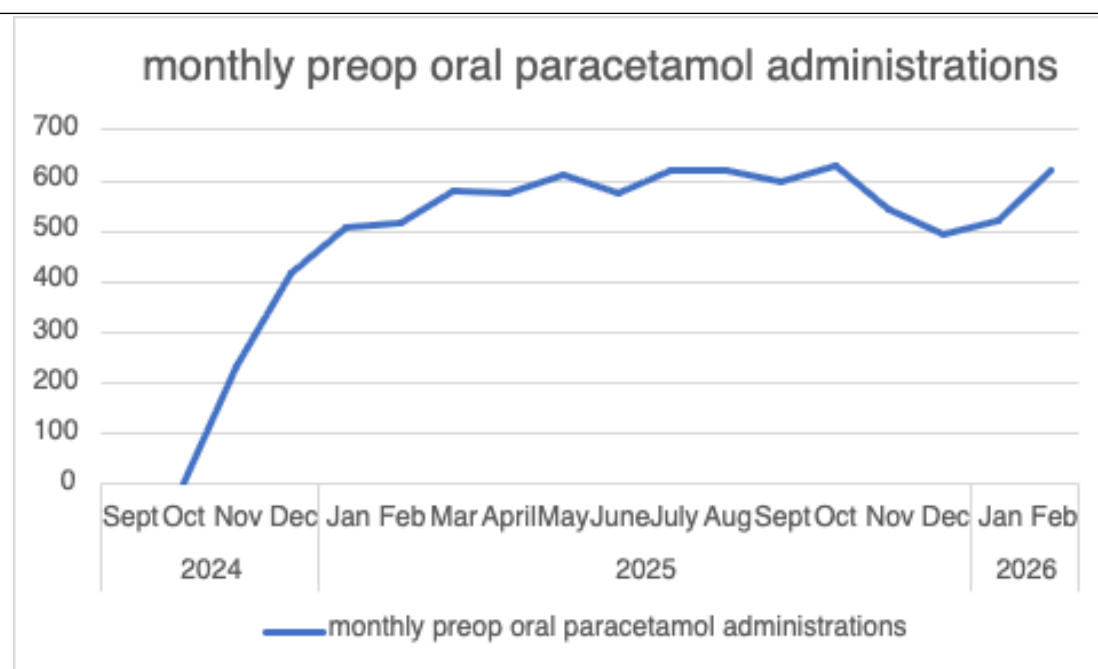


Table 2: Carbon emissions¹ and cost² per dose of paracetamol

formulation	dose (mg)	carbon per dose (g)	cost per dose (\$)
intravenous	1000	628	1.38
suspension	150-1000	151	0.1-0.4
tablet	1000	38	0.03

EMR data analysis showed that 30% of the nurse-initiated preoperative paracetamol doses were given to patients aged 12 years or older. It was assumed in these calculations that these patients received tablets, and that all patients less than 12 years received oral suspension. The carbon cost for oral suspension was calculated using a 1g dose, as the difference for a smaller dose is small.

References

1. Davies JF, McAlister S, Eckelman MJ, McGain F, Seglenieks R, Gutman EN, Groome J, Palipane N, Latoff K, Nielsen D, Sherman JD; TRA2SH, GASP and WAAREN collaborators. Environmental and financial impacts of perioperative paracetamol use: a multicentre international life-cycle assessment. Br J Anaesth. 2024 Dec;133(6):1439-1448. doi: 10.1016/j.bja.2023.11.053. Epub 2024 Jan 30. PMID: 38296752.
2. costs based on 2026 RCH costs provided by pharmacy staff

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 produced from administering a dose of intravenous paracetamol at RCH is considerably higher than for oral paracetamol, as illustrated in Table 3.

Table 3 – waste generated by type of paracetamol administration

Intravenous – 1 dose	Oral – suspension (10ml)	Oral – 2 tablets
unused medication 0-90ml (pharmaceutical waste)	Small plastic syringe (general waste)	1/5 th blister pack (general waste)
100ml tempered glass bottle (not recyclable - typically disposed of in general waste or sharps waste)	1/20 th of a 200ml glass bottle (general waste)	1/50 th cardboard box (recycling)
alcohol wipe to clean the rubber seal (general waste)		Paper cup (general waste)
plastic spike (sharps waste)		
Large plastic syringe (general waste)		

By reducing the average monthly number of intravenous paracetamol doses given in theatre from 314 to 54, we have avoided the waste from 3,120 doses per year of intravenous paracetamol.

This waste reduction is offset by the increase in waste from an additional 519 oral paracetamol doses per month, or 6,228 oral doses per year. However, as outlined in Table 3, this waste is far less per dose than the intravenous paracetamol waste generated.

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

Since implementation in November 2024, the rate of administration of preoperative oral paracetamol has improved from 54 to 573 administrations per month, representing a change from 4.18% to 31.67% of eligible patients. The rate of either preoperative or intraoperative paracetamol administration roughly doubled, from a monthly average of 368 to 627 administrations.

Since evidence supports that preoperative paracetamol administration reduces intraoperative and postoperative opioid use, improves multimodal pain management and reduces postoperative nausea and vomiting (PONV), we can infer that our patients benefitted from this intervention. However, we did not measure opioid use, pain scores or rates of PONV in recovery as part of this project.

To ensure patient safety was maintained after implementation, we tracked incidents of paracetamol double dosing using a dashboard report built for us by staff at the Centre for Health Analytics. Double dosing incidence was low, and as we limited dosing to 15mg/kg, when double dosing did occur it was not considered that an unsafe total paracetamol dose had been given. To support this, we also tracked liver function tests for patient where double dosing occurred in the dashboard report. There were no cases of worsening liver function related to double dosing incidents.

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

The reduction in intravenous paracetamol, balanced by an increase in oral paracetamol given preoperatively, has resulted in an overall cost saving over 2 years of \$6,830, or an average annual saving of \$3,415.

Table 4: Total annual cost of pre- and intra-operative paracetamol administration at RCH (\$)

	intravenous	oral suspension	oral tablet	total
2023	4973.76	58.2	5.868	5037.828
2024	1577.4	106.14	10.701	1694.241
2025	852.72	613.248	84.39	1550.358

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

One of the great benefits of this quality improvement project was the opportunity for a multi-disciplinary team of motivated staff members to learn how to run a quality improvement project in the departments of anaesthesia and nursing. As we did not have any staff already experienced in planning and implementing quality improvement projects, we learned together while working on this project. Our capacity to run subsequent quality improvement projects, in conjunction with data analysts from the Centre for Health Analytics, has improved as a result of the work we have done on the PROACTIVE project.

By building our healthcare staff's capacity to run quality improvement projects, we become more able to improve care to our patients, including by reducing unnecessary carbon emissions and waste, thus benefitting the wider community.

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

The system improvements implemented in the PROACTIVE project are specific to the workflow of the RCH operating theatre environment. However, the national shortage of intravenous paracetamol in 2024 also led to restrictions and resultant ongoing reductions in the use of the intravenous formulation on the wards. This demonstrates that it is possible to save money, waste and carbon emissions by substituting intravenous for oral paracetamol where clinically appropriate, and by designing systems that nudge clinician behaviour towards the less wasteful option.