Environmental Sustainability Competition 2025/26

Final Project Submission Form

Health Service: Royal Children's Hospital

Title of project:	**Department:** PICU
Rationalising Blood Gas Sampling in PICU	

Introduction

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

As the CNC-Quality and CNE we have worked in PICU for several years, both as bedside nurses and in advanced practice nursing roles. Throughout this time, we have developed a strong commitment to ensuring that clinical practices in PICU are purposeful, evidence-based, and carefully considered. This is particularly important given the vulnerability of our patient population. Children in PICU are often at increased risk of infection and have significantly smaller circulating blood volumes compared with adult patients, meaning even routine investigations can contribute to cumulative harm.

After becoming aware of the published work from Royal North Shore Hospital aimed at reducing arterial blood gas sampling, we recognised this as both a feasible and valuable initiative to explore within our PICU. We reflected on our current practices and noted that while blood sampling is often carefully considered for specific high-risk groups, such as pre-transplant patients, this level of deliberation is not always applied consistently across the broader PICU population.

The Royal North Shore project demonstrated meaningful improvements in patient outcomes, including reductions in iatrogenic anaemia, infection risk, and healthcare costs. These findings highlighted an important opportunity to review and potentially optimise blood gas sampling practices within our unit. Implementing a similar initiative in our PICU aligns with our goals of reducing unnecessary interventions, improving patient safety, and contributing to more sustainable healthcare practices.

What was the problem you tackled?

There was limited governance guiding decision-making around when arterial blood gas sampling was clinically indicated in PICU. Our project aimed to replicate the Royal North Shore blood gas reduction initiative, adapted to the scale and context of our PICU.

Within RCH and PICU, specific guidelines already exist to support blood gas sampling decisions for certain patient groups, including those with diabetic ketoacidosis, following liver transplantation, and patients requiring haemofiltration. We observed that the presence of these guidelines appeared to improve staff confidence and consistency when determining whether a blood gas was required.

However, outside of these specific clinical scenarios, we identified considerable variation in decision-making practices among staff, often influenced by differences in clinical experience. Non-invasive monitoring modalities such as end-tidal CO_2 ($EtCO_2$), SpO_2, and clinical assessment were sometimes perceived as less reliable than the reassurance provided by a blood gas result.
To address this variation, we aimed to develop a decision-support tool to guide clinicians in making more consistent, evidence-based decisions regarding blood gas sampling in PICU.

What was your SMART Goal?

To reduce unnecessary arterial blood gas sampling in PICU by implementing a blood gas decision-support tool and targeted staff education, including case-based decision-making discussions and guidance on appropriate sampling indications. Following a one-month education and tool rollout period, supported by weekly maintenance education sessions, we aim to achieve a measurable reduction in blood gas sampling rates in PICU within six months post-implementation, compared with the six-month baseline period prior to implementation, while maintaining patient safety and clinical decision-making standards.

What system factors contributed to the problem?

One of the key issues was the lack of clear guidelines to support nurses in deciding when a blood gas is actually needed. Without a consistent approach, decisions are often based on individual judgement, which can vary and lead to unnecessary testing. There's also limited system support, such as prompts or targeted education, which makes it easier for blood gases to be done "just in case" rather than based on clear clinical indications.

Who were the key stakeholders?

This project included the following stakeholders:

- PICU Intensivists (x1 General Intensivist, x1 Cardiac Intensivist)
- Extracorporeal Life Support Medical and Clinical Nurse Consultant (CNC)
- ECLS Medical and Clinical Nurse Consultant (CNC)
- Liver transplant CNC team
- Heart Failure CNC team
- PICU Bedside Nurses
- Laboratory Services

What was the intervention?

A blood gas sampling decision support tool was created. The tool was created based off the Royal Northshore published paper and reaching out to multiple other paediatric and adult ICU centres to assess what resources they had for blood sampling decision making.

Following creation of the blood sampling decision tool, the tool was shared with specialist teams including PICU Intensivist, ECLS medical and nursing team, liver transplant team, heart failure team and bedside nurses of varying experience.

One month of education was provided on the decision-making tool. Formal 30 minute sessions occurred three times a week (Mon-Fri) to nursing staff including the tool, the changes to practice and case studies. Twice weekly bed to bed education was undertaken to in between formal sessions to teach staff how to apply the tool for their individual patients. Subsequent maintenance education was provided weekly for three months following.

Medical staff were provided five-minute education sessions pre-morning handover on the tools implementation.

A hard copy of the decision tool was placed at each PICU bedspace and on each of the medical computers.

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

The project measured the impact of introducing a blood gas decision support tool in PICU using a before-and-after evaluation design.

The main measured outcomes included:

- Total number of blood gas tests performed
- Blood gas test performed per bed day
- Estimated Financial Savings
- Estimated Carbon savings

These were measured by comparing six months pre-intervention (February 2024 to July 2024), with six months post-intervention period (September 2024 to February 2025). Blood gas data was obtained from the Centre for Health Analytics (CHA) using EMR data and cross checked with the number blood gas tests. Use of CHA blood gas testing numbers provided a greater accuracy for blood gas test performed in PICU when compared to the laboratory provided numbers as this included other wards such as the Cardiac ward utilising PICU blood gas machines.

In addition to the measured outcomes, the project observed a positive cultural change when staff were deciding to perform a blood gas. More deliberate discussion surrounding the need for a blood gas was noted amongst staff.

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

Implementation of this project highlighted several challenges within the PICU environment. Blood gas testing was embedded in routine, nurse driven practice and often used as a form of clinical reassurance, leading to initial resistance due to concerns about missing deterioration.

Key enablers included strong staff commitment to reducing unnecessary testing and making more considered clinical decisions, meaning the change was largely welcomed. Strong medical leadership provided a clear authorising environment and reinforced the importance of the initiative. Broad multidisciplinary consultation and a non-prescriptive decision support tool encouraged discussion and supported clinical judgement. Bedside education was particularly effective in supporting practical implementation.

An additional barrier included the creation of the decision tool, stakeholder engagement and implementation of the tool was able to be completed during allocated work time. Through utilisation of Advanced Practice Nursing roles and engagement of the wider PICU education team, this project was able to be developed and implemented in paid time.

The key learning was that behaviour change is most effective when it aligns with clinician values and supports, rather than replaces, clinical judgement. Simple, low-cost interventions, combined with leadership and engagement, can achieve meaningful and sustained improvements in practice.

What are the next steps with this project?

The next phase of this project will focus on sustaining and expanding the observed improvements in blood gas utilisation within PICU. The decision support tool has now been embedded into practice.

This project has established a foundation for further rationalising of diagnostic testing initiatives within PICU. Planned future directions include the rationalisation of other frequently overused investigations, such as chest X-rays and routine blood testing, using similar decision support approaches. Collectively, these steps aim to embed a culture of considered, evidence-based investigation practices that balances patient safety, resource utilisation, and environmental sustainability.

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 carbon saving was estimated using published data from McAlister et al., who found that single arterial blood gas test has the carbon footprint of 49g CO2e per test.

Raw Data:

- Pre-intervention total blood gas tests= 16,144
- Post-intervention total blood gas tests= 12,978
- Overall reduction in total blood gas tests= 3,166

Calculation:

- 3,166 tests not performed x 49g CO2e per test
- =155,134g CO2e saved
- =155,134/1000
- =**155.1kg CO2e saved over 6 months**

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 was not directly measured through a formal waste audit, so the project cannot report a precise kilogram reduction in waste.
However, it is reasonable to state that reducing 3,166 blood gas tests reduced consumption of single-use blood gas sampling consumables and therefore reduced associated waste, primarily:

- Clinical waste from blood-contaminated sampling item such as bluey
- Single use plastic consumables
- PPE related waste associated with sample collection analysis
- Solutions required to maintain and run blood gas analysers

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

This project improved patient care by reducing unnecessary invasive blood sampling while maintaining safe and effective clinical decision-making. Following the implementation of the decision support tool, there was a measurable reduction in blood gas utilisation, with total tests decreasing from 16,144 pre-intervention to 12,978 post-intervention, representing an approximate 20% reduction. In addition, the median number of blood gas tests per bed day decreased from 3.8 to 3.4, indicating a sustained change in clinical practice.

Reducing the frequency of blood gas sampling has several important clinical benefits. It decreases the need for line access and blood draws, thereby reducing the risk of line-associated infection and minimising cumulative blood loss. This is particularly significant in critically ill infants and children, who are more vulnerable to iatrogenic anaemia and its downstream consequences, including transfusion exposure. With an approximate 0.5ml of blood loss per blood gas test performed, the reduced 3,166 blood gas tests performed represented a 1.5L blood loss saving.

In addition to these direct patient benefits, the project supported improved clinical decision-making. The decision support tool encouraged deliberate, team-based discussions regarding the necessity of testing, reducing reliance on routine or reflexive ordering. This approach enhanced clinical reasoning, supported junior staff, and contributed to a more individualised model of care.

Importantly, pre and post implementation data demonstrated there was no increase in adverse events or mortality, supporting the safety of reducing unnecessary blood gas testing.

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

There were 3,166 more blood gas tests in the pre intervention period. Applying a cost per blood gas test of $33, the cost of blood gas tests in the pre-intervention period was $532,752 (16,144 blood gas tests) and in the post-intervention period $428,274 (12,978 blood gas tests), representing an absolute cost saving of $104,478 during the post-intervention period. After adjusting for difference in bed days between periods, the cost difference was $103,865, representing a 20% reduction in costs.

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

The project had several social benefits.

For patients and families, it reduced unnecessary invasive procedures and supported a more thoughtful, individualised approach to care. In a paediatric intensive care setting, reducing unnecessary blood sampling is important not only clinically, but also in terms of patient comfort and family experience to reduce anxiety and stress associated with performing a blood gas test.

For staff, the project improved confidence and reduced ambiguity amongst staff. The decision support tool created a shared framework for decision-making surrounding indications for performing blood gas sampling, especially supporting new and graduate nurses. It also shifted decision-making from an individual burden to a team discussion, which helped staff feel more supported in their decision.

Furthermore, the process of obtaining, analysing, and acting on a blood gas is estimated to require approximately 10 minutes of nursing time per test. Based on the reduction of 3,166 blood gases during the study period, this equates to a saving of over 525 hours of nursing time. This represents a meaningful reduction in nursing workload, enabling greater capacity for direct patient care and other clinical priorities.

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

This project is highly generalisable, particularly within other ICU and PICU environments where blood gas testing is frequently performed and often embedded in routine practice. The intervention was low-cost, simple to implement, and focused on supporting clinical decision-making rather than enforcing prescriptive rules, making it well suited to critical care environments that require flexibility and clinical judgement.

Its success relied on factors that are easily transferable across critical care units, including multidisciplinary engagement, bedside education, and the use of routinely available data to monitor impact. The decision support approach can be readily adapted to suit different patient cohorts and unit-specific workflows, including cardiac, surgical, and general intensive care populations. Furthermore, the intervention used in this project is easily translatable to reducing other commonly overused investigations, such as chest x-rays and routine blood tests, across both paediatric and adult critical care environments.

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