SUSQI PROJECT REPORT
The 2 P's Project

Start date of Project: 29th May 2025
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Team Members:

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- Resmi Robin - Band 6 Sister
- Mownisha Sundar - Band 5 staff Nurse
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Background:

The cardiac Critical Care Unit at the Liverpool Heart and Chest Hospital is a busy 30 bedded unit with high medication use. The use of IV medication and subsequently IV giving sets on the unit, is high.

Medications were often prescribed to be given via either the IV or oral route. Electronic prescribing records were used where a nurse selected the administration route of a medication via a drop-down box. There were no guidelines to help nurses choose the most appropriate route of administration and therefore decided by individual nurses. As a result, practice amongst nursing staff varied from individual to individual.

Medication given via the oral route, when clinically appropriate, is the preferred route due to reduced costs, reduced infection risks to patients, improved patient experience and reduced staff time pressures. Medications given orally have a lower carbon footprint than those given IV, due to reduced packaging, transport costs, and they do not require the use of giving sets and other equipment (BMJ, 2023). However, it was understood that staff on the unit used the IV route in the majority of cases. Misconceptions regarding the efficacy of IV paracetamol (it being stronger than the oral equivalent) existed amongst the clinical staff. There was a brief period where the unit experienced a shortage of IV paracetamol, and staff during this time, confidently administered medication enterally with no concerns or compromises to care. However when IV stocks resumed, nurses reverted back to their usual practice of giving IV medication. It was understood that this was due to their perceived effectiveness.

For medications that are required to be given via IV, the recommended hanging time for giving sets is between 72-96 hours, medication dependent (Gloucestershire Hospitals NHS Foundation Trust, 2023). On the unit, lines were not routinely labelled to outline expiry dates, therefore line-change practice

varied from one practitioner to another. Giving sets were regularly changed more frequently than recommended, and in some cases changes were done each shift or each time medication was administered. It had been estimated, this could equate to a threefold increase in frequency compared to standard guidelines, not only raising concerns around infection prevention by increasing line manipulation (Gillies et at, 2004), but undermining the units sustainability efforts, through excessive plastic waste.

Specific Aims:

To explore sustainable alternatives in patient care and improve the patient's experience by focusing on 2 issues related to medications:

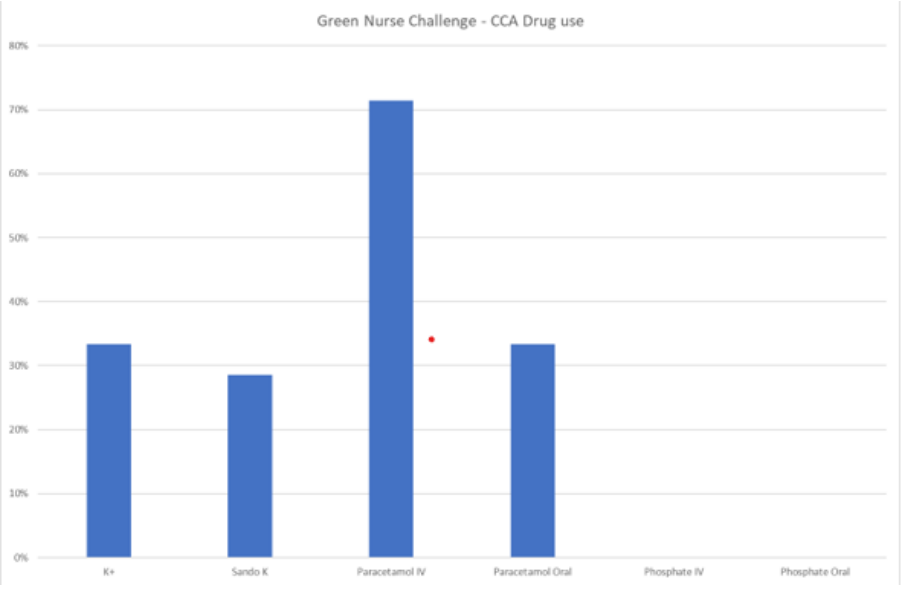
1) Encourage the administration of potassium and paracetamol using the enteral route in place of the intra-venous route, when clinically appropriate (titled The 2 Ps project).
2) Standardise the hanging times of IV giving sets to 72 hours for paracetamol, potassium and phosphate to reduce the number of unnecessary changes, reduce risks of infection through unnecessary detachment/re-attachment of lines, and improve patient experience.

Methods:

Studying the system:

Aim 1: Encourage the administration of potassium and paracetamol using the oral route in place of the intra-venous route (The 3 Ps project).

The Critical Care Matron (with a previous service improvement role) recruited a team of nurses from band 5-7 who had expressed an interest in improvement and sustainability. The team obtained baseline data (Appendix 1) by reviewing 40 patient records. Immediate post-op patients were omitted from the study. Three drugs were looked at - paracetamol, potassium and phosphates. Data confirmed a significant preference for IV route over oral route in the Unit, as per Graph 1:



70% of patients received IV paracetamol compared to just 30% via the oral route.

IV potassium was also favoured over oral (sando K). In some cases, IV medications were used when clinically indicated - if potassium levels are well below accepted range or immediately post cardiac surgery, where the IV route is the most efficient and effective route. The results warranted further

exploration. While the project initially intended to look at 3 medications, the use of phosphate was virtually nil and was therefore excluded from the study.

To understand nursing perceptions and current practices, the team devised a questionnaire. (Appendix 2). Staff were asked:

- Their role and experience
- Their perceptions of IV medication use, when oral alternatives are available
- How confident they felt in switching from IV to oral route
- Their understanding of patient outcomes and patient experience regarding the impact of reducing IV medications

A total of 34 responses were received. Most staff felt that reducing IV medication use would not negatively impact patient outcomes but may increase infection risks associated with unnecessary discontinuation of lines. Many felt this could be mitigated against if the lines were left attached.

The team wanted to explore understanding about the effects of IV paracetamol - there being a perception amongst staff that it was stronger than an oral dose. The team consulted with the pain team at the Liverpool Heart and Chest who advised of the poor evidence base for IV paracetamol versus oral. Explanations were offered regarding faster action of IV use and often patient preference. The unit staff were advised of the variance with regards to patient absorption times. Therefore, the pain team recommended IV for pain reasons for 24hrs only before undertaking a review. They were in support of the project's proposals of replacing it with oral doses in critical care.

Questionnaire responses showed that almost all staff (32/34) felt confident to undertake the switch independently from the IV to oral route. 1% of the staff felt they lacked confidence and therefore would need to seek advice before making changes.

<u>Aim 2: Standardise the hanging times of IV giving sets to 72 hours</u>

We wanted to explore the practice of changing giving sets. Staff were asked about their current practices related to giving set changes when using *IV Paracetamol, potassium, and phosphate.*

Giving Set Change Frequency:

- 6% every shift
- 27% every 24 hours
- 55% every 72 hours
- 12% other

The results confirmed inconsistencies in practices in the workforce, with overuse of giving sets and consequently unnecessary workload. There was a lack of awareness about the guidelines for the hanging times of paracetamol and potassium which led to inconsistencies of labelling lines.

<u>Implementing change:</u>

Aim 1: Encourage the administration of potassium and paracetamol using the oral/enteral route in place of the intra-venous route (The 2 Ps project). The team agreed to take on the role of being green champions to support the matron in the project. The team of 8 staff were to lead by example and

support their peers in adopting sustainable practices. Micro-teaching sessions were carried out across the Critical Care Unit by the champions. These were brief, focused sessions introducing the aims of the initiative, the proposed changes, and the environmental and clinical rationale behind each change.

Pharmacy teams supported staff ensuring the switch was clinically appropriate, safe and effective. Pharmacy technicians provided the team with an insight on costing and supported with bedside teachings. Pharmacy colleagues sent reports of medication usage and cost analysis - providing data for May, June and July. All Staff were encouraged to ask questions and share their concerns.

A Poster was designed (Appendix 3) to prompt staff to consider the changes and remind them of the teachings undertaken.

Aim 2: Standardise the hanging times of IV giving sets to 72 hours

The pharmacy team provided labels to attach to IV lines informing staff when they were due to be changed (Appendix 4). Over a 4 week period the focus was on nursing staff compliance. Labelling was systematically monitored using a data collection sheet (Appendix 4) which tracked whether dated labels were consistently applied. Where noncompliance was identified, targeted bedside teaching and micro teaching sessions were delivered. The aim was to stress patient safety/ infection control improvement and provide consistency across the team. Posters formed visual prompts of the orange labels - raising awareness and reinforcing the new practice.

Measurement:

Patient outcomes:

For each patient we looked at:

- Length of admission
- How many doses of potassium and paracetamol were administered
- How many doses were oral, and how many were IV
- What route was used (e.g. via central or peripheral line)
- Of the doses given IV route, how many were avoidable.

Environmental sustainability:

Aim 1

Assuming that the carbon footprint of a medication's active ingredient is the same in an IV bag as in a tablet, we based the carbon footprint comparison of IV bag and oral medication on their packaging and information leaflet plus the carbon footprint of the items needed for administering IV fluids - giving set and posiflush. A process-based cradle-to-grave carbon footprinting methodology was used which included the extraction of raw materials, primary material production and disposal. Potassium and paracetamol IV bags are both made of PVC with the empty bags weighing 29g and 24g respectively. It was assumed that the empty IV bags get disposed of as infectious waste which will be autoclaved and incinerated at low temperature. Potassium IV bags are packaged in additional PVC plastic bags of 16g, paracetamol IV bags are delivered 10 in a 95g cardboard box. We have allocated the weight of the cardboard box proportionally to an individual paracetamol IV bag, 9.5g. Information leaflets made of paper weighed 5 and 6g respectively. It was assumed that packaging and information leaflet are disposed of in recycling waste.

Oral potassium tablets are delivered 20 in a 14g plastic tube, with 5 tubes in a 18g cardboard box. This results in a weight of the plastic tube per tablet of 0.7g and weight of the cardboard box per tablet of 0.18g. The weight of the information leaflet per tablet was assumed to be 0.1g. As the plastic of the tube is unknown it was assumed that it is made of average rigid plastic. It was assumed that the plastic tube gets disposed of as domestic waste and incinerated at low temperature. Cardboard boxes and information leaflets are recycled.

Paracetamol tablets are packaged in blister strips made of plastic and foil, 10 per strips. The weight of the empty blisterstip is 2.8g. Based on information from a previous project, it was assumed that the PVC of the blister strip weighs 0.224g and the foil 0.056g per tablet. With 10 blister strips in a packet, the weight of the cardboard packet per tablet is 0.22g. The weight of the information leaflet per tablet is 0.02g. Similarly to the potassium tablets, it was assumed that the empty blister strip is disposed of as domestic waste and incinerated at low temperature and cardboard box and information leaflet are recycled.

For the Giving Set, the material composition (LDPE/HDPE) was taken from Rizan C et al. , and apportioned to the weight of the Green Nursing Teams Giving Set which is 41.09g and disposed of as infectious waste, autoclaved and incinerated at low temperature. It was assumed that the Giving Set came in a plastic/paper packaging pouch which weighed 3.69g and was recycled.

The carbon footprint of the posiflush was based on cost. A posiflush costs around 17p.

The emissions factors for materials and recycling was sourced from the UK Department of Energy Security and Net Zero (DESNZ) GHG conversion factors 2025. The emission factors for waste disposal - apart from recycling - was taken from Rizan C et al.'s study on the carbon footprint of waste streams in a UK hospital. For the posiflush the emissions factor for pharmaceuticals was taken from the UK Government emissions factors for SIC Codes database.

Economic sustainability:
Medication usage and cost data were collected from multiple departments across the organisation. The Procurement Department confirmed the unit cost of each IV giving set is between 45p for the paracetamol set and £2.34 for the potassium set.

The financial cost of line labels was known in the department. 300 Labels - Orange, 'Discard After Date Expiration' Labels - 1.5 x 0.5 inch Food Freshness Labels/Medication Expiration Labels for Pharmacies, Bakeries, Healthcare - 1 Roll £15 plus delivery of £5. We ordered 1,500 at a time.

Pharmacy teams sent reports of medication usage and cost analysis for May, June and July.

Social sustainability:
We asked patients about their preferences of how they receive medication and staff on their experience of administering medication with each method. Staff time was also considered.

Results:

Patient outcomes:

IV medications continue to be used when clinically indicated, for example if potassium levels are well below the accepted range or immediately post cardiac surgery, the IV route is the most efficient and effective and will be used. As in agreement with the pain team, IV would continue to be used for the first 24 hours following a patients surgery.

Switching from IV to oral medications in critical care settings can significantly enhance patient comfort and dignity by removing the need for infusion lines or syringe drivers. This change allows patients greater freedom of movement, including more frequent and independent visits to therapeutic spaces like the Critical Care garden. Trips to the ambulance bay are popular with long-term patients (family members bring along patients' pets - bringing boosts to patient morale and reduction in anxiety (ICS, 2020 & BACCN, 2012). Improved mobility supports earlier and more effective rehabilitation, which can lead to quicker, safer discharges and reduced length of stay in critical care.

Minimising line manipulation through our second change to extend the life of hanging times may improves patient comfort and reduces risks such as phlebitis, fluid overload and medication errors. Research shows there is no increase in infection risk associated with longer hanging times (Gillies et al., 2004; Cochrane, 2005).

Environmental sustainability:

Aim 1:

Assuming one giving set and one posiflush is needed to administer the IV potassium the carbon footprint of IV potassium is 0.352 kgCO2e - 0.155 kgCO2e due to the giving set , 0.041 kgCO2e for the posiflush and 0.156 kgCO2e for the IV potassium bag. An equivalent amount of potassium in Sando K tablets would require 4 tablets which have a carbon footprint of 0.0113 kgCO2e. Using oral potassium tablets would lead to net carbon savings of 0.341 kgCO2e. Without taking into account the giving set and posiflush, the net savings would be 0.145 kgCO2e.

Administering paracetamol intravenously has a carbon footprint of 0.297 kgCO2e - 0.155 kgCO2e for the giving set, 0.041 kgCO2e for the posiflush and 0.104 kgCO2e for the paracetamol IV bag. An equivalent amount of paracetamol in tablets would require 2 tablets, which have a carbon footprint of 0.003 kgCO2e, leading to net savings of 0.297 kgCO2e. Without the giving set, the GHG emissions net savings would be 0.101 kgCO2e.

From May to June, on average 856 IV bags of potassium and 1298 IV bags of paracetamol per month were used. Assuming that a third of IV bags could be switched to tablets, savings of 97.3 kgCO2efor Potassium and 128.6 kgCO2e per month could be achieved. Extrapolated to a year, switching from IV to oral would lead to GHG emissions savings of 1,167 kgCO2e for Potassium and 1,543 kgCO2e for Paracetamol. This is a total saving of **2,710 kgCO2e**, equivalent to driving 7,973 miles in an average car.

Aim 2
Unfortunately data was unavailable, and the project excluded in the final reporting to date. We plan to continue the project and collect data in the near future.

Economic Sustainability
Aim 1:
From May to June, on average 856 IV bags of potassium and 1298 IV bags of paracetamol per month were used. Assuming that a third of IV bags could be switched to tablets, we were able to extrapolate the following costings.
Paracetamol:

- IV cost: £1,074.97/month
- Oral cost (2 tablets per dose): £741.43/month
- Monthly savings: £333.53

Potassium:

- IV cost: £11,162.30/month
- Oral cost (4 tablets per dose): £7,679.45/month
- Monthly savings: £3,482.85

Additional savings from reduced use of giving sets: £1,196.15/month. Total projected annual savings**: £56,148.**

Aim 2:
Unfortunately data was unavailable, and the project excluded in the final reporting to date. We plan to continue the project and collect data in the near future.

Social sustainability
Patient feedback:
10 patients gave responses:

- 6 patients preferred oral medication
- 2 patients said either
- 4 patients preferred IV (1 stated IV works better)

Nurses did not want to wake sleeping patients with oral medications and would at times opt for the IV route. Not all staff felt confident in making decisions about when to make changes.

Staff
Staff reported that administering IV medications is significantly more resource-intensive than oral alternatives, involving multiple steps such as drug preparation, double-checking procedures, documentation, flushing lines, and safe disposal of packaging and sharps. This process increases workload and reduces time available for direct patient care. IV administration is often chosen out of habit or perceived efficacy, despite limited line access and time constraints. Additionally, handling heavy boxes of IV supplies can negatively affect staff safety, morale, and wellbeing. Transitioning to oral medications reduces nursing workload, enabling more time for high-value, patient-facing activities and improving overall staff experience.

Discussion:

Critical Care is a high contributor of plastic waste in healthcare and recognised as an environmental hotspot. As part of a commitment to be more sustainable, the Cardiac Critical Care unit wanted to reduce the environmental impact and improve resource efficiency in medication administration, but faced barriers that were both operational and clinical. Some challenges included

- Misconceptions about the efficacy of IV paracetamol (it being stronger than the oral equivalent). The Pain team provided clarity on this and stressed it supported the oral over IV route after the first 24hrs.
- Inconsistencies in guidelines hanging times led to inconsistencies in practice.
- Labels are sometimes difficult to write on (and can depend on the type of pen used)

Unfortunately the data was unavailable to measure the impact of extending hanging times. This is something that the team wish to continue to promote and plan to collate this data in the future. The team plans to review the practice of line removal (for around 2,200 patients per year). The hope is that where the enteral route is embedded in staff behaviours, there may be scope to remove IV lines sooner and further progress could take place exploring other themes around patient safety and improvement.

Amongst the clinical staff, there was a lack of awareness regarding the carbon footprint of medications and equipment, and an impression that sustainability was not a clinical priority. This led to a reluctance for staff to change practice. However, by recruiting green champions and pharmacy colleagues, to undertake teaching sessions, we were able to engage staff, strengthen team cohesion and promote professional pride.

To ensure this is a lasting change, the team have taken additional steps to revise the prescribing border set. Once the patient is beyond 24 hrs, oral medication will appear as the only route prescribed. There are plans to share the project and its findings across the organisation and at the senior nurse meetings. Plans to review on-going medication usage and costs are in place. The team has set up monthly reviews and will host regular meetings with the critical care pharmacist and unit manager. The Critical care procurement lead will monitor consumption data over the next 6-12 months.

Conclusions:

With a newly appointed matron, the Challenge came at the right time - proving to be deeply rewarding. The matron was instrumental in providing encouragement and support to staff who are passionate about quality improvement and environmental responsibility. The Green Nurse Challenge allowed the team to build on previous green initiatives (the "Gloves Off" campaign) providing a natural progression into broader sustainable clinical practices.

The team have championed safe, more appropriate decision-making by promoting enteral medication routes where possible, thus reducing the need for IV administration, and identified that IV lines for particular medications, do not need to be replaced more frequently than every 72hrs.

The project has increased environmental insight of clinical staff leading to behavioral change. By promoting enteral routes, where clinically appropriate, the team have improved patient comfort and

reduced infection risks. Together with cost and carbon savings, they have embedded environmental decisions, as part of the care provided and not just as an afterthought.

Key elements of the initiative included staff engagement and building a team to lead the project. Staff were brought onboard through teaching and the use of creative signage to prompt and embed change. With the revisions of the prescribing border, the team are confident these changes will be long lasting. They plan to share their learning across the Trust to encourage other teams to consider changes they might make.

References

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Appendices

Appendix 1. password is greennurse Green Nurse Challenge Excel.xlsx

Appendix 2. link for questionaire https://forms.office.com/e/PXVTxSFhcV?origin=lprLink

Appendix 3: Posters

Appendix 4: Line monitoring label and spreadsheet

72 hr lines Project (Line label present)

This data collection is to look at Nurse compliance with labelling Paracetamol. Potassium, and maintenance fluids

Date	Bed No	Yes	no	Label present but unclear

Critical success factors

Please select one or two of the below factors that you believe were most essential to ensure the success of your project changes.

People	Process	Resources	Context
☐ Patient involvement and/or appropriate information for patients - to raise awareness and understanding of intervention **X Staff engagement** **X MDT / Cross-department communication** ☐ Skills and capability of staff **XTeam/service agreement that there is a problem and changes are suitable to trial (Knowledge and understanding of the issue)** **X Support from senior organisational or system leaders**	☐ clear guidance / evidence / policy to support the intervention. ☐ Incentivisation of the strategy – e.g., QOF in general practice **X systematic and coordinated approach** **X clear, measurable targets** **X long-term strategy for sustaining and embedding change developed in planning phase** ☐ integrating the intervention into the natural workflow, team functions, technology systems, and incentive structures of the team/service/organisation	☐ Dedicated time **X QI training / information resources and organisation process / support** ☐ Infrastructure capable of providing teams with information, data and equipment needed **X Research / evidence of change successfully implemented elsewhere** ☐ Financial investment	☐ aims aligned with wider service, organisational or system goals. **X Links to patient benefits / clinical outcomes** **X Links to staff benefits** ☐ 'Permission' given through the organisational context, capacity and positive change culture.