Case Study Report: Critical Care getting 'Pumped Up' to reduce unnecessary doses of Proton Pump Inhibitor medication.

Team Members:

- Leeanne Hardy: Senior Sister, Quality Service and Improvement, Critical Care
- Laura Moven: Junior Sister. Practice Education, Critical Care
- Laura Robinson: Advanced Pharmacist for Critical Care.
- Rachel Kontogonis: Advanced Pharmacist for Critical Care

Background:

Within critical care and nursing care in general, we often use research based 'care bundles' with the aim of bringing together focused interventions to improve care given and avoid unnecessary harm. This has a very positive impact on quality of care, however, can sometimes lead to interventions continuing when no longer necessary. For example, a medication may commence in an acute phase of illness or post operatively, but then continue beyond this and even after discharge into the community.

Overuse of medication comes with huge financial and environmental costs[1]. Pharmaceuticals alone count for about 25% of carbon emissions in the NHS, the largest single contributing factor. Breaking this down, the impact comes from the manufacturing and distribution, the active pharmaceutical ingredients (APIs) and pharmaceutical waste[2]. APIs have been found in many river sites worldwide at levels deemed unsafe for aquatic organisms, which can have negative effects on the health of ecosystems and humans[3]. The UK Governments 2021 National overprescribing review estimates 10% of medications dispensed in primary care are overprescribed[4].

Literature has suggested that patients often continue taking proton pump inhibitor (PPI) medications for extended periods of time when no longer clinically indicated. This may be due to PPI being prescribed in an acute setting and continued through to and beyond discharge or prescribed in the community and dispensed on repeat. PPI use has been linked to several negative health outcomes including gastric neoplasia, renal disease, increased risk of fracture, dementia, liver disease and micronutrient deficiency[5]

Within our trust an 'Infection Prevention Collaborative' has been formed to look closely into the relationship between PPI's and Clostridium difficile infections (CDI) with research identifying increased risk for patients to acquire CDI when given PPIs, particularly if long-term[6,7]. CDI can increase patient length of stay in hospital and lead to increased risk of moisture lesions (If bed bound)[8]. Evidence

suggests long-term use of PPIs is associated with increased risk of community acquired CDI[9] however if a PPI is discontinued within one month the risk of developing CDI is diminished[6]. CDI is recognised as one of the major preventable causes of increased morbidity, mortality, and increased health care costs[10].

The critical care environment is dynamic by nature and held together by very experienced and forward-thinking professionals with a keen interest in challenging practice and improving patient care. This ideally places our team to lead a review into PPI medications prescription and use. If we can stop low value (not clinically required) prescriptions and unnecessary doses, we can positively effect patients, the critical care team, and the wider community. A reduction in medications will also support our team in reducing our impact on the environment and supporting the NHS ambition to be a net zero healthcare system by 2040.

Specific Aims:

To reduce the number of unnecessary doses of proton pump inhibitor (PPI) medications given to patients within critical care in order to;

- Improve patient care and reduce potential risk of side effects of medication (including increased infection risk).
- Reduce the carbon footprint associated with PPIs on critical care.
- Provide a financial saving to the NHS.

Methods:

Studying the system:

Our Critical Caren facility in Northampton is a 16 bed unit that cares for patients with a variety of needs; surgical emergencies, post op elective surgical patients and medical emergencies. We reviewed our current practices to determine if unnecessary doses of PPI were a problem, and to understand the extend of this problem. We;

- Conducted a literature review into the relationships between PPI medication and poor health outcomes such as increased risk of CDI.
- Reviewed the indications and contraindications of PPI's, using information from the Critical Care Compendium-Stress Ulcer Prophylaxis Guide[11]
- Completed an audit of PPI prescriptions and administered doses for all elective patients to establish whether a PPI prescription or dose was necessary or not.

Planned changes:

We plan to cascade our project findings and reduce unnecessary doses of PPIs by;

- Delivering teaching sessions to both medical and nursing teams
- Adding pertinent information in the patient's communication book
- Expanding on the current checklist on ward charts to include 'Review requirement for PPI'
- Include review of PPI in Fresh Eyes tool (NHS England & Improvement[12])
- Increasing awareness of and engagement with an algorithm in the Management of patients with CDI Trust protocol. This algorithm allows health professionals to refer and review patients admitted with a PPI and to identify if they should be discontinued.

- interviewing the medical team to assess if there are any knowledge gaps in when a patient requires a PPI and when it is clinically appropriate to stop.
- Set up a sustainability group on the unit to ensure changes remain embedded, and to complete future projects.

We plan to repeat our initial audit following implementation of the above changes to look at actual savings.

Measurements:

We included both emergency and elective patients in our audit data collection. With consideration of shift patterns, weekends, and bank holidays we were able to audit PPI prescriptions and doses for 19 days to identify the number of unnecessary doses. We captured data on

- Patients' medical history and reason for admission
- Current dietary intake status (NBM, oral diet, NG gut protection or full established NG feed)
- Other medications which would increase risk of a stress ulcer (e.g. anti-platelets), as patients on these medications would still require PPI medication.
- Number of PPI doses given and administration method (IV, oral or NG)
- If each dose was necessary or unnecessary (as per the Critical Care Compendium-Stress Ulcer Prophylaxis Guide).

Environmental sustainability:

We listed all items used in administering 1 dose of IV pantoprazole, NG lansoprazole and oral lansoprazole (The most used PPIs in critical care at NGH). This included the actual drug and syringes, needles diluents, flushes and cleaning wipes. Using the cost per item, we applied emissions factors available from the Greener NHS database to identify the total CO2e attributed to administration method.

Table 4: Total C02e per single PPI dose

	Total Calculated KgC02e per item of dose	Total Calculated kgC02e of waste per dose	Total kgC02e per dose*
IV	0.662	0.0316	**0.6936**
Oral	0.129	0.000021	**0.129021**
NGT	0.427	0.0038764	**0.430876**

**While each administration method is associated with a different amount of kgCO2e per dose (as the medications are different prices and require different consumables), our data cannot be used to compare environmental impacts of different administration methods, which would require a process-based carbon footprint method, rather than a cost based analysis.*

Economic sustainability: The cost of individual consumables was sourced from the hospital procurement team and the cost of PPI medications from the pharmacy team. We weighed every consumable (including packaging) and applied the weight of each item to the corresponding waste disposal stream to identify cost savings from reduced waste disposal.

Social sustainability: Social impact was evident from when we started to collect our baseline audit information. Both medical and nursing colleagues were aware of the audit and therefore, anecdotally began paying more attention to PPIs and commenting they had reviewed the PPIs. Therefore, our baseline audit may reflect an underestimation of potential savings.

Staff feedback was gained via conversations with colleagues. Moving forward, we would like to create a survey to gain feedback from the multidisciplinary team on whether our project has raised awareness and/or improved confidence to question prescriptions (whether it be the route prescribed or de prescribing).

Clinical and health outcomes: It is too early to comment on whether the project has reduced incidence if poor health outcomes and CDI, however this is something we plan to measure with our changes fully embedded in liaison with the infection prevention and control (IPC) team.

Results:

Clinical and health outcomes:

As per our literature review, reducing the number of unnecessary doses or prolonged use of PPI's (without review), is likely to ensure patients are not put at any additional risk, and has the potential to reduce incidence of several negative health outcomes. This may increase quality of life for patients and reduce pressures on both community and acute health and social care systems. With all the benefits outlined this will positively affect the wider community.

Additionally, reducing incidence of CDI may decrease the use of antibiotics used to treat CDI, which may combat antibiotic overuse, a growing concern as suggested in the NHS Long-term Plan on antimicrobial resistance[13]. While it is too early to assess this, we plan to measure with our changes fully embedded in liaison with the infection prevention and control (IPC) team.

Environmental sustainability:

Our audit identified there are potentially a total of 2.8 doses of PPI given unnecessarily per day, equating to 21.221kgC02e saved during the 19 day audit period. Extrapolated across a year, with our changes implemented and embedded successfully, we anticipate a reduction of 414.263kg C02e. This is equivalent to 1,193 miles driven in an average car (1.7 return journeys from Northampton to Glasgow).

With the assumption that reduced unnecessary doses of PPI will reduce incidence of medical complications and infections such as CDI, there would be further environmental savings by reduced need to treat these, as well as potential for reducing length of hospital stay.

Social sustainability:

Nursing staff would gain valuable time from reduced medication administration, including time to collect the medication from the Omnicell, collecting the consumables, to locate a second nurse to

check the IV medication against the prescription and patient identity, to administer the medication, disposing of waste and lastly cleaning, hand washing etc. Reduced cases of illness and CDI associated with PPI medications may reduce nurse's workload and time spent caring for patients.

Whilst carrying out the audit, we explained to staff, doctors and patients (if they were awake), what we were doing and what we were hoping to identify and benefits that could be gained. Colleagues on critical care engaged in the project and showed an interest in the work we were doing. Staff were keen to learn more about the risks associated with prolonged PPI use and helped us to complete our baseline audit.

Our management team were also supportive of the project and potential benefits to patients, staff, and the environment. We were pleased to hear many colleagues agreed that PPIs often continue to be given to patients for longer periods than necessary. One colleague who recently joined the team from overseas commented that he was very glad to see this project take place and he used to see PPIs given unnecessarily back in his home country.

Anecdotally, we witnessed evidence of behavior change in our colleagues prior to implementation of any changes. As awareness of the audit and project grew, we noted that PPIs were being discontinued sooner than they would have been previously. In addition, a new gastroprotection guideline was introduced in the hospital which helps to gives guidance as to when a patient should be prescribed the PPI, giving clarity to the medical team.

We also discussed the project as part of a band 6 study day to communicate actions and projects taking place within critical care. This sparked lots of conversation and ideas to improve sustainability in many of other aspects of care. The matron for critical care has suggested we form our own 'Green team'.

Economic sustainability:

Based on our 19 day audit, we identified a potential cost saving of £131.07. Extrapolated across a year, critical care has the potential to save £2,237.16.

These financial savings are based upon the direct cost of the medication and consumables required to administer each type. Using the NHS Efficiency Map Tool 2019[13], this is a 'service productivity improvement' whereby there is potential to improve patient care in additional ways (e.g. by reducing side effects, etc.) and therefore making additional future cost savings. For example, if CDI infections are reduced, the resources used in managing infections such as faecal management systems, pads, wipes, syringes, needles, saline/water for injection and specialized pressure mattresses would not be needed.

The NHS led Clinical Commissioning Groups (CCG) fine hospital for high rates of CDI infection associated with a lapse in care. Reducing PPI medication and the risk of CDI infections, has potential cost savings from reductions in fines.

Barriers encountered:

Our audit happened to fall on the long bank holiday weekend which affected elective patient lists and therefore our data collection. We decided to extend our audit to ensure we were collecting data collection to obtain more accurate findings.

An added barrier we encountered was the audit and how data was completed by different individuals. This made some of the data interpretation complicated, for example, on occasion people forgot to specify the PPI the patient was receiving and just wrote yes. However, we extended our audit to ensure that we obtained enough data and fed back to the team about being more accurate when completing the audit.

Once medical staff became aware of the project, we noted behaviour change within the team which may have negatively influenced our baseline data collection. However, conversely this highlighted that our project promotion was good, and staff were more aware of the risks of PPI overuse which ultimately benefits patients, with changes made by the team before we specifically targeted awareness and behaviour change.

Conclusions:

We have successfully shown that financial, environmental and health outcomes can be positively influenced by closer monitoring and reduction of unnecessary PPI doses. In addition, we found that the potential savings were significant over a year's projection, with benefits that may reach staff, patients and the wider community.

A key element that contributed to success of the project has been positive staff engagement. While awareness during our audit influenced behaviour and may have led to an underestimation of the problem, ultimately behaviour change is the goal, and shows staff care about patients and want to improve their care. This is a positive indication that our planned changes to target staff awareness and behaviour will be very successful.

If repeating the audit, we would be more discreet during baseline data collection in order to not influence behaviour at the time. We would also seek further information on duration of the patient being nil by mouth (NBM). Prescription of PPI also needs to be considered, as some of our elective patients only remain NBM until they have been reviewed by the doctors the next day resulting in unnecessary doses. We will liaise with our Infection prevention and control team who recently worked with Nye Bevan ward to review PPI prescription and clinical need on admission to their ward enabled doctors to review patients admitted already taking a PPI. This could be adopted in critical care to improve review of PPI prescriptions, to help clarify if a patient requires a PPI and if it could be stopped prior to transfer from critical care. This will prevent patients being discharged from hospital on an unnecessary PPI.

We feel that this project would be excellent to cascade across the wards in the Trust, having greater patient numbers and perhaps being able to 'catch' those who have continued taking PPI on a longer-term basis. The data collection sheet is straight forward and not critical care specific, therefore making it readily transferrable to other departments.

Following on from the learning gained from this project we could consider focusing on other pharmaceuticals given in critical care. We administer numerous doses of IV paracetamol; however, this could be converted to an oral or nasogastric dose. There could be significant cost financial, social and carbon savings from carrying out a project in this area.

At NGH we have several platforms which enable us to promote and spark interest in these types of projects across the trust. The Quality Improvement team are very encouraging to support staff to carry out projects to help improve the quality of care we provide. We have access to rolling screensavers that would reach all areas within the trust to raise awareness. We could also use the weekly bulletins, senior nurse forums and shared decision-making groups which aim to give staff at all levels the autonomy to improve care. Our trust also has an excellent energy and sustainability manager, the 'Eco Ninja', who produces an inspirational monthly newsletter to all staff, which would be a perfect platform to promote project ideas that reduce unnecessary medication doses.

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Appendix 1: Financial cost, emissions factor and C02e per item used in administering a PPI dose.

	Item	Cost (£)	Emissions Factor	GHG emissions (kgC02e)
IV	IV Pantoprazole 40mg	3.26	0.127682	0.416
	Blunt fill needle	0.02	0.464916	0.0093
	10ml syringe	0.04	*	0.059
	water for injection	0.77	0.127682	0.0983
	prefilled saline	0.22	*	0.0466
	Clinell chlorhexidine wipe	0.01	*	0.328
	Total	£4.32		**0.662**
Oral	oral lansoprazole 30mg	0.96	0.127682	0.1226
	Paper tablet pot	0.015	0.464916	0.00697
	Total	£0.98		**0.12957**
NGT	Oral lansoprazole 30mg	0.96	0.127682	0.1226
	Single use purple syringe (50ml)	0.27	0.464916	0.1256
	White plastic cup	0.2	0.464916	0.093
	Sterile water	0.68	0.127682	0.086
	Total	£2.11		**0.4272**

Appendix 2: Breakdown of consumables by weight and waste stream.

	Item	Clinical Waste (g)	Domestic Waste (g)	Recycling (g)
IV	Pantoprazole vial	12g		
	Pantoprazole box			8g
	Blunt fill needle	1g		0.5g
	10ml syringe	5g		1g
	Water for Injection			5g +1g packaging
	Prefilled saline 10mls	11g		
	Clinell chlorhexidine wipe		1g	
	Total IV waste weight (per dose)	**29g**	**1g**	**15.5g**
Oral	Paper tablet pot			**1g**
	Total oral waste weight (per dose)			**1g**
NGT	Single use purple enteral 50ml syringe	36g		3g
	White plastic cup			1g
	sterile water 1litre bottle			96g
	Total NGT waste weight (per dose)	36g		100g

Appendix 3: Carbon emissions in kgC02e created by waste per single PPI dose

	Clinical waste (tonnes)	Clinical Waste emissions (kgC02e)	Domestic waste (tonnes)	Domestic waste emissions (kgC02e)	Recycling waste (tonnes)	recycling waste emissions (kgC02e)	Total waste emissions (kgC02e)
IV	0.000029	0.031146	0.000001	0.000172	0.0000155	0.0003255	0.0316435
Oral					0.000001	0.000001	0.000021
NGT	0.000036	0.038664			0.0001	0.0001	**0.038764**