

Cutting Costs and Carbon: The Case for Oral Paracetamol in Elective Surgery

I. Waters^{1,2}, L. Geoghegan³, I. Hauptfear⁴, A. Cafferkey¹, A. Sherwin¹.

1. Day Surgery Unit, Department of Surgery, Anaesthesia and Critical Care, St James's Hospital, James's St., Saint James, Dublin 8, Ireland.
2. Emergency Department, St James's Hospital, James' St., Saint James, Dublin 8, Ireland.
3. Intensive Care Unit, University College Hospital, Euston Rd., London, England, United Kingdom.
4. Department of Anaesthesiology, Washington University School of Medicine, St. Louis, Missouri, United States.

Abstract

Aim

IV paracetamol is approximately 10 times the cost and has 68 times higher carbon emissions compared to oral paracetamol (PO) however, it has been shown to be equally as effective. This paper aims to assess potential environmental and financial savings of an oral paracetamol switch in a large day surgery unit using a simple behaviour change intervention.

Methods

Charts were collected at random from the Day Surgery Unit over a four-week period. An education campaign was carried out aimed at Anaesthetic trainees and data was collected over a second four-week period. The proposed financial and carbon cost savings of the intervention were then calculated.

Results

The proportion of patients who received preoperative PO paracetamol significantly increased post-intervention, from 5% (2/40) to 24.4% (11/45) ($p=0.014$). Projected over a one-year period, we estimate that our intervention would save the hospital €188.04 and reduce carbon emissions by 54.53 kgCO₂e from elective day cases alone, without compromising patient safety.

Discussion/Conclusion

The education intervention led to a shift towards preoperative prescribing of oral paracetamol. The relatively simple intervention could be adapted and applied to other

settings in order to yield further cost and carbon emission savings, such as the main theatre, surgical wards, and the emergency department.

Introduction

Climate change is the greatest global health threat of the 21st century, and there is a call for transformative solutions that radically reduce the carbon footprint of the healthcare system¹.

The supply chain accounts for approximately 62% of healthcare's carbon emissions². This is a targetable area with innumerable opportunities for impactful change. Paracetamol is one of the most commonly used drugs worldwide. As its pharmacological properties become better understood, we should be striving to use it in a way that promotes patient safety and the wellbeing of our planet. There are significant potential financial and carbon savings associated with switching from intravenous to oral paracetamol, where clinically appropriate³.

Human health is dependent upon the health of the planet¹. Ironically, the healthcare industry is one of the greatest contributors to the climate emergency, contributing 5-15% national greenhouse gas emissions in developed countries⁴. The most substantial contribution to these emissions comes from procurement and supply chains (approximately 62% in the NHS), with the rest being attributed to delivery of care, and patient and staff travel². Within the supply chain, pharmaceuticals and chemicals are the most significant component, accounting for between 19-32% of total healthcare greenhouse gas emissions^{2,5}. An Emissions Baseline Report estimated the HSE's (Health Service Executive) annual total of greenhouse gas emissions was 881.9 ktCO₂e in 2019 with the largest contributions from Purchased Goods and Services and Waste Generated in Operations⁶. The HSE Climate Strategic Framework recommends prescribing oral paracetamol instead of intravenous where clinically appropriate, as one of the green initiatives introduced with the aim of meeting their commitment to net-zero by 2050⁷. Paracetamol is one of the most commonly used drugs in the world, accounting for 6% global pharmaceutical consumption, and is integral to perioperative pain control^{3,8}. The route of administration of paracetamol perioperatively has not been found to have any significant impact on pain control or any other surgical outcome³. Furthermore, it is estimated that IV paracetamol generates 68 times the carbon emissions of PO, and costs 10 times as much⁹. This includes estimated cost and emissions from packaging, disposal, and transport emissions but does not include other equipment required for intravenous administration for example the IV cannula and giving set which carry their own environmental impact. Intravenous paracetamol is available in both glass and plastic bottles with estimated carbon emissions of 0.193 kgCO₂e and 0.130 kgCO₂e per 1 g paracetamol. Considering the comparable bio-efficacy of the two formulations, and the strong evidence

behind a 'sip 'til send' policy in surgical centres, there are few clinical scenarios in which PO paracetamol is contraindicated preoperatively ¹⁰.

Nudging is an evidence-based technique used to influence prescriber behaviour and has been successfully used to increase generic prescribing and reduce unnecessary antibiotic use¹¹. This audit aimed to assess change in prevalence of PO versus IV paracetamol prescribing for elective day case procedures following a suite of nudging techniques to increase adherence amongst anaesthesiology doctors.

Methods

A chart review was conducted in the Day Surgery Unit (DSU) of a large tertiary referral centre to capture the pattern of paracetamol prescribing perioperatively for elective day surgery cases. Charts were selected at random over a four-week period and the following data was collected from the kardexes; preoperative paracetamol dose prescribed (yes / no), intraoperative paracetamol dose given (yes / no), and postoperative paracetamol dose given (yes / no). Other analgesics prescribed intraoperatively and postoperatively were also noted. Patients who did not receive general anaesthetic were excluded. This pre-intervention cohort included 40 patients.

An education campaign then took place, primarily aimed at anaesthetic trainee doctors as well as clinical nurse managers and consultants. The campaign was targeted at the non-consultant hospital doctor changeover period in January 2024. The campaign involved posters, messages into anaesthetic doctors' text groups, and engagement with important stakeholders such as the nurse managers of the DSU and the hospital's Medical Board. It also involved changing the pre-operative kardex from suggesting IV paracetamol by default, to having both an option for IV and PO. Following this campaign, the charts were re-audited with the same parameters as above. 45 patients were included in the post-intervention cohort.

The results of the study were analysed using non-parametric methods to determine the significance of the intervention. Based on these results, the estimated cost and carbon savings for the hospital if the behaviour was to continue for a one-year period were calculated.

Results

The number of patients prescribed preoperative oral paracetamol increased from 5% to 24.4% post-intervention which was statistically significant ($p=0.014$) [Table 1]. None of these patients were prescribed an intraoperative IV dose. The reduction in patients prescribed intraoperative IV paracetamol, 82.5% pre-intervention to 75.6% post-intervention, was not statistically significant. This was due to a reduction in patients who were not prescribed any

paracetamol preoperatively or intraoperatively. Overall, there was a statistically significant change in the prescribing patterns of paracetamol administration routes before and after the intervention period ($p=0.018$).

The DSU in St James's Hospital performed 1,477 elective surgeries in 2024. Projected over a one-year period, we estimate that our intervention would save the hospital €188.04 and reduce carbon emissions by 54.53 kgCO₂e from elective day cases alone (based on estimated cost of €0.03 per 1 g oral paracetamol vs. €0.67 per 1 g IV and carbon emissions of 0.193 kgCO₂e for IV paracetamol (glass bottle) and 0.003 kgCO₂e for oral paracetamol)^{12, 9}. In total, St James's Hospital uses 87,367 units of IV paracetamol annually. If two thirds of these patients were prescribed PO instead of IV, €37,152.60 and 11,070 kgCO₂e would be saved each year, based on figures used in a similar study by NHS Scotland¹². If an oral paracetamol switch was adopted across other hospital departments, substantial reductions in both costs and carbon emissions could be made.

Discussion

The behaviour change intervention was successful in influencing the decisions of the prescriber regarding the route of administration of paracetamol. However, the large majority of cases were still receiving IV paracetamol over PO. A study by the National Green Theatres Programme estimated that if IV paracetamol use was reduced by 70%, there is the potential for NHS Scotland to save £53,000 and 38 tonnes of carbon¹². The HSE Ireland has committed to net-zero emissions by 2050, and one of the strategic objectives in their Climate Action Strategy is to 'work in consultation with key supply chain and product partners to include sustainability criteria in all tender procurement processes and establish a credible decarbonisation trajectory'⁴. Given the findings of the NHS Scotland study, targeting paracetamol use in hospitals would potentially be an effective way for the HSE to decarbonise healthcare procurement.

Despite our educational intervention, prescribing rates of PO paracetamol preoperatively remained relatively low. The education campaign could be more successful and yield more long-term benefits if the audit cycle were to be repeated. A member of the study team could be present when patients are being clerked on arrival in the Day Surgery Unit in order to remind and guide prescribers about the benefits of PO paracetamol, without withholding the option to prescribe IV if necessary. This is known as 'choice architecture' and is an integral part of a successful nudge in a health system¹³. Introducing an electronic prompt to consider PO paracetamol if appropriate could be a useful aide memoir for prescribers. However, approval for such prompts can take several months so was not feasible within the time constraints of this study.

This study did not capture whether the cases had a specific contraindication to PO paracetamol or not. A repeat study in which the proportion of patients prescribed IV over PO by clinical necessity were identified could establish a more precise picture of unnecessary IV paracetamol use in this centre. Following on from this, a protocol for paracetamol prescribing for elective surgical cases could be developed. Furthermore, this study did not examine the carbon emissions and cost of manufacturing or clinical waste disposal associated with the different forms of paracetamol. Given there is an approximately 12 times the carbon emissions associated with the life cycle of IV vs. PO paracetamol, this information would undoubtedly add valuable savings to our data if included⁵.

It should be noted that though this study was carried out in an elective day surgery unit, it is a template project that could be repeated in main theatre, surgical and medical day wards, and the emergency department. If a significant IV to PO switch occurred in all of these settings, given all of the above evidence and the results of our study, the potential cost and carbon savings could be remarkable.

The Royal College of Surgeons Edinburgh recently published the Intercollegiate Green Theatre checklist with recommendations divided into four sections (anaesthesia, preoperative, intraoperative, and postoperative) for physicians to reduce carbon emissions in the perioperative setting¹⁴. There is a focus on avoiding unnecessary medication administration in the pre -, intra-, and post-operative stages. This is an evolving checklist which will be updated as new evidence emerges. It may be helpful to suggest considering alternative routes of medication administration if clinically appropriate to remind prescribers of the environmental impact associated with the intravenous route.

The education of anaesthetic trainees led to a shift towards preoperative prescribing of oral paracetamol rather than intraoperative intravenous paracetamol. The intervention was found to yield significant cost and carbon savings, with no compromise of patient care. Further education to other members of the multidisciplinary team involved in perioperative management and increased efforts at nudging to improve uptake of PO paracetamol prescribing may increase the shift in IV to PO. The intervention we carried out could be adapted and applied to other settings in order to yield further benefits, such as the main theatre, surgical wards, and the emergency department.

Declarations of Conflicts of Interest:

None declared.

Corresponding author:

Isabel Waters,
Emergency Department,

St James's Hospital,
James's St.,
Saint James,
Dublin 8,
Ireland.

E-Mail: watersi@tcd.ie

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Appendix:

Table 1

	Preoperative PO	Intraoperative IV	Neither	Route not documented	
Pre intervention (n=40)	2	33	4	1	40
Post intervention (n=45)	11	34	0	0	45
	13	67	4	1	85