The Centre for Sustainable Healthcare

Estimating the Carbon Footprint of Unnecessary IV Cannulation in England

Topic Area

Adaptation	☐	Communications and engagement	☐	Estates and facilities (energy, waste, water)	☐	Food, catering and nutrition	☐
Funding and financial mechanisms	☐	Medicines	☐	Research, innovation and offsetting	☐	Strategic ambition	☐
Supply chain and procurement	☒	Sustainable models of care	☒	Travel and transport	☐	Workforce, networks and system leadership	☐
Green/blue space and biodiversity	☐	Digital transformation	☐	Sustainability education	☐		
Other (please specify):							

**Topics aligned with the 12 Greener NHS workstreams (NHS England) are shaded.*

Aim

To estimate the carbon footprint of unnecessary cannulation in England.

What was the problem?

In 2019 the NHS carbon footprint was calculated at 25 megatonnes of carbon dioxide equivalents (CO2e). The supply chain was responsible for 62% of these GHG emissions and generates a substantial amount of non-recyclable waste[i]. Annually, the NHS creates 133,000 tonnes of plastic waste, with only 5% of it being recyclable[ii]. To support the NHS in achieving net zero by 2045 and reduce its contribution to plastic pollution, it is important to start tackling the environmental impact of goods purchased and used by the healthcare sector.

IV cannulation is a commonly performed invasive procedure, with as many as 70% of patients being cannulated[iii]. However, many studies suggest that not all cannulations are necessary with various

evidence showing between 30% and 56% of cannulations are unused[iv,v]. Similarly, one study found that 45% of patients admitted to a ward with an unused ED cannula remained unused at 72 hours post-admission[vi].

Methods

This study was based on a single cannulation using the following items: 1x cannula, 1x disposable tourniquet, 2x 5ml saline flush, 2x 10ml plastic syringe, gauze dressing, 2x non-sterile gloves and 2x alcohol wipes.

The carbon footprint of each individual item was undertaken in 2021 and estimated using a hybrid carbon footprinting methodology. The majority of the carbon footprint was based on a process-based carbon footprinting analysis. However, for the saline flush, the data to carry out a process-based carbon footprint analysis was not available. In this case, environmental input-output analysis was used based on the SDU carbon emissions factor for pharmaceuticals.

The carbon footprint of the cannula, plastic syringe, disposable tourniquet, alcohol wipes and gauze dressing was estimated using a cradle-to-grave process-based carbon footprinting analysis, looking at the extraction of the raw materials, packaging, transport and waste. Manufacturing of primary products into the actual items was excluded from the scope due to data availability. A 2021 study from C Rizan, M Reed and M Bhutta estimating the carbon footprint of PPE was used to provide the carbon footprint of the non-sterile gloves within this report[vii]. Shipping distances were calculated using the Pier2Pier tool and road distances with Google Maps. Waste disposal factors were taken from Rizan et al 2021[viii] and material conversion factors were taken from the 2020 BEIS Government Greenhouse Gas Conversion Factors for Company Reporting[ix] and the ICE database[x].

What were the results/Impact?

The carbon footprint of an IV cannulation was estimated to be 416g carbon dioxide equivalents (gCO_2e).

The two 10ml plastic syringes are the largest contributor to the carbon footprint of the cannulation process with 118 gCO_2e (28%). The two alcohol wipes are the second largest contributor adding 66 gCO_2e (16%). Non-sterile gloves contribute 52 gCO_2e (13%), disposable tourniquet adds 47 gCO_2e (11%), saline flush adds 47 gCO_2e (11%), the cannula 46 gCO_2e (11%) and the gauze dressing 41 gCO_2e (10%) (Figure 1)

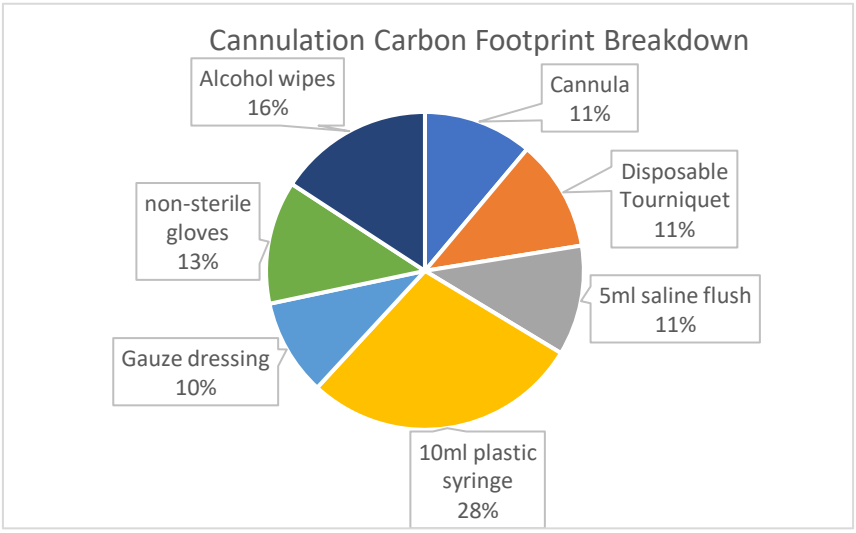

Figure 1: Cannulation carbon footprint breakdown

In 2021/22 there were 16.6 million A&E attendance in England[xi]. If 70% of these attendances required at least one cannulation and 45% were unnecessary, the total GHG emissions would be estimated at 2,175.26 tonnes CO_2e. Reducing the amount of unnecessary cannulation in ED would not only support the NHS in reducing its supply chain emissions but could also save money, reduce staff time, and have patient benefits.

Want to know more?

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- Location & NHS Region if within the UK: Centre for Sustainable Healthcare
- Has this project or story been made public in any form before? Yes/ No This was undertaken as part of a larger project completed in 2021.

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[i] Tennison I, Roschnik S, Ashby B, et al. Health care's response to climate change: a carbon footprint assessment of the NHS in England. *Lancet Planet Health*. 2021;5(2):e84-e92. Health care's response to climate change: a carbon footprint assessment of the NHS in England - The Lancet Planetary Health

[ii] The plastic pandemic: could the environmental impact of the NHS response to covid-19 be reduced? - The BMJ

[iii] Cooke M, Ullman AJ, Ray-Barruel G, Wallis M, Corley A, Rickard CM. Not "just" an intravenous line: Consumer perspectives on peripheral intravenous cannulation (PIVC). An international cross-sectional survey of 25 countries. PLoS One. 2018 Feb 28;13(2):e0193436.

[iv] 30% of emergency patient cannulas unnecessary (hospitalhealth.com.au)

[v] green-team-cannulation.pdf (royaldevon.nhs.uk)

[vi] Limm E, Fang Z, Dendle C, Stuart R, Egerton-Warburton D. Half of all peripheral intravenous lines in an Australian tertiary emergency department are unused: pain with no gain? *Ann. Emerg. Med.* 2013; doi: 10.1016/j.annemergmed.2013.02.022.

[vii] Rizan C, Reed M, Bhutta MF. Environmental impact of personal protective equipment distributed for use by health and social care services in England in the first six months of the COVID-19 pandemic. *Journal of the Royal Society of Medicine*. 2021;114(5):250-263. doi:10.1177/01410768211001583

[viii] Chantelle Rizan, Mahmood F. Bhutta, Malcom Reed, Rob Lillywhite, The carbon footprint of waste streams in a UK hospital, Journal of Cleaner Production, Volume 286, 2021, 125446, The carbon footprint of waste streams in a UK hospital - ScienceDirect

[ix] 2020 BEIS Government Greenhouse Gas Conversion Factors for Company Reporting. Government conversion factors for company reporting of greenhouse gas emissions - GOV.UK (www.gov.uk)

[x] The Inventory of Carbon & Energy database. Embodied Carbon Footprint Database - Circular Ecology

[xi] NHS digital. 2021-22.. Hospital Accident & Emergency Activity 2021-22 - NDRS (digital.nhs.uk)

Picture credit: Devon ED Green Team Competition 2018. green-team-cannulation.pdf (royaldevon.nhs.uk)