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VIEWPOINT

Recyclable and contaminated waste from cardiac procedures: a call to action for a sustainable catheterisation laboratory and operating theatre

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Globally, healthcare produces 4% to 5% of the greenhouse gas (GHG) emissions, with a predicted 3-fold increase by 2050[1]. The exponential growth of medical waste contributes to global carbon emissions and poses a significant challenge to environmental sustainability[2]. Hospitals contribute disproportionately to a substantial carbon footprint, especially in energy intensive areas such as radiology suites, operating rooms, and cardiac catheterisation laboratories (CCLs). The number of cardiac procedures worldwide is increasing, with expanding medical facilities to cater for a growing population. Scarce attention has been given to quantifying and reducing waste from CCLs and cardiac operating theatres (COTs) to help lower the carbon footprint[3].

Our CCLs and COTs have a routine waste management protocol in place: all contaminated waste gets collected in designated "yellow" bags, gets shredded, autoclaved, and then placed in disposal bags that go to landfills. Incineration of contaminated waste is another disposal route. Non-contaminated waste including paper, plastics, and cardboard boxes (packaging from balloon catheters, stents, guides etc.) are collected in "green" bags. All this potentially recyclable waste goes to landfills due to the lack of an established recycling programme.

A considerable quantity of waste is produced by invasive cardiac procedures, with increasing amounts generated as the procedural complexity rises, dictated by patient characteristics and comorbidities. We have noticed the least amount of waste with diagnostic angiography, followed incrementally by percutaneous coronary interventions (PCIs) and then more complex PCI involving intravascular imaging and plaque modification techniques. Chronic total occlusion PCI produces the largest amount of PCI-related waste. The highest volumes among all cardiac procedures at our institution are produced during structural interventions and coronary artery bypass graft surgeries, with valve repair or replacement.

The amount of cardiac procedure-related waste in our daily practice can be extrapolated to all CCL and COT procedures performed globally (roughly 5 million CCL procedures, including 250,000 transcatheter aortic valve replacements and 1.3 million COT procedures annually)[4]. This indicates that an enormous amount of waste is produced worldwide, of which a sizeable amount is potentially recyclable. Few studies have attempted to quantify the amount of waste that is produced from cardiac procedures. Doshi et al[2] quantified the amount of recyclable waste and noted more recyclable waste with a PCI (1.4 kg) compared to a diagnostic right heart study (0.7 kg). A Stanford team noted 15% recyclable waste per procedure, which would amount to 12 tonnes of material diverted from landfills annually[5].

Sustainability is an important issue that requires prompt attention, new learning and swift action from all interventionists and cardiac surgeons. Defining the problem, its causes, and potential solutions are the first steps in this process. Sustainability means taking measures to reduce carbon emissions and other gases that result in global warming and climate change, reducing material consumption, conserving resources, and improving waste management. Carbon dioxide (CO_2), nitrous oxide, methane and fluorinated gases are GHGs that leave a climate footprint that is measured in CO_2 equivalent (CO_2e). The global healthcare sector produces 2 gigatonnes of CO_2e annually, equivalent to 4.4% of the net global emissions, and ranks as the 5th largest emitting entity on the planet. As a perspective, this is equivalent to 514 coal-fired powerplants GHG emissions over a year. The USA, China and the EU are responsible for more than half of this carbon footprint[1].

The sources of the healthcare climate footprint arise from 3 scopes. Scope 1 refers to direct emissions from healthcare facilities (HCFs), accounting for one-fifth of

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GHGs. Scope 2 is indirect emissions from purchased energy sources used to run HCFs (one-tenth of GHGs). Scope 3 refers to the healthcare supply chain involved in production, transport, use, and disposal of goods required by HCFs, including food, hospital equipment, medications, instruments, and medical devices. This carbon-intensive supply chain accounts for three-quarters of the GHG emissions. Up to one-quarter of scope 3 emissions are produced overseas by external supply chains. Agriculture and food provision, pharmaceuticals, and transport account for 9%, 5%, and 7%, respectively, of the GHG emissions. Waste management, including incineration or autoclaving of contaminated waste, and healthcare solid waste that finds its way to landfills, accounts for 3% of the GHG emissions. Lastly, metered dose inhalers used in asthma, which have hydrofluorocarbons as propellants, and the anaesthetic gases, which use nitrous oxide and fluorinated gases, account for 1% of the healthcare GHG emissions. Overall, fossil fuel consumption accounts for half of the carbon footprint across all measured scopes[1].

Several countries have taken steps to lower healthcare emissions with the Paris Agreement goal of achieving net zero emissions by 2050. This demands decarbonisation across all 3 scopes, transition to renewable energy, and an emphasis on the healthcare supply chain, with engagement of suppliers and manufacturers for low carbon procurement of products and operations. "Reduce, reuse, and recycle" are applicable for implementation in all cardiac services[3].

1. Reduce wastage by removing non-essential items included in procedural kits. Avoid "opened but not used" items, loss of expired items due to inventory mismanagement, and water and paper wastefulness. Replace diagnostic angiography with computed tomography angiography or ischaemia testing if indicated. A repository of near-expiry items for preferential use helps to avoid wastage.
2. Reuse items that are safe to resterilise after appropriate infection control clearance. Sterile single-use items, such as catheters, balloons, manifolds, and syringes, cannot be reused, but many metal instruments and plastic bowls are reusable. Reusable blood pressure cuffs and pulse-oximeters are also preferred.
3. Recycle 100% of the uncontaminated paper, plastic, and cardboard boxes from cardiac procedures. There needs to be a streamlined segregation of this recyclable waste and an appropriate waste management strategy that diverts these materials away from landfills.

Implementing these practical principles is the first step in our goal towards sustainable cardiac services in the catheterisation laboratory and the operating theatre.

More studies are needed to quantify the volume of contaminated waste, the amount of recyclable waste, and the impact of recycling as it pertains to invasive cardiac procedures. A cost-effective recycling strategy for uncontaminated waste would decrease landfills and GHG emissions. Establishing a CCL and COT sustainability team, with baseline waste audits and the identification of ways to implement the "reduce, reuse and recycle" mantra are practical steps that we can all take to help our planet.

"*Patience with small details makes perfect a large work, like the universe.*" Rumi.

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Conflict of interest statement

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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