From big hands to green fingers: it is time for a change

It has been generally accepted that—apart from a possible natural shift through variations in the solar cycle—human activities are the main driver of climate change. CO2 and other greenhouse gas (GHG) emissions are by far the largest contributor to global climate change.

Health care is a surprisingly large source of these GHG, accounting for some 5% of global CO2 emissions. In the USA, it is even 10% [1].

An estimated 70% comes from the supply chain and the energy to manufacture, ship and dispose medical equipment, plastic packaging and pharmaceuticals used by our hospitals every day [1].

It has been estimated that each year in the USA, health damage from these pollutants produced by the health care system is estimated at 4,70,000 years of life lost from pollution-related disease [2].

A fundamental credo of health care practice is ‘first do no harm’, but ironically, our practice itself causes significant pollution and consequently indirect adverse effects on public health.

Aside from this tremendous emissions footprint, health care is also one of the largest waste-producing sectors. Generating over four billion pounds of waste each year, the health care system in the USA is the second largest contributor of trash with one-third produced by operating rooms [3]. The Dutch artist, Maria Koijck displayed the amount of waste created for one procedure: her own procedure of breast reconstruction after breast cancer. The image of herself between this waste is truly powerful (Fig. 1). The video she created of the making of this picture is gripping and went instantly viral in 2021: https://www.youtube.com/watch?v=w28M7wjIr6E.

Orthopaedic surgeons have a particularly resource-intensive field. We require the strictest ‘energy-intensive’ operating theatre ventilation standards and have an intrinsic anxiety for everything that could contaminate our workspace. This results in extra surgical drapes, antibiotics, rinsing, disinfectants and whatever else we have protocolised. And think of all the single-use items, plastic wrappers, gowns, drapes and covers that we use.

A hip arthroscopy for femoroacetabular impingement produces an average of 9.4 kg of waste [4]. A standard primary total knee replacement (TKR) generates approximately 14 kg of waste [5].

Many of our products are disposable. Some of them have dramatically improved the quality of care. We cannot imagine having to use reusable gauzes, needles or gloves. However, there are surely more environmentally friendly alternatives for some products, such as gowns, drapes, single-use instruments or even complete disposable instrument sets.

Mahatma Gandhi once said, ‘If you want to change the world start with yourself’. This certainly applies to climate change.

On a global scale, we rely on international initiatives such as the Paris Agreement, phasing out fossil energy. On a national scale, we rely on our governments to push for progress in renewable energy sources, reduce GHG emissions, take initiatives toward greener transportation, encourage good insulation of buildings, etc. Many hospitals already take initiatives to reduce waste and reduce CO2 emissions.

But all of us have the authority to bring forth positive changes as of tomorrow. We all can take our energy, effort and practices to the ‘operating’ table. ‘Twenty-five years ago people could be excused for not knowing
much, or doing much, about climate change. Today we have no excuse’. (Desmond Tutu) [6].

Many hospitals already have installed ‘an OR green team’. If your hospital does not have one, then we would encourage you to take the initiative to do so. There are several practical examples you can incorporate to make your next procedure greener and the planet more sustainable. A recent systematic review [7] identified five simple actions.

1. Waste reduction by recycling, reuse and reprocessing

- **Refuse** to use disposable (single-use) instruments.
- **Reduce** the instruments on your standard trays (only use what is necessary), switch to Reusable gowns, drapes and cotton OR towels. New ‘closed waste management systems’ collect and dispose surgical waste fluid, making the plastic containers unnecessary.
- **Repurpose** is also referred to as upcycling; try to think of different uses for the product you are discarding. And lastly, **Recycle**, which goes hand in hand with maximising waste segregation.

- ‘Overage’ is the term used for items opened and/or prepared for an operation but not used. Attempts to reduce overage have been made in routine hand surgery with the development of minimal packs of key surgical instruments. This resulted in a 55% reduction in instrument costs and a 13% reduction in waste [8]. It seems this approach can be easily copied for most other orthopaedic procedures.

2. Waste reduction by segregation

Waste destruction processes generate high GHG emissions. In the OR, there are two types of waste: regulated medical waste (RMW) and domestic waste. RMW is health care-related waste with the potential to spread diseases through blood or other types of contamination. RMW disposal is highly regulated, requires more energy, and is more costly. Educating health care workers in proper segregation increases the weight of recyclable materials and decreases the weight of RMW. Segregation bins on the OR together with education and, ideally, a colour labelling of products will help to improve waste segregation [9].

3. Sterilisation

- **Refuse** to use single-use instruments and ask for proper alternatives.
- **Redesign** the procedure trays to include only the instruments necessary to perform a safe procedure including emergencies. Perhaps, developing an ‘escape set’ to be opened for procedures that are more challenging.
- Single-use polypropylene packaging (blue wrap) for sterilisation of surgical instruments generates serious plastic waste, estimated at 115 million Kg per year in the USA alone. Rigid sterilisation containers (RSCs) are a proven and tested alternative. In general, these types of containers have 85% less environmental impact in carbon footprint [10].

4. Anaesthesia gas management

Talk with your anaesthesiologist. Preferably and if possible use locoregional or spinal anaesthesia. Anaesthetic gases have a strong greenhouse effect. If general anaesthesia is necessary, use intravenous medication. When anaesthetic gas has to be used, avoid desflurane, isoflurane and nitric oxygen, as well as use sevoflurane instead. From all anaesthetic gases, sevoflurane has the smallest cradle-to-grave footprint [11]. Other tips from anaesthesiologists are pausing gas flow during intubation and using low-flow anaesthesia (<1 L/min) and low-fresh gas flow of sevoflurane induction in children [12].

5. Improvement of energy use

Explore the option and if possible reduce airflow rates overnight and in the weekends. Heating, ventilation and air conditioning (HVAC) thermal energy systems comprise 90–99% of overall energy use in the OR [13]. Reduce the total of stand-by operation theatres for emergencies to the safest minimum. Ask your hospital technician what the air flow start-up time of the theatre is. It is probably shorter than the delay between the request for an emergency theatre and the patient arriving in the OR.
The gold standard is the use of laminar flow for arthroplasty surgery. Although this has been questioned recently in a NICE review, drawing no firm conclusion on the use of ultra-clean air (laminar flow) from the available evidence [14]. Still, very few arthroplasty surgeons would be willing to operate in a non-laminar flow theatre, as guidelines do still advise them to use it. However, almost all other orthopaedic surgeries can definitely be safely performed without this. This certainly applies to arthroscopic surgery, ‘the solution to pollution is dilution’.

Use LED lights and motion sensors and turn off (medical) devices at the end of the day. It is a persistent myth that computers use more energy to restart than just remain in sleep mode. Turning off the computers, lights and other devices at the end of the day saves energy.

These are just a few examples and fortunately there are many more. Some you can implement yourself and straight away and for others such as reusable gowns and drapes you need to involve the hospital management. But remember that you are the captain on the ship. You have the authority to do it and for an excellent reason. Have a firm discussion with your anaesthetiologist tomorrow. Ultimately, the greenest procedure is the unnecessary procedure that is not performed. It has been estimated that 30% of surgical interventions are unnecessary [15]. Think about it when you are considering to schedule your future patients for surgery [16].

In 2022, the first ‘net zero’ operation was performed at the Solihull Hospital in the UK. To do so, the entire team made adjustment to their standard practice (many of which we have mentioned above), and at the end of the operation, the carbon output was reduced by almost 80%. To be truly ‘net zero’, the remaining output was offset through a variety of carbon compensation projects, including the planting of some trees on the hospital grounds.

Remembering the words of Gathorne Robert Girdlestone: ‘the bone is a plant with its roots in the soft tissue and what it requires for its welfare are the skills of a gardener rather than those of a cabinet maker.’ Now is the time to show orthopaedic surgeons not only have strong hands but green fingers too! [17].

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References


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