News & Opinion

Beyond the bedside, into the bloodstream: microplastics pollution and hospital waste management

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Abbreviations

PPE – personal protective equipment
PVC – polyvinylchloride

Introduction

Concerns about our planet's health have turned our attention to our use of plastic and how dependent we are on it. This mass attention is evidenced by the popularity of the recent Glasgow Climate Pact agreement and is reflected in the increased posts created about the United Nations Climate Conference (COP), which is the decision making body of the UNFCCC (United Nations Framework Convention on Climate Change).[1] Viral media has demonstrated the devastating effects of single-use plastics and general plastic overproduction on our environment. It has caused huge concern in how we dispose of plastic and what implications it can cause. Now all industries and service sectors, including healthcare, are being criticised. They protest for the need for mitigation of waste disposal and management in hospitals to be improved so that they can be more environmentally friendly.

Recent evidence has shown that 75% of all waste and debris in the ocean consists of plastic.[2] This undoubtedly has detrimental effects that can disrupt the careful balance of biological ecosystems and indirectly affect global human populations' health. Therefore, it is imperative that hospitals should consider plans to effectively manage plastic as 30% of all waste from hospitals consists of plastic.[3]

Why plastics?

There are many variations of plastic used within the medical field with the most common being polyvinylchloride (PVC). PVC is flexible and inert to chemical reactions; therefore, its properties are essential in equipment such as face masks, bags for IV and infusion tubes.[4] It further demonstrates its suitability as a key material for healthcare as it is able to be sterilised via gamma radiation. This method has the highest certainty to cause sterility compared to other sterilisation options.[5] Therefore, it provides the highest guarantee to maintain patient safety through minimising the risk of infections. This is important as not all materials can be sterilised this way but fortunately plastics can.

The complications

However, this method of sterilisation has its drawbacks and has the potential to cause harm in patients. Gamma radiation has been shown to change the structure of medical devices that consist of polymer[5] which includes PVC. This can cause unintended side effects of the equipment that can lead to malfunction or degradation of the product. Furthermore, PVC from hospitals and other plastics can be difficult to recycle due to the plastic being used in equipment that is in contact with potentially infectious substances.

With the way the plastics are used such as catheters or tubing inserted into humans, it causes it to be unsuitable for recycling. This is because of its exposure to human tissue, including blood.[3] The exposure makes recycling this plastic an issue of infection control and safety

of public health. Therefore, other methods are favoured instead such as landfill. The NHS long term plan has identified this and states that in 2016 to 2017, 15% of its wastes were sent into landfill,[6] which is a statistic it is hoping to reduce. Whilst landfill remains one option to dispose of plastic, incineration is also used in combination.

Incineration of plastics itself causes the release of toxic gases and, more specifically to PVC, can cause the release of halogens which contribute to climate change and reduced air quality.[7] The reduction in air quality may lead to respiratory diseases to population around the world and therefore would be inadvisable for healthcare systems to use this method. However, the incineration process is still used and leaves a residue called bottom ash. Bottom ashes are disposed of into landfill sites, where both burnt and unburnt plastics can leach into open water systems and introduce microplastics.[8]

Microplastics are defined as plastics consisting of polymer that have a diameter smaller than 5mm[9] and have been recorded to have been found in marine life. In areas of Brazil, 18% to 33% of catfish have been found with plastic debris within their system.[7] If consumed, microplastics can be introduced to the person leading to damage to most organ systems. More specifically, it damages blood vessels and causes atherosclerosis.[9] This may lead to increased cases of health problems such as higher blood pressure, and hence increases in the the number of individuals visiting hospitals. Samples taken from across 15 patients have detected 9 different types of microplastics with the largest being 469µm.[10] Although not all heart samples showed plastics, the detection of these plastics highlights future health complications that healthcare systems will have to face. Therefore, it is in the hospitals' best interest to manage plastic waste effectively. This is not only due to the negative health effects of microplastics on global populations, but also their potential to increase the already overwhelming volume of patients needing to be seen.

Reducing, reusing and repurposing

Recycling single-use plastics currently seem unfavourable for medical environments. However, other methods of plastic management have been seen to be effective. In the US, tonsillectomy packaging and equipment have been reduced from 40 disposable items to 28.[11] This demonstrates that plastic usage can be minimised without compromising patient safety, and removing 12 pieces of unnecessary packaging is significant across many surgeries. Not only is this method effective in waste management but it can also help a hospital's budget as the cost of tonsils packs was reduced by USD$11.25.[11] This study should showcase the incentive for more studies to be conducted on other surgeries. There is the possibility to identify further unnecessary plastic which can help reduce spending and decrease contribution to landfills and incinerators.

Improving on how healthcare is delivered can also reduce the waste of equipment. Greener NHS has identified that in a hospital, 40% of cannulated patients did not require the use of the cannula for their treatment which led to an extra 24,000 kg CO2 per year.[12] Not only has this impacted the environment and cost a portion of the budget, but it has also affected patient care. Cannulating a patient when not needed puts the individual through extra unnecessary pain and discomfort, which does not reflect a hospital's value of causing the least amount of harm to a patient. The solution would be to challenge this behaviour and raise awareness,[12] which is a method that requires little to no budgeting and focuses on teamwork and communication.

Another approach to manage plastic usage is swaying away from single-use plastics and prioritising reusability. An example is a switch from paper pulp trays to plastic. An observation has demonstrated in favour of plastic trays compared to paper pulp trays as they are more environmentally friendly. This change has an initial higher CO2 emission to produce plastic trays, but in a larger time frame it proves to produce less CO2 due to the constant incineration of the pulp trays compared to the plastic trays.[13] Another incentive is the monetary benefits; an analysis states that only £10,500 would be needed to replace all paper pulp trays compared to £14,000 to constantly produce paper pulp trays.[13]

Due to plastic's wide range of properties, innovators have found ways to repurpose its attributes. An example would be from the COVID-19 pandemic which led to a large insurgency of personal protective equipment (PPE) waste, especially masks. The masks, instead of being disposed of, have been found to be useful in the production of concrete and can be processed to be incorporated into the mixture. It provides extra resistance to fires and can create more time before the concrete explodes from extreme heat.[14] Though the process of turning the masks into a suitable ingredient for concrete mixture may produce CO2 emissions, it avoids the plastic from being dumped into landfills and incinerators.

Conclusion

To conclude, this paper has identified both the positives and negatives of plastic. For example, how plastics can contribute to a destructive process that directly affects the environment, such as when they are disposed of in landfill sites or incinerated. It is also important to recognise the clear correlation between environmental health and human health. Through several methods of plastic disposal, it has an indirect effect on people's bodies. As hospitals' goals include reducing diseases, it is contradictory to perform actions that harm people's health.

On the other hand, plastic proves itself to be a key material for maintaining a sterile environment within healthcare settings, which maintains the important goal of patient safety. It is also difficult to deny the countless benefits plastic provides, especially when in certain cases it can help reduce our emissions through reducing paper waste, as plastic is reusable.

From the analysis of all information provided from the articles referenced, the issues identified do not lie within plastic as a material itself but rather in how plastic is managed. Hospitals require close monitoring of where their waste is disposed and to improve communication with waste removal services. Healthcare systems would also benefit from re-evaluating packaging in all levels of care, as when time and resources are allocated, significant improvements can be made. These not only benefit the environment but have been proven to provide monetary benefits. Reducing costs in one aspect means that funds can be redistributed to other sectors that desperately require funding.

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Soren Gurung is a medical student at the University of Plymouth who is interested in tackling the negative environmental effects the healthcare industry can have. They take particular interest in what larger companies and smaller communities can do to help become more environmentally sustainable.

Other notable interests they have are in plastic surgery and the mechanism behind beauty standards within that industry. Soren currently plans to create further research behind this and the phenomenon of "euro-centricty". They also have curiosity in dermatology, which he wishes to produce literature on in the future.