

Article

Single-use plastic and COVID-19 in the NHS: Barriers and opportunities

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Abstract

Background: Single-use personal protective equipment (PPE) has been essential to protect healthcare workers during the COVID-19 pandemic. However, intensified use of PPE could counteract the previous efforts made by the UK NHS Trusts to reduce their plastic footprint.

Design and methods: In this study, we conducted an in-depth case study in the Royal Cornwall Hospitals NHS Trust to investigate plastic-related issues in a typical NHS Trust before, during and after the pandemic. We first collected hospital routine data on both procurement and usage of single-use PPE (including face masks, aprons, and gowns) for the time period between April 2019 and August 2020. We then interviewed 12 hospital staff across a wide remit, from senior managers to consultants, nurses and catering staff, to gather qualitative evidence on the overall impact of COVID-19 on the Trust regarding plastic use.

Results: We found that although COVID-19 had increased the procurement and the use of single-use plastic substantially during the pandemic, it did not appear to have changed the focus of the hospital on implementing measures to reduce single-use plastic in the long term. We then discussed the barriers and opportunities to tackle plastic issues within the NHS in the post-COVID world, for example, a circular healthcare model.

Conclusion: Investment is needed in technologies and processes that can recycle and reuse a wider range of single-use plastics, and innovate sustainable alternatives to replace single-use consumables used in the NHS to construct a fully operational closed material loop healthcare system.

a result, the amount of waste increased by an average of 500 tonnes a week, costing local taxpayers an extra £50,000 per week for additional landfilling. A recent study³ showed that 123,000 tonnes of unrecyclable plastic waste (which could result in 1.4 million tonnes of greenhouse gas emissions) would be generated in a year if the UK population consumes one disposable surgical mask per person per day.

As the frontline of this pandemic, the UK NHS required immediate access to personal protective equipment (PPE). More than 30 billion items of PPE were procured by the UK government to provide a continuous supply of PPE during the COVID-19 pandemic.⁴ Most of the items (including respirators, masks, face shields, goggles, gowns, aprons, coveralls, and gloves) are made of plastic material. The need to use such unprecedented amounts of PPE, however, is contrary to the NHS Net-Zero Long Term Plan to reduce single-use plastic in clinical activity, catering area, and through its supply chains.⁵

The current linear model of single-use items (from material extraction, to product manufacturing, use in healthcare facilities, and eventual disposal at the end-of-life) sourced globally generates an enormous amount of waste, which has a large environmental impact.⁶ It has been a challenging year for the healthcare sector with regard to service provision; however, the pandemic has highlighted our dependence on goods produced outside the UK and Europe. The reliance on importing such goods is not only expensive both in monetary and environmental terms, but also hindered the efficient and timely supply chains of emergency equipment in a time of crisis. It is essential that the global health community needs to move away from its previous 'normal' and reflect on the challenges and opportunities of delivering safe and effective health services in the face of climate change and the continued burden of the COVID-19 pandemic.

Moving from the current single-use linear model to a circular system is crucial. This will require the engagement of a wide range of stakeholders and overcoming a number of individual, institutional and cultural barriers and challenges.⁷ To explore these barriers and challenges but also opportunities, we undertook an in-depth analysis of single-use plastic items in a single major provider, Royal Cornwall Hospitals NHS Trust. An NHS trust is

Introduction

COVID-19 saw a surge in using single-use plastic in all sectors and among the general public as a means to halt the spread of the virus. For example, an unprecedented 40% of residual waste collected by Bradford Council were contaminated and non-recyclable during the first COVID-19 peak,¹ where the average contamination rate before COVID was only 2.4% across England.² As

Significance for public health

This study provides novel empirical evidence on the procurement and use of single-use plastic before and during COVID-19 pandemic from a typical UK publicly funded healthcare provider. Through the interviews which we conducted with the frontline workers, we elicited both antecedent and concurrent attitudes towards single-use plastics to investigate the impact of COVID-19. In the face of both climate change and pandemic crises, we argue that a closed-loop system, also known as the circular economy, must be implemented in our healthcare.

an organisational unit within the National Health Service in England and Wales which provides hospital services, community services and/or other aspects of patient care and generally serves either a geographical area or a specialised function (i.e., ambulance services). Health services in England and Wales are divided into 254 such Trusts.⁸ Additionally, supplementary data from the Manchester University NHS Foundation Trust is included in the discussion to provide a comparative element to the study.

Design and Methods

Case study site

The Royal Cornwall Hospitals NHS Trust (RCHT) is one of the sustainability front runners within the NHS, having declared a 'Climate Emergency' in March 2020 and explicitly working towards a sustainable healthcare system. The Trust has focused on reducing their carbon emissions in recent years by investing in better buildings, infrastructure and waste management. For instance, they have recently installed seventy additional cycle shelters, secured four electric vehicle charging points at site, and piloted the reuse of anaesthetic gases. The Trust is also part of a national trial into using reusable face masks and clinical gowns.⁹ Hence, the RCHT provides a rich case-study into the impact of COVID-19 on their commitment, ongoing efforts and ability to achieve net zero carbon emissions by 2030 and future circular plastic systems.¹⁰

Data

A mixed-method approach, combining both quantitative and qualitative data, was used. Ethical approval was obtained from the University of Exeter (reference: eUEBS004005) before we started this study on September 2020 for a period of four months. We collected secondary data on both procurement and usage with regard to masks, aprons, and gowns from the hospital procurement department. The procurement data cover the period between April 2019 and June 2020, while the usage data are only available for the months from April 2020 to August 2020. Usage data provide the quantity of single-use plastic delivered to the wards. If one assumes that all delivered items are used in the wards, this reflects aggregate single-use plastic usage.

The meetings with RCHT staff were conducted online via MS Teams during October and November 2020. The interview questions were designed to capture the overall impact of COVID-19 on the Trust regarding plastic use. In particular, we interviewed two senior managers in a group meeting to elicit the general perception of plastic use, their responses during the first COVID-19 peak, and any impact on plans to tackle the plastic issue in the future. In addition, ten individual interviews were conducted with a wide range of staff (e.g., ward matrons, consultants, nurses, catering and procurement staff) to elicit their experiences and concerns with regard to PPE during the pandemic.

Results

Before the pandemic

In response to the RCHT sustainability agenda, a large effort had been made pre-COVID-19 to improve recycling of plastic and address aspects of single-use plastic. This included awareness raising, use of recyclable cardboard and reusable cutlery sets wherever possible, and measures to ensure that staff segregated different waste into appropriate bins. For PPE, in particular, Figure 1 shows

that the average monthly procurement of face masks per staff, including both surgical and filtering facepiece respirator masks, was kept at a minimum (almost zero) before the COVID-19 pandemic, while about 20 aprons/gowns per staff per month were procured pre-COVID. According to the interviewees, while the occupational health and safety measures, which were used to protect both health workers and patients, were followed rigorously, wearing PPE was perceived as undesirable in general. This is because it is perceived to cause treatment delays in times of emergency, entail additional cost, and generate more waste.

For waste, RCHT managers indicated that, pre-pandemic, work had already begun to reduce the plastic waste in the hospital, such as the planned purchase of a Sterimelt machine. This machine enables the hospital to recycle and repurpose wasted surgical masks, filtering facepiece Type IIR masks, and other plastic such as tray wraps. It is a relatively new technology: polypropylene masks are melted and the plastic produced is then collected and turned into other usable products such as toolboxes. However, little is known about the total life-cycle greenhouse gas and other emissions of this machine, nor its cost-effectiveness in the context of a circular economy.

Moreover, our interviewees noted that recycling, specifically what can and cannot be recycled, remains an on-going issue within the hospital. For example, there is currently no company in Cornwall that is capable of recycling cutlery. Sometimes this also leads to confusion among frontline workers as to which plastics can be recycled and which cannot when the materials look almost identical; or why some plastic can be recycled in other areas but not in their local area. As a result, many recyclables have ended up in the waste bins.

During the pandemic - Clinical areas

The pandemic turned the issue of single use plastic into a matter of life and death and a national panic over availability, efficacy and disposal. On the right hand-side of the vertical line in Figure 1, the figures show that the procurement of masks soared after the first outbreak of the pandemic. By April 2020, almost 1.7 million masks were procured. Meanwhile, the number of full-time staff at the hospital had increased from 4,829 to 5,192 over the previous 12 months.¹¹ For aprons and gowns, the procurement increased by almost 70% in March 2020 in comparison to February 2020 procurement.

Interviews with RCHT staff highlighted that the procurement

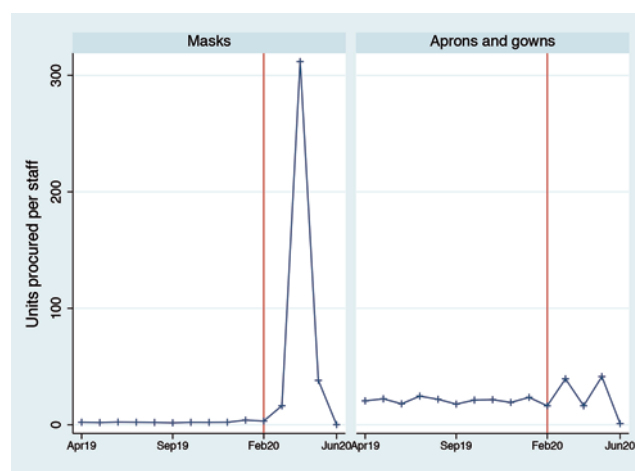


Figure 1. Monthly procurement per staff at the Royal Cornwall Hospitals NHS Trust.

of PPE was made by the NHS England centrally and distributed to each NHS Trust based on estimated local demand, a practice referred to as the 'push model'.¹² Interviewees explained that this model led to poorly organised procurements and an initial oversupply of PPE as both the urgency of the pandemic and the lack of clinical knowledge of the transmission pathways of the virus meant that it was hard to predict what and how much PPE may be required, which later left unused stockpiles.¹³

The advice and guidance also changed over time as more information was obtained about the transmission of the virus. For example, hand sanitiser gel was encouraged for use rather than gloves in non-covid areas by April 2020. This is because, according to the RCHT interviewees, wearing gloves may lead individuals to believe that their hands are clean, thus not developing or adhering to best practice of in hand-washing. Staff were also required to change aprons and gowns less frequently in June 2020 as this was found to have little impact on protecting the staff from the virus. In regard to masks, the practice shifted from changing masks between each patient or surgical case to discarding a mask when leaving the ward so that masks could be used between patients. The dynamic management of PPE by the RCHT and the fact that Cornwall has had overall one of the lowest COVID infection rates in England,¹⁴ meant that the procurement of masks, aprons, and gowns, had dropped to zero by June as presented in Figure 1 and RCHT were sitting on a stockpile of PPE.

Figure 2 shows that the use of masks, aprons and gowns at the Royal Cornwall Hospital peaked during the summer and returned to the April 2020 levels by the end of August 2020. In particular, an average of three face masks were used per staff on a single day in June compared to two masks in either April or August 2020. Similarly, the number of aprons and gowns used per staff per day almost doubled during the period of May, June, and July in relation to April or August 2020. Although there are no data available on gloves, the interview with a RCHT consultant noted that only one pair of gloves was used during an individual procedure before COVID. When the pandemic started, a full set of PPE was used for each procedure, including full-body apron/gown, a face mask, a visor/goggle, and 2-4 pairs of gloves.

By November 2020, visors/goggles were no longer used in surgery and the number of pairs of gloves had been reduced to 2-3 per operation. However, these were voluntary activities since there was no strict policy on the use of PPE at the hospital. Some people continued using full PPE to protect themselves. The interviewee estimated

that ten aprons/gowns, ten face masks, and forty pairs of gloves are used on a 'bad day' for an anaesthetist during COVID, while the figures for pre-COVID period were estimated at zero aprons/gowns, zero face masks, and ten pairs of gloves, respectively.

In the maternity unit, there is a guideline to use eye protection in exposure prone procedures before COVID. However, nurses usually assess the risk of each individual case and only wear eye protection when the risk of splashing blood is high. According to our interviewee from the maternity unit, this may have been changed by COVID because wearing protections became the 'new normal' for the nurses who started their career during COVID.

Most interviewees noted that the number of regularly scheduled patients (including both inpatients and outpatients) dropped because of COVID, except in the maternity unit in which only those with minimum interventions were arranged virtually. However, interviewees observed that the decrease in plastic use associated with regularly scheduled patients was dwarfed by the increase in PPE caused by COVID. Moreover, because the RCHT staff avoided the use of PPE in most areas before COVID, a decreased patient load had little impact. For example, even in the (pre-COVID) infection ward face masks were only used for investigating certain infections such as influenza, although gloves and aprons were always used by the nurses.

Face-to-face assessments gradually resumed (subject to capacity) at the hospital after the first national lockdown restrictions were lifted in June 2020. However, this further increased the use of single-use plastic because the hospital had to provide all patients with face masks, aprons, plastic medical bags, personal care items, and cleaning wipes, and more hand gels were used. Pre-COVID patients were asked to bring their own personal items, but this had been reversed by COVID. Patients were advised to not bring any personal items because they could be contaminated. Therefore, interviewees noted that a huge number of disposable consumables were provided by the hospital since the start of the COVID-19 pandemic, further adding to the waste.

During the pandemic - Non-clinical areas

For non-clinical activities in the hospital, our interviews with catering staff found that the unit had switched to compostable plastic (Vegware which, however, would most likely be incinerated alongside other general waste) in place of conventional fossil fuel plastic cutlery in May 2020. Meanwhile, 95% of the customers, including staff, patients, and their families, used takeaways during COVID because of social distancing, up from approximately 50% before COVID. For a cup of coffee, customers were not allowed to use their own reusable cups or mugs, but the catering unit provided recyclable cups and lids procured from the hospital cafe.

With regard to the delivery of catering services to patients, new procedures were introduced during the pandemic. In particular, staff who delivered patient meals could no longer complete the task within a single visit; and each time the staff re-entered the ward, they had to change to a new face mask and a new apron, and an additional pair of gloves and goggles/visors in the COVID ward. Furthermore, in the COVID ward, plastic forks and knives and bottled water were also used for a short period of time at the beginning of the pandemic. But after learning more about the virus, they are now using reusable cutlery like the other wards.

Another issue during COVID was that staff assumed everything in the clinical area was contaminated (including paperwork and milk bottles) and discarded them in the bins for contaminated waste. Interviewees noted that this increased not only plastic bin bag usage, but also the energy consumption for decontaminating the excessive amounts of waste.

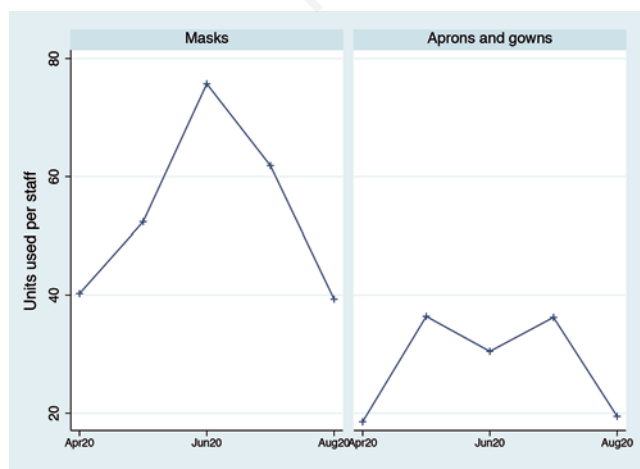


Figure 2. Monthly usage per staff at the Royal Cornwall Hospital.

The on-going situation: One year later

The pandemic and the subsequent PPE crisis have intensified attention on single-use plastic in the NHS, not just in terms of PPE but also the embedding of single-use devices and equipment across patient care and NHS operational activities. One recent study¹⁵ outlined the reasons for the wide-spread use of plastic in health care services: just in time purchasing systems to minimise storage; planned obsolescence from manufacturers and suppliers; and a mistaken belief that re-use impacts risk and patient safety. All of these can be overcome but a fundamental review and re-design of the ways in which patient services are organised, implemented and evaluated are required. This will also require overcoming changes in practices as well as perceptions, both within and outside of medical environments.

Our interviewees with the RCHT staff indicated that there may be some psychological effects of COVID-19 on the behaviour of using single-use plastic. For example, interviewees noted that when people saw a full bin of surgical masks, some might feel urged to avoid using surgical masks whenever possible while others might feel the opposite. Outside of work, some interviewees who were concerned about climate change before COVID and continued their effort to reduce plastic waste; while others became more cautious because of COVID and started to purchase pre-packaged fruits instead of a loose fruit, for instance. At the same time, interviewees noted that they have become more sustainable (e.g., growing vegetables from seeds) because the shortage of supplies caused by the national lockdown had limited their access to certain goods; and more discussions about sustainability on social media helped them to learn.

As the pandemic has continued, efforts have also been made to replace single-use masks with reusable masks in COVID-low-risk units. For example, six thousand fabric reusable masks were bought and distributed in November to non-clinical areas in the Royal Cornwall Hospital. These reusable masks can last for at least 40 washes. According to the RCHT managers, this reusable mask can be decontaminated and recycled as general fabrics via the fabric recycling bins.

There are many opportunities for, and wide re-use and remanufacture of, single-use plastics with reductions of the material and carbon footprint of medical devices, but this will require a culture shift and willingness to innovate and move beyond a business as usual mind set. Examples include: the re-manufacture of electro-

physiology catheters;¹⁶ replacing desflurane to lower carbon alternatives in anaesthetics;⁸ and technologies that can transform clinical wastes, such as blister packs and IV bags, into feedstock chemicals.¹⁷ The RCHT is already working with local businesses to create a circular economy in Cornwall, e.g., the Sterimelt machine, and aims to create items for re-use in the hospital.

Comparison with Manchester University NHS Foundation Trust (MFT)

While we were undertaking the study at the RCHT, through a Plastics Research and Innovation Fund (PRIF) project teams meeting we learned that the University of Manchester PRIF team was studying the top ten plastic products in the MFT supply chain. The procurement data which they collected from the MFT includes masks, aprons, and gowns, before and after COVID. They also had some conversations with MFT staff regarding plastic use during COVID. Though their approach was not systematically equivalent to ours, we provide their findings in this section to complement this study. However, it is not designed as a two-site study.

As compared to Figure 1 (RCHT), Figure 3 shows a similar trend at the MFT before the pandemic but not after. Their diverse responses to the first COVID-19 outbreak could be attributed to the large differences in the scale and timing of the pandemic experienced by both Trusts (e.g., significantly higher COVID hospital patient burden in Manchester compared to Cornwall), as well as inventory management, storage capacity, organisational culture, the types of institutions within the trust (e.g., community sites), and local population structure to name a few.

Interviews with the MFT sustainability team and Supply Chain Coordination Limited staff highlighted the need for ongoing collaborations across different teams in order to reduce the use of single-use plastic. While there is willingness, the pandemic has led to reduced capacity, both in terms of time and energy, to focus on issues that are not related to COVID. This has meant that while improvements have been made in certain specific areas such as guidelines for PPE use, progressing wider initiatives has been made more difficult. In addition, sustainability policies unrelated to plastics, such as the drive to decarbonise the NHS estates and supply chains, have to some extent contributed to deprioritising the single-use plastic reduction.

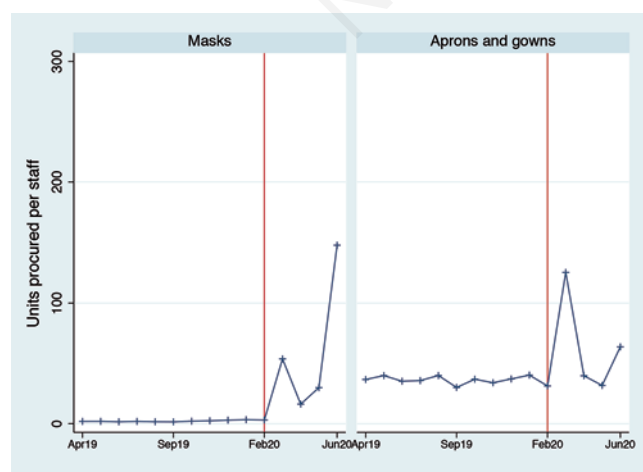


Figure 3. Monthly procurement per staff at the Manchester University NHS Foundation Trust.

Conclusions

While the COVID-19 pandemic has significantly increased the procurement and use of single-use plastic, the efforts to reduce plastic consumption at both the RCHT and MFT are on-going. However, the interviewees did reveal a bias towards single-use plastics, as they are easy and convenient to use in a medical setting and are generally perceived as safer than reusable alternatives especially during and post pandemic.

To ensure environmental sustainability and continued safety for staff and patients, the solution is not just to reduce single use plastic waste in health service provision. Instead, the focus on tackling plastic use should start from the product design stage, with environmental sustainability and reusability built into products and processes. In the absence of a closed-loop system, for example, the initially procured PPE which was not fit for purpose and now takes up space and energy for storage, while the disposal of stockpiles of the single-use items supplied at the early stage of the pandemic continues to be a challenge.

Therefore, investment is needed in technologies and processes that can recycle and reuse a wider range of single-use plastics, and innovate sustainable alternatives to replace single-use consumables

used in the NHS to construct a fully operational closed material loop healthcare system. For example, companies such as Rutherford Solutions are working with various NHS trusts on closed loop circular economy solutions for single-use medical plastics and showing significant financial, and product savings for the NHS¹⁸.

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