Inspire Tomorrow

Reducing plastic waste in respiratory healthcare for a more sustainable future

Authored by Dsposal, Reply and Chiesi Limited. Funding was provided by Innovate UK and Chiesi Limited. Editorial support by M+F Health and G. Sutton.

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Executive summary

In 2020, the clean-tech company *Dsposal* and design studio *Reply* launched a research project with the aim to assess ways of reducing plastic waste in healthcare, with a focus on treatments for lung conditions, such as pressurised metered dose inhalers (pMDIs). This research project was awarded funding from the Plastic Research and Innovation Fund offered by Innovate UK.[1] As part of UK Research and Innovation, Innovate UK were offering funding for human-centred design projects for sustainable plastics and to reduce the harm that plastics have on our environment. The aims of this research project were to investigate how to reduce the environmental impact of inhalers, minimise or eliminate unnecessary plastic waste, and ultimately design an inhaler device that is acceptable by users. The project team secured access to the research and development team at Chiesi Limited, the UK affiliate of a global biopharmaceutical company within the respiratory health market. The focus at Chiesi in recent years has been on reducing or eliminating the powerful greenhouse gases ('F gases') from their inhaler products[2] and this was an opportunity to assess the significance of other components within inhaler design for sustainability. It was anticipated that this project would add user and stakeholder insights to the development of a product design brief that could transform the inhaler industry.

Although the initial ambition of this research project was to re-design inhaler actuators so that they can be reused and recycled, the team were unable to present such a specific output as commercial and confidentiality issues prevented access to companies that manufacture component parts of inhalers.

Furthermore, this research project took place during the COVID-19 pandemic meaning that the team were unable to speak to any practice nurses due to the additional strain placed on frontline workers. The findings from this research project, therefore, focus predominantly on inhaler users, and the user behaviour changes required to reduce the environmental impact of inhalers.

The team surveyed 1012, and interviewed 49, inhaler users (or their carers) with the aim to understand the types of conditions, level of usage and disposal of inhalers. A Theory of Change Framework was used to look at desired long-term goals and a COM-B behaviour model to understand how to influence user behaviour to increase reuse and recycling of inhalers.

There is a growing awareness that climate change is affecting human health; planetary health and human health are inextricably linked.[3] The climate crisis is real and present, and healthcare has a significant role to play in addressing the climate emergency.[4] This has been recognised during the project, and recommendations proposed are aimed at minimising environmental impact overall.

This report documents the outputs of the research and provides practical short, medium and long-term steps for manufacturers, healthcare professionals and waste industry to improve the sustainability of inhalers and the healthcare system.

The environmental impact of inhalers

Inhalers are an essential part of the treatment of respiratory conditions such as asthma and chronic obstructive pulmonary disease (COPD),[5] accounting for 3% of the total carbon footprint of the NHS.[6]

1 Dsposal. Manchester SMEs backed by Innovate UK to improve sustainability of inhalers. October 2021. Available at: https://dsposal.uk/articles/manchester-smes-backed-by-innovate-uk
2 Chiesi Limited. Driving sustainable care together: Annual & Sustainability Report 2021. Available at: https://www.chiesi.uk.com/pdf/Chiesi_A&S_Report_2021_EN_Long_Digital_v.6.0.pdf
3 Economist Intelligence Unit. Climate change and its impact on lung health: a focus on Europe. Available at: https://impact.economist.com/perspectives/healthcare/climate-change-and-its-impact-lung-health-focus-europe
4 NHS England. Greener NHS campaign to tackle climate 'health emergency.' January 2020. Available at: https://www.england.nhs.uk/2020/01/greener-nhs-campaign-to-tackle-climate-health-emergency/
5 Usmani OS. Choosing the right inhaler for your asthma or COPD patient. *Ther Clin Risk Manag*. 2019; 15:461–472
6 NHS England. Delivering a 'Net Zero' National Health Service. 2020. Available at: www.england.nhs.uk/greenernhs/wp-content/uploads/sites/51/2020/10/delivering-a-net-zero-national-health-service.pdf

One type of inhaler device, pressurised metered dose inhalers (pMDIs), consists of a plastic casing and the actuator, which houses an aluminium canister with a metering valve containing the active ingredient combined with a medical grade propellant. In today's inhalers the propellants used are fluorinated gases (f-gases) with a high global warming potential (GWP). Most pMDI actuators are moulded out of thermoplastic polymers such as polypropylene.[7]

It can be said that the single most effective way to reduce plastic waste and increase sustainability is simply to manage the condition better.[8] If patients receive the right inhaler at the earliest opportunity and have the skills and knowledge to manage their condition, this can greatly reduce plastic waste due to a reduced number of inhalers used per patient. The impact on the environment through greater control of respiratory conditions means better outcomes for the patient and the planet.

This is not to absolve manufacturers of their responsibility. There is much work to be done to re-engineer inhalers to be more reusable and recyclable. Redesigning inhalers, however, takes investment and time, with input from patients, clinicians, regulators and payers. Developments for more sustainable products are well underway and in the meantime the waste industry, local councils and the pharmaceutical industry can do more to support patients and the healthcare system to reduce the environmental impact of inhalers, such as, in the short term, establish effective inhaler recycling schemes.

This report makes the following three over-arching recommendations to address the current situation:

- **Reduce the number of inhalers initially prescribed:** The change that is likely to have the greatest impact in the near term would be for people's conditions to be well-managed and for people to effectively use their inhalers.[9] The 'greenest device' is the one that the patient can use correctly, will use, and has been trained how to use it.[10]

- **Reuse the inhaler to lessen need for new actuators:** A truly reusable inhaler will require substantial redesign. Any new design will need to solve issues related to the dose counter, an essential component to help patients use their device, but adds to the complexity of the reusability; A reusable device also needs to allow for interchangeability across medicines and brands; and abide with regulation. The reusable solution will need careful communication to users and prescribers to ensure full adoption.

- **Recycle all inhalers effectively:** Since only a fraction of inhalers are recycled today, and only as a result of pilot schemes set up to test feasibility, a multi-stakeholder approach would be needed to establish nationwide recycling of inhalers. Recycling the propellant into other industries such as air conditioning and refrigeration would be the ideal arrangement, however, thermal oxidation through high temperature incineration would also permanently remove the propellant greenhouse gases from the atmosphere. All stakeholders, including healthcare system policy makers, should be included in the design and implementation of the scheme.

7 Jeswani, H. K. & Azapagic, A. Life cycle environmental impacts of inhalers. *J Clean Prod.* 2019; 237:117733
8 Keeley, D., Scullion, J. E. & Usmani, O. S. Minimising the environmental impact of inhaled therapies: problems with policy on low carbon inhalers. *Eur Resp J.* 2020; 55:2000048
9 Wilkinson, AJK *et al.* Costs of switching to low global warming potential inhalers. An economic and carbon footprint analysis of NHS prescription data in England. *BMJ Open.* 2019;9:e028763
10 Usmani, Omar S. The Greenest Inhaler: A Patient-centric Approach. *Emergency Medicine Journal,* 2022 ;10[Suppl 2]:2-7

Methodology

We used a **Theory of Change** (TOC) to look at desired long-term end goals and worked backwards using existing knowledge and research. This meant our TOC evolved as the project developed and we gained more understanding. Similarly, the behavioural model, known as **COM-B** (see figure 1), is a framework that looks at what is needed in order to create and sustain behaviour change. It is normally depicted as a wheel focusing on the 3 key aspects: Capability, Opportunity and Motivation. Both capability and opportunity will influence motivation, and in turn, behaviour.

Primary research

Our primary research consisted of an industry perspective and a user perspective. For the user research we conducted an initial screener survey, a recruitment survey, in-depth interviews with 49 individuals, analysis and applications of the COM-B and TOC models. 15 Healthcare sector and Industry specific interviews were conducted by Dsposal with professionals within healthcare, waste and pharmacy.

Interviewees were asked to add their condition on our screening survey and we spoke to the following in our research:

- 28 individuals with asthma
- 7 individuals with COPD
- 5 individuals with asthma and other conditions: asthma and COPD, asthma and allergies, asthma and bronchospasms and asthma and lung blood clots
- 1 individual with multiple sclerosis
- Carers of seven children with asthma and one child with asthma and other condition (allergies)

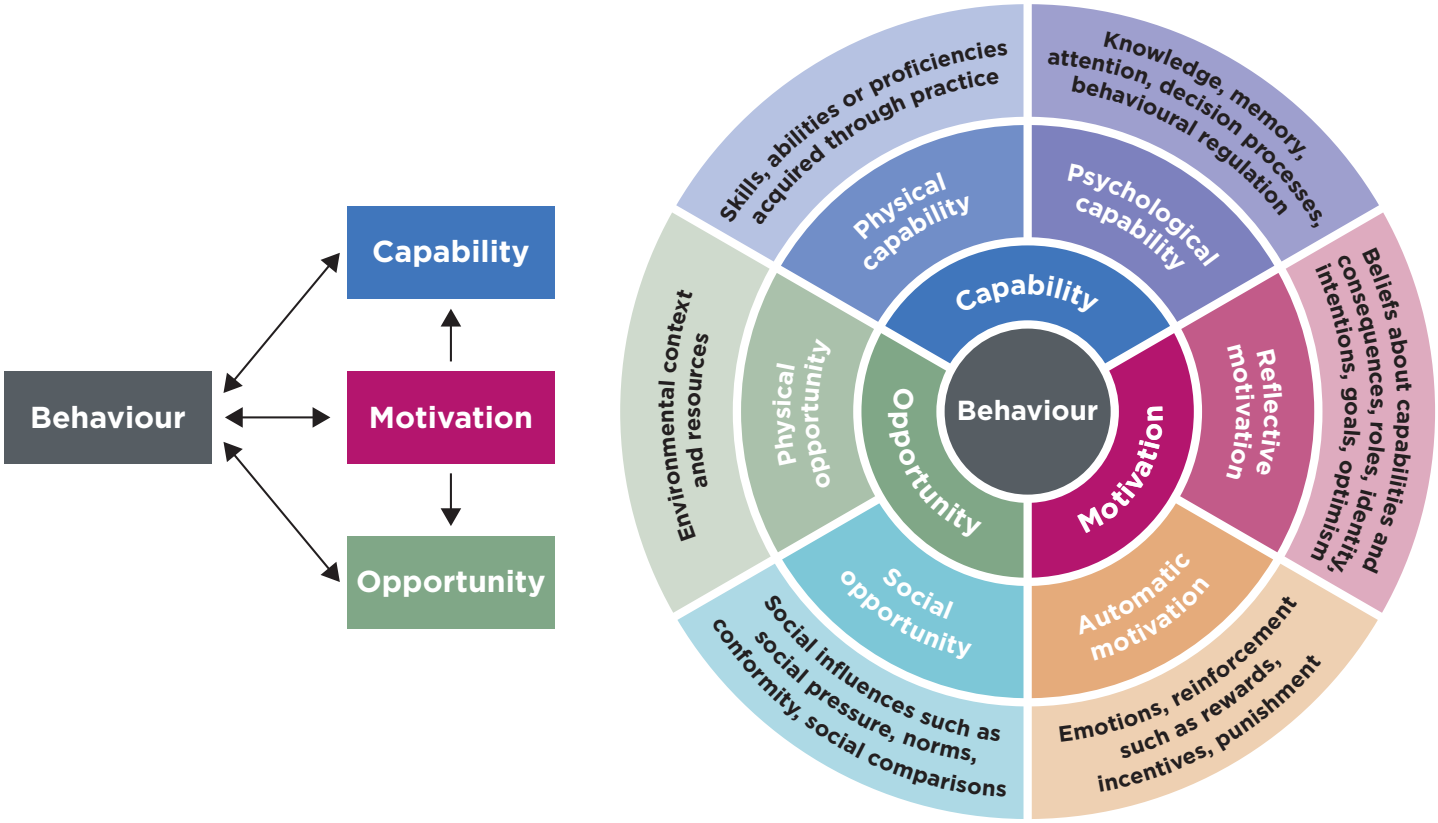


Figure 1 The COM-B behavioural model.[11]

11 Blebil AQ, *et al.* Using COM-B model in identifying facilitators, barriers and needs of community pharmacists in implementing weight management services in Malaysia: a qualitative study. *BMC Health Serv Res.* 2022 Jul 19;22(1):929

Health Sector and Industry - user interviews

Interviewees were found and obtained through Dsposal's network. A total of 15 interviews were conducted with the following groups:

- 7 healthcare professionals (GPs, prescribing pharmacists, and pharmacists from meds management teams)
- 3 waste management and recycling companies
- 5 individuals responsible for implementing and running a successful instore take back scheme pilot at a major international brand
- We also spoke to various people at Chiesi on a number of occasions

Secondary research

Our secondary research phase was divided into two parts: user focused and industry focused. This included:

- **Users - desk (or literature) review**: This focused on the user's perspective.
- **Industry - desk review:** An initial review of industry publications and articles, similar to the user perspective.

Support on the materials research came from the Sustainable Materials Innovation Hub at the Henry Royce Institute who provided advice on different material types, their suitability for a reusable and recyclable actuator and their environmental impact.

Modelling use of inhaler actuators in asthma patients

Following recommendations of how to reduce and reuse inhaler actuators, a modelling approach was applied to predict how these measures would impact actuator use. A cohort analysis was used to predict how the Reduce and Reuse strategies could affect actuator use of a cohort of newly diagnosed asthma patients over 4 years.

The cohort analysis worked with the assumption that there are 160,000 newly diagnosed asthma patients every year[12], averaging 13,333 per month. 13,333 new asthma patients were introduced to the model every month, for 4 years. It was assumed that 10% of these patients would leave the cohort per month due to various reasons, including incorrect diagnosis, leaving the UK or recovery from asthma. Using this model, it is predicted that there would be 529,271 newly diagnosed asthma patients at the end of the 4 years.[13]

To calculate the number of actuators used by this cohort over 4 years on current treatment strategies, it was assumed that patients are prescribed an average of 2.1 inhalers per month.[14] This was incorporated into the cohort analysis model, which predicted that 29,011,220 actuators would be used by this cohort over the 4 year period.[15]

The number of actuators prescribed to this cohort of patients if a reduce strategy was implemented was also predicted using the model. The reduce strategy includes measures to improve patient inhaler use, including patients managing their condition properly, using their 'preventer' correctly and only using their 'reliever' when necessary.[16] In the reduce strategy, patients would be prescribed an average of 1.2 inhalers per month, with 2 inhalers prescribed following diagnosis, followed by 1 new preventer inhaler per month and 1 new reliever inhaler every 6 months.[17] This reduce strategy would result in 16,388,751 actuators being used by the newly diagnosed cohort of patients over 4 years[18] which is a reduction of 43.51%.

12 British Lung Foundation. Asthma Statistics. Available at: https://statistics.blf.org.uk/asthma
13 Dsposal data on file
14 Established from user research. Also adheres to the guidance provided by Global Initiative for Asthma (GINA). 2022. Global Strategy for Asthma Management and Prevention. Available at: https://ginasthma.org/wp-content/uploads/2022/07/GINA-Main-Report-2022-FINAL-22-07-01-WMS.pdf
15 Calculation: Average numbers of inhalers prescribed per newly diagnosed patient per month x the number of newly diagnosed patients per month, established across a 4 year period accounting for 10% reduction in cohort each month
16 There are two main types of inhaled therapy; preventers which are used to maintain the condition and relievers which can be used to ease the onset of symptoms. Please see Asthma + Lung UK for more information. Available at: https://www.asthmaandlung.org.uk/conditions/asthma/types-asthma
17 Average estimated for non-severe adherent asthma patient
18 Dsposal Data on File. Calculation: 1.2 inhalers per newly diagnosed patient per month x the number of newly diagnosed patients per month, established across a 4 year period accounting for 10% reduction in cohort each month

Finally, the reuse strategy proposed in this research was incorporated into the model to predict the number of actuators used over 4 years. If the reuse strategy is implemented, patients would receive 2 actuators following diagnosis for their preventer and reliever inhaler. Patients would then receive the aluminium canisters for these reusable actuators. It is assumed that patients would require 2 new actuators every 2 years.[19] It is predicted that the cohort of newly diagnosed patients would use 1,803,504 actuators over 4 years if this reuse strategy was implemented.[20] Resulting in a 94% reduction from the baseline figure over the four years.

For the recommendations that came under Recycling we assumed no changes to inhaler prescription or use, so no cohort analysis was undertaken to model changes.

Current situation: Inhaler devices and the environment

Respiratory disease and need for inhalers

Respiratory diseases, especially asthma and chronic obstructive pulmonary disease (COPD), are very common.[21] There are 5.4 million people in the UK being treated for asthma and 1.4 million people have been diagnosed with COPD.[22,23] On average around three people a day die from an asthma attack.[24] The mainstay of treatment for these conditions are medicines delivered through inhalers. Around 80 million inhalers are prescribed every year in the UK, with around 70% of these being pressurised metered dose inhalers (pMDIs).[25,26]

These pMDIs consist of a single use plastic 'actuator' and an aluminium canister which contains the medication and propellant gas (Figure 2).

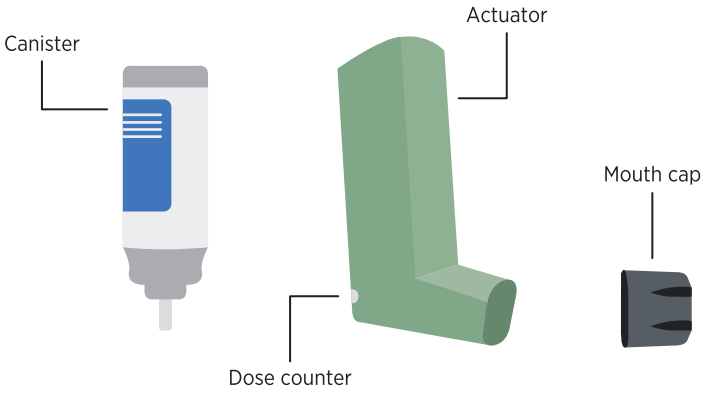


Figure 2 Components of an Inhaler. *A complete inhaler is made up of a variety of material and parts; the actuator, mouth cap, canister (including a valve) and dose counter (optional).*

Facts about inhalers

- Of the 80 million inhalers prescribed every year, 70% are pressurised metered dose inhalers (pMDIs),[27,28] which contain propellant gases that are powerful greenhouse gases if allowed to enter the atmosphere.[29]
- pMDIs contribute 7% of F-Gases in the UK with refrigeration and air-conditioning systems making up 77%.[30]
- The UK is phasing down F-gases (Hydrofluorocarbons) by 79% by 2030,[31] pMDIs are currently exempt from this phase down.[32]
- Alternative types of inhalers with lower carbon footprints do exist, namely dry powder inhalers (DPIs) and soft mist inhalers (SMIs), but they are not suitable for all patients.

19 To account for any accidental damage or possible wear and tear over time
20 Dsposal Data on File. Calculation: 2 actuators per newly diagnosed patient per year x the number of newly diagnosed patients per year (by each month), established across a 4 year period accounting for 10% reduction in cohort each month
21 Public Health England. Respiratory disease: applying All Our Health. Available at: https://www.gov.uk/government/publications/respiratory-disease-applying-all-our-health/respiratory-disease-applying-all-our-health
22 British Lung Foundation. Asthma Statistics. Available at: https://statistics.blf.org.uk/asthma
23 Asthma + Lung UK. COPD in the UK: Delayed diagnosis and unequal care Executive Summary. Available at: https://www.asthmaandlung.org.uk/sites/default/files/2023-03/delayed-diagnosis-unequal-care-executive-summary.pdf
24 National Health Service. Asthma attacks. Available at: https://www.nhs.uk/conditions/asthma/asthma-attack/
25 House of Commons Environmental Audit Committee. UK Progress on Reducing F Gas Emissions, April 2018. Available at: https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/469/469.pdf
26 Chiesi data on file
27 House of Commons Environmental Audit Committee. UK Progress on Reducing F Gas Emissions, April 2018. Available at: https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/469/469.pdf
28 Chiesi data on file
29 Jeswani, H. K. & Azapagic, A. Life cycle environmental impacts of inhalers. *J Clean Prod.* 2019; 237:117733
30 Climate Change Committee. The Sixth Carbon Budget F-gases. 2018. Available at: https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-F-gases.pdf
31 UK Government. Fluorinated gases (F gases) Available at: https://www.gov.uk/guidance/fluorinated-gases-f-gases
32 UK Government. Uses of F gas (HFCs) exempt from the phase down. Available at: https://www.gov.uk/guidance/uses-of-f-gas-hfcs-exempt-from-the-phase-down

The impact of inhalers on the environment – Plastic isn't the problem

Undoubtedly, if actuators were made of non-plastic material, it would reduce the amount of plastic waste, but altering the material would not significantly reduce the impact on the environment.[33] It's worth noting that 'plastic' is not a single material; the term covers a large and growing variety of polymers, each with their own properties. There are many positive qualities of plastics, including the fact that they often come with a lower carbon footprint than most other common materials when the environmental cost of production and transport is considered.[34]

The component on the pMDI that impacts the environment the most is the propellant gases used to carry the active ingredient into the lungs. The propellants used today are powerful greenhouse gases, and capturing and recycling remaining propellant when the inhaler is no longer needed or used can divert the waste gases from the domestic waste streams and thus prevent these from entering the atmosphere.[35]

The NHS and the UK Parliament Environmental Audit Committee have both identified inhalers as part of their drive to reduce the national carbon footprint.[31,36] The NHS Long Term Plan set targets to deliver accelerated reductions in the total NHS emissions by moving to lower carbon inhalers, such as dry powder inhalers (DPIs) and soft mist inhalers (SMIs).[37] Although these alternative types of inhalers with lower carbon footprints do exist, they are not suitable for all patients and it is important that changing inhaler devices does not cause unintended consequences for patients' care.

Crucially, supporting the innovation in and use of lower carbon propellants and alternatives is also highlighted as a requirement to meet these emissions targets.[31] Therefore research into alternatives in inhaler design is essential to meet such needs. The Environmental Audit Committee has highlighted that almost all inhalers, including canisters, are being thrown into refuse.[38] This means the inhalers aren't properly recycled or disposed of effectively, and greenhouse gases leak into the atmosphere.

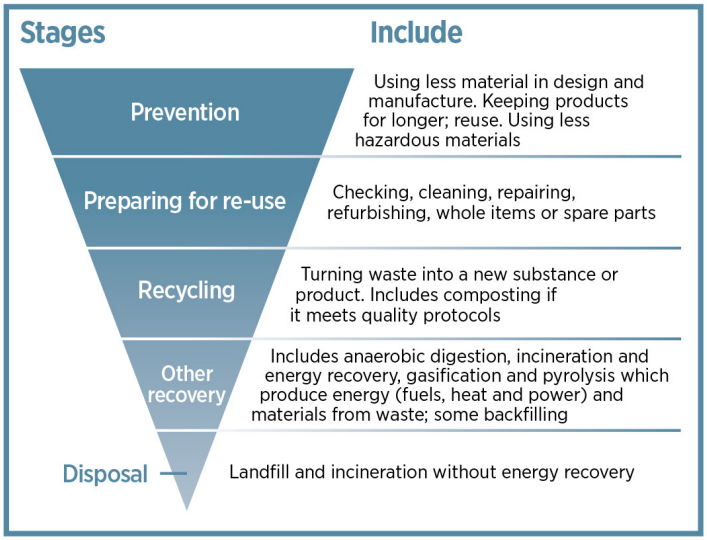
Different types of pMDIs have different carbon footprints, mostly due to the gases used, which can vary from 60.4g to 163.5g CO_2 equivalent (CO_2e) per puff.[39] Pharmaceutical companies are developing new types of propellant gas which significantly reduce the environmental impact of pMDIs.[40,41] Chiesi, for instance, is working in partnership with global manufacturer, Koura, to launch an environmentally friendly medical propellant (hydrofluoroalkane HFA-152a) with pMDIs. The propellant HFA-152a will minimises the carbon footprint of pMDIs whilst safeguarding an invaluable therapeutic option for patients.[42]

One area of concern is the lack of clarity and consistency in life cycle analyses for measuring a product's carbon footprint. Without a consistent measurement standard, the reporting of carbon footprints can be inaccurate and noncomparable, with stakeholders and patients lacking sufficient robust information to make an informed decision regarding the environmental impact of the inhalers they are using, making it harder to inform change.

33 SMI Hub Report. The potential for alternative materials used to reduce the environmental impact from pressurised meter-dose inhaler (pMDI) actuator. Henry Royce Institute. 2022. Available at: https://dsposal.uk/media/18872/smih-report-pmdi-actuator.pdf
34 Voulvoulis *et al.* Examining the Material Evidence: The Carbon Footprint. Available at: https://www.imperial.ac.uk/media/imperial-college/faculty-of-natural-sciences/centre-for-environmental-policy/public/Veolia-Plastic-Whitepaper.pdf
35 Recycle Now. Inhalers. Available at: https://www.recyclenow.com/recycle-an-item/inhalers
36 NHS England. Delivering a 'Net Zero' National Health Service. 2020. Available at: www.england.nhs.uk/greenernhs/wp-content/uploads/sites/51/2020/10/delivering-a-net-zero-national-health-service.pdf
37 NHS Long Term Plan. January 2019. Available at: https://www.longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf
38 Environmental Audit Committee. UK Progress on reducing F-gas Emissions: Fifth Report of Session 2017–19. April 2018. Available at: https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/469/469.pdf
39 Northeast and Devon Formulary and Referral. The environmental impact of inhalers. Available at https://northeast.devonformularyguidance.nhs.uk/formulary/chapters/3.-respiratory/the-environmental-impact-of-inhalers
40 Chiesi Limited. Chiesi outlines €350 million investment. Available at: www.chiesi.uk.com/img/news/613_final-021219_chiesi-investment-in-carbon-minimal-pmdis-december-2019.pdf
41 Astra Zeneca. AstraZeneca progresses Ambition Zero Carbon Programme with Honeywell partnership to develop next-generation respiratory inhalers. Available at: https://www.astrazeneca.com/media-centre/press-releases/2022/astrazeneca-progresses-ambition-zero-carbon-programme-with-honeywell-partnership-to-develop-next-generation-respiratory-inhalers.html
42 Chiesi Limited. Koura opens world's first HFA 152a medical propellant production facility. Available at https://www.chiesi.com/en/koura-opens-worldrs-first-hfa-152a-medical-propellant-production-facility/

Ways to improve the situation

Reduce, Reuse and Recycle, or the 3 Rs, is a term coined to encourage better waste management and improved resource efficiency. It is the foundation of the 'waste hierarchy'.[43] Beyond the 3 Rs the hierarchy also includes 'recovery' (e.g. energy from waste) and 'disposal' (e.g. landfill), with the options ranked according to what is best for the environment. Reduction (or 'prevention') can be found at the top, followed by reuse, recycling, recovery and disposal. This is the overarching framework used in this report to consider opportunities for change to actuators and inhalers.



The following sections outline in greater detail the benefits and challenges of reduce, reuse and recycle policies, in the context of increased inhaler sustainability. It is necessary to balance the size of the opportunity with the scale of the change required. Reduce will in theory have the maximum impact, but the changes required are highly complex.

Reduce the amount or footprint of inhalers in the first instance

From a waste hierarchy perspective, the priority should be to prevent waste. A reduction in the number of inhalers used and prescribed by improving the management of these conditions would mean less plastic waste and a reduction in environmental impact. Improving quality of life and patient health would also lessen the need for acute care, such as hospitalisation or trips to the Accident & Emergency Department, further reducing impact on the environment.[44]

The Opportunity

Calculations indicate that if inhalers were correctly prescribed and used and conditions managed in the approximately 160,000 people who are diagnosed with asthma each year,[45] there would be:

- 873,657 fewer inhalers prescribed after the first year, a reduction of 41.24% compared to the current model (2,118,583)[46]
- Cost savings to the health service of between £1.56 million and £2.73million[47]
- A reduction of 10.78 tonnes of plastic and around 15,726 tonnes of CO_2e[48]

How these estimates are calculated

The current model is based on the average of 2.1 inhalers per user per month as determined from our user research. This reduction is almost entirely in reliever inhalers. The average carbon footprint of pMDI inhalers is 18kg per inhaler.[49] Reducing the number of inhalers from 2.12 million to 1.24 million would save the equivalent of up to 15,726 tonnes of CO_2 in the first year and by the end of year four as much as 227,204 tonnes of CO_2.[50] Improving inhaler technique and adherence to the *right* medication regime means patients only use the reliever inhaler occasionally (use two a year, receiving an additional device once every six-months), and are routinely prescribed one preventer device per month.

43 DEFRA. Guidance on applying the Waste Hierarchy. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69403/pb13530-waste-hierarchy-guidance.pdf
44 UK Parliament. Improving asthma outcomes in the UK. 2021. Available at: https://researchbriefings.files.parliament.uk/documents/CDP-2021-0185/CDP-2021-0185.pdf
45 British Lung Foundation. Asthma Statistics. Available at: https://statistics.blf.org.uk/asthma
46 Dsposal data on file
47 Dsposal data on file
48 Dsposal data on file
49 Wilkinson, AJK *et al.* Costs of switching to low global warming potential inhalers. An economic and carbon footprint analysis of NHS prescription data in England. *BMJ Open.* 2019;9:e028763
50 Dsposal data on file

Target outcomes

The study identified three target outcomes necessary in order to achieve the improvements in sustainability outlined above:

1. Inhalers are produced to have as low environmental impact as possible
2. When people use their inhaler, they use it effectively (technique, medication, training, information)
3. Patients have a well-managed condition

Patient care is paramount

While still targeting reducing inhalers, in particular reliever inhalers, the priority in all healthcare should be the care and effective treatment of patients. Although a managed condition over time will likely require fewer inhalers, some lung conditions are severe, and may require additional treatments.

Although an individual patient may be able reduce their inhaler usage through effective inhaler device prescribing and management, this should never come at the cost of destabilising the clinical symptoms of a patient. Knowledge about environmental effects may encourage some people to change, but this must not be at the expense of good management of the condition, and not cause people to feel the treatment they need for their lung condition is responsible for environmental damage.

Reduce: What needs to happen?

The following section outlines what behaviour changes will be necessary to achieve each desired outcome.

Target outcome 1: Inhalers are produced to have as low environmental impact as possible

Target behaviour	Discussion
Manufacturers: Motivated to produce effective inhalers while minimising their environmental impact.	The most environmentally impactful changes that can be made to pMDIs is to reduce the environmental impact of the propellant gases. Pharmaceutical companies are already engaged in this work and it was beyond the scope of this project to conduct research into this specific area. The possibility of manufacturing actuators out of different materials was explored. From a 'reduce' perspective, the insights from the interviews indicated that altering the material of the actuator would deliver no discernible environmental benefit, in part because no alternative material is significantly lower impact than the current material, and partly because the process to find a suitable alternative that is acceptable for pharmaceutical products and be approved by regulators and the manufacturing changes required, would in itself come with a substantial environmental footprint. However, pharmaceutical companies should review the impact of the full life cycle of their products and make changes in manufacturing processes where they will reduce the overall environmental impact.
Manufacturers: Take end of life and waste management into account during the design and manufacturing stage to ensure products can be appropriately dealt with once they become waste.	If changes are made during manufacturing and design these should take waste and recycling possibilities into account, so effective disposal can be easily achieved and sustainable. One barrier to this is that the cost of dealing with products and packaging once they become waste isn't currently borne by the manufacturer. Through its own targets for environmental impact, the NHS could collaborate with manufacturers to drive best practice behaviour. This will mean, however, that a large and coordinated approach will need to be taken.

Target outcome 2: When people use their inhaler, they use it effectively (technique, medication, training, information)

Target behaviour	Discussion
Users: Physically capable of using the inhalers effectively.	Being able to use the inhaler as designed means that the correct amount of medication reaches the lungs. The addition of a 'spacer device' can aid good inhalation techniques.[51] However, spacers can be bulky and difficult to carry. Further re-design of the inhaler, including spacer technology, could help to address this. Education on inhaler technique is covered in the subsequent behaviour.
Users: People use up the full number of doses of inhalers before moving onto a new one.	Users may have multiple inhalers of the same brand and type, most notably for the reliever type inhaler, to keep devices dotted around the house/car/workplace. It is not uncommon for inhalers to be reordered for dispensing irrespective of whether the previous one was empty. As a result, users may struggle to use up inhalers within the expiry date. Curtailing the number of devices prescribed and dispensed per month may reduce stockpiling and has been identified by the British Medical Association (BMA) as a priority.[52] The volume and frequency of inhaler prescriptions should also be monitored (through staff training and GP clinical systems), as these provide the opportunity to identify patients overusing reliever inhalers, a source of waste, but more importantly, a chance to improve the management of the condition.

51 Please see here for explanation. Asthma + Lung UK. Spacers. Available at: https://www.asthma.org.uk/symptoms-tests-treatments/treatments/spacers
52 British Medical Association. Sustainable and environmentally friendly general practice. Available at: https://www.bma.org.uk/media/2570/bma-sustainable-and-environmentally-friendly-general-practice-report-june-2020.pdf

Target outcome 3: People have a well-managed condition

Target behaviour	Discussion
Users: Have good habits around preventer and reliever inhaler use so they are taking their medication correctly.	Respiratory conditions, especially asthma and COPD, are often highly variable, with symptom control dependent on many factors, including seasons, airborne pollution and other triggers.[53,54] Adherence to the medication necessary to maintain good control is also variable, with lifestyle, age of diagnosis, level of education, concomitant conditions and stigma all potentially impacting.[55] Redoubling efforts to educate inhaler users on the importance of good adherence to preventer medication would have a beneficial impact on health and the environment. Clearly this can be challenging which medical professionals have long worked to address and continue to do so, but education and knowledge would be key.
Users: Able to identify if their condition isn't well-managed and feel empowered to seek help.	Individuals are often not able to determine what is a well or poorly managed condition.[56] Aiding individuals to better spot signs of poorly managed asthma through education will support the drive to reduce the impacts of inhalers on the environment and encourage more sustainable care. Even with this knowledge, users may struggle to detect signs of poorly managed conditions, therefore the success of this intervention will require corresponding support from healthcare professionals, the healthcare system, individuals, their families and carers.
Users: Able to access high quality medical help and support.	An appropriate intervention here is one in which healthcare systems embrace the framework "Know it, Show it, Teach it, Review it."[57] When patients understand their condition and have a say in the choice of medication or treatment used, adherence improves. Long term reminders and adherence feedback, along with visual inhaler displays and videos, may also form part of ongoing support for patients.[58,59]
Healthcare professionals: Have the capability to prescribe the most effective, most sustainable option for therapy and can support inhaler users effectively.	Healthcare professionals in general practice cannot have specialist-level understanding of therapies for every illness. Formulary guides and decision aids are important tools. Some Integrated Care Systems (ICSs) have included sustainability indicators and environmental impact reduction targets on the patient pathways for asthma and COPD.[60] To support the prescribers, support tools should be made available to help and guide prescription choice and shared decision making with patients.

53 D'Amato G, Cecchi L, D'Amato M *et al.* Climate change and respiratory disease. *Eur Respir Rev.* 2014;23(132):161-9
54 Doherty RM, Heal MR, O'Connor FM. Climate change impacts on human health over Europe through its effect on air quality. *Environmental Health.* 2017;16(Suppl 1):118
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59 Price D, Keininger DL, Viswanad B, Gasser M, Walda S, Gutzwiller FS. Factors associated with appropriate inhaler use in patients with COPD - lessons from the REAL survey. *Int J Chron Obstruct Pulmon Dis.* 2018: 26;13:695-702
60 Northeast and Devon Formulary and Referral. The environmental impact of inhalers. Available at https://northeast.devonformularyguidance.nhs.uk/formulary/chapters/3.-respiratory/the-environmental-impact-of-inhalers

Reuse inhalers so fewer new actuators need to enter the system

Next on the waste hierarchy is reuse. One of the initial ambitions for this project was addressing the feasibility of making the actuator reusable. From a practical perspective the current design of pMDIs would be suitable for reuse, though there are complex clinical and regulatory tests and requirements that would need to be met. Reusable/refillable inhalers are available, but currently none that are pMDIs.

The Opportunity

Reusable actuators, with standardisation to enable the interchange of different medicines and brands into the same actuator, would undoubtedly reduce plastic waste. It may be theoretically feasible that an actuator could be made reusable for two years based on the current material qualities of the plastic, however, implementing a reusable solution will require extensive product and clinical testing and human factors research.

Targeting only newly diagnosed asthma patients, reusing plastic actuators for a two-year period (with the average monthly inhaler use of 2.1/month as seen in user research) the number of prescribed actuators falls significantly. By the end of the first year the number of prescribed actuators will be reduced to 319,992 compared to the current model (2,118,583): a percentage reduction of 84.90%.[61] By the end of year four, 336 tonnes of plastic would have been saved. It is impossible to model this for all inhaler use, but it is worth bearing in mind that newly diagnosed asthma patients make up around 3% of the total number of people in the UK with asthma.[62]

Changes to material and/or design should reflect the target outcomes outlined under 'Reduce' and align with recycling efforts. If patients were familiar with separating the two elements of the inhaler (to replace empty canisters), it may be easier to encourage two different behaviours for the waste canisters and actuators, meaning it would be easier to recycle and reuse. An extra benefit is that unlike many items being redesigned for reuse, a reusable actuator would not require 'heavy-weighting' to ensure durability so should not cause significant additional material use, even if some users did not reuse as desired.

Target outcomes

The report identified four target outcomes necessary to achieve the improvements in sustainability outlined above:

1. Inhalers are designed to maximise the potential for reuse of the actuator
2. Healthcare professionals can effectively prescribe and manage reusable actuators
3. Users will use multiple canisters in one reusable actuator in a way that doesn't have a net negative impact
4. Inhalers are not lost or misplaced

61 Dsposal data on file
62 British Lung Foundation. Asthma Statistics. Available at: https://statistics.blf.org.uk/asthma

Reuse: What needs to happen?

The following section outlines what behaviour changes will be necessary to achieve each desired outcome.

Target outcome 1: Inhalers are designed to maximise the potential for reuse of the actuator

Target behaviour	Discussion
Manufacturers: Make actuators from a reliable, robust and appealing material.	Polypropylene, the material most actuators are made from, is a suitable material for reuse. It is durable, has suitable levels of flexibility to enable the canister to be removed and replaced, is lightweight and has a relatively low carbon footprint compared to other potential materials (for example metals or glass). Work would be needed to ensure that a reusable actuator can safely and consistently deliver the correct dosage of medication. Testing and clinical approval would need to be conducted in order to bring them to market. Fitting the dose counter to the canister or allowing for resetting, would prevent waste and ensure patients receive medicine every time. Minimising the number of materials the dose counter is made of (to aid recyclability) would also be beneficial. Manufacturers should also consider end of life during the redesign/design and manufacturing stages to ensure products can be appropriately dealt with after disposal.
Manufacturers: Consistent inhaler design across manufacturers so that they can be reused no matter the brand.	Any lack of consistency in material use and design across brands would cause issues with reuse, if it prevented switching of medicine or brand. Standardisation is needed, of both material and design, to maximise reuse. Manufacturers will need to collaborate to standardise the material and design of actuators. The NHS should incentivise standardisation across pMDI design and could be a driver for this change.

Target outcome 2: Healthcare professionals can effectively prescribe and manage reusable actuators

Target behaviour	Discussion
Healthcare professionals: Prescriptions don't automatically come with a new actuator but there are mechanisms for flexibility.	It will be important for patients to receive only the canister for repeat prescriptions. The initial prescription would include a reusable actuator, replaced only as needed. Pharmacies would then need to stock both canisters and actuators so they were available to users when their current one expires or breaks.
Healthcare professionals: Able to use reusable actuators and train others.	Healthcare professionals will need to know how to assemble/disassemble, clean, and check reusable actuators, so they can train users. Developing materials to share with patients to assist them in reuse would also be necessary.

Target outcome 3: Users will use multiple canisters in one reusable actuator in a way that doesn't have a net negative impact

Target behaviour	Discussion
Users: There is motivation to keep and reuse the actuator.	Communicating to inhaler users and their carers the impact and need for reuse will help reinforce positive attitudes towards reusing an inhaler and the benefits of reduced waste and cost savings to the NHS.
Users: Have the confidence to reuse and are comfortable with it working effectively.	Providing clear labelling and guidance on the use and shelf life of reusable actuators and training healthcare professionals to support users will address any concerns about wear and tear, incorrect assembly and faulty inhalers.
Users: Happy to assemble/ reassemble and clean their inhaler and reset the dose counter if it has one.	All users should be able to dismantle or reassemble, regardless of manual dexterity or sight issues. Redesigning actuators for reuse would provide an opportunity to create a device which is accessible for all. Easy-to-understand information on inhalers and their reuse, combined with healthcare professional led training will ensure good hygiene and the effective delivery of the correct amount of medicine to the lungs.

Target outcome 4: Inhalers are not lost or misplaced

Target behaviour	Discussion
Users: Able to effectively manage one or multiple inhalers.	A key element for reuse to work effectively is that individuals are able to retain the same actuator for a long period of time. If the individual frequently loses or misplaces their actuator, the waste of plastic would not be reduced. It is important efforts are focused on supporting easy management. In particular, communication methods, using multiple channels for ease of access, with regular reinforcement of actions required to keep the actuator in good condition would be needed. Colour of actuators is also important in distinguishing between medication, so should be standardised (e.g., blue for reliever, brown for preventer).

Recycle inhalers effectively

Most components of a pMDI, the actuator (polypropylene), the canister (aluminium) and the gases (Hydrofluoroalkanes), are all currently recyclable and there are facilities in the UK to undertake this process. However, this is not the full story. The propellant gases require specialist processing,[63] and residual active pharmaceutical ingredients (APIs) could be harmful to the public.[64] Right now, inhalers should not be placed in local authority kerbside collections as they cannot be recycled and municipal waste processes do not treat the waste to permanently remove the harmful substances.

While there is currently no consistent, national approach to facilitate the recovery and recycling of inhalers, the recent postal recycling feasibility scheme 'Take AIR' (Action for Inhaler Recycling), funded by Chiesi Limited and piloted in the Leicestershire area for 2 years, demonstrates that the desire and logistics are in place for such a scheme to succeed on a national footing.

Take AIR was the first and only scheme to allow people to dispose of and recycle their empty, unwanted or out-of-date inhalers through the post, something which 77% of people said would encourage them to recycle – supporting a more sustainable way of living for people with respiratory illnesses.[65] Pre-paid, pre-addressed, envelopes were available for patients to obtain from their local pharmacy. The envelopes were posted directly to a waste management company where the inhalers were sorted and the propellant gases extracted and recycled, along with the aluminium and plastic. Any non-recyclable materials were converted into energy through a process called energy-from-waste.

The Opportunity

If pMDIs are treated appropriately, at the end of their life all major components can be effectively recycled in the UK, including the propellent gases. It may also be economically viable as the recovered aluminium and gases have commercial value. The main challenge is to collect more inhalers for recycling. If all of the over 56 million pMDIs prescribed each year in the UK were recycled, it would equate to around 650 tonnes of plastic and 470 tonnes of aluminium.[66] From an impact perspective, capturing and recycling the propellent gases has the greatest impact for the environment. If all pMDIs were fully recycled, it could lead to a CO_2e reduction of 189,000 tonnes per year based on the gas alone.[67]

Target outcomes

The study identified three target outcomes necessary to achieve the improvements in sustainability outlined above:

1. The system supports the ability to recycle
2. Users have the ability to recycle
3. Can be made from recycled material

63 Grundon. Aerosol Reprocessing. Available at: https://www.grundon.com/facilities/aerosolreprocessing/
64 Abhijeet G. Parvatker, *et al* Cradle-to-Gate Greenhouse Gas Emissions for Twenty Anesthetic Active Pharmaceutical Ingredients Based on Process Scale-Up and Process Design Calculations. *ACS Sustainable Chemistry & Engineering* 2019 7 (7), 6580-6591 DOI: 10.1021/acssuschemeng.8b05473
65 Chiesi UK Asthma Survey. April 2020. [data on file]
66 Chiesi data on File
67 Chiesi data on File

Recycle: What needs to happen?

The following section outlines what behaviour change will be necessary to achieve each desired outcome.

Target outcome 1: The system supports the ability to recycle

Target behaviour	Discussion
Manufacturers: The materials used can be recycled and are consistent across inhaler manufacturers to aid recyclability.	The majority of the components in an inhaler are currently recyclable and there are facilities which exist in the UK that can recycle the aluminium, gases and polypropylene. The priority from a recycling perspective should be to ensure that the gases are captured and recycled as these have by far the largest environmental impact. Care should be taken by manufacturers not to design and produce new inhalers with difficult to recycle materials and take account of the waste management system to maximise the likelihood of inhalers being recycled.
System: The infrastructure exists to capture inhalers and send them for recycling.	Collection or capture of inhalers at the end of their useful life so they can be appropriately dealt with remains a major challenge. A number of pilot schemes have demonstrated the feasibility of takeback schemes, postal return and pharmacy-led initiatives. However, bringing together manufacturers, the NHS and waste industries to agree a comprehensive national inhaler recycling scheme promoted through a wide-spread and effective communications campaign would be needed to ensure its success. If a staged approach is necessary this should start by targeting the canister, as this has a much higher environmental impact if not treated properly.
Manufacturer/waste industry: Dose counter can be handled by the current system either through change of material or change in processes. Manufacturers/users: Dose counter can be removed easily by the user & the user knows what to do with the parts from a recycling perspective. Manufacturers: Dose counter can be part of the canister.	Dose counters should be present on all pMDIs to maximise effective treatment and reduce overall waste, but they are currently regarded as a contaminant by recyclers. There are potential options to; redesign the dose counter material; develop new processes to separate actuator from dose counter at a facility or by the user; or to make dose counters part of the canister. However, all of these would pose significant design and engineering challenges and are considered a long-term collaborative effort to identify the most appropriate solution.

Target outcome 2: Users have the ability to recycle

Target behaviour	Discussion
Users: Know where and how to recycle.	There is widespread lack of knowledge and information for individuals on where and how to dispose of their inhalers. Once an effective scheme, at national or local level, is implemented, it will be vital that users know what to do. Information (websites, leaflets, videos, etc) must be made available to users and healthcare professionals to ensure proper understanding and maximise participation.
Users: Willing to recycle, including taking to a collection point outside of their home if necessary.	When creating a recycling scheme, the views and needs of users should be taken into consideration. This could include location, process and its impact on daily life, and required incentives to maximise participation. It may not be possible to solve for all user needs (such as kerbside recycling), but efforts should be made to design any new scheme with users in mind.
Users: Motivated to recycle as they understand the benefits/impact of recycling their inhaler.	Although many users are highly motivated to recycle, the 'why' can sometimes be lost, leading to poor rates of recycling. Getting the message across about the importance of recycling the canisters and gases and how impactful this can be from a climate change perspective may be compelling. Inadvertently increasing levels of stigma will need to be avoided (i.e., individuals feeling like 'polluters' due to the carbon footprint of their inhalers).

Target outcome: Actuators can be made from recycled material

Target behaviour	Discussion
Manufacturers and waste industry: Actuators can be made from recycled material, there is enough feedstock and provenance can be guaranteed.	The use of recycled plastic poses challenges for manufacturers. There is a regulatory requirement for all medicinal products that the material is of a standard to prevent chemicals leaking, leaching or being extracted from the materials used. The lack of traceability of materials through the waste industry means that it is currently exceptionally challenging, if not impossible to use recycled materials for pharmaceutical devices in close contact with the active pharmaceutical ingredient. Developing a closed loop recycling system could allow high grade, traceable polypropylene products to be recycled in a large enough volume to make it viable.
Users: Happy with the use of recycled material.	With more and more products on the market made of recycled material it appears this is unlikely to be a barrier as long as safety and hygiene were guaranteed. Manufacturers should provide information to users to reassure them of safety aspects and promote the benefits of recycled materials. This is viable, as with every medical device or medication on the market, it will need to go through rigorous testing, trials and regulatory approval.

Conclusion

Model from Research

Reduce the number of inhalers initially prescribed

It is acknowledged that this poses the greatest challenges for successful implementation, yet improved inhaler technique and adherence to the right medication regime in newly diagnosed asthma patients alone could reduce the number of prescribed inhalers by 41.24% (Figure 3). This would save the equivalent of up to 15,726 tonnes of CO_2e in the first year, and by the end of year four as much as 227,204 tonnes of CO_2e.[68,69] Manufacturing changes would support this intervention, along with effective training for healthcare professionals and users.

> It is impossible to model for all inhaler use, but it is worth bearing in mind that based on Asthma+ Lung UK prevalence data, newly diagnosed asthma patients (160,000 per year) make up around 3% of the total number of people in the UK treated for asthma (5.4million) so the overall impact could be much greater.[70]

Reuse the inhaler to lessen need for new actuators

It is technically feasible that an actuator could be made reusable for two years. Looking solely at preventer inhalers, this would reduce the number of waste actuators by up to 23 times (Figure 3). Again, looking solely at newly diagnosed asthma patients, a two-year reusable plastic actuator would reduce the number of prescribed actuators by 84.90% after the first year. By the end of year four 336 tonnes of plastic would have been saved.[71]

Recycle all inhalers effectively

The majority of current pMDI components are recyclable, but we need to capture waste inhalers and ensure they are treated appropriately. There are over 56 million pMDIs prescribed each year in the UK; if all of these were recycled it would equate to around 650 tonnes of plastic and 470 tonnes of aluminium.[72] While recycling these resources is important, capturing and recycling the propellent gases has a higher impact. If all pMDIs were recycled, it could lead to a CO_2e reduction of 189,000 tonnes per year.[73]

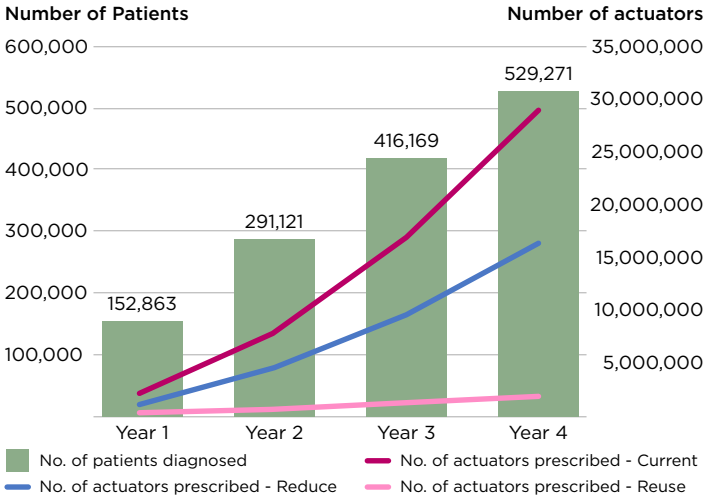

Figure 3. The number of patients diagnosed and the amount of actuators prescribed over a 4 year period based on the Current, Reduce and Reuse models.[74]
A cohort analysis was performed to model the number of newly diagnosed patients over a 4 year period. This was based on the UK figure of 160,000 newly diagnosed asthma patients per year with an assumption that 10% per month would leave the cohort. The number of actuators used by this cohort under the current treatment strategy has been modelled (red line) based on an average of 2.1 actuators being prescribed per cohort member per month. Predictions of actuator use for the same cohort following the Reuse strategy (blue line) were modelled based on being prescribed 1 reliever inhaler every 6 months and 1 preventer inhaler per month. Predictions of actuator use for the same cohort following the Reuse strategy (green line) were modelled based on being prescribed actuators in month 1 which would be reused for a period of 2 years. Because the recycle strategy didn't affect numbers of actuators prescribed, they were not modelled in this way.

68 Reply 2021. [Data on file]
69 Prescqipp. Bulletin 295: Inhaler carbon footprint. Available at: https://www.prescqipp.info/our-resources/bulletins/bulletin-295-inhaler-carbon-footprint
70 British Lung Foundation. Asthma Statistics. Available at: https://statistics.blf.org.uk/asthma
71 Chiesi data on file
72 Chiesi data on file
73 Chiesi data on file
74 Dsposal data on file

What you can do

In this report, we have discussed some of the main opportunities to improve inhaler sustainability and the target outcomes required to make this happen. The target outcomes have covered the different stages of the inhaler journey; from design and manufacture to the healthcare settings stage, on to when the inhaler is in use, and finally to the end-of-life stage. Multiple actors will need to engage and make the changes to the system to achieve the target outcomes. The activities required from healthcare professionals and policymakers and pharmaceutical manufacturers are summarised in the following table.

Required activity	**Audience**		
	Healthcare Professionals treating respiratory diseases	*Healthcare Policymakers*	*Pharmaceutical Manufacturers*
Redesign pMDIs to support a reusable actuator and bring to market as the default prescription.			✓
Redesign pMDIs for the most effective and efficient use and to consider needs for end of life.			✓
Openly publish standardised environmental footprint of products and explore how this might be integrated into healthcare systems.		✓	✓
Communicate disposal needs of products on packaging.			✓
Mainstream sustainability considerations in training, prescription and procurement.	✓	✓	
Support inhaler users to better manage their condition and effectively use and dispose of inhalers.	✓	✓	✓
Develop an effective inhaler recycling scheme, roll out and communicate to inhaler users and healthcare system.	✓	✓	✓
Develop a low-carbon propellant for use in pMDIs.			✓

Chiesi: Protecting patients and the planet

At Chiesi, we believe true 'sustainability' in respiratory care can only be achieved with a broad array of projects that protect both our patients and the planet. This holistic approach, combined with our commitment to sustainability, means we are committed to supporting and implementing the key recommendations of this report. Here's what we are doing today:

- Pledging to become Net Zero by 2035 – reducing the greenhouse gas emissions generated by Chiesi – well ahead of the UK national target of 2050.[75,76]
- Continuously working to reduce the environmental impact of respiratory treatments, from becoming one of the first pharmaceutical companies to move away from chlorofluorocarbons (CFCs) to continuing to invest millions in low global warming potential innovations to treat respiratory diseases.[40]
- Supporting the NHS strategy to reduce medical waste and empowering patients to change the way they dispose of inhalers by returning them to local pharmacies.[77]
- Avoiding 'one size fits all' solutions and ensuring patients have access to the treatments and information they need.

Finally, it is important that both pMDIs and DPIs remain an option for patients depending on their needs. The choice of inhaler device should be the result of an informed discussion between a healthcare professional (HCP) and their patient.[78]

This research project has also revealed that changes in user behaviour are crucial to the success of a reduce, reuse and recycle policies. Using the COM-B model, these behaviours have been divided into Capabilities, Opportunities and Motivations. The success of many of the target outcomes are dependent on these user behaviours (Figure 4).

75 Chiesi Group. Chiesi Group calls for #ActionOverWords in the fight against climate change. Available at: https://www.chiesi.uk.com/img/news/646_chiesi-group-microsite-press-release.pdf
76 Chiesi Group. Chiesi is recertified as a B Corp and sets new tougher objectives for action by 2025 Available at: https://www.chiesi.uk.com/img/news/746_chiesi-is-recertified-as-a-b-corp-and-sets-new-tougher-objectives-for-action-by-2025-.pdf
77 NHS Long Term Plan. January 2019. Available at: https://www.longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf
78 Kaplan A, Price D. Matching inhaler devices with patients: the role of the primary care physician. *Can Respir J.* 2018; 9473051

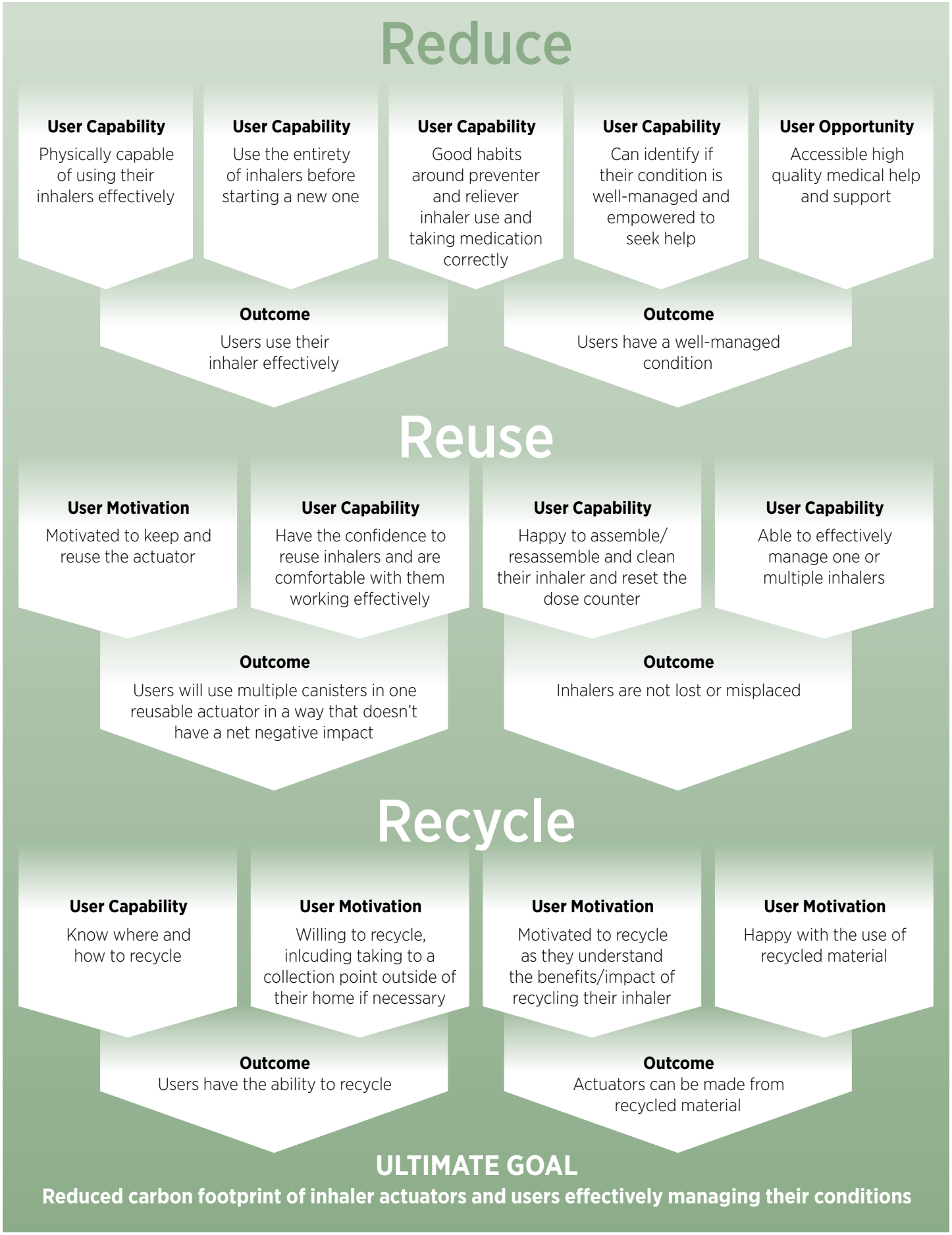

Figure 4 Summary of Target Outcomes to Reduce, Reuse and Recycle Inhaler Actuators that are dependent on User Behaviours. *User behaviours have been classified according to the COM-B model e.g. Capability, Opportunity, Motivation. Change in user behaviour will contribute to achieving the outcomes and ultimately, the goal to reduce the carbon footprint of inhalers*

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This report forms part of Chiesi's commitment to stand with all those doing their part to halt climate change. As an organisation, Chiesi is proud to have taken decisive and ambitious action to ensure patients can continue to access the therapeutic options that best suit their needs, whilst innovating to find the most environmentally conscious solution available.

Chiesi is a B-Corp organisation, and aims to be net-zero by 2035, by deploying a detailed plan, with clear and measurable milestones for emissions reduction. This plan is timed to ensure targets are hit, and when that will happen. Progress reports on environmental impact and progress will be published annually to ensure transparency.

"Decarbonisation is an essential step which we believe all businesses must take to achieve an equitable and regenerative global economy. Humankind survival depends on it," said Maria Paola Chiesi, Vice Chair of the Chiesi Group. "We know it is not an easy path but one that requires continuous effort and improvement across all business dimensions if we are to make a measurable, real-world impact."