# SUSQI PROJECT REPORT

## Reducing the environmental impact of medications in frail patients on a medical ward.

**Start date of Project**: April 2025
**Date of Report**: July 2025


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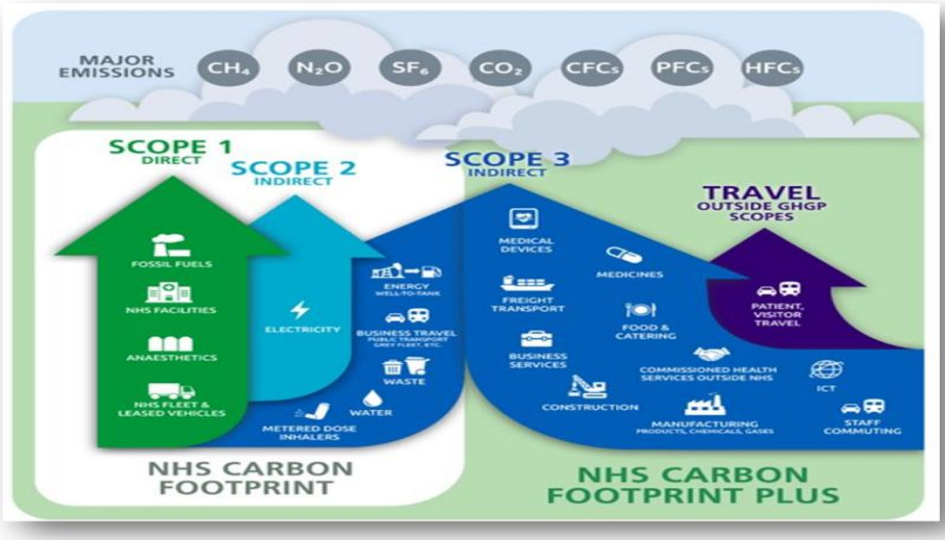
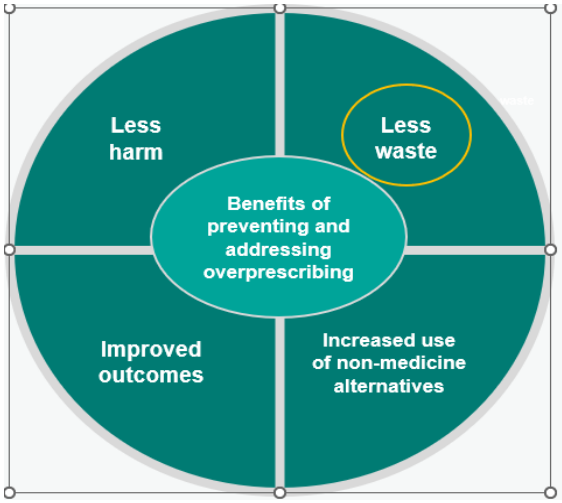
### Background:

Climate change is recognised as a worldwide problem requiring significant action to address. On our current trajectory, the World Bank predicts that by 2030 climate change will reverse recent public health gains putting 100 million people back into poverty and causing at least an additional 250,000 deaths annually.[1] Health systems are major contributors to climate change itself with the NHS being UK' biggest public greenhouse gas emitter, responsible for approximately 5% of all UK environmental emissions with over 20 million tons of carbon from NHS England alone.[2]

NHS England has set out an ambitious target of delivering the world's first net zero health service and responding to climate change, improving health now and for future generations.[3] In order to achieve this, a concerted effort is required addressing direct and indirect contribution towards carbon footprint by the NHS, as outlined in the NHS England summary.[4]



Medicines account for around 25% of emissions from the NHS, from inhalers and anaesthetic and medical gases (5%) and emissions that are embedded in the supply chain of pharmaceuticals (20%). Reducing waste and ensuring appropriate polypharmacy are cornerstones of the NHS strategy to address this, as summarised in the Overprescribing Report.[5]




Frail patients make up a significant proportion of inpatient care and for these patients, the process of deprescribing is important. Deprescribing is the process of actively stopping long term medications where the benefit no longer justifies the potential harms. The risk benefit profile of drugs changes with age, such that treating conditions aggressively may confer long term benefit in patients with lower degrees of frailty however for those who are more frail and unlikely to achieve long term outcomes, the risk of harm may exceed any benefit. Many medicines are used based on long term small benefits. Antihypertensives work like this and reduce the long-term risk of cardiovascular events. However, for a frail patient long term risk may no longer be an appropriate part of the consideration and the problems of treatment such as postural hypotension and falls may now exceed the benefit. The rationalisation of such treatments is the basis for deprescribing. Within this process there is the ability to reconsider the risk / benefit of long-term medications. This also reduces the burden of treatment on the patient/carer and on the environment. Because they are long term medications, the decisions around deprescribing are more significant and may have an impact over years rather than a few weeks.

This project was conducted on Astley Ward where the patients are predominantly frail. As part of an effective Comprehensive Geriatric Assessment, patients undergo a review of their prescribed treatments on admission with the aim of ensuring that treatment is still appropriate and not potentially harmful. The project ran concurrently with a multi-centre NIHR funded research study which aimed to test a behavioral intervention on encouraging proactive deprescribing in frailty (**C**ompre**h**ensive Geri**atr**ician Led **Me**dication **R**eview - Charmer). Nationally it is the largest research study completed in ageing with approximately 27,000 patients recruited. Astley ward is a participating site where intervention ran from November 2024.

The other aspect which the project aimed to address is the issue of medicine wastage for any treatments which are no longer needed and have been supplied to Astley ward. Currently

there is no formal system for medication assessment and reuse and this has the potential cost and environmental implications. Views of staff on sustainability agenda were also sought to assess engagement and willingness to participate in the process.

The project team contained Consultant Frailty Pharmacist, as polypharmacy is a research topic of interest; our Director of Digital Medicine and Trust Sustainability Lead; Astley ward manager and ward pharmacist, as well as our resident doctors who analysed the datasets on deprescribing.

## Specific Aims:

The 3 aims of the project were:

1. Improve deprescribing through effective polypharmacy reviews and measure impact on reducing the carbon footprint while ensuring medication is optimised to reduce the risk of harm.
2. Assess waste incurred due to medication being supplied to the ward which is not used
3. Engage staff members on the ward with the ambition to make sustainable approach part of routine practice

## Methods:

**Deprescribing through effective polypharmacy reviews**

Using the Clinical Informatics system, a report of admission and discharge medication was extracted for the months of September 2024 (pre-intervention) and June 2025 (post-intervention). Data from reports was utilised to formulate a list of medication which was discontinued and started during the hospital admission for a sample of 20 patients in each month, and the impact of the intervention was quantitively and qualitatively analysed in terms of absolute number of medication deprescribed, effect on anticholinergic load, cost and carbon footprint data on discontinued medication.

**Staff education and behaviour change**

The ward became an active site for the NIHR funded study in November 2024 and we aimed to embed proactive deprescribing changes by June 2025.

- Several educational activities were undertaken to aid proactive deprescribing as part of the larger research study. The education was provided in the form of workshops with video presentations and opportunity for feedback from the multidisciplinary team. Educational activities included all rotating resident doctors, new consultants and pharmacists covering Astley ward. Discussion within the workshops included:
    - Evidence on the benefits of deprescribing as well as the groups of medications that were most likely to be appropriate for review.
    - Recognition of barriers and challenges for staff (e.g. lack of time and competing priorities among tasks).
    - Patient perceptions of deprescribing - for some staff there were concerns that patients themselves may not wish to engage in deprescribing process, however research suggests that patients are overwhelmingly happy to consider this during hospital admissions.[9]
- Pharmacy teams contributed towards ensuring indication was obtained for medication prescribed when this information was uncertain.
- Checklist was added on the ward round note to document when deprescribing discussion has been completed.

**Quantification of medication waste**

- Staff were encouraged to save any medication supplied to the ward but not used in the week 13th – 20th of June 2025 and these items were then analysed for cost and carbon impact. There is currently no formalised process for review, return and reuse of medication not utilised during hospital admissions.

**Staff engagement**

- Paper questionnaires containing 3 questions regarding environmental sustainability were distributed to assess Astley ward staff engagement in the agenda. The questionnaire was provided by the Trust Sustainability Team.

## Measurement:

*Patient outcomes*:

Astley ward medical team completed a checklist as part of their ward round process to show if conversations with patients regarding deprescribing were completed. An analysis of 20 medication reviews was completed for September 2024 (pre intervention) vs June 2025 (post intervention) to understand if the reviews were taking place and the impact of the reviews on deprescribing practice. The anticholinergic score (assessment of effect of certain medication which may be harmful in frail patients) was reviewed as part of this process.

Ideally data would also be collected on long term outcomes/longitudinal data on re-admissions to understand impact of reduced polypharmacy – but this was not possible to collect in the scope of this project. The Charmer national deprescribing study will aim to capture data on long term outcomes.

*Environmental sustainability*:

Deprescribing through effective polypharmacy reviews:

We planned to estimate the greenhouse gas (GHG) emissions associated with wasted pharmaceuticals using an Environmentally Extended Input-Output Analysis (EEIOA). The financial cost of unused medication was provided, adjusted to 2022 prices using the UK Bank of England inflation rate, and then converted into GHG emissions using the 2022 UK Government Standard Industrial Classification (SIC) emission factor for pharmaceuticals. Each deprescribed medication was also assessed via Medicine Carbon Footprint Formulary and classified in line with the following definitions, where data was available.[10]

| MCF Rating | g CO2e per dose |
|---|---|
| $CO_2$ Low | 0 - 10 g CO2e |
| $CO_2$ Medium | 10 - 100 g CO2e |
| $CO_2$ High | 100 - 1000 g CO2e |
| $CO_2$ Very High | ≥ 1000 g CO2e |

Quantification of medicines waste for medicines supplied but not used:

For emissions related to waste disposal on Astley Ward, the pharmaceutical waste was weighed, and the resulting mass was converted into GHG emissions using the clinical waste incineration emission factor from "The carbon footprint of UK hospitals" reference.[6]

*Economic sustainability*:
Deprescribing through effective polypharmacy reviews:
The number of deprescribed drugs was calculated from the medication reports for 20 patients from Sep 24 and June 25. Their costs were calculated according to current BNF tariffs and the cost difference between newly prescribed and deprescribed medicines thereby derived. In addition, the cost and burden of medication administration is noted to decrease after an effective polypharmacy review which has wider benefits but was beyond the scope of this project.

Quantification of medicines waste for medicines supplied but not used:
One week's waste medication was collected from Astley ward and quantified. The value of the drugs was calculated from the current BNF tariff.

*Social sustainability*:
To understand staff attitudes on reducing the environmental impact of healthcare, questionnaires were distributed to the staff on the ward.

## Results:

*Patient outcomes*:
Analysis has revealed that the percentage of patients where deprescribing discussion was completed increased from 0% baseline (Sep 24) to 60% in (Jun 25) from a random sample of 20 patients from each month. This has the potential to improve person-centred care and embed a process of continuous monitoring of appropriateness of medication.

The average percentage of regular medications deprescribed increased from 10% to 20% when the sample of 20 patients was analysed before and after the intervention. Both for September and June data, the number of medications on discharge increased (average 8.7 on admission in Sep to 9.6 on discharge (+0.9); average 9.6 on admission in June to 10.9 on discharge (+1.3)). The increase in absolute numbers is not surprising as there are often new pathologies and deficiencies identified during hospital admission – the most important aspect of effective polypharmacy review is minimisation of harm from inappropriate medication.

The difference in anticholinergic burden between admission and discharge medication changed form an increase of 15% in Sep 24 to 4% in June 25 in the 20-patient sample. As frail patients are especially vulnerable to adverse effects like confusion, falls, and functional decline, reducing anticholinergic burden is critical for their safety and independence.

Medications stopped included anti-hypertensives and blood thinners – these are long term medications that can cause potential harm for patients or may no longer be able to confer benefit due to relative shortened life expectancy. Medications started included vitamin D, folate, iron and laxatives. Pain relief was often modified. Some of these will be prescribed as treatment courses and will be discontinued once nutritional deficiency replaced e.g. folic acid/iron.

Frail patients are at increased risk of harm from inappropriate polypharmacy as majority of clinical trials and hence evidence base does not include this patient cohort.[7] The guidelines which are then

derived from these trials do not necessarily address the needs of our frail patient cohort. Hospital admission presents an opportunity to address this and complete proactive deprescribing process (i.e. not waiting for the harm from medication to occur). Currently approximately 51% of older people admitted to hospital are prescribed at least one inappropriate medicine[8] which are deprescribed in less than 10% of the people, and are stopped almost always after they have caused harm.[9] Patients tell us that they would like us to consider this issue during hospital admission – in fact 97.4% would be happy to have a medicine deprescribed.[11]

*Environmental and economic sustainability*:
Impact of deprescribing through effective polypharmacy reviews:

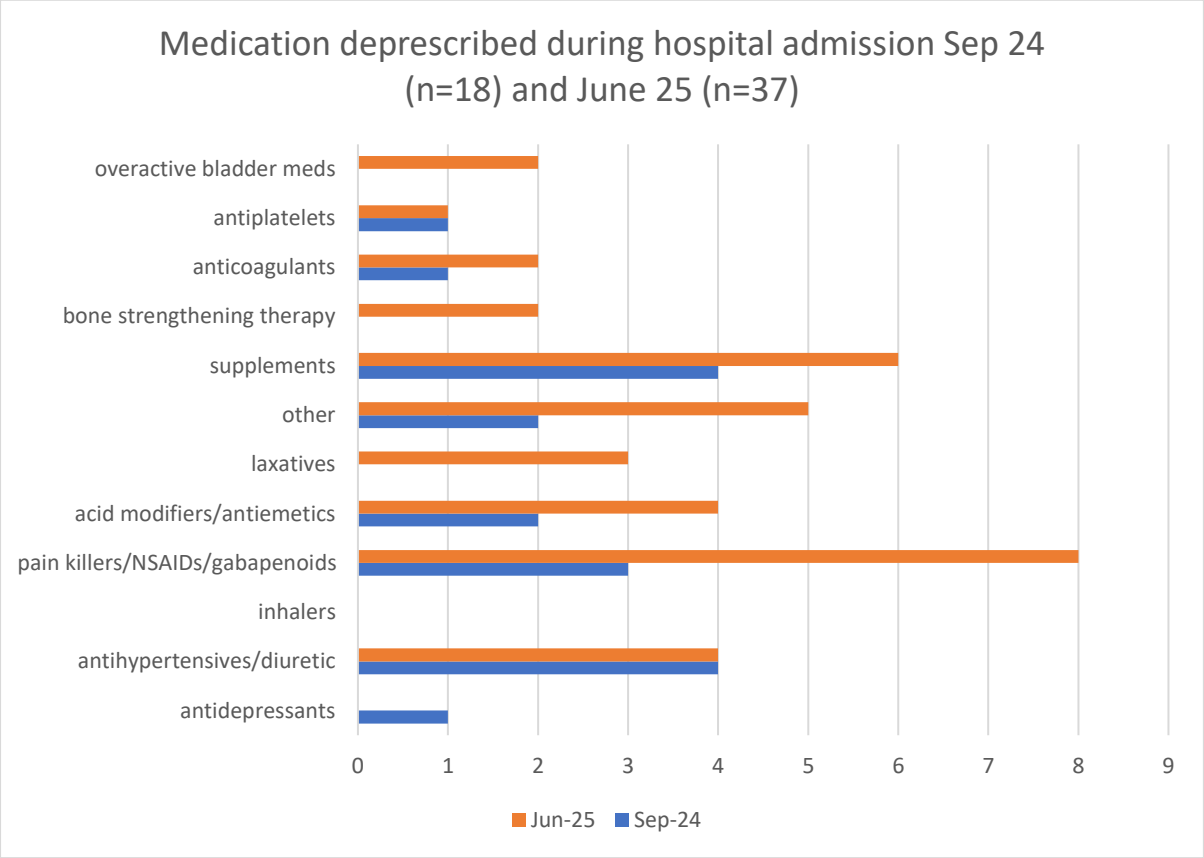
| For 20 patient sample | September 2024 | June 2025 |
|---|---|---|
| Total number of medications preadmission | 173 | 185 |
| Number of medications deprescribed | 18 | 37 |
| **Percentage deprescribed** | **-10%** | **-20%** |
| Number of medications started | 36 | 59 |
| **Percentage newly started** | **+21%** | **+32%** |
| **Overall change admission vs discharge** | **+11%** | **+12%** |
| Cost avoided from deprescribed medicines for 1 month | £85.56 | £115.07 |
| Cost added with newly started medication | £157.98 | £276.39 |
| Overall cost difference | +£72.42 | +£161.32 |
| Change in anticholinergic score admission vs discharge medication | +15% | +4% |
| Number of discontinued medicines with medium/high score for carbon footprint | 7 | 16 |

From our sample of 20 patients, we have achieved an increase of 10% in deprescribing rates however we noted that more newly prescribed items were started in the June cohort vs Sept cohort (32% compared to 21%). Overall, as the population who are frail have a high likelihood of new pathologies and deficiencies being identified during hospital stay, our global number of changes from admission vs discharge medication did not differ much (Sep 24 +11% and June 25 +12%).

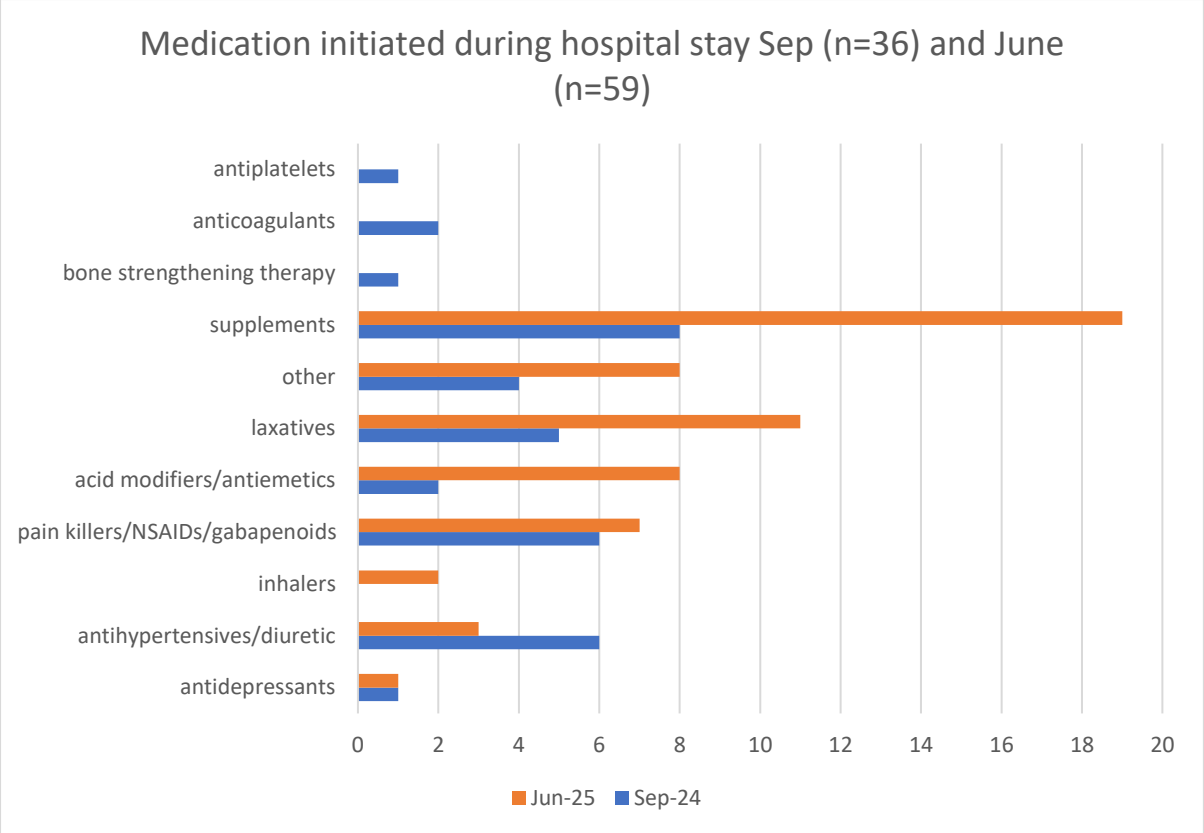
The similar global number of medications between admission and discharge is likely due to two factors. First, patients may have changed medical needs and require new medications. Second, one agent from a class being deprescribed may need to be replaced by another agent in the same class due to interaction. Due to the second reason, determining the true deprescribing rate is challenging, and it was not possible to estimate the financial and carbon impact of deprescribing. More data and monitoring are required to identify which medications are truly deprescribed, rather than replaced with another agent in the same class.

It is important to note that we deprescribe inappropriate medication to reduce harm and often prescribe nutritional supplements/laxatives/analgesia as these are pathologies which we find during hospital admission.

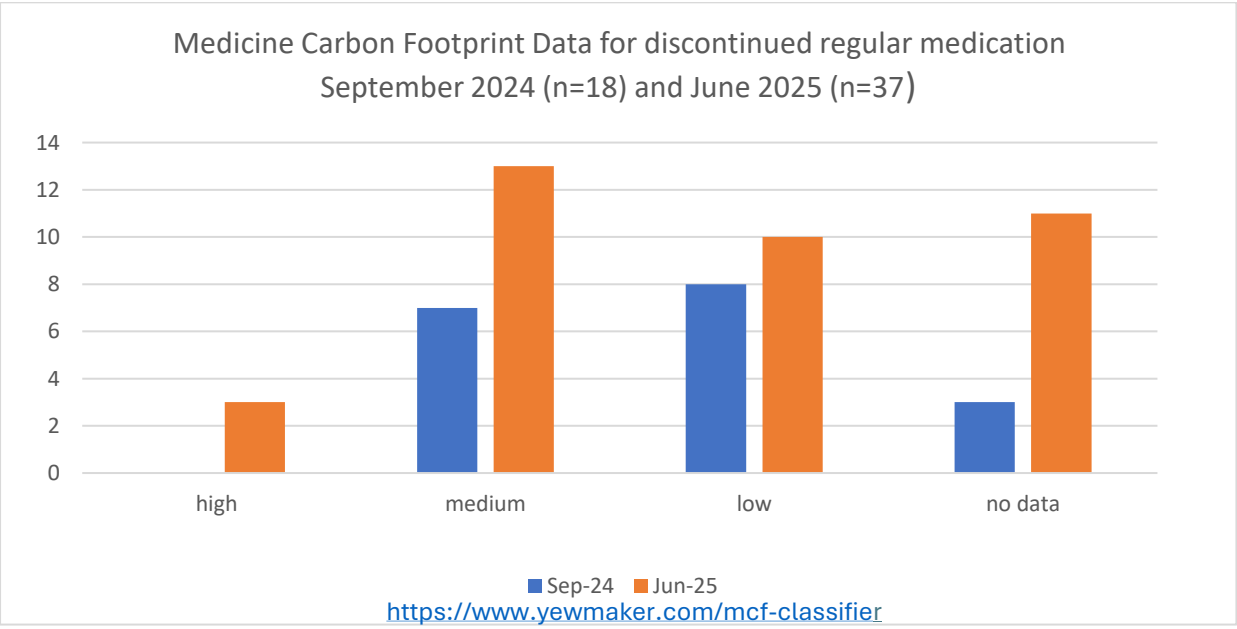
Medication deprescribed during hospital admission:




Medication initiated during hospital stay:




While we could not quantify specific figures for this project, the carbon footprint of deprescribed medication is often medium/high. Data from a Quality Improvement project undertaken in Central Liverpool Primary Care Network showed that around 46% of discontinued medication has a medium to high carbon footprint [12] which is similar to what we have achieved. From our dataset, using carbon footprint ratings of low-high from the Medicine Carbon Footprint Classifier created by YewMaker, the percentage of medication with high/medium carbon footprint also increased in June sample (43%) compared to September (40%).




https://www.yewmaker.com/mcf-classifier

**Assessment of medicines waste for medicines supplied but not used:**
Tables 1 and 2 describe the GHG emissions from pharmaceutical waste on Astley Ward over one week, including emissions from both the unused medications and their disposal.

| Drug | Tally | GHG emissions (kgCO2e) |
|---|---|---|
| Ciprofloxacin 400mg/200ml | 9 | 49.40 |
| Meropenem 500mg Infusion | 10 | 17.51 |
| Calcichew D3 | *89* | *1.44* |
| Mirabegron 25 | *12* | *2.45* |
| Co-Codamol 30/500 | 15 | 0.11 |
| Lidocaine prilocaine cream and dressing | 1 | 0.47 |
| Sodium Bicarbonate tablets | 11 | 0.04 |
| Hyoscine Butylbromide | 92 | 0.78 |
| *Total* | | *72.20* |

| | GHG emissions (kgCO2e) |
|---|---|
| Pharmaceuticals | 72 |
| Waste disposal | 3 |
| *Total* | *75* |

Assuming a consistent weekly rate of pharmaceutical waste, and that all pharmaceutical waste is incinerated, the annual greenhouse gas (GHG) emissions from unused and wasted medications in Astley are estimated to be approximately 3,922 kg$CO_2$e. Extrapolating this figure across the 10 wards would be 39,000 kgCO2e per year.

Reuse of unused medication, if implemented, would reduce the number of drugs purchased and is therefore cash releasing. Assuming a similar volume and cost of approximately £340 per week, implementation of a reuse scheme has potential to save £17,680 per annum just from one ward. Extrapolated across 10 wards, the potential saving is around £170k. A project from Southmead Hospital that reused medication was recently the winner of the Sustainability Hero NHS Award, they saved over £200k per annum and reduced the carbon footprint by 287,000 kgCO2e.[13]

*Social sustainability*:
Staff survey revealed high level of engagement with 80% of the sample being aware of the organisation's environmental aim, 90% being somewhat or slightly concerned about environmental impact of healthcare and 80% feeling that it is their responsibility to address this.

## Discussion:

This project has demonstrated that deprescribing of drugs in frail patients can be achieved though routine review and education within the teams. The study showed an increase in deprescribing of potentially harmful or no longer useful medication was improved following system redesign of ward round notes and educational activities. The benefits are to the patient with reduced risk of harmful effects, to the environment in the reduction of provision of medication that is not providing benefit and to the Trust in terms of reduced cost. While this study is limited in size and scale, long term benefits are not possible to measure. It was interesting to note that a significant percentage of deprescribed medication had high or medium carbon footprint. We recognise the importance of deprescribing potentially harmful medication as we usually find new pathologies which necessitate new treatments to be initiated in frailty, hence individualized optimisation is the cornerstone of effective practice in Ageing and Complex Medicine.

The reuse of drugs presents a real potential cash releasing activity to the Trust. This would be in the order of £170,000 but would need a systematic process for it to be successful. This work would require the oversight of pharmacy team and has the potential to deliver a significant reduction in financial and carbon expenditure. While the value of a weeks' worth of medications calculated in this report is assumed to be representative for the whole organization, which may not be accurate, it does provide an estimate of size of effect. These findings and projections can be used to support a business case for reuse of hospital supplied medication being embedded into the Trust systems and workflow.

The project team will continue to engage with the pharmacy team to raise awareness of these findings. It is important to recognise that pharmacy are enthusiastic about supporting change; however, to implement this effectively at a Trust-wide level, dedicated time and resources will be essential, as this is not limited to a frailty or ward-specific issue.

## Conclusions:

Reducing inappropriate polypharmacy has the potential not only to minimise harm to patients but also to reduce the carbon footprint and impact on the financial cost of healthcare. In addition, more effective reuse and resupply of unused medication can generate cost savings while further reducing environmental impact. Staff on our ward are motivated and keen to contribute to these efforts, recognising the importance of addressing the environmental impact of healthcare.

References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- [2] k9-fph-sig-nhs-carbon-footprint-final.pdf
- [3] Greener NHS » National ambition
- [4] B1728-delivering-a-net-zero-nhs-july-2022.pdf
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- [9] Scott, S., Clark, A., Farrow, C. *et al.* Attitudinal predictors of older peoples' and caregivers' desire to deprescribe in hospital. *BMC Geriatr* **19**, 108 (2019). https://doi.org/10.1186/s12877-019-1127-x
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- [12] Deprescribing Medication Reviews | Sustainable Healthcare Networks Hub
- [13] The Sustainability Partnership Awards — Sustainability Partnerships

## Critical success factors

Please select one or two of the below factors that you believe were most essential to ensure the success of your project changes.

| People | Process | Resources | Context |
|---|---|---|---|
| ☐ Patient involvement and/or appropriate information for patients - to raise awareness and understanding of intervention<br><br>X **Staff engagement**<br><br>☐ MDT / Cross-department communication<br><br>☐ Skills and capability of staff<br><br>X **Team/service agreement that there is a problem and changes are suitable to trial (Knowledge and understanding of the issue)**<br><br>☐ Support from senior organisational or system leaders | ☐ clear guidance / evidence / policy to support the intervention.<br><br>☐ Incentivisation of the strategy – e.g., QOF in general practice<br><br>X **systematic and coordinated approach**<br><br>☐ clear, measurable targets<br><br>☐ long-term strategy for sustaining and embedding change developed in planning phase<br><br>☐ integrating the intervention into the natural workflow, team functions, technology systems, and incentive structures of the team/service/organisation | ☐ Dedicated time<br><br>☐ QI training / information resources and organisation process / support<br><br>☐ Infrastructure capable of providing teams with information, data and equipment needed<br><br>☐ Research / evidence of change successfully implemented elsewhere<br><br>☐ Financial investment | ☐ aims aligned with wider service, organisational or system goals.<br><br>☐ Links to patient benefits / clinical outcomes<br><br>☐ Links to staff benefits<br><br>☐ 'Permission' given through the organisational context, capacity and positive change culture. |