HSE Greener Models of Healthcare Framework

HSE Climate and Sustainability Programme

An Overview of the United Nations Sustainable Development Goals

Executive Summary

Climate change presents a fundamental threat to human health. It affects the physical environment as well as all aspects of both natural and human systems; including social and economic conditions and the functioning of health systems. As climatic conditions change, more frequent and intensifying weather and climate events are observed, including storms, extreme heat, floods, droughts and wildfires. These weather and climate hazards affect health both directly and indirectly, increasing the risk of deaths, non-communicable diseases, the emergence and spread of infectious diseases, and health emergencies.

The Health Service Executive (HSE) is required to *"use the resources available to it in the most beneficial, effective and efficient manner to improve, promote and protect the health and welfare of the public"* (Health Act 2004), is committed to reforming and improving the delivery of care to help reduce greenhouse gas (GHG) emissions and is aligned with the Sláintecare Reform Programme, which prioritises digital healthcare, promotes social prescribing and facilitates service users care closer to home. The impact of COVID-19 has led to a large increase in the use of digital services, not just for provision of healthcare services, but also enabling people to work from home as far as is reasonably possible. This prevents avoidable commuting and reduces air pollution impacts.

Within this framework, the first section outlines an introduction to greener models of healthcare within the HSE and presents an overview of best practices (internationally and nationally). Within section two, we explore key building blocks for greener models of healthcare. Following this, the framework presents an overview of key focus areas that are recommended for action. Finally, within section four, the framework includes recommendations for implementation.

It is intended that this document will be a live document that will be updated and expanded as required to reflect emerging best practices and mandated requirements outlined in the Climate Action Public Sector Mandate, which is updated annually.

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Abbreviations

- ALARA – As Low As Reasonably Achievable
- AMR – Antimicrobial Resistance
- AMRIC – Antimicrobial Resistance and Infection Control
- AMS – Antimicrobial Stewardship
- BRAN – Benefits, Risks, Alternatives, Nothing
- CAI – College of Anaesthesiologists of Ireland
- CAP – Climate Action Plan
- CBT – Cognitive Behavioural Therapy
- CDM – Chronic Disease Management
- CGM – Continuous Glucose Monitoring
- CHO – Community Healthcare Organisation
- CME – Continuing Medical Education
- CO_2 – Carbon Dioxide
- CO_2e – Carbon Dioxide Equivalent(s)
- COP – Conference of Parties
- CT – Computed Tomography
- DoT – Department of Transport
- DoH – Department of Health
- DPI – Dry Powder Inhaler
- DVC – Doctor Visit Card
- ED – Emergency Department
- EM – Emergency Medicine
- EMT – Executive Management Team
- EPA – Environmental Protection Agency
- EV – Electric Vehicle
- F-Gas – Fluorinated Gas
- GOLD – Global Initiative for Chronic Obstructive Lung Disease
- GP – General Practice
- GPP – Green Public Procurement
- GDM – Gestational Diabetes
- GHG – Greenhouse Gas
- GINA – Global Initiative for Asthma
- GMS – Medical Card
- GLP-1 – Glucagon-like Peptide-1
- HFA – Hydrofluoroalkane
- HFCs – Hydrofluorocarbons
- HSE – Health Service Executive

- HSCP – National Health and Social Care Professions Office
- HVC – Heart Virtual Clinics
- ICJ – International Court of Justice
- ICPCD – Integrated Care for the Prevention and Management of Chronic Disease
- ICS – Inhaled Corticosteroids
- IDE – Irish Doctors for the Environment
- ICT – Information and Communication Technology
- IR – Interventional Radiology
- IV – Intravenous
- IVC – Intravenous Cannula
- LABA – Long-Acting Beta2-Agonist
- MART – Maintenance and Reliever Therapy
- MDI – Metered Dose Inhaler
- MDT – Multidisciplinary Team
- MRI – Magnetic Resonance Imaging
- mL – Milliliter
- NHP – National Heart Programme
- NHS – National Health Service
- NSAT – National Sustainability Assessment Tool
- NWIHP – National Women and Infants Health Programme
- OECD – Organisation for Economic Co-operation and Development
- OGP – Office of Government Procurement
- OPD – Outpatient Department(s)
- PCRS – Primary Care Reimbursement Services
- PwD – People with Diabetes
- PR – Pulmonary Rehabilitation
- SABA – Short-Acting Beta2-Agonist
- SEAI – Sustainable Energy Authority of Ireland
- SDG – Sustainable Development Goal
- SMI – Soft Mist Inhaler
- SO – Strategic Objective
- SusQI – Sustainable Quality Improvement
- TILDA – The Irish Longitudinal Study on Ageing
- T1D – Type 1 Diabetes
- T2D – Type 2 Diabetes
- WHO – World Health Organisation
- WONCA – World Organisation of Family Doctors
- WTEs – Whole Time Equivalents

1. Introduction

The climate crisis is fundamentally a health crisis. Its impacts span respiratory illnesses, water- and vector-borne diseases, malnutrition, non-communicable diseases, mental illness, and increased injury and mortality from extreme weather events. Every part of the human body is at risk, and the combined effects of climate change, biodiversity loss, and pollution—the "triple planetary crisis" (UNFCCC, 2022)—are placing unprecedented strain on healthcare systems with long-term consequences for global health. Climate change is the biggest global health threat of the 21st century (Costello et al., 2009).

At the same time, the healthcare sector contributes significantly to the problem, accounting for 4.4% of global greenhouse gas emissions (Karliner et al., 2019). If it were a country, the sector would rank as the fifth largest emitter in the world. Modern healthcare delivery is fundamentally unsustainable—both resource intensive and inefficient. Without decisive action to reduce its carbon footprint, emissions from the health sector could triple by 2050, unintentionally worsening the very health outcomes it seeks to protect (Health Policy Partnership, 2022).

The greatest benefits in healthcare come from shifting toward a model focused on disease prevention rather than treatment. Minimising the prevalence of diseases associated with modifiable factors such as obesity and air pollution (see e.g. Bergstra et al., 2022), including hypertension, diabetes, joint problems requiring replacement, chronic obstructive pulmonary disease, and coronary artery disease, will greatly reduce carbon emissions linked to their treatment. Achieving this will require an unprecedented multi-faceted and ambitious approach.

Modern healthcare is built on a culture of single-use, disposable materials, overconsumption of resources, and other highly wasteful practices. Although these measures were well intentioned and considered necessary for infection control, disease management, patient safety, and other reasons, it is now time to explore and adopt more sustainable alternatives. At a fundamental level, we are struggling to uphold one of the core principles of healthcare: 'First, do no harm' — in practice, we are causing harm.

While there has been an acceleration of global efforts to address environmental damage, particularly since the signing of the Paris Agreement in 2015,[1] much more needs to be done. The Paris Agreement is the first legally binding international Treaty on climate change, adopted by 196 parties at the UN Climate Change Conference (COP21) in Paris in 2015. Its overarching goal is to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit temperature increase to 1.5oC above pre-industrial levels. Ireland's emissions have continued to climb since. The EU Green Deal provides a package of policy initiatives launched by the Commission in 2019 to set the path to a green transition with the ultimate goal of reaching climate neutrality by 2050. At national level, the Climate Action Plan provides a roadmap for halving Ireland's emissions by 2030 and reaching net zero by 2050.

In July 2025, the ICJ issued a landmark Advisory Opinion[2] affirming that all states have a legal duty under international law, not just under the Paris Agreement, to prevent significant environmental harm, cooperate globally, and regulate businesses' emissions, including fossil fuel activities. The Court ruled that failure to act on fossil fuel production, consumption, subsidies, or licensing might be considered an internationally wrongful act, potentially triggering liability. It also recognised the right to a clean, healthy, and sustainable environment as a fundamental human right and held states responsible for regulating private sector climate impacts. This ruling establishes that states not only have an ethical obligation to act, but also a legal obligation to address the climate crisis.

The HSE has published its Climate Action Strategy 2023 – 2050 (the "Strategy")[3] which sets out the HSE's commitment to achieve net-zero emissions no later than 2050, delivering healthcare which is environmentally and socially sustainable. The Strategy outlines how the HSE will contribute to putting

1 The United Nations – The Paris Agreement
2 The ICJ – Obligations of States in Respect of Climate Change
3 HSE – Climate Action Strategy 2023 – 2050

Ireland on a more sustainable path by cutting emissions, creating a healthier, cleaner, and greener society, and helping to protect, prepare and educate the population for the health consequences of climate change and biodiversity loss. It comprises six priority areas, ten strategic objectives and two enabling functions, summarised below (Table 1).

The purpose of the Strategic Framework Documents, developed for each SO, is to translate the HSE's vision for a net-zero health service that is environmentally and socially sustainable into a practical programme for delivery of the relevant strategic objective.

This document provides a framework for greener models of healthcare delivery and supporting implementation plan to reduce the environmental impact of the delivery of models of care, pharmaceutical products and services used while continuing to prioritise patient safety, prevention, and population health.

Table 1. Overview of HSE Climate Action Priority Areas and Corresponding Strategic Objectives

	Priority Area	Corresponding Strategic Objectives
A.	**Sustainable Buildings and the green environment**	**SO1** – Achieve a 50% reduction in energy usage, and a 51% reduction in energy-related GHG emissions by 2030 and a net-zero emission target by 2050 (at latest) under the requirement set out for public sector bodies in the Climate Action Plan 2021.
		SO2 – Develop a HSE Green Space Framework and supporting implementation plan to optimise the use of green space for the promotion of the health and wellbeing of patients, staff and local communities.
B.	**Transport and Mobility**	**SO3** – Develop a HSE Transport Framework and supporting implementation plan to eliminate, reduce and substitute transport emission sources associated with delivering and accessing healthcare.
		SO4 – Develop a mobility framework and implementation plan to promote travel initiatives to avoid unnecessary patient and staff journeys. Where journeys are required, support and encourage active travel, low carbon or public transport alternatives.
C.	**Sustainable Procurement**	**SO5** – Develop a procured goods and services waste reduction framework and supporting implementation plan to reduce waste and related emissions, strengthen supply chain resilience and support the transition towards a circular economy.
		SO6 – Develop a baseline for all HSE supply chain emissions and work in consultation with key supply chain product partners to include sustainability criteria in all tender procurement processes and establish a credible decarbonisation trajectory (no later than 2025).
D.	**Greener Models of Healthcare**	**SO7** – Develop a framework for greener models of healthcare delivery and supporting implementation plan to reduce the environmental impact of the delivery of models of care and pharmaceutical products / services used while continuing to prioritise patient safety, prevention and population health.
E.	**Water and Waste Management**	**SO8** – Develop a HSE Waste Management Framework and supporting Implementation plan to minimise food waste generation, increase recycling and reduce the amount of clinical waste generated.
		SO9 – Develop a data driven water consumption framework and implementation plan to report and manage water consumption and conservation measures to reduce wastage.

F.	**Adaptation and Resilience**	**SO10** – Ongoing implementation of the measures set out in the Department of Health Adaptation plan 2019 -24 and all subsequent plans.
	Enabling Function	**Description**
1	**Measurement and Assurance**	The Measurement and Assurance Work stream will coordinate the collection, collation and calculation of the relevant sustainability data across the ten work programmes, including climate (Scope 1, 2 and 3 emissions), water usage, waste disposal and relevant biodiversity data. Identification of metrics and key performance indicators, target setting and tracking implementation of the Strategy will be enabled. The methodologies used will be in line with international standards.
2	**Collaboration, Communication, Awareness and Training**	In recognition of the need to inspire and upskill the workforce to embrace sustainability and adapt dynamically, the HSE recognises the need to educate and upskill a large workforce to act as climate activists and to equip staff with the knowledge to promote an overall culture of sustainability awareness.

1.1 Context

This section sets out the key policy areas relevant to the design, development, and implementation of the greener models of healthcare programme. The overarching Sláintecare[4] policy sets out to transform how health services are delivered in Ireland, building towards equal access to services for every citizen based on patient need and not on their ability to pay. The goal is for one universal health service for all, which will allow people to stay healthy in their homes and communities for as long as possible. New models of integrated care are based on those principles, which are also key to effective delivery of sustainable healthcare services.

The HSE is also committed to supporting the 17 UN SDGs to promote prosperity while protecting the planet. Although the HSE contributes to most SDGs in one form or another, as they directly relate to health or contribute to health indirectly, health has a central place in SDG Goal 3 “Ensure healthy lives and promoting wellbeing for all ages”.

Figure 1. An Overview of Sustainable Development Goals relevant to Greener Models of Healthcare

Goal 3:
Good health and wellbeing

Goal 12:
Responsible consumption and production

Goal 13:
Climate action

The HSE’s Vision for a healthier Ireland, with the right care, at the right time and in the right place is synonymous with the sustainable healthcare agenda. New models that seamlessly integrate virtual, home-based and in-person care to deliver the right service in the right place at the right time using all options available will underpin the delivery of a more sustainable health service that is directly aligned with the HSE Vision.

The HSE’s Integrated Care Agenda[5] aims to join up our health and social care services to deliver patient care that is safe, timely, efficient and as close to home as possible. Integrated care puts

4 Gov — Sláintecare Implementation Strategy and Action Plan 2021 — 2023
5 HSE — Integrated Care (Chronic Disease)

the patient need at the centre of everything to improve the quality of care and patient outcomes. Grounded in the principles of prevention, patient empowerment, and multidisciplinary planning and delivery, the HSE is implementing a large-scale integrated care programme for chronic diseases. This programme is designed to build a cohesive system of care that enhances patient experiences and outcomes. In addition, there are many clinical programmes and other relevant programmes established with the aim of improving the quality, access and value of healthcare services. These include approximately thirty-one national clinical programmes under the auspices of Clinical Design and Innovation, the Public Health Reform Programme, Cancer Control Programme, Women and Infant's Programme, amongst others.

A crucial step in delivering integrated care is through the HSE's Regional Reform Programme[6]. Under the programme, six health regions have been established with responsibility for management of health and social care services in their area. A comprehensive Integrated Service Delivery Model for the health regions is being developed, with appropriate structures to deliver integrated care for local populations. Integrated Health Areas will provide the sub-structures that will focus on the health of the population across the range of care services provided, from living well at home to inpatient care.

Internationally and nationally, there are a number of key policies that inform and provide mandated targets for inclusion and consideration by the HSE in its journey becoming a sustainable health service

Table 2. Summary of Relevant European and National Policies

European Policy	Key Points
The European Green Deal[7]	• Writes into law the goal set out in the European Green Deal for Europe's economy and society to become climate-neutral by 2050. The law also sets the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. • Climate neutrality by 2050 means achieving net zero GHG emissions for EU countries, mainly by cutting emissions, investing in green technologies and protecting the natural environment. • The law aims to ensure that all EU policies contribute to this goal and that all sectors of the economy and society play their part.
EU Climate Law[8]	• Legally enshrines the EU's target of reaching climate neutrality by 2050 and includes provisions for increasing the EU's climate ambition for 2030 and establish a European Scientific Advisory Board on Climate Change.
2030 Climate and Energy Framework[9]	• EU-wide target and policy objectives for 2030 in areas including greenhouse gas emissions reduction, renewable energy and energy efficiency.
National Climate Action Plan 2024[10]	• Annual Report must include disclosure of GHG emissions, update on implementation of mandate and a sustainable activities report. All reported using the SEAI Public Sector Monitoring and Reporting System.
Sláintecare[11]	• 10-year plan to reform the health and social care system. Aims to provide high-quality care to everyone across Ireland. The plan is to ensure services are delivered in a sustainable manner.
Public Sector Climate Action Mandate[12]	• Annual Report must include disclosure of GHG emissions, update on implementation of mandate and a sustainable activities report. All reported using the SEAI Public Sector Monitoring and Reporting System and publicly available.

6 HSE – Health Regions
7 The European Union – The European Green Deal
8 The European Union – Climate Law
9 The European Union – 2030 Climate and Energy Framework
10 Gov – Climate Action Plan 2024
11 Gov – Sláintecare
12 Gov – Public Sector Climate Action Mandate – Climate Action Plan 2023

Clinical Programmes[13]	• Vehicle through which multi-disciplinary clinical design leadership and innovation are enabled and central to implementation of greener models of healthcare.
Healthy Ireland Action Plan '21-'25[14]	• Framework for national implementation of Healthy Ireland. • Integrated care promotes an integrated approach to healthcare provision.
Sharing the Vision 2020-2030[15]	• Mental Health Policy document for services in Ireland from 2020-2030. Outlines plans for developing services with a people first approach. Sharing the Vision offers a partnership-based approach allowing for a wider policy impact.

The National Climate Action Plan 2024[16] sets out the roadmap to deliver Ireland's commitment to net zero emissions no later than 2050 and a 51% reduction in GHG emissions by 2030. The emission reduction targets are supported by enhanced climate governance and reporting frameworks, as well as annual Climate Action Plans, carbon budgets and sectoral emission ceilings. The EPA's projections of progress against targets consider various scenarios and even the most optimistic scenario shows that there is a significant gap to close if Ireland is to achieve the legally binding emissions reduction targets. The latest Climate Action Plan (CAP 24), sets out the policies, measures and actions needed to close this gap and ensure compliance with carbon budgets and sectoral emission ceilings, adopted by the Government in 2022.

In Climate Action Public Sector Mandate, a number of actions for implementation by public sector bodies were identified, relating to targets, buildings and vehicles, people, circular economy, ways of working (See Appendix 3). While the greener models of healthcare programme is not the primary owner of any of these actions, the programme will play an important role across the areas listed. The team will engage closely with relevant stakeholders to provide a joined-up approach to addressing those actions particularly those relating to climate and circular economy.

In addition to our climate mitigation strategies, the health adaptation agenda is also an important consideration in preparation for current and future climate change impacts. Adaptation, which refers to the process of adjustment to actual and expected climate change effects, is a critical component of the long-term global response to climate change. The WHO defines climate resilient sustainable health systems as one where healthcare facilities can anticipate, respond to, cope with, recover from and adapt to climate related shocks.

The National Climate Change Adaptation Framework[17] outlines the national policy to reduce Ireland's vulnerability to the negative impacts of climate change and provides the structures for adaptation planning at national, regional and sectoral levels. Sectoral Adaptation plans[18] have also been developed for seven target sectors, including health. Under the governance of the Department of Health, the first health sectoral adaptation plan 2019-2024 is ending and a new Health Sector Adaptation Plan is being developed to plan how the sector will protect the health and wellbeing of people in Ireland, the smooth delivery of our health and social care services and our critical infrastructure.

13 HSE – National Clinical Programmes
14 Gov – Healthy Ireland
15 HSE – Sharing the Vision – A Mental Health Policy for Everyone
16 Gov – Climate Action Plan 2024
17 Gov – National Adaptation Framework
18 Gov – Sectoral Adaptation Planning

1.1.1 HSE Climate Action Strategy 2023-2050 and HSE Greener Models of Healthcare Framework

Guided by the requirements of CAP 24 and the Strategy, the strategic objective is intrinsically aligned with Sláintecare goals for one universal health service for all that will allow people to stay healthy in their homes for as long as possible and the HSE's Vision for a healthier Ireland, with the right care, at the right time and in the right place. Both are synonymous with delivery of sustainable healthcare. The HSE has a responsibility to provide a healthcare model that reduces the environmental impact while improving patient outcomes and staff motivation. Embedding disease prevention and health promotion at every level of care will be central to achieving this, reducing avoidable illness while supporting healthier, longer lives. This will require us to adopt approaches to when, where, how and what care is delivered. The HSE needs to adopt proven models and approaches from other countries and embrace sustainable practices to shape the future of healthcare, moving beyond the era of single-use and becoming a climate resilient sustainable Irish health system.

1.2. Structure of the Work Programme Group

To accelerate the delivery of the greener models of healthcare objective, a greener models of healthcare advisory group was established (See Appendix 1). The greener models of healthcare Work Programme's Advisory Group aims to explore and coordinate the implementation of opportunities to deliver healthcare services more sustainably, focusing on disease prevention, reducing greenhouse gas emissions and optimising circular economy practices.

1.2.1 Scope

Given the broad cross-cutting nature of the greener models of healthcare work programme, it is important to define the specific scope that will be covered during the first phase of the Programme. The initial focus will be on embedding sustainability into the care that we provide. Crucial to this effort is ensuring that sustainability principles are central to both new and existing clinical programs within the HSE clinical design and innovation unit and other HSE clinical functions. The goal is to embed sustainability across all care pathways, scaling up successful initiatives and implementing proven solutions. This framework should act as a guide to clinical staff on how to ensure the care they provide is sustainable. Additionally, support innovation and continuous learning from emerging solutions as they evolve, before scaling their broader application.

From an environmental perspective, the focus will be on the climate impact of clinical and care programmes (Scope 1, 2, and 3 emissions are categories that classify GHG emissions, helping organisations understand their total carbon footprint) and circular economy opportunities, with a particular focus on embedding leaner models of care. There is a key dependency on the Measurement and Assurance work programme to provide a clear and robust methodology and metrics to track the in-scope environmental impact of greener models of healthcare, such as Scope 1, 2, 3 CO_2e emissions and waste. The greener models of healthcare work programme will assess and make recommendations about where there is opportunity to drive progress in reducing carbon emissions and waste generation and how that should be implemented. The Green Teams at regional level will have overall governance and responsibility for implementation. The Measurement and Assurance work programme will provide methodology to track the environmental impact of greener models of healthcare.

At this stage of the programme, biodiversity, water sustainability, and air pollution will not be considered under the remit of the greener models of healthcare programme. Biodiversity is covered under Strategic Objective 2 of the Climate Action Strategy, to optimise the use of green space for the promotion of the health and wellbeing of patients and the local communities. Water sustainability and air pollution will be considered at a later stage of the programme. The HSE Climate and Sustainability Programme has produced strategic framework documents on these areas.

Table 3. Activities for the Greener Models of Healthcare Work Programme Categorised into their Key Focus Areas

In-Scope	Out-of-Scope
Clinical Programme • Models of care developed for new and existing clinical programmes • New clinical strategies in development • Public health measures for disease prevention should take priority • Decisions regarding pharmaceutical products and services • Health promotion programmes across community and acute services **Environmental** • Climate (Scope 1, Scope 2, Scope 3 CO_2e emissions) • Circular Economy (waste management)	**Environmental** • Biodiversity • Water sustainability (consumption, quality) • Pollution **Other** • Development of emissions calculation methodology, including Scope 3 calculations (dependency – measurement and assurance function) • Calculation of waste and circular economy metrics (dependency – measurement and assurance function)

1.3 Best Practice Review

To inform the development of the greener models of healthcare programme, a review of international models was conducted.

Table 4. International Best Practice Measures

Best Practice	Best practice measures undertaken/in progress
World Health Organisation	The World Health Organisation Operational Framework for building climate resilient health systems identifies six building blocks[19] • Leadership and governance • Health workforce • Health information systems • Essential medical products and technologies • Service delivery • Financing

19 WHO – Operational framework for building climate resilient health systems

Best Practice	Best practice measures undertaken/in progress
Nordic Innovation	The Nordics Model for Sustainable Healthcare[20] encompasses products, services and healthcare operations with superior environmental performance – without compromising the quality level of the care itself. When describing sustainability issues in relation to healthcare, three different dimensions need to be considered. 1. Sustainable health. This includes disease prevention, promotion of healthy lifestyles and public health issues. 2. Sustainable healthcare. This includes sustainable hospitals, behaviors and technologies. 3. Environmental health which is environmental effects on human health.
National Health Service (NHS)	The NHS principles of low carbon care are based on keeping people healthy; providing the right care, in the right place, at the right time; low carbon treatments and care settings; and clinical leadership, systems and workforce. The Centre for Sustainable Healthcare principles for sustainable clinical practice are designed to reduce resource use while maintaining or improving health outcomes.[21] Two avenues to reduce carbon emissions and improve healthcare outcomes, are identified; reduce activity (through prevention, empowerment, and lean pathways); reduce carbon intensity (through low carbon alternatives and operational resource use).

As well as looking at the overarching strategic frameworks across other systems, a review of specific initiatives in comparable geographies in the NHS England, NHS Scotland, NHS Wales and New Zealand was conducted. These were selected as the most appropriate comparator organisations for the greener models of healthcare programme as they are public sector health organisations with comparably large jurisdictions, which face similar challenges to the HSE, and which have demonstrated experience with transforming healthcare practices to be more resource-efficient and sustainable. Therefore, they provide useful comparative models to guide our thinking and planning on greener models of healthcare.

1. **NHS England**[22]: NHS England has undertaken many sustainability strategies to lower their carbon footprint. These include transitioning to lower carbon inhalers and transforming anaesthetic practice by using lower carbon alternatives. In addition, they have initiated efforts to capture, destroy, or reuse anaesthetic gases. Measures to decrease the emission of leftover nitrous oxide gas canisters have also been put in place to further enhance their sustainability practices.

2. **NHS Wales**[23]: The Welsh government declared a climate emergency in April 2019 and committed to achieving a carbon neutral public sector by 2030. The targets set by the Welsh government apply to all public sector bodies including the NHS.

3. **NHS Scotland**[24]: In 2019, NHS Scotland became the first National Health Service in the UK to commit to net zero emissions and launched the Climate Emergency and Sustainability Strategy, 2022-2026. The Strategy outlines five priority areas to becoming an environmentally and socially sustainable service and includes the National Sustainability Assessment Tool (NSAT), which measures their progress across 16 areas of sustainability. The mechanism for sustainable change in NHS Scotland is Quality Improvement (SusQI), integrating sustainability into the QI Framework, so that sustainability is included in every QI and transformation project and is embedded into the operations and governance of the system. The Centre for Sustainable Healthcare works with healthcare providers, health boards and trusts to make progress towards achieving net zero through provision of free e-learning modules, sustainable healthcare short courses and green team competitions.

20 Nordic Innovation – Nordic Sustainable Healthcare
21 Centre for Sustainable Healthcare – The Principles of Sustainable Healthcare
22 NHS – Delivering a 'Net Zero' National Health Service
23 NHS Wales – Decarbonisation Strategic Delivery Plan
24 NHS Scotland – Climate Emergency and Sustainability Strategy: 2022-2026

4. **New Zealand (Northland District Health Board):** New Zealand have initiated a syringe recycling scheme as well as significant efforts to reduce the use of Desflurane, an anaesthetic gas, by substituting it with lower carbon alternatives. Another stand out initiative is the integration of circular economy principles for traditional single use medical equipment. The Northland District Health Board have established a triple aim strategy that focuses on co-benefits between health, environment, and costs.

Table 5. An Overview of Greener Models of Healthcare Initiatives across the NHS

No.	Best practice measures undertaken/in progress	England	Scotland	Wales	New Zealand
1	**Sustainable Inhaler Prescribing Patterns** • Transition to lower carbon inhalers with a low global warming potential (GWP), such as dry powder inhalers (DPIs). • Introduce additional inhaler-specific disposal facilities in hospitals in partnership with industry stakeholders. • Prioritise non-pharmacological interventions such as smoking cessation, exercise, and the correct use of preventative therapies. • Work with senior medical staff and the Welsh Respiratory Health Implementation Group to help identify high and low GWP inhalers available on the market. • Work with community pharmacists and information and communication technology (ICT) departments to adapt green practice prescribing system to include a feature where high-GWP inhalers are flagged, and suitable alternatives are suggested. • Modify repeat prescription ordering systems to reduce prescriptions for unnecessary reliever inhalers.	✓		✓	✓
2	**National Green Theatres** • Review single-use products used in theatres. • Review controls of theatre air and scope the potential for investment in systems to make improvements e.g. sensor controls. • Investigate the potential to move to systems for fluid capture and disposal; patient warming in neonatal, paediatric care, and efficient fluid warming equipment. • Introduce reusable sharp boxes.		✓		

No.	Best practice measures undertaken/in progress	England	Scotland	Wales	New Zealand
3	**Management and use of Anaesthetic Gases** • Use lower carbon alternatives. • Effective capture, destruction and reuse of anaesthetic gases. • Efforts to reduce the atmospheric release from leftover nitrous oxide gas canisters. • Support trials of volatile gas capture technology to determine its efficacy in real-world situations. • Support efforts to produce medical grade oxygen as a by-product of Scotland's growing hydrogen industry. • Monitor and mitigate N_2O leakage. • Ensure medical gas capture technology is integral to all new builds and major refurbishments.	✓	✓	✓	✓
	• Develop a value-based healthcare strategy that aims to reduce low value and futile treatments which lead to patient regret. This includes carrying out specific research to better understand the current barriers to implementing value-based healthcare on the clinical frontline and with patients and clinicians and working to find solutions to overcome the barriers identified.		✓		
	• Each health board which provides clinical services will establish a sustainable clinical service delivery function as a core part of its Climate Emergency Response Team.		✓		
	• Behavioural change to reduce pharmaceutical waste and over-prescribing.		✓		
	• Syringe recycling scheme supported by partner recycling company.				✓
	• Integration of circular economy principles for traditional single-use medical equipment e.g. collection, cleaning, and reprocessing of patient transfer mats instead of linear usage models (use to landfill).				✓

CASE STUDY 1

Case Study 1. Minimising the Environmental Impact of Inhalers in General Practice[25]

Reducing the carbon footprint of inhaler prescribing in general practice is an important step in tackling healthcare's contribution to climate change. This audit, conducted in a mixed rural-urban general practice in Ireland, retrospectively assessed the number and type of inhalers prescribed.

This was followed by an educational intervention, aiming to switch patients from high-carbon MDIs, which contain hydrofluorocarbons, to low-carbon DPIs where clinically appropriate. This included patient counselling and consent, aligned with best practice.

Inhaler use was re-audited six months later, and a potential carbon saving of approximately 21,448 kg of CO_2 was estimated.

CASE STUDY 2

Case Study 2. Reducing over prescription through the Antibiotic Stewardship Program[26]

The Mayo Clinic in Florida, US has implemented a computerised clinical decision support system that provides physicians with evidence-based guidelines on appropriate antibiotic use. The system, known as the Antibiotic Stewardship Program, uses data analytics to identify patients who may be at risk of over prescription of antibiotics and provides real-time feedback to physicians on their prescribing patterns. The program has been shown to have several positive impacts, including

- **Reduction in antibiotic use.** The program has been shown to significantly reduce the use of unnecessary antibiotics, which can lead to antibiotic resistance and other adverse outcomes. A study conducted at the Mayo Clinic found that the program was associated with a 30% reduction in antibiotic use.
- **Improved patient outcomes.** By reducing the use of unnecessary antibiotics, the program has been shown to improve patient outcomes and reduce the risk of adverse drug events. A study published in the Journal of Hospital Medicine found that the program was associated with a 40% reduction in the risk of Clostridioides difficile infection.
- **Cost savings.** The program has been shown to lead to cost savings by reducing the use of unnecessary antibiotics and associated adverse events. A study conducted at the Mayo Clinic found that the program was associated with a cost savings of approximately $600,000 over a two-year period.

25 Audit of the Carbon Footprint of Inhalers in an Irish General Practice
26 Want to safeguard the efficacy of antibiotics? There's a team for that – Mayo Clinic News Network

1.4 Current State Assessment

The purpose of the current state assessment is to review what green initiatives are already underway across the system. This will inform a view of what is working well, where there is opportunity to further develop successful impactful initiatives and where there are important gaps that need to be addressed. It will inform a scheduling and prioritisation assessment and will also provide a means of capturing and communicating good practice, which can be shared across the system.

There are several positive Sustainable initiatives underway across the HSE. These include:

- The launch of the Green Theatre Compendium.
- The work of the National Nitrous Oxide Mitigation Group in reducing N_2O and Entonox-related emissions; the Green Emergency Medicine (EM) Project and accompanying Green EM Playbook.
- The high uptake of My Green Lab certification across Ireland.
- Notably, in 2025, the Irish College of General Practitioners appointed its first Programme Lead in Planetary Health and Sustainability, signalling a strong commitment to advancing sustainable primary care.
- Multiple prevention and Health and Wellbeing programmes or services are widely available within the HSE.

These are just some examples of encouraging progress — all of which should be highlighted and supported.

See the individual sections in chapter 3 for more detailed guidance on various specialties and topics.

This work is augmented by the efforts of IDE, a non-governmental organisation and registered charity of healthcare professionals and students dedicated to promoting good health through caring for the environment. IDE continues to make a meaningful difference both within the healthcare service and in driving wider policy change to promote planetary and human health. An extensive mapping exercise has been developed by IDE which provides an overview of other key initiatives underway across the system. This includes work done in 2023 on a central source of the green initiatives that have been implemented, project opportunities for further investigation and green initiatives that have not been successful (which also provide important lessons). The projects listed are projects that are being implemented by green teams across the country. There are 96 initiatives listed. The initiatives covered include energy, water, circular economy, biodiversity and procurement. This database provided a useful source of information to begin to map the current-state assessment and share progress in this space as implementation of the greener models of healthcare initiative evolves.

The HSE has also recently appointed a Climate and Sustainability Clinical Fellow. This inaugural role reflects the HSE's commitment to driving meaningful, clinically relevant change across the healthcare system. This momentum must be sustained and the potential for further similar clinical leadership roles, where healthcare workers are supported to combine clinical and environmental work in a paid capacity, should be actively explored.

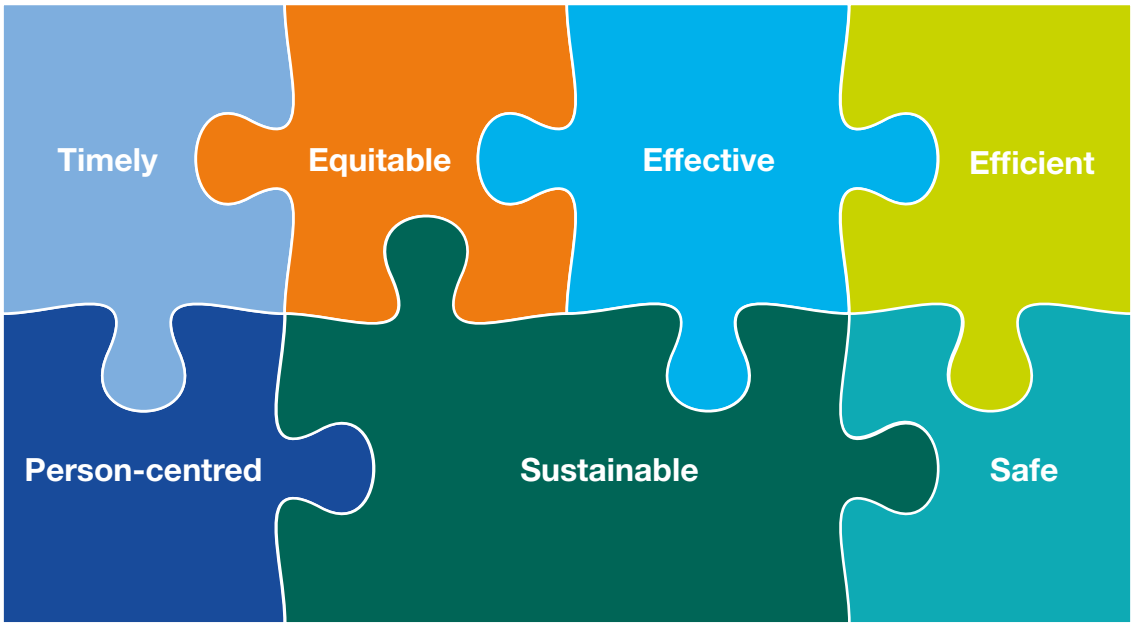
2. Approach

Unpacking the complex objective of this framework will involve re-evaluating the delivery of all of our services across the HSE. The approach and principles will need to be re-considered regarding how to enable more sustainable ways of working while achieving the same/improved outcome. Some core principles will be challenged to find more sustainable alternatives, without compromising on people's experience of engaging with the health system, quality and safety of patient care. A core element of the how care is delivered will see people engaging appropriately with the health system on an ongoing basis, before they are patients and/or service users, as a preventative model that empowers people. Giving people the tools to control their own health and wellbeing in a much more proactive way, which aims to provide the most effective approach to delivering a truly sustainable healthcare model.

2.1 Structure

The HSE Clinical Design and Innovation unit brings clinical leadership to the heart of the decision-making process with the ultimate aim of improving the quality, access and value of healthcare in the country. National Clinical Programmes and Strategies are seen as key transformation forces and have the potential to play a strong role in supporting the transformation that is required to reduce the environmental impact of the delivery of models of care, pharmaceutical products and services used.

Sustainability should be viewed as a fundamental characteristic of healthcare, which must run through the entire model of care. Healthcare should be considered not only in terms of what can be delivered to an individual today, but also the effects on the population, the environment, and the patients of the future.



Therefore, the clinical programmes and other clinical areas of care provide the structure through which the greener models of healthcare programme will be implemented. The greener models of healthcare programme will develop a clear methodology for embedding sustainability into all existing and new future models of care.

As knowledge and expertise expands in use of measurement methodologies and tools, the climate and sustainability programme aim to assist existing and new clinical programmes, to get a better understanding of their emissions and how to measure them. This will allow progress against that baseline to be tracked. The next step is to identify the key emissions drivers within the clinical programmes and to prioritise those areas for embedding sustainable change in the clinical operating model of the programmes and in the governance and reporting arrangements already established.

2.2 Methodology

Aligned with the Sláintecare vision for a health service that is accessible for everyone based on need, not means and the HSE vision for a healthier Ireland by delivering the right care in the right place at the right time, the methodology for embedding sustainability in the clinical programmes to deliver greener models of healthcare is outlined below.

A list of external stakeholders who have been engaged with to date is listed below. Engaging with these key external stakeholders enabled a broader collection of knowledge and data. Ongoing collaboration with these external stakeholders is envisioned throughout the next phases of the programme (Table 6).

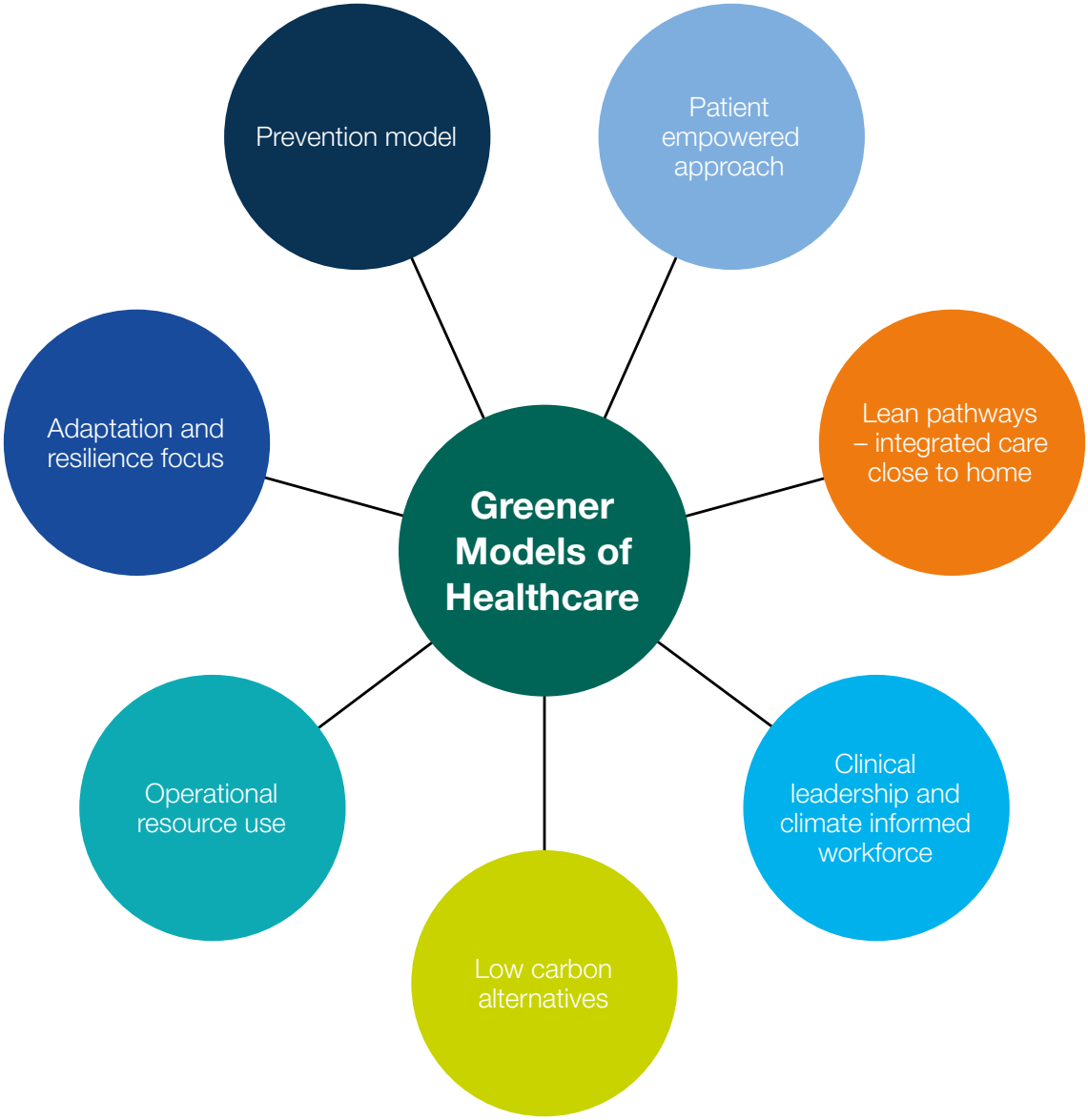
Table 6. External Stakeholders

External Stakeholders
Clinical Design and Innovation Day
Climate Action Unity Network
Climate and Health Alliance
Department of Health
Environmental Protection Agency
Irish Doctors for the Environment
Irish College of General Practitioners
Royal College of Physicians Ireland
Royal College of Surgeons Ireland
NHS England
NHS Scotland
NHS Wales
World Organisation of Family Doctors
VHI Health Insurance

2.3 Seven Key Building Blocks for Greener Models of Healthcare

The seven building blocks that should be incorporated in the development of all new models of care and used as a check for existing models of care and care pathways (Braithwaite et al., 2024) are set out below.

Figure 2. An Overview of Greener Models of Healthcare Building Blocks



2.3.1 Prevention Model

Disease prevention is the first principle of sustainable healthcare and the most effective way to reduce the environmental harm caused by healthcare activities. A preventative approach results in benefits of improved health and environmental outcomes.

Health and wellbeing should be central to the models of care developed across the clinical programmes. Funding of public health and disease prevention programmes is essential and will reduce healthcare demand in the long term. Targeting the upstream social determinants of health to promote wellbeing and prevent illness onset will tackle problems at source. For example, Healthy Ireland's aim to create an Irish society where everyone can enjoy physical and mental health and where wellbeing is valued, at every level of society. Health in All Policies (as recommended by WHO) is also needed to ensure that other sectoral policies and commercial determinants of health do not cause avoidable adverse health impacts.

2.3.2 Patient Empowered Approach

Prevention of ill health is not always possible, and it is inevitable that individuals will need to use healthcare systems at various stages of life. By empowering patients to take an active role in co-managing their health, we can reduce future healthcare demands, leading to fewer hospital visits, shorter stays, and less duplication and waste across the course of care.

Innovative approaches were adopted in response to the COVID-19 pandemic, which provide the evidence of the success of experimentation when individuals think outside the box. Digital solutions, such as home-monitoring devices, may allow closer surveillance of medical conditions, leading to better control and helping to avoid hospitalisation. Examples of this include healthcare professionals enabling patients to better manage their insulin regimens and blood sugar monitoring through self-management education, helping to avoid unnecessary admissions and long-term complications.

2.3.3 Lean Care Pathways – Integrated Care, Close to Home

Minimise wasteful and low value activities by improving efficiency. Efforts to embed sustainability should be focused on delivery of the right care at the right time, in the right place and will have a strong emphasis on the prevention of ill health. A lean care pathway applies a systems thinking approach carefully considering appropriateness of investigations, diagnoses, treatments and procedures. Considerations include:

- Optimising community care to reduce hospital admission. Providing healthcare closer to home has additional benefits in terms of encouraging active travel and reducing air pollution through reduced vehicle use.
- Employing telephone and e-health strategies to enable remote healthcare consultations, thereby reducing the need for travel.
- The use of wearables and connected devices can help care teams to monitor important biometric data. There is, however, a responsibility to consider the environmental impact of increased digitisation of medicine in terms of data creation and storage and ensure that tech companies employed must committed to minimising their carbon emissions.

2.3.4 Leadership and Climate-Informed Workforce

Clinical and sustainability leadership is central to the delivery of the changes required by our healthcare system. National clinical programmes and strategies are the vehicle for sustainability considerations to be recommended and implemented. The HSE is currently in transition to a regionalised care delivery model. This type of regionalised model is directly aligned with the sustainable healthcare agenda. The Climate and Sustainability Programme are working with the six regional green committees to develop a green plan template that will be used by regions to translate the recommendations in each of the frameworks into a prioritised implementation plan for their region.

Healthcare professionals must understand the environmental impact of the care they provide and decisions they make. Learning about sustainable healthcare and actions they can take in daily practice is essential. Sustainability leaders are key to ensuring implementation and constant focus.

2.3.5 Low Carbon Alternatives

Implementing low carbon alternatives will require restructuring of key resource intensive areas. These areas include low carbon pharmaceutical prescribing, reducing reliance on consumables, and programmes to reduce, reuse, repurpose and recycle clinical instruments.

2.3.6 Operational Resource Use

Healthcare workers must consider the resources they utilise when providing care such as reducing their energy usage, water usage, the amount of waste generated and transport used.

2.3.7 Adaptation and Resilience

Adaptation is the process of adjusting to the actual or expected effects of climate change. We must reduce our vulnerability across the health sector to the effects of climate change by making necessary adjustments, thus increasing our resilience from dangerous climate related events. This will involve protecting people's health and wellbeing to prevent avoidable illness and increasing the resilience of our health and social care services and our critical infrastructure to severe weather events and other negative effects of climate change.

Even as we move towards being a low-carbon and environmentally sustainable country by 2050, some changes to our climate are still likely to occur. This is because the climate system is slow to react, and some changes are already locked in.

Therefore, effective adaptation planning and action is imperative to protect the health and wellbeing of people in Ireland, the smooth delivery of our health and social care services, and our critical infrastructure.

3. Key Focus Areas

Given the urgency of the climate crisis and the responsibility of the HSE and similar organisations to proactively pursue tangible progress against the targets set in the Climate Action plan 2025, over 15 key clinical areas with high impact have been identified as a starting point. These high-impact recommendations should be activated immediately to build momentum and demonstrate measurable progress toward the strategic objective.

See Appendix 3 for the contributors to each separate section.

3.1. Sustainable Medication Use

3.1.1 Background and Context

It is generally accepted that prescription of a medicine is the most common intervention used to diagnose, cure, treat and prevent disease and medicines play a central role in sustainable provision of healthcare (National Institute of Health and Care Excellence, 2015). Optimising the use of medicines can help patients avoid other potentially more costly healthcare services, including ED attendances, hospital stays, surgeries and long-term care. In all, according to the HSE Annual Report 2023, a total expenditure on medicines exceeded €3 billion in 2023. According to the baseline emissions data for the HSE (excluding Section 38 and 39 organisations) from Healthcare Without Harm, pharmaceuticals contribute approximately 160 kt CO_2e which represents roughly 19% of the HSE's total emissions. As such, pharmaceuticals represent a significant component of Irish health spend and emissions.

There is robust evidence that pharmaceuticals, from research, production, supply and disposal represent a significant ecological threat. Globally, pharmaceuticals are estimated to contribute 25-30% of total healthcare emissions and thus represent a significant carbon footprint. Sources of the carbon footprint of medicines encompass sourcing, manufacture of the active pharmaceutical ingredient, excipients and packaging production, transport, and associated corporate emissions. Use of medicines also generates significant plastic waste, which represents an ecological threat, as do pollution arising from medicines manufacturing processes, inadvertent industrial contamination and subsequent incineration of waste medicines. Pollution through inappropriate disposal and human excretion can lead to contamination of water and land systems.

Reducing the environmental impact of medicines requires a dual approach:[27]

- **Reducing demand** by preventing illness and eliminating low-value care.
- **Optimising medicines use** to ensure the lowest clinically justifiable environmental footprint.

Achieving sustainable pharmaceutical use requires a multi-level, system-wide approach, with coordinated action from a broad range of stakeholders — healthcare professionals, allied health staff, support teams, patients, supply chain personnel, procurement, and finance. This will require ambitious leadership that spans all parts of the health service — public and private, from primary care to specialist tertiary care.

3.1.2 Approach to Framework

This framework is built around the identified seven building blocks informing sustainable medicines use. At its core is strong clinical leadership, driving progress through the adoption of the five principles of sustainable healthcare: prevention, patient self-care, lean service delivery, low-carbon alternatives, and efficient resource use. The final pillar focuses on adaptation and resilience in medicines use. Each pillar includes actionable recommendations, delivered through a suite of initiatives. Flexibility is embedded to allow for ongoing developments in the field.

27 The PRESTO Report – Sustainability and Resilience in the Irish Health System

Sustainability Leadership and Climate-Informed Workforce

A sustainable medicines strategy for Ireland must address the entire lifecycle of medicines. This includes appointing sustainable medicines advocates and champions, supported by adequate training to build knowledge in sustainable healthcare and medicines use.

In the pre-clinical phase, upstream activities such as research, development, manufacturing, packaging, regulation, reimbursement, and supply chains must adopt mitigation strategies to reduce GHG emissions, waste, and pollution. Stakeholders include research institutions, the pharmaceutical industry, regulators, and procurement bodies. Early adoption of EU sustainability policies will accelerate national progress.

In clinical settings, both primary and secondary care must focus on sustainable procurement, prescribing, dispensing, patient use, and disposal. Empowering healthcare professionals — including prescribers, pharmacists, AMS teams, and compounding staff — to apply a sustainability lens to practice is essential. Patient engagement is also critical to optimise medicine use and reduce waste.

Medicines waste carries both financial and environmental costs. Improper disposal increases risks, including antimicrobial resistance and endocrine disruption. Reducing waste benefits health outcomes and mitigates environmental harm.

Prevention

Prevention is the cornerstone of sustainable healthcare. Approximately 1 million people in Ireland today suffer from diabetes, asthma, COPD or cardiovascular disease. Data from TILDA, reports that 64.8% of the over 65 age cohort in Ireland live with co-morbidity.

Every week many hundreds, or thousands, of infectious diseases are diagnosed and notified to the Health Protection Surveillance Centre, with infections ranging from mild illness to requiring hospitalisation, to potentially fatal. Infectious diseases can also complications other illnesses in hospitals. Many of these are vaccine preventable diseases, or environmentally acquired or spread from person to person, and can be prevented through effective vaccination, interruption of environmental source-exposure pathways and effective infection, prevention and control.

Non-infectious hazards can result in avoidable illness and death, such as acute exacerbations of cardiovascular and respiratory diseases resulting in avoidable premature deaths by air pollution, avoidable stress and cardiovascular impacts by environmental noise exposure, avoidable organ damage by chemical contamination of drinking water and avoidable 350 cases of lung cancer per year from radon gas in our homes. Specific public health interventions can prevent all of these impacts, if they are implemented effectively.

Avoiding the onset of a preventable diseases will reduce the environmental impact of medicines, free up healthcare capacity to deal with unavoidable health issues and enhance our population's quality of life. To do so, there must be a shift from reactive care to pro-active care driven by the desire to improve outcomes, enhance quality of life, and create a more sustainable and efficient health and social care system. This can be achieved by strategies that increase and maintain the health status/ wellness of the public, and thus work prior to the start of the pharmaceutical life cycle resulting in multiple co-benefits for humans and planetary health alike (Caban & Stepnowski, 2021). Prevention strategies provide both individual and population benefits.

Patient Self-Care

There is growing evidence supporting self-care across a range of health areas — including communicable and non-communicable diseases, mental health, and sexual and reproductive health (Narasimhan et al., 2023). Self-care empowers patients to make informed decisions about their health, improving outcomes and promoting more efficient healthcare use (Wedmore, 2023). When patients are trained in self-care and self-management, it can reduce unnecessary prescribing and the environmental footprint of care.

Self-management involves patient education, co-designed treatment plans, and the development of skills to support self-monitoring and adherence (Cussans et al., 2021). Effective self-management can reduce complications, hospitalisations, and medicine waste. Poor adherence remains a major

issue: about 50% of patients with chronic diseases do not take medicines as prescribed (WHO, 2024), leading to significant waste (Stewart et al., 2023), particularly in patients with multimorbidity, where non-adherence ranges from 16–61% (Foley et al., 2021).

Improper disposal of unused medicines can damage land and water systems (Ryan et al., 2014). Non-adherence is multifactorial and requires interventions focused on health literacy and behavioural change. Medicines self-monitoring programmes have shown benefits in improving use, adherence, outcomes, and reducing adverse events (Ryan et al., 2014). Most patients are unaware of the environmental harm of discarded medicines (Cussans et al., 2021). Involving them in conversations about sustainable care could support adherence and open the door to non-pharmacological options, such as social, green, or blue prescribing. Shared decision-making can further support informed choices and strengthen alignment between treatment goals and patient values.

Green and Blue Prescribing are a form of Social Prescribing that use nature-based interventions and activities to improve people's health and wellbeing. These can include local walking groups, community gardening projects, or open water swimming, to name but a few examples. There is a strong and growing evidence that nature based social prescribing plays and important role in improving mental and physical health and reducing loneliness.

Lean Service Delivery

A substantial portion of healthcare activity is low-value, offering little or no benefit to patients while contributing to environmental harm (OECD, 2017). Reducing unnecessary and inappropriate prescribing improves both patient outcomes and planetary health (International Pharmaceutical Federation, 2015). Inappropriate and excessive medicine use contributes to greenhouse gas emissions and waste, often without clinical benefit. In the NHS, an estimated 10% of prescriptions are considered overprescribed (Mir at al., 2021). Ireland shows high rates of polypharmacy—22% of adults aged 65 and over were prescribed ten or more regular medicines in 2012 (Moriarty et al., 2015).

Medicines waste results from overprescribing, unnecessary dispensing, non-adherence, and expiry due to suboptimal stock management. Community pharmacies face costs for accepting returned medicines, and lack of standardised disposal options for patients increases the risk of environmental contamination and safety concerns.

Low-value care refers to medical treatment that provides little or no benefit in specific clinical situations. It is a major problem worldwide because it raises costs, causes iatrogenic harm to patients, wastes healthcare resources, and often interferes with the delivery of high-value care.

Reducing antimicrobial use is essential to addressing antimicrobial resistance (AMR), a growing global threat. Ireland is a high-use country within the EU and is required to reduce antimicrobial consumption by 27% by 2030 as per EU council recommendations.[28] Stewardship strategies are central to meeting this target, with added environmental benefits. An estimated 8,500 tonnes of antibiotics enter river systems each year from domestic consumption alone, contributing to global water pollution (Macedo et al., 2025).

28 The European Union – Council recommendation on stepping up EU actions to combat antimicrobial resistance in a 'one health' approach

Antimicrobial Resistance and Infection Control

AMR and climate change are recognised as two of the greatest threats to human and animal health. These threats are intrinsically interlinked public health priorities. Appropriate use of antibiotics is critical to curb, and hopefully reverse, the growing trend of AMR. Preventing inappropriate use of antimicrobials and consequent AMR requires national and local surveillance plans and actions supporting AMS. The key role that all healthcare workers play in supporting the responsible use of antimicrobials across all healthcare settings is underpinned in the HSE Antimicrobial Stewardship Guidance for all healthcare settings.

The HSE AMRIC team have a preferred antibiotics initiative commonly referred to as the *Green Red Antibiotic List*. The AMRIC antimicrobial guidelines[29] for community prescribers recommend the preferred use of *Green Agents* which are more appropriate, effective, have fewer side effects, and are less likely to lead to resistant infections compared to *Red Agents*. The AMRIC prescribing guidelines also highlight and promote the key message to prescribers that in many cases, the preferred treatment is no antibiotics.

Implemented initiatives to date include a mouse-mat provided to GPs to assist them with their antibiotic decision-making at the point of prescribing. The latest version highlights risks associated with the red agents. This antibiotic decision tool has also been made available to community pharmacists to increase their awareness of the initiative.

The AMRIC and HSE PCRS have also collaborated on a nationally co-ordinated QI initiative to support appropriate antibiotic prescribing in the community setting. Each quarter, over 3,000 GMS GPs receives an individualised report on their antibiotic prescribing for their GMS. This report provides the individual GP with a breakdown of his or her use of *green* vs *red* agents in addition to their overall rate of antibiotic prescribing. Each report also includes an educational nudge to promote best Eco-Pharmaco-Stewardship in the prescribing of antibiotics. Educational messages to date are listed on antibioticprescribing.ie.[30]

The aim of this quality improvement is to improve patient safety, quality, and appropriateness of antibiotic prescribing in the community. The initiative aims to maximise the use of green agents and overall minimise prescriptions, ensuring that only those most likely to benefit receive them. The initiative also supports sustainable prescribing and medication use by optimising the use of antibiotics and thus mitigating the environmental footprint associated with unnecessary antibiotic use.

Following implementation of the initiative, there has been a sustained improvement in the quality of antibiotic prescribing in the community setting. Building on the success of this initiative AMRIC are extending Green Red Antibiotic prescribing to GP Out of Hours services nationwide initially and planning further extending to daytime services.

Sustainable prescribing—using evidence-based guidance, de-prescribing where appropriate, and prioritising non-pharmacological interventions like green, blue, and social prescribing—can reduce carbon impacts while improving care. Tools such as ChoosingWisely.org,[31] MedStopper.com,[32] the BRAN framework (see figure below),[33] and STOPP/START guidance can support this work.

29 HSE – Antibiotic Prescribing
30 HSE – Key Messages from AMRIC to Community Prescribers
31 ABIM Foundation – Choosing Wisely
32 MedStopper
33 AOMRC – Choosing Wisely / BRAN

Figure 3: BRAN Framework

Embedding structured, person-centred medicines reviews such as the Benefits, Risks, Alternatives, Nothing (BRAN) framework or those piloted in the iSIMPATHY project[34] can reduce unnecessary prescribing, improve adherence, reduce adverse drug reactions, deliver cost savings (O'Mahony et al., 2024), and improve patient reported outcomes (Kinahan et al., 2025). Such models are critical to improving both the safety and sustainability of prescribing, particularly for high-risk patient groups.

Low Carbon Alternatives

Low carbon prescribing is encouraged but currently limited, by the lack of accurate eco-labelling for medicines. Reliable carbon footprint data exists mainly for propellant metered dose inhalers and anaesthetic gases, enabling successful reduction strategies within these areas such as inhaler switching programs in several countries.

Accurate environmental impact assessment requires life cycle analysis, yet patent laws prevent license holders from disclosing this data. A recent advance, the Medicines Carbon Footprint formulary (Taylor et al., 2024), estimates carbon footprints based on molecular structure, categorising medicines using a traffic light system. While promising, it excludes emissions from manufacture, packaging, distribution, and clinical use, and does not account for ecological impacts. Importantly, medicines with high footprints may be medically necessary; environmental considerations should be balanced alongside efficacy and safety (Richie, 2021). Eco-Pharmaco-Stewardship offers a comprehensive, holistic approach to minimising the environmental impact of pharmaceuticals (see text box below).

Eco-Pharmaco-Stewardship is a comprehensive, lifecycle-based approach to managing the environmental impact of pharmaceuticals. It addresses every stage of a medicine's life — from research and development, manufacturing, prescribing, use, and disposal — without compromising patient access to essential medicines. Eco-Pharmaco-Stewardship considers the roles and responsibilities of all stakeholders involved, including public services, the pharmaceutical industry, environmental experts, healthcare professionals, and patients. The approach emphasises holistic environmental risk management, aiming to minimise the ecological footprint of medicines while ensuring their availability and efficacy for those who need them.

Future availability of detailed carbon and ecological data could enable green procurement policies and eco-formularies integrating environmental impact with efficacy, safety, and cost. Choosing oral administration reduces carbon emissions compared to IV administration, which has higher footprints due to packaging, cold storage, and consumables like plastics and needles (Lim et al., 2024; Eii et al., 2023). Prioritising oral tablets or capsules in preference to liquids where clinically appropriate offers multiple benefits. For example, the HSE AMRIC IV to oral switch toolkit aims to provide local AMS teams with supports to implement local initiatives for antimicrobials and to act as local champions (see image below[35]).

34 The iSIMPATHY Project
35 AMRIC – Stop, or Go PO Poster

Adaptation and Resilience

Climate change is increasing extreme weather events, disrupting global and local supply chains essential to healthcare, including raw materials, energy, transport, and communication.

To maintain resilient, secure supply chains, the HSE must include supply risks as part of its wider climate change and adaptation plans, from past disruptions and preparing for future threats such as floods, storms, heatwaves, and droughts.

Operational Resource Use

Sustainable operational use of medicines covers non-clinical aspects such as production, packaging, delivery, and management within the Irish healthcare system. This includes energy, water, and materials used in manufacturing; the type and amount of packaging; transport and storage requirements; and the proper disposal or destruction of medicines. It does not relate to the therapeutic value of the medicine itself, but rather to the environmental footprint embedded in its supply chain.

Medicines represent a significant portion of healthcare's environmental footprint. Their impact extends beyond clinical use to upstream processes (e.g. raw material extraction, manufacturing, and packaging) and downstream effects (e.g. waste and emissions from disposal). These resource demands are often hidden, but carry considerable environmental costs. Reducing them is essential for delivering safe, effective care within planetary boundaries.

Benefits of Improving Operational Sustainability

Enhancing the sustainability of medicine-related operations can:

1. Cut greenhouse gas emissions, especially from transport and cold-chain logistics.
2. Reduce water use and chemical waste in manufacturing.
3. Minimise packaging waste, particularly non-recyclable materials.
4. Lower costs from over-ordering, expiry, and inefficiencies.

By adopting more resource-efficient practices, healthcare systems can achieve the same clinical outcomes while reducing environmental harm and improving long-term sustainability. Other health systems have shown that comparable outcomes can be delivered with fewer operational inputs.

3.1.3. Recommendations for Action

Below is a table of recommendations for actions.

Table 7. An Overview of Sustainable Medication Use Recommended Actions

Sustainability Leadership and Climate-Informed Workforce	**Embed Shared Responsibility and Governance:** Adopt a multi-stakeholder approach across the medicines lifecycle with clear governance, supported by formal green medicines teams, designated champions, regional green teams, and the Climate Action and Sustainability Programme. **Empower through Education and Incentives:** Provide targeted training (e.g. HSELanD) to boost environmental literacy and incentivise staff to lead and participate in sustainable practice. **Measure, Monitor, and Drive Accountability:** Develop and use clear metrics to track GHG emissions, plastic use, and medicine-related waste, supported by robust reporting and accountability mechanisms. **Strengthen Waste and Stewardship Systems:** Prioritise waste stewardship through collection schemes, digital tracking of unused medicines. **Strengthen Cross-Sector Stewardship:** Collaborate with veterinary professionals to align antimicrobial practices and promote One Health approaches to sustainability.
Prevention Model	**Integrate Sustainability into Health Promotion:** Work with HSE Health and Wellbeing to embed planetary health messages across prevention programmes (e.g. the environmental benefits of obesity prevention, such as the co-benefits of active travel and sustainable diets). **Protection:** implement all effective public health interventions to prevent exposure to avoidable health hazards and provide maximum immunity to vaccine preventable infectious diseases. **Empower Healthcare Providers:** Support providers to recognise opportunities to integrate prevention into routine care, implementing Making Every Contact Count to support positive behaviour change to address key risk factors for chronic disease and use existing resources for healthy lifestyle initiatives, including smoking cessation, healthy eating, physical activity, and vaccine uptake, backed by training and incentives.

Prevention Model	**Expand Access to Preventive Care:** Enhance evidence informed and National Screening Advisory Committee recommended screening in primary and secondary care, promote wider use of public health recommended self-testing for communicable diseases, and fully implement all National Immunisation Advisory Committee recommended vaccine programmes, using targeted strategies to reduce vaccine hesitancy when needed. **Drive Improvement through Education and Innovation:** Encourage staff to engage with HSE Health and Wellbeing initiatives, complete communication training and support evidence informed quality improvement projects and spark innovation funding. Services should take a population health approach to clinical design and delivery, ensuring that prevention and environmental sustainability are incorporated (see Population Health Service Improvement[36]).
Patient Self-Care	**Raise Patient Awareness:** Educate patients on the environmental impact of medicine waste, proper disposal, and ecological effects of unused medicines. **Support Self-Monitoring and Management Tools:** Promote structured self-management education programmes (e.g. DISCOVER Diabetes and pulmonary rehabilitation) and digital tools to improve adherence and reduce avoidable prescribing.
Lean Service Delivery / Avoid Low-Value Care	**Optimise Appropriate Prescribing:** • Consider environmental impact in prescribing decisions across primary and secondary care. • Follow best practice and evidence based prescribing guidelines, for instance the HSE AMRIC Antibiotic Prescribing Guidelines. **Reduce Medicines Waste:** • Prioritise non-pharmacological options (e.g. social, green, blue prescribing). • Prioritise comprehensive medicines review and deprescribing strategies. • Apply prescribing frameworks (e.g. BRAN). **Empower Patients:** • Use shared decision-making tools (e.g. BRAN, green conversations). • Support adherence and promote safe disposal of medicines. **Incentivise Improvement Initiatives:** Address overprescribing and waste. **Set up a HSE Green and Blue Prescribing programme:** • Establish a Green and Blue Prescribing Programme across the HSE.

36 HSE – Population Health Service Improvement

Low Carbon Alternatives	**Pioneer Eco-Pharmaco-Stewardship Nationally.** **Promote Low-Carbon Medicines Initiatives:** • Develop respiratory health inhaler programme aimed at optimising control of COPD and asthma in line with GOLD and GINA international guidance and thereby reducing the carbon impact of inhalers and of healthcare to treat exacerbations. • Encourage prescribing oral tablets/capsules first-line over other formulations when clinically appropriate. • Assess opportunities to reduce IV and subcutaneous formulations. **Embed Environmental Decision-Support Tools in Electronic Prescription and Health Record Software:** • Implement prompts highlighting environmental hotspots in prescription software. • Include alerts suggesting oral over IV routes where appropriate (e.g. paracetamol). • Use prompts to trigger clinician review and support sustainable prescribing. **Hospital Pharmacy Initiatives:** • Improve sustainable procurement and stock control. • Patient-specific dose dispensing. • Dispense smaller quantities and starter packs and enhance compounding units. **Community Pharmacy Initiatives** • Adopt climate-informed procurement practices, prioritising lower-impact medicines and suppliers. • Strengthen stock management and control to reduce waste. • Introduce patient-specific dispensing (e.g. smaller quantities, starter packs) to minimise unused medicines. • Provide tailored patient education on sustainable medicine use and disposal.
Adaptation and Resilience	**Consider Medication Impact on Vulnerable Patients:** Develop adaptive care plans for extreme heat events. **Maintain Adequate Stock Levels:** Anticipate increased demand and potential supply disruptions of critical medications. **Prepare for Vector-Borne Diseases:** Keep medication stocks above normal minimums (e.g. antimalarials). **Expand Cold Chain Capacity:** Wholesalers should increase refrigerated transport capacity.

Operational Resource Use	**Mandate Environmental Reporting in Procurement:** Require suppliers to disclose and reduce carbon, water, and material footprints of medicines and packaging. Include environmental risks in HSE procurement policies/decision-making frameworks. **Redesign Delivery Logistics:** Pilot and scale low-carbon delivery methods such as route consolidation, electric vehicles, and reduced delivery frequency. **Promote Green Packaging:** Phase out non-recyclable materials (e.g. Polyvinylpyrrolidone plastics) in favour of recyclable, compostable, or minimal packaging. **Develop and Track Sustainability Metrics:** Monitor CO_2 emissions per product, packaging intensity, and cold-chain energy use. **Foster Collaboration:** Engage regulators, manufacturers, wholesalers, and providers to co-develop sustainable solutions ensuring access and equity.

3.2. Sustainable Inhaler Prescribing and Use

3.2.1. Background and Context

MDIs, widely used for the treatment of asthma and COPD, contain HFA propellants. These propellants, released when the inhaler is used by the patients, are potent greenhouse gases and contribute significantly to healthcare-related emissions. In the UK, MDIs are estimated to account for 3.9% of the total carbon footprint of the NHS.

In contrast, SMIs and DPIs do not use HFA propellants and therefore offer a lower carbon alternative without compromising clinical efficacy. A shift in prescribing practices from MDIs to these greener alternatives presents an opportunity to reduce the environmental impact of respiratory care.

Ireland has a substantial burden of respiratory disease, with an estimated 450,000 people living with asthma and 380,000 with COPD. Among GMS/DVC-eligible patients, there are approximately 20,000 emergency department attendances and 16,000 GP claims annually due to acute asthma attacks. Of note, around 60% of asthma patients do not have their condition adequately controlled. according to the latest available data from the OECD, Ireland's hospitalisation rate for COPD is significantly higher than the OECD average (Department of Health, 2024).

This lack of control reflects not only suboptimal clinical outcomes, but also a significant fiscal and environmental burden. Improving respiratory care requires a multifaceted, holistic strategy that includes:

- Accurate diagnosis and regular review.
- Enhancing adherence and inhaler technique.
- Promotion of guideline-based prescribing.
- Empowering patients with self-management education.
- Environmentally conscious prescribing decisions.

Table 8: Inhaler Quantity Sold in Ireland in 2019 and Associated Estimated Emissions

	Units	% of total	Carbon footprint (tonnes CO_2)
MDIs	2,608,433	**58.90%**	**54,584**
DPIs and SMIs	1,818,854	41.10%	1,819
Total	4,427,287	100.00%	56,403

Data from 2019 indicate that Irish inhaler prescribing patterns do not yet reflect a widespread transition to low-carbon options. Addressing this requires aligned action from policymakers, clinicians, and patients.

The intersection of clinical care and sustainability is clear: better respiratory outcomes can be achieved alongside reduced emissions. Prioritising quality care and responsible inhaler choices will benefit both public health and the environment.

3.2.2 Approach to Framework

A detailed breakdown of inhaler prescribing and relevant guidelines is beyond the scope of this document. However, the key principle is achieving optimal asthma and COPD control, guided by internationally recognised standards such as:

- **GINA (Global Initiative for Asthma) –** provides evidence-based recommendations for asthma management, emphasising controller-based treatment and reducing reliance on SABAs.
- **GOLD (Global Initiative for Chronic Obstructive Lung Disease) –** offers similar guidance for COPD, focusing on symptom control, exacerbation prevention, and appropriate inhaler use.

Adherence to GINA and GOLD guidelines improves disease control and has the potential to reduce carbon emissions. Specifically, GINA recommends inhalers that are generally non-MDIs and excludes SABA as the primary reliever, contributing to a lower environmental impact. Furthermore, indirect carbon reductions come from fewer exacerbations, which reduce the need for high-impact interventions like hospital admissions and nebulisation.

To achieve this, we must:

- Promote evidence-based prescribing, supported by GINA/GOLD-aligned national guidelines.
- Prioritise correct inhaler technique and patient self-management.
- Support switching from MDIs to DPIs/SMIs where clinically appropriate or to lower-carbon MDIs where alternatives aren't suitable.

Ultimately, the goal is to keep asthma and COPD under optimal control using inhalers that suit the individual, with minimal reliance on reliever inhalers. The best inhaler is the one a patient can use correctly, as suboptimal technique in COPD and asthma can increase the risk of hospitalisation and emergency visits by up to 50% (Usmani, 2019).

3.2.3. Recommendations for Action

Below is a table of recommended actions.

Education of Patients, Guardians, and Healthcare Staff	• Empower patients and carers with knowledge about good asthma and COPD management, focusing on disease control and proper inhaler technique. This should be done in close collaboration with bodies such as the Irish Asthma Society and COPD Support Ireland. • Leverage existing resources, including the HSE/Asthma Society MART leaflet/action plan and the IDE Inhaler Toolkit[37]. The IDE Toolkit, already embedded in the Tallaght University Hospital Adult Medicines Guide, demonstrates how such tools can be successfully integrated. New tools should be co-produced with patients. • Educate public and run public awareness campaigns on the carbon footprint of inhalers and how to optimise inhaler use. • Maintain a clear message: sustainability and good clinical care can go hand in hand, but avoid creating fear or confusion that might reduce necessary inhaler use. • Train healthcare staff, notably prescribers and pharmacists, on rational prescribing and ensure inhalers are only replaced when needed, not routinely or automatically. • Integrate education on inhaler types and environmental impact into undergraduate/postgraduate curricula, CME, Chronic Disease Ambulatory Care Hubs, EDs, and primary care.
Embed Sustainability into Clinical Guidelines	• Align national guidance with leading evidence-based frameworks (e.g. GINA, GOLD), National Institute for Health and Care Excellence • Ensure national prescribing and cost guidance incorporates environmental sustainability as a core principle. • Enable prescribing systems to support non-automatic inhaler repeats and structured medicine reviews.
A Hard Move Away from Large Volume MDIs	• Prioritise switching to low-carbon alternatives such as DPIs and SMIs where clinically appropriate. • Maintain a clear message: sustainability and good clinical care can go hand in hand, but avoid creating fear or confusion that might reduce necessary inhaler use. • Monitor and support prescribing behaviour change through policy, data, and feedback loops. This should be done in collaboration with HSE procurement and suppliers. • Inform decision making on reimbursement mechanisms to potentially support and incentivise lower-carbon prescribing and dispensing.

37 IDE – Inhaler Toolkit

Inhaler Waste Management and Recycling	• Develop a dedicated waste stream for safe and sustainable aerosol inhaler recycling and disposal. • Define procurement requirements for inhaler suppliers relating to packaging, recyclability, and environmental standards.
Data, Quality Improvement and Patient-Centred Monitoring	• Utilise PCRS dispensing data to support local and national improvement efforts. • Include cost-benefit analyses of sustainable inhaler switching. • Capture and respond to patient experience to ensure changes are clinically sound and socially acceptable.

3.3. Green Theatres and Anaesthetic Gases

3.3.1 Background and Context

Green Theatres

The focus of the Green Theatres initiative has been to build on work being done and completed internationally and consider how that thinking can be applied to the Irish setting. The focus of the group has been the creation of a Green Theatre Compendium.[38] This was launched in February 2025 and provides a roadmap for reducing the carbon footprint of surgery before, during and after the surgical procedure, while delivering safe and effective surgical care. In recognition that the surgical suite is a unique carbon hotspot in hospitals, the Green Theatres Compendium will be rolled out across the hospital network in the coming months.

Table 10. An Overview of the Intercollegiate Green Theatres Checklist

Sample Action Items Included	Reduce the use of inhalational anaesthetic agents where clinically appropriate
	Promote more environmentally friendly techniques such as regional and total intravenous anaesthesia
	Minimise the wastage of drugs and equipment
	Measure carbon emissions related to anaesthesia gases at a national level
	Advocate for the measurement and reduction of the environmental footprint of healthcare
	Consider the triple bottom line in all contract tenders
	Promote research in sustainability and life cycle analysis
	Consider the triple bottom line of economic, social, and environmental effects where possible

38 RCSI – Sustainability Principles and Practice in Surgery

Anaesthetic Gases

Anaesthesiology has a particularly high environmental footprint due to its heavy reliance on pharmaceuticals, single-use medical equipment, and plastics—all of which are resource-intensive to produce and dispose of. In addition, the use of inhalational anaesthetic gases such as nitrous oxide, isoflurane, desflurane, and sevoflurane—all of which are potent greenhouse gases—further contributes to anaesthesiology's environmental footprint. These gases are minimally metabolised by the body, so the majority are released into the atmosphere, where they exert a considerable global warming effect.

In 2019, agents used across all public hospitals, and the majority of private hospitals amounted to 17,865 tonnes CO_2e (Keady et al., 2023). 84% of this was related to N_2O use, either as pure N_2O (42%) or Entonox (58%). A large proportion of N_2O is lost before clinical use due to leaks in the piping systems or manifolds. Therefore, there is potential for rapid and significant reductions in emissions from inhaled anaesthetic gases.

To address this, the Anaesthetic Gases Action Group, in collaboration with the CAI, has introduced a national nitrous oxide mitigation project (see case study below). Through site visits, engagement with key stakeholders, and the support of local champions, the team has assessed the supply of N_2O and Entonox at sites identified as high risk for leaks. Based on an assessment of hospital-specific schematics and estimated clinical use of N_2O and Entonox, the team review manifold sizes and pipe networks and provid recommendations on measures to reduce CO_2e emissions from N_2O and/or Entonox.

The Consensus Statement on the Removal of Pipeline Nitrous Oxide in the United Kingdom and Republic of Ireland,[39] co-signed by the CAI, recommends that nitrous oxide is no longer considered essential in modern anaesthetic practice. Continuous piped supply to theatre suites is therefore deemed unnecessary. Clinical sites are advised to decommission nitrous oxide manifolds and, where ongoing access is required, transition to point-of-use cylinders. This change should be implemented by the end of the 2026/27 financial year.

In recognition of the scale of the damage caused by anaesthetic gases—not only through their appropriate clinical use, but also due to wastage from leaking pipes—the Fluorinated Greenhouse Gas (F-Gas) Regulation was adopted in February 2024 and came into effect in March 2024. This regulation introduces new obligations related to the use of hydrofluorocarbons. In particular, the use of Desflurane will be prohibited from 1 January 2026, except where its use is strictly required and no alternative anaesthetic can be used on medical grounds.

The CAI have provided the following guidance on the use of desflurane as part of their Desflurane Guidance[40]: New technologies may permit vapour capture and subsequent incineration or re-cycling of desflurane. In circumstances in which these technologies are not being used, the College considers that the use of desflurane is no longer justifiable. The College strongly advises its members and fellows to transition to more sustainable anaesthetic techniques.

39 Consensus Statement on the Removal of Pipeline Nitrous Oxide in the United Kingdom and Republic of Ireland
40 CAI – Desflurane Guidance

EU Fluorinated Greenhouse Gas (F-gas) Regulation 2024[41]

Article 4(1): The intentional release into the atmosphere of fluorinated greenhouse gases, shall be prohibited where the release is not technically necessary for the intended use.

Article 4(1a): Where the release is technically necessary in accordance with the first subparagraph, operators of equipment that contains fluorinated greenhouse gases or facilities where fluorinated greenhouse gases are used shall take all measures that are technically and economically feasible to prevent, to the extent possible, their release into the atmosphere, including by recapturing the gases emitted.

Article 4(2): Operators and manufacturers of equipment that contains fluorinated greenhouse gases or facilities where fluorinated greenhouse gases are used, as well as undertakings in possession of such equipment during its transport or storage, shall take all necessary precautions to prevent the unintentional release of any such gases. They shall take all measures that are technically and economically feasible to minimise leakage of the gases.

Article 2 Scope 1. This Regulation applies to the fluorinated greenhouse gases listed in Annexes I, II and III, either as substances or as mixtures containing such substances.

ANNEX II – Other fluorinated greenhouse gases referred to in Article 2(1)(5) – unsaturated hydro(chloro)fluorocarbons, fluorinated substances used as inhalation anaesthetics and other fluorinated substances.

Article 13(4): The use of desflurane as inhalation anaesthetic is prohibited as from 1 January 2026 and shall only be permitted when such use is strictly required, and no other anaesthetic can be used on medical grounds. The healthcare institution shall keep evidence on the medical justification, and provide it, upon request, to the competent authority of the Member State and the Commission.

Waste (under waste management legislation)

These gases should be classed as hazardous waste and dispatched accordingly. Currently, this means dispatch abroad for treatment. Any surplus desflurane should be collected and treated appropriately.

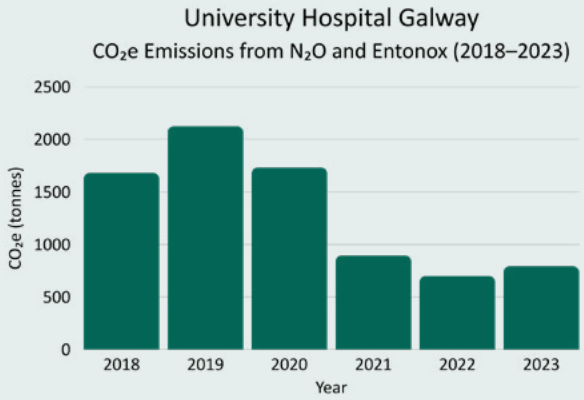
41 The European Union – Fluorinated Greenhouse Gases

CASE STUDY 3

The Nitrous Oxide Mitigation Project[42]

Purpose	Reduce CO_2e emissions from N_2O and Entonox waste and use in the Republic of Ireland.
Overview of the problem	N_2O has been commonly used as both an anaesthetic and pain-relieving agent for over a century. There is diminished use in contemporary anaesthesia, often limited to complex dental cases, paediatric anaesthesia and obstetric emergencies requiring general anaesthesia. It remains an important analgesia agent used in obstetric practice, usually in the form of Entonox. N_2O is a potent greenhouse gas. In 2019, total emissions from inhaled anaesthetic agents used across all public hospitals and the majority of private hospitals amounted to 17,865 tonnes CO_2e (Keady et al., 2023). 84% of this was related to N_2O use, either as pure N_2O (42%) or Entonox (58%) (Keady et al., 2023). A large proportion of N_2O is lost before clinical use due to leaky piping systems or manifolds (Chakera, 2021).
Approach	An action group was formed through the CAI to address the carbon footprint of N_2O and Entonox use and waste in the Republic of Ireland. The group included anaesthesiologists and clinical engineers. Using monthly usage data from BOC (supplier), we have identified hospitals with high N_2O consumption. Where no mitigation strategy was in place, we contacted clinical and technical staff to arrange multidisciplinary meetings with local stakeholders. Site visits are being carried out to educate teams and offer tailored solutions for more sustainable management of N_2O and Entonox. The approach is being revised as needed. Those who should be informed of the project locally: general manager, director of nursing and /or midwifery, and clinical director. Those who should be invited to attend the meeting: anaesthetic representative (project sponsor), facilities or maintenance manager (project coordinator), theatre nursing representative, midwifery representative, maintenance, facilities and estates, portering, quality improvement, energy officer, sustainability officer, and biomedical engineering. We conduct a one-hour meeting with a brief presentation followed by a discussion. The goal is to form a local project group to assess N_2O and Entonox demand and supply. Demand is evaluated through clinical discussions, staff surveys, and department meetings. Supply is assessed with technical staff through pipeline walks, manifold checks, and leak tests. Local groups are encouraged to meet regularly after the initial one a regular basis.
Progress to date	15 sites across Ireland have implemented N_2O mitigation plans.

42 CAI – The National Nitrous Oxide Mitigation Project

Example	The chart below shows the combined CO_2e emissions from N_2O and Entonox at University Hospital Galway between 2018 and 2023, highlighting the sharp reduction following the detection and repair of an N_2O pipeline leak in early 2021. 
Solution	**1. Site Assessment and Tailored Action Plans** • Collaborate with engineers and clinical teams to assess infrastructure and develop site-specific solutions. **2. Leak Detection and Prevention** • Conduct regular leak tests. • Make leak testing mandatory during installation, maintenance, and audits. **3. Rationalise Gas Supply** • Limit pipework to essential areas (e.g. theatres only). • Decommission unused outlets; consider portable cylinders where appropriate. **4. Manifold downsizing or ideally, decommissioning.** **5. Continuous Monitoring** • Monitor N_2O usage by area and investigate anomalies to detect leaks or overuse. **6. Staff Education** • Train staff on correct use and environmental impact. • Promote a culture of accountability. **7. Alternative Practices** • Explore cracking, scavenging, and improved disposal methods to reduce emissions.

3.3.2 Recommendations for Action

Below is a list of recommended actions.

- Phased implementation of the Green Theatre Compendium
- **Set up local green theatre teams** comprising representatives from all major stakeholder groups within the theatre setting.
- **Review of high-volume single use products** used in theatres and their environmental impact.
- Improve waste segregation at point of use.

- **Review theatre air control systems and anesthetic gas scavenging system,** exploring opportunities for efficiency improvements — including sensor-controlled ventilation and ensuring anesthetic gas scavenging system is switched off when not in use
- Implement ongoing monitoring and oversight of N_2O and Entonox usage.
- Ensure oversight is not only clinical but also includes managerial, engineering, and estates involvement.
- **Targeted Education on Entonox Use —** Provide training and awareness for point-of-care staff, particularly midwifery teams, on responsible and safe Entonox use.
- **Commit to the Consensus Statement** on the Removal of Pipeline Nitrous Oxide in the UK and Republic of Ireland, with a target date of full compliance by end of 2030.
- **End the Use of Desflurane —** Fully cease the use of desflurane as part of efforts to reduce volatile anaesthetic emissions.

3.4. Emergency Medicine

3.4.1. Background and Context

EM operates at the critical interface of acute patient care, making it both a significant contributor to healthcare's carbon footprint and a powerful platform for climate action. As the first point of contact for many patients, ED are uniquely positioned to set the tone for sustainable practice across the wider hospital and community care. By modelling low-carbon, high-quality care from the outset, EDs can influence behaviours, workflows, and expectations throughout the healthcare system.

In response, the Green Emergency Medicine Project and the accompanying Green EM Playbook are being developed to provide EM departments and staff with clear, practical guidance on how to deliver more sustainable care. By embedding sustainability into the core of EM delivery, we can reduce environmental impact while improving patient outcomes and enhancing system resilience.

Low Carbon Alternatives in Clinical Practice

Substituting IV medications for oral alternatives, reducing single-use consumables like unnecessary gloves and IVCs, and aligning diagnostic practices with clinical need represent targeted efforts to minimise carbon-intensive clinical interventions. These practical steps show how EM can integrate sustainability without compromising care quality. Optimising medication use (e.g. switching to dry powder inhalers when clinically appropriate) and recycling clinical instruments where possible are key interventions. Rationalising pathology investigations in University Hospital Galway ED has resulted in a 68% reduction in daily venous blood gas analysis in ambulatory patients, and a 31% reduction in non-ambulatory patients.

Disease Prevention and Health Promotion

Preventing emergencies before they occur is the most sustainable form of care. EM teams can work in partnership with public health and primary care to promote full implementation of effective vaccination programmes, injury prevention, smoking cessation, and chronic disease management. Targeting the upstream causes of emergency presentations reduces avoidable admissions and lowers demand on high-resource environments like EDs.

Operational Resource Use

EDs can lead by example in reducing energy, water, and waste. When waste reduction becomes a core value of the ED, a culture of resource stewardship is fostered and seen as integral to high-quality, sustainable care. Simple changes like switching off idle monitors, using recycled paper, efficient use of lighting, and encouraging active travel among staff contribute to a culture of conservation. Sustainable procurement policies and efficient supply chains also reduce the hidden emissions of

emergency care. There is active work underway in two EDs to improve waste segregation, with reductions in yellow clinical waste (infectious/hazardous) and increases in white/green waste streams, reflecting better compliance and material recovery. These improvements reduce incineration needs, support recycling efforts, and lower the ED's environmental burden.

Lean Pathways and Integrated Care

Streamlining EM pathways to prioritise "the right care, at the right time, in the right place" cuts waste. Virtual triage, electronic consultations, and remote monitoring reduce unnecessary ED visits and enable timely intervention in lower-carbon community settings. Integrating EM with urgent care, general practice, and home-based services allows for more sustainable care close to home. Multiple EDs have implemented reductions in reduction in IVC placements to ensure that invasive interventions are only used when necessary, lowering complication risk and material use. These changes reduce patient burden, unnecessary procedures, and carbon-intensive laboratory processing.

CASE STUDY 4

Reducing Unnecessary IV Cannulation in Ambulatory Patients – University Hospital Galway

As part of the Green EM pilot, University Hospital Galway's Emergency Department undertook a focused service evaluation to examine the use of IV cannulas in ambulatory patients within the subacute waiting area. These patients are typically less acutely unwell, yet high rates of IV insertion raised questions regarding clinical necessity, resource efficiency, and environmental sustainability.

Over a five-day observation period, the department evaluated 53 patients using a combination of direct observation, analysis of clinical documentation, and electronic health records. The results highlighted significant overuse: 58% of patients had an IV cannula inserted, 70% of discharged patients had a cannula despite not receiving IV treatment, only 13 out of 24 patients who received treatment were administered medications via the IV route

This practice was not only inefficient, but it also introduced avoidable patient discomfort, contributed to plastic waste, and used staff time that could be better allocated. The audit estimated that over 80 minutes of nursing time was spent inserting cannulas for a small cohort of patients in just five days.

In response, Galway ED is implementing an educational campaign focused on: Reinforcing appropriate clinical thresholds for IV insertion, increasing visibility of blood test costs, and embedding blood gas and IV stewardship discussions into daily huddles.

This initiative illustrates how seemingly routine clinical practices can be re-evaluated through a sustainability lens, yielding benefits for patients, staff, and the environment. Galway's work contributes to the growing evidence base for rationalised cannulation practices and sets the stage for follow-up audits to measure impact and drive culture change.

By targeting one of emergency medicine's most ubiquitous interventions, Galway ED has taken a meaningful step toward greener, more patient-centred care — precisely the kind of local leadership that will drive national progress under the Green EM programme.

Patient Empowerment and Community-Based Care

Many frequent ED users benefit from social prescribing (see e.g. the HSE Social Prescribing Framework[43]) and education initiatives that connect them with community supports, mental health services and green spaces. Empowering patients to manage chronic conditions and engage with their environment reduces reliance on EDs and fosters health equity. Efforts to shift from intravenous (IV) to oral paracetamol use, where clinically appropriate empowers patients with safer, lower-impact treatments while reducing unnecessary interventions e.g. IVC. This reduces the environmental footprint of medications and supports self-management in non-critical cases.

Clinical Leadership and Workforce Education

Healthcare professionals who work in EDs play a leadership role in embedding sustainability into high-pressure care environments. They do this by critically evaluating routine practices, such as the use of non-sterile gloves, and promoting alternatives when safe. Promoting awareness of the environmental impact of clinical decisions, such as imaging, prescribing, and disposables and incorporating sustainability into staff inductions can drive more climate-conscious practice.

Adaptation and Resilience

Emergency Medicine must also prepare for the health impacts of climate change, including extreme weather events, air pollution, and heat-related illness. Building climate resilience into ED infrastructure and workflows, such as surge capacity planning and backup energy systems, ensures that EM can continue to deliver care in crises. Sustainable practice is adaptive practice, and the ED community is preparing for this future with innovation and leadership.

3.4.2. Recommendations for Action

Below is a table of recommended actions.

Expand Clinical Leadership Roles in Sustainability	• Scale up the appointment of sustainability leads across EDs, integrating climate action into the clinical leadership structure. Appoint dedicated sustainability roles, such as Green ED champions or clinical fellows, to oversee and drive sustainable practices at the site level. • Provide training and resources to ED leaders on embedding sustainability into clinical decision-making and practice.
Integrate Sustainability into Everyday Clinical Practice	• Incorporate sustainability guidelines into routine ED care protocols and promote the adoption of care pathways that reduce waste, unnecessary diagnostics and patient visits, support sustainable prescribing, and encourage energy-efficient practices, ultimately lowering emissions. Implement the recommendations in the Green EM Playbook and Green EM Checklist • Provide standardised, data-driven tools to track and monitor sustainability outcomes in ED settings, ensuring continuous improvement. Engage clinical staff in ongoing education and awareness campaigns about sustainability, empowering them to adopt green practices.
Build Resilient, Low-Carbon Emergency Systems	• Strengthen surge planning and infrastructure resilience in EDs, ensuring climate adaptation strategies are embedded in operational procedures. • Foster collaboration across healthcare sectors (e.g. primary care, social services) to reduce reliance on hospital or ED-centric care models where appropriate and promote community-based care solutions.

43 HSE – Social Prescribing Framework

3.5 Integrating Climate Change into Cancer Care

3.5.1. Background and Context

Cancer care intersects significantly with environmental sustainability. From prevention to survivorship, every stage of the cancer care continuum offers opportunities to reduce emissions, avoid unnecessary interventions, and deliver higher-value, patient-centred care.

A significant proportion of cancers are preventable through proven strategies such as human papillomavirus vaccination, screening, smoking cessation, alcohol reduction, primary prevention of radon exposure in homes and workplaces, healthy weight management, sun protection, and physical activity (e.g. Frick et al., 2023). These interventions improve not only physical health but also mental wellbeing, and they are associated with better outcomes in cancers such as breast and colorectal. Preventing cancer is the most sustainable form of cancer care.

Overall, it is crucial to reflect on the broader impact of healthcare practices, such as how plastic use in medicine contributes to carcinogenic micro-plastics in the environment, and how pharmaceutical residues enter the food chain.

3.5.2. Recommendations for Action

Below is a list of recommended actions.

- **Prioritise cancer prevention strategies** as the most sustainable way to reduce cancer incidence and improve patient outcomes.
- **Embed low-carbon clinical practices** by:
  - » Following guideline-based care to avoid unnecessary diagnostics and interventions.
  - » Optimising chemotherapy use with dose banding and vial sharing within the pharmacy aseptic unit.
  - » Preferring oral drug formulations when clinically appropriate to lower emissions and plastic waste.
  - » Use toolkits (e.g. GLAS[44]) to support de-prescribing, resource optimisation, and climate-smart practice.
- **Enhance sustainable service delivery** through:
  - » Increasing use of virtual consultations and community-based care to reduce patient travel.
  - » Leverage community-based care including community intervention teams, wearable health tech, and e-health tools to reduce the need for in-person hospital visits.
  - » Promoting less intensive yet effective treatment schedules in oncology.
- **Expanding digital tools** like e-prescribing and e-communications, while balancing their environmental footprint.

44 ICGP – GLAS Toolkit

3.6. Prevention and Management of Chronic Disease

3.6.1. Background and Context

The National Clinical Advisor and Group Lead for Chronic Disease oversees four national clinical programmes: Diabetes, Heart, Respiratory, and Obesity, as well as the ICPCD. The ICPCD programme aims to enhance healthcare for individuals with chronic conditions and multimorbidity by providing a continuum of preventive, early diagnosis, proactive management, and support services. This approach emphasises prevention of chronic disease and self-management in the community as key priorities across the population. It also aims to support early and direct GP access to chronic disease diagnostics and specialist and multidisciplinary support in the community. Furthermore, it emphasises strong coordination with hospital services to deliver person-centred care at the lowest clinically appropriate level of complexity.

3.6.2. Sustainable Practices and Current Initiatives been undertaken by ICPCD

Aligned with climate action principles, significant efforts have been made to implement lean pathways and integrated care close to home through e-health solutions and improved access to care in the community setting.

Key Initiatives in Sustainable Healthcare across the entire ICPCD

- **Reducing Hospital Visits:** Implementation of "a one-stop shop" approach to care in the chronic disease hubs. This approach is designed to respond to the specific clinical needs of each patient by providing diagnostics and multidisciplinary review within a single clinic, while also supporting the management of multimorbidity through integrated, patient-centred care. Examples of this include the integrated cardiorespiratory clinic in Cuan Aoibhean ("Breathe Easy Breathe Strong") and the cardio-renal-metabolic clinic in Galway City Hub in partnership with University Hospital Galway. This integrated approach drives efficiency of specialist service utilisation while also minimising patient travel, and consequent travel-related emissions, by consolidating appointments.
- **Leveraging Technology:** Adoption of digital health solutions (e.g. Nurse-Led Virtual Palpitation Clinic using the Alive-Cor device[45]) to create alternative care pathways, reducing travel-related emissions and improving healthcare access.
- **Community-Based Care:** 95% of GPs now offer the Chronic Disease Management Programme to their eligible patients. 92% of patients with chronic disease are now managed solely in primary care. 40% of participants have two or more chronic conditions indicating management of complex chronic disease in the community. This programme is ensuring delivery of patient care closer to home, reducing unnecessary hospital utilisation and associated travel.
- **Public Health and Health Protection:** carries out public health risk assessments and provides statutory advice to authorities to protect the population, especially those most at risk e.g. with existing heart and lung diseases, from hazardous air pollutants.
- **Telehealth Expansion:** Virtual consultations for patients and GPs support effective care delivery while reducing environmental impact. For example, data from one chronic disease community specialist team shows that 64% of cardiology referrals to the hub were managed virtually — either through virtual consultations or clinical queries. This model is now being extended to diabetes and respiratory care in some teams, with ICPCD supporting the scale-up across all teams.

45 HSE – Impact of a Nurse-Led Virtual Palpitation Clinic

CASE STUDY 5

Clinical Programme-Specific Example: Community Pulmonary Rehabilitation (PR) in Kerry

Ten patients participated in an eight-week community PR programme. Pre-assessment data recorded patient transport modes, CO_2 emissions, travel distances, and costs.

Results (2023):

- 109 patient hours saved
- €557.56 cost savings
- 6,502 km less travelled
- 930.87 kg CO_2 emissions reduced

Conclusion: Community PR significantly lowers carbon emissions, improves cost-effectiveness, and enhances patient accessibility.

CASE STUDY 6

Clinical Programme-Specific Example: National Heart Programme (NHP) – Virtual Care Pathways

GP-to-Consultant heart virtual clinics and e-advisory services (clinical queries dealt with via email between Consultant and GP) were developed to offer a more flexible scheduled care service more responsive to the needs of the patient which would also minimise in-person visits and alleviate pressure on outpatient departments.

Results (Jan-Aug 2024):

- Seven sites implemented heart virtual clinics, managing 287 new referrals and conducting 251 virtual consultations.
- Two sites adopted e-advisory services, generating 138 new referrals and 133 case contacts.
- Over 25% of GPs opted for virtual pathways over traditional OPD referrals.

Conclusion:

- Reduced patient travel, lower carbon emissions, and improved system efficiency.
- Enhanced integration of GP and specialist services improves patient-centred care.
- Challenges such as technological infrastructure gaps, clinician training and payment for non-GMS patients need to be addressed in order to scale up these models.

3.6.3 Recommendations for Action

Below is a list of recommended actions.

- **Enable staff to deliver scheduled care in a variety of ways,** including virtual methods, by providing appropriate ICT equipment and infrastructure. Support staff engagement with virtual care through expanded training and resources.
- **Strengthen prevention and management of obesity,** ensuring that treatments are assessed for their environmental impact and that those with disproportionately high carbon footprints are addressed.
- Optimise resources by implementing sustainability tools in Ireland's future electronic health records, enabling healthcare providers to make environmentally informed decisions easily and accessibly.
- **Educate healthcare staff on climate-conscious care** and promote eco-friendly practices.

3.7. Diabetes Care

3.7.1 Background and Context

Diabetes is one of the most common and rapidly growing medical conditions, impacting over 500 million people worldwide with a projected increase to 780 million by 2045 (Sun et al., 2022). The majority (80-90%) of patients with diabetes have T2D which is the main driver of this increase. However, rates of T1D and GDM are also increasing. Drivers of increasing incidence of T2D include both modifiable and non-modifiable risk factors.

Modifiable risk factors include the increasing population prevalence of overweight, obesity, and sedentary lifestyles, and non-modifiable risk factors include an aging population. Climate change directly affects PwD and influences the disease's incidence and prevalence. PwD experience increased heat sensitivity due to reduced skin blood flow and sweating. Rising temperatures lead to higher rates of primary care consultations and hospitalisations among PwD, with mortality increasing at temperature extremes (both heat and cold). Research also links climate change and environmental pollution to the development of T2D.

Prevention Model

With the rise in T2D, preventive strategies to address overweight and obesity are essential to make a meaningful impact on disease incidence. Research indicates that preventing T2D in people at high risk contributes to reducing the healthcare sector's carbon footprint — a goal directly supported by the CDM Programme[46] in general practice. Lower socioeconomic groups are disproportionately affected by diabetes and should be a focus for targeted public health interventions.

One of the key goals of diabetes care is to achieve near-normal blood glucose levels to reduce the risk of complications such as diabetic nephropathy, which can progress to end-stage renal disease requiring dialysis — a treatment with a substantially higher environmental impact than standard glucose-lowering therapies.

The Third Report of the CDM Treatment Programme has demonstrated that repeated GP visits as part of the CDM programme are improving glycaemic control in individuals living with diabetes (Health Service Executive, 2025). Maintaining glycaemic control at 7% (53 mmol/mol) on a single agent or achieving a 1% (11 mmol/mol) reduction in HbA1c through additional therapy, has been associated with reduced carbon emissions (Fordham et al., 2020), highlighting how structured care can benefit both patient outcomes and the healthcare sector's environmental footprint. How this control is achieved appears important, as treatment choices differ in their environmental impact. For example, adding insulin to oral glucose-lowering therapy has been estimated to generate a

46 HSE – Chronic Disease Management Programme

considerably greater lifetime carbon footprint compared with remaining on oral agents alone (Marsh et al., 2016).

Overall, preventing complications and optimising therapy selection can contribute to both improved patient outcomes and a lower carbon footprint for diabetes care.

Patient Empowerment

From initial presentation through diagnosis and interventions, people living with type 2 diabetes manage their condition collaboratively with a MDT, including consultant endocrinologists/diabetologists, specialist nurses, dietitians, podiatrists, psychologists, pharmacists, and administrators across primary, community, and hospital services. Self-management education is a cornerstone of care, delivered through the CDM programme and structured community specialist team programmes such as the Diabetes Prevention Programme and DISCOVER Diabetes.

Specialist Nurses in Diabetes play a key role in educating patients on glucose targets, pattern recognition, insulin adjustment, and strategies to avoid unnecessary blood testing. This empowers patients to co-manage their condition, optimising glycaemic control, reducing long-term complications, and preventing unnecessary hospital admissions. Clear guidance on the proper disposal of diabetes-related waste—covering recycling, landfill, incineration, and electronic waste—is also essential to minimise the environmental impact of diabetes care.

Lean Care Pathways – Integrated, Community-Based Care

The Enhanced Community Care programme promotes shifting chronic disease management, such as T2D, from acute hospitals to primary care in the first instance with additional MDT and specialist input provided in the community via the chronic disease hubs where required, to meet more complex clinical need as close to home as possible. Technologies such as CGM, smartpens, insulin pumps, and connected apps enable remote data sharing and virtual consultations, reducing the need for in-person visits while maintaining effective glycaemic control.

Low Carbon Alternatives

Adopting reusable insulin pens and cartridges significantly reduces plastic waste compared to disposable pens. For medications like GLP-1 analogues, choosing disposable pen devices with lower carbon footprints (e.g. one-month dose pens instead of multiple smaller pens) helps reduce environmental impact. Pen recycling initiatives (such as Pencycle) and selecting CGM devices with lower carbon footprints, when clinically appropriate, further support sustainable diabetes care.

3.7.2. Recommendations for Action

Below is a list of recommended actions.

- **Empower patients through education** on diabetes self-management, including guidance on appropriate disposal of diabetes-related waste and promoting the use of low-carbon alternatives such as reusable insulin pens, eco-friendly disposable devices, and recycling schemes.
- **Expand community-based care** with technologies that support remote monitoring and reduce unnecessary hospital visits.

3.8. Green Laboratories

3.8.1 Background and Context

The most sustainable laboratory test is the unnecessary test that is avoided and not done. This is why the first step in diagnostic sector sustainability is elimination of low value testing, i.e. elimination of unnecessary tests and tests repeated too soon. To achieve this, laboratory professionals need to engage with their clinical colleagues to create guidelines for rational use of laboratory testing and then implement them.

HSE Laboratory Services Reform programme has commenced this clinically and environmentally necessary work by producing several testing guidelines,[47] but whole-system thinking and acceleration in execution are necessary. MedLIS,[48] the national laboratory information system, will be an excellent sustainability tool by making all Irish patients' tests visible to all the health professionals treating them. It has in-built capacity to support guideline-driven demand management at the national level, once implemented. However, MedLIS is still several years away from completion.

Once any laboratory test is ordered, it is a carbon-expensive affair. Laboratory operations are energy-intensive, consume large volumes of water, and generate significant waste — including hazardous materials and single-use plastics. Plastic use is a particularly striking example: life science research alone consumes an estimated 5.5 million tons of plastic-ware annually (Urbina et al., 2015). The prevailing culture of disposability, combined with high water and energy demands, makes laboratories among the most resource-intensive areas in healthcare.

The first step in waste management, including the waste of energy and the waste of water, is sensible procurement. Applying sustainability criteria to laboratory equipment tenders will go a long way towards reducing waste.

In Ireland, awareness of the environmental impact of laboratory work is growing. A number of laboratories either have achieved or are in the process of achieving My Green Lab certification. An activist bottom-up Clinical Green Labs Network has been established by enthusiastic pathologists and scientists in April 2024 and is now meeting quarterly under the auspices of the HSE Climate Action and Sustainability Office.

The way forward is making sustainability everybody's job by incorporating it into all laboratory activity, making it an integral part of every job description and an item in every quality and management meeting.

3.8.2. Recommendations for Action

Below is a list of recommended actions.

Education	A dedicated Green Labs HSELanD module is being developed. This module should become an obligatory training requirement for all laboratory personnel in Ireland.
Funding	HSE and section 38/39 healthcare facilities to provide ring-fenced funding to support labs transitioning to sustainable practices, including capital costs for energy-efficient equipment and recycling infrastructure.
Certification	HSE and section 38/39 healthcare facilities to finance and encourage uptake of laboratory sustainability certifications (e.g. My Green Lab) as a national standard.

47 HSE – Laboratory Services Reform Programme – Advice and Guidance
48 HSE – MedLIS

Policy and Procurement	HSE and section 38/39 healthcare facilities to commit to make laboratory medicine sustainable by embedding sustainability into all laboratory work roles descriptions and include sustainability as a mandatory agenda item for all quality and management meetings. Irish National Accreditation Board to consider including sustainability along ISO 15189:2022 laboratory assessments Embed sustainability criteria in all laboratory procurement processes. Embed minimum retesting intervals and rational investigations protocols into local and national clinical guidelines.
Networking and Leadership	Encourage all Irish clinical laboratories to join the Clinical Green Labs Network to share best practices, resources, and data.

3.9. Radiology

3.9.1 Background and Context

Radiology is a specialty that uses technology to create images of the body to assist with patient diagnosis and follow-up. Some conditions will not be visualised on imaging, as a structural or textural change is required for an abnormality to be appreciated. For this reason, there is nuance in selecting the correct study and the appropriate timing of that study.

There are many disadvantages to ordering an inappropriate study, including false positive or false negative findings, incidental findings, delays for other patients, unnecessary radiation exposure, and cost — all of which must be considered when requesting imaging. In recent years, there has been an exponential increase in the volume of imaging studies performed in both inpatient and outpatient settings. This increase is due to multiple factors (see e.g. Maskell, 2022), including medico-legal considerations and the use of imaging as a surrogate for absent services. However, it has also led to a considerable amount of duplication.

The downsides of this increase have been less well recognised and understood, including the significant carbon footprint associated with imaging. Within radiology, we are well accustomed to the "as low as reasonably achievable" principle, or ALARA, which dictates that radiation exposure to a patient should be kept as low as reasonably possible. A similar approach should be applied to the environmental impact of radiology, where clinically appropriate.

Scanner Contribution

Radiology is a significant contributor to a hospital's overall energy consumption, with notable variation in the carbon footprint of different imaging modalities. Unsurprisingly, the workhorses of the radiology department, MRI and CT scanners, account for a significant share of carbon emissions (Buckley & MacMahon, 2021). MRI, in particular, is among the most energy-intensive, with each study generating up to 20 kg of CO_2 (e.g. Martin et al., 2018). As such, powering down imaging systems, especially MRI and CT scanners, when not in use can lead to considerable reductions in CO_2 emissions (Merkle et al., 2023).

It is important that radiology works closely with procurement to ensure scanning and other radiology equipment is optimised in terms of energy efficiency as well as specific features including radiation dose reduction or lower helium features. In addition, artificial intelligence features may be added to improve efficiency.

Choosing Wisely: Evidence-Based Modality Selection and Environmental Impact

Evidence-based medicine refers to the application of the best available research to clinical care and should always be a goal in medical decision-making. In radiology, this includes selecting imaging studies that are both accurate and appropriate.

A study evaluating the American College of Radiology Appropriateness Criteria, an evidence-based tool to guide clinicians in imaging decisions, found that 48% of listed patient conditions had multiple "usually appropriate" imaging options, each with differing energy consumption levels (Alshqaqeeq et al., 2020). This is a crucial consideration, as imaging modalities vary significantly in their environmental impact. For instance, ultrasound generates just 1.15 kg of carbon dioxide equivalents (CO_2e) per abdominal exam, compared to 19.72 kg CO_2e for MRI (Martin et al., 2018).

Low-value Imaging

Low-value care is defined as: "An intervention where evidence suggests it confers no or very little benefit on patients or risk of harm exceeds likely benefit, or, more broadly, the added costs of the intervention do not provide proportional added benefits." (Scott & Duckett, 2015)

In imaging, a low-value procedure would be an examination with little or no impact on the management of the individual patient, thus, from a societal perspective, increasing costs and constituting unnecessary risks. The combination of low-value imaging and limited capacity in imaging departments creates bottlenecks and waiting lists in healthcare, which threatens health service sustainability (Brady et al., 2021).

Globally, up to 50% of imaging studies are felt to be of low value (Kjelle et al., 2022; Hendee et al., 2010; Sheng et al., 2016; Soltana et al., 2021; Ingraham et al., 2016)

A detailed study from the Norwegian context identified drivers for low-value imaging ranging from the organisation and funding of health services through health service organisations' culture and routines to an exaggerated belief in technology, defensive medicine, a lack of communication and guidelines, and clinicians giving in to patients demanding tests (Brandsæter et al., 2023). In addition, private insurance was discussed as a driver.

To achieve sustainable imaging, there is a need for societal efforts as well as specific actions in healthcare. Utilisation of clinical decision support tools as well as guidelines such as American College of Radiology Appropriateness Criteria and iRefer as well as effective communication and education will help to achieve this.

Data storage

Data storage is often overlooked when assessing radiology's environmental footprint. A particularly under-recognised contributor is the rapidly growing demand for storage driven by medical imaging. As of 2020, Ireland's National Integrated Medical Imaging System (NIMIS) held over 28.5 million imaging studies — more than 1 petabyte of data — with storage needs increasing by approximately 23% annually over the past five years (Buckley & MacMahon, 2021). An average CT study occupies around 160MB (Buckley & MacMahon, 2021), reflecting growing complexity due to thin-section reconstructions, multi-planar reformats, and advanced post-processing.

Storing and transmitting this data consumes energy, and with radiology increasingly integrating artificial intelligence, computing demands — and their associated energy use — are only set to rise. While the energy cost of storing a single study is small, the cumulative effect of retaining large volumes of redundant or clinically irrelevant data results in unnecessary carbon and financial costs. If current growth trends persist, clear guidance will be needed to limit storage of data with no enduring clinical or research value.

Some of this data could be ethically discarded after a defined retention period, reducing environmental impact without compromising patient care and potentially offering cost savings. An open discussion is needed around long-term data retention, with patients and carers helping to shape policies on data donation for research or consent-based deletion — ensuring data use remains aligned with public interest and environmental responsibility.

CASE STUDY 7

The Energy Cost of Idling Workstations

The energy use of radiology reporting stations may appear minor compared to imaging acquisition, but idle machines can carry a significant environmental and financial cost.

A 2014 study at St. Vincent's Hospital, Dublin, found that leaving reporting workstations powered on after hours cost approximately €7,253 annually and generated CO_2 emissions equivalent to those of 10 passenger cars.

This highlights the cumulative impact of unattended systems and underscores the importance of simple energy-saving measures — like powering down equipment after use — in reducing healthcare's carbon footprint.

Contrast Media

Contrast is used in many CT and MRI studies to image vascular structures as well as providing detail of solid organs and pathology.

Iodinated contrast media is also used in other disciplines including cardiology and vascular surgery. The potential ecotoxicology of radiopharmaceuticals such as iodinated contrast agents and gadolinium-based contrast agents has attracted scrutiny in recent times, owing to the nonselective treatment of water. The increasing pollution of the aquatic environment by radiopharmaceuticals is suggests a link to the increasing number of contrast-enhanced radiological procedures performed globally over the past two decades (Zanardo et al., 2023).

Contamination of water sources from radiopharmaceuticals is concerning as these chemicals end up in water via patients voiding post examination. Dekker and colleagues reported increasing contamination of water sources by iodinated contrast media (Dekker et al., 2022). Similarly, high concentrations of gadolinium contrast medium in various water sources have been reported (Brünjes & Hoffmann, 2020).

The use of non contrast techniques should be employed where possible, which should be considered when developing patient care pathways. Repeat imaging might also be performed without contrast if optimal information is provided to make that decision.

Interventional Radiology

Interventional Radiology is a growing service within hospitals, with a substantial portion of its carbon footprint linked to heating, ventilation, and air conditioning systems (Chua et al., 2021). Environmental challenges in interventional radiology mirror those in surgery, particularly the reliance on single-use sterile instruments and the resulting plastic waste. Interventional radiology faces many of the same sustainability issues as surgery and the operating theatre. Efforts to reduce environmental impact should therefore be aligned across these disciplines to ensure coherent and effective strategies.

3.9.2 Recommendations for Action

Below is a list of recommended actions.

- Promote a culture of appropriate referral for imaging and reduce unnecessary, duplicate and low value imaging studies. This in turn will contribute to value based healthcare and lower radiation doses to patients
- Develop or adopt tools to measure the carbon footprint of radiology services across the HSE.
- Interventional radiology should create sustainable practice guidelines or participate in wider initiatives such as the Green Theatres Compendium.
- Promote responsible data management by establishing frameworks for data donation for research or for data destruction after a defined retention period.

- Optimise care pathways to reduce the environmental impact of imaging — by selecting appropriate modalities and avoiding unnecessary repetition.
- Radiology departments should implement clear protocols for powering down equipment and monitors when not in use.
- Optimisation of equipment including scanners in conjunction with procurement, for energy efficiency as well as radiation reduction techniques as well as the introduction of artificial intelligence where appropriate.

3.10 General Practice

3.10.1 Background and Context

The HSE established the CDM Programme[49] in 2020. To date, it has been a resounding success with 400,000 patients enrolled on the programme until the end of 2023, reflecting an uptake of 80% among eligible medical card and doctor visit card holders. Anecdotally, the scheme is popular with patients, giving them an opportunity to learn more about their illness, and to set realistic goals for self-management, and express any worries or concerns about their treatment and prognosis in a 'non-acute' consultation with a GP or a GP Nurse. This model is due for expansion with the addition of new chronic diseases to the already established list of qualifying conditions, giving further opportunities for preventative health interventions in the community.

3.10.2 Approach to Framework

Prevention Model

Taking a patient empowered approach to prevention and co-managing health issues is a fundamental tenet of the primary care approach. GPs and GP practice nurses provide regular and opportunistic evidence-based health information and guidance to their patients and are in a position to assess the impact of these improvements over time. The CDM programme provides dedicated time for medication reviews in specific conditions. Expanding support for GPs through the CDM programme to optimise these reviews could reduce potential harm from polypharmacy while also generating positive environmental and climate benefits.

Many patients consult their GP about their cholesterol, blood pressure, and their heart health. Evidence shows that an environmentally friendly plant-based diet is also a heart healthy diet. If this information, and other targeted lifestyle actions for prevention were disseminated to GPs, and supported by hospital based medical and nursing colleagues, and primary care, they could be further integrated into the quality of advice on primary, secondary and tertiary prevention that is so important during these patient-led consultations. These are examples of when patients may be more motivated for behaviour change, resulting in a dual win for the patient and the planet.

Young patients can be health engaged, and some are climate conscious. They are an important patient subgroup to engage with their GP and / or GP practice nurse on preventative health topics and lifestyle behaviours such as substance abuse, stress, healthy eating, sleep and physical activity. This presents an opportunity for additional education around social prescribing and climate positive behaviours, and for addressing the various stages of prevention. Expanding the CDM Prevention Programme to include individuals aged 18 and over will enable earlier identification and proactive management of chronic disease risk factors, helping to reduce the future burden of CDM on the health system, which typically increases with age.

49 HSE – CDM Programme

The Strategic Action Plan for Creative Arts and Health[50]

In November 2019, the WHO recognised the role of art in healthcare by launching its Health Evidence Network synthesis report. The first joint Strategic Action Plan for Creative Arts and Health in Ireland has been developed in partnership by the Department of Culture, Communications and Sport (Creative Ireland), DoH (Healthy Ireland/Sláintecare), the HSE and the Arts Council/An Chomhairle Ealaíon. The Strategic Action Plan 2025 builds on the arts and health partnership between the departments and agencies concerning the use of creative programming to deliver national health and wellbeing policies and strategies. Creativity and access to cultural activities has a significant potential role to play in the delivery of greener, more sustainable, holistic and community-integrated future-focussed healthcare models.

Lean Care Pathways

Providing healthcare closer to the patient's home is aligned with the values of Sláintecare and delivers a reduction in air pollution and carbon emissions by reducing unnecessary journeys to hospitals. Prevention of hospital admission by optimising care in the community and improving dialogue and streamlining services between primary care community services and GP practices delivers further significant waste reduction. Optimising community care will reduce hospital admissions. Providing healthcare closer to home has additional benefits in terms of encouraging active travel and reducing air pollution through reduced vehicle use and reduced public transport impact.

Clinical and Sustainability Leadership

The Irish College of GPs has appointed a programme lead in planetary health and sustainability for the first time in 2025, indicating ambition to promote sustainable primary care in Ireland going forward. The College has endorsed the continuation of the Working Group in Sustainability and Planetary Health as the reformed advisory group to the national programme lead, and supports their continued engagement with HSE, other medical colleges, researchers and international organisations active in primary care planetary health and sustainable healthcare policy and research. The Irish College of GPs' delivers educational courses which aim to include green policies, awareness of green safer prescribing and the carbon footprint of different radiology modalities.

Operational Resource Usage

In contrast to hospital staff, many GP practices have control over the physical space they operate from. Performing energy upgrades, adding green spaces such as flower beds or planter pollinators, bicycle sheds or nature messaging around the GP practice can model positive climate messages for patients and the wider community. This can help promote climate and health friendly behaviours. Practices can use recycled paper, when printing is required.

Many GPs are already skilled at judicious usage of tests and referrals where appropriate for good clinical care. Further education for doctors and patients along with their families on the relative carbon footprints of imaging (MRI - high carbon footprint versus ultrasound - low carbon footprint) and the carbon footprint and costs of laboratory tests could improve this further and help to reduce unnecessary diagnostic testing that some patients expect are available on demand.

Partnerships with Other Stakeholders

Primary care is entrepreneurial and innovative when given adequate support. During COVID-19, primary care teams rapidly adopted e-prescribing and telemedicine from a low baseline. This shift led to a significant and sustained reduction in printing and paper waste. Many GP practices have retained telemedicine in some form, offering a viable alternative to fossil fuel-powered journeys for carefully selected patient cohorts.

Health Innovation Hub Ireland and the HSE in conjunction with the Irish College of GPs are rolling out a new inhaler recycling programme through GP and pharmacy pilot sites. The focus will be to recycle key components of the inhaler devices while providing education to primary care teams and patients on the outsized carbon footprint of inhalers in primary care.

50 Creative Ireland – The Strategic Plan for Creative Arts and Health

3.10.3 Recommendations for Action

Below is a list of recommended actions.

- **Prescribing Practices:** Optimise inhaler prescribing and usage and encourage a shift to low-carbon alternatives (e.g. DPIs) where clinically appropriate. Expand capacity to prioritise person-centred medicines reviews, enabling optimisation of therapy, reduction of polypharmacy-related harm, and improved patient outcomes.
- **Recycling and Waste:** Expand inhaler recycling programmes beyond current pilots, enabling full recycling of all inhaler components in partnership with pharmacies and manufacturers.
- **Integrated Lifestyle and Preventive Health Promotion:** Promote plant-based diets, active travel, physical activity, smoking cessation, and alcohol reduction as core preventive health strategies. These low-carbon, high-impact interventions reduce the burden of chronic disease, improve population health across all ages, and contribute to environmental sustainability.
- **Practice Environment:** Provide financial and technical support for energy retrofits and sustainable upgrades in primary care premises, including the creation of green space.
- **Leadership and Education:** Develop climate-health training for primary care staff and integrate sustainability into continuing professional development.

3.11. Infant Feeding

3.11.1 Background and Context

The National Maternity Strategy (2016-2026)[51] recognises the need for greater breastfeeding support in maternity services, with Ireland continuing to have some of the lowest breastfeeding rates in Europe. Breastfeeding not only provides long-term health benefits for both mother and baby, but it is also the most environmentally sustainable way to feed an infant.

It is essential to acknowledge that, for certain families, formula feeding their baby may be the most appropriate or viable option for their specific circumstances. The HSE supports the variety of means in which babies and young children can be fed. However, it also must be recognised that he environmental impact of formula production and use is significant, from dairy farming and manufacturing to packaging, preparation and waste. Ireland alone produces over 10% of the world's infant formula (Bord Bia, 2015). Agriculture accounts for 39% of the country's total GHG emissions, with dairy farming responsible for a large proportion of that percentage (Environmental Protection Agency, 2024).

These realities highlight the environmental challenges associated with formula feeding, in contrast to breastfeeding, which represents a low-carbon, zero-waste alternative.

3.11.2 Sustainable Infant Feeding Practices and Initiatives undertaken by the HSE

Initiatives aimed at breastfeeding education and support are aligned with programs such as the National Women and Infants Health Programme (NWIHP), and the National Healthy Childhood Programme, which emphasise the importance of fostering healthy habits from the outset of life.

Key initiatives are:

- **Investment in lactation posts:** The number of lactation/infant feeding WTEs working in the HSE nearly quadrupled from fifteen WTEs in 2017 to fifty-nine WTEs by the end of 2024.
- **Enhanced hospital and community-based breastfeeding supports:** Every county has greater access to in-person and virtual breastfeeding support groups, with two hundred and thirty services listed on mychild.ie.

51 Gov – National Maternity Strategy

- **Leveraging campaigns and technology:** Implementation of a dedicated child health communications campaign with fifty-six multipage breastfeeding guides on the HSE's website, printed breastfeeding resources, live chat and email with lactation consultants and the HSE app-based supports in line with public-facing messaging
- **Implementation of national standards for infant feeding in maternity services:** The National Women and Infants Health Programme introduced a self-assessment process for maternity hospitals and units to evaluate their practices effectively and benchmark progress against the standards. In 2024, seventy-two action plans were submitted across the eight Health Information and Quality Authority themes, ten focusing explicitly on enhancing exclusive breastfeeding efforts and maximising these initiatives through the 2024 self-assessment. These plans underscored the necessity for system-wide support regarding the impact of supplementation on the breastfeeding experience and the importance of adopting climate-conscious practices in feeding methods.

Maternity services support all methods of infant feeding. For mothers who are unable to breastfeed, are advised not to, or choose to exclusively formula feed, it is important to implement strategies that reduce the environmental impact of formula feeding — such as optimising portion sizes, minimising waste, and limiting the use of single-use plastics where possible.

In response to the ten action plans submitted, a sub-group called the supplementation sub-group was established within the infant feeding specialists forum. This multidisciplinary team was formed to explore educational initiatives and improve service delivery, with a focus on enhancing infant feeding practices through data collection and evidence-based, sustainability-conscious recommendations. The group's objectives include collecting standardised national data on formula feeding practices, identifying best practices that align with sustainability, and providing improvement recommendations for healthcare providers, service users, and national stakeholders. Data on Day One and Day Two formula volumes and infant weights were collected. The audit also examined the environmental impact of formula feeding. The audit involved 52 infants across seven Irish maternity hospitals and units, accounting for 696 feeding episodes. Of the 48,720 mL of formula available, only 21,090 mL (43%) was used, while 27,630 mL (57%) was wasted. The data showed significant variation in feeding practices between clinical sites, highlighting the need for standardised educational resources for parents. During this audit, all unused infant formula and associated containers were observed to be disposed of via general waste streams. From a sustainability perspective, the findings emphasise the importance of reducing waste and implementing resource-efficient strategies, including best-practice formula use and effective waste disposal practices. For instance, reducing the volume of ready-to-use newborn infant formula bottles from e.g. 70 mLs to 40 or 50 mLs, could both reduce waste and the risk of potential overfeeding (Hannon et al., 2024).

The National Formula Feeding Audit highlights the need for further enhanced support and education on infant feeding in Irish maternity services. The significant amount of formula waste noted in this audit highlights environmental concerns. Promoting a culture prioritising breastfeeding can improve public health and sustainability, aligning with the core principles of prevention model and low carbon alternatives objectives.

The infant feeding specialists forum's supplementation subgroup promotes evidence-based practices and climate-conscious strategies, empowering service users, healthcare professionals and those at national strategic level to enhance infant health while addressing environmental issues.

3.11.3 Recommendations for Action

Below is a list of recommended actions.

- **Promote Sustainable and Inclusive Infant Feeding Practices:** Optimise breastfeeding as much as possible as the most environmentally sustainable choice, while also supporting safe, accessible, and environmentally responsible alternatives for mothers who cannot breastfeed for medical reasons. The HSE should continue to prioritise and expand access to dedicated breastfeeding spaces across healthcare and community settings, building on the facilities already in place in maternity and co-located sites.
- **Develop Targeted Health Promotion Strategies:** Develop targeted strategies to optimise evidence-based breastfeeding and formula milk administration practices, while minimising environmental impacts in clinical and operational settings.
- **Minimise Waste with Evidence-Based Strategies:** Reduce infant feeding-related waste by exploring measures, such as market soundings with formula companies to provide smaller or more sustainable packaging options.
- **Engage with Healthcare Professionals:** Collaborate with healthcare professionals to promote evidence-based infant feeding practices and increase awareness of their environmental implications.
- **Establish Sustainable Waste Disposal Schemes:** Implement waste disposal and recycling systems for infant formula and related items across maternity hospitals and units, aligned with sustainability goals.

3.12. Mental Health

3.12.1. Background and Context

The climate crisis is increasingly recognised as a significant contributor to mental health issues. Climate change negatively affects mental health at an individual level and a community level. A multifaceted approach within our healthcare system is needed to help address the climate crisis to help foster a sense of hope and empowerment.

84 million people are affected by mental health problems across the EU.[52] Climate change is expected to worsen mental health outcomes worldwide, specifically for vulnerable individuals and communities. Unfortunately, the impact of climate change on mental health remains largely unexplored in comparison to the impacts on physical health.

The climate crisis can affect mental health through several pathways (see e.g. Cianconi et al., 2020). These include extreme weather events, which may lead to post-traumatic stress disorder, anxiety, and depression, extreme temperatures, which can influence mood; worsening of behavioural disorders; increased risk of suicide, and negative effects on the wellbeing of individuals with pre-existing mental health conditions. The climate crisis has also heightened distress and climate anxiety associated with changing livelihoods and loss of social cohesion in communities. The climate crisis has also led to new concepts, such as *ecoanxiety*, which refers to feelings of loss, helplessness, and frustration arising from difficulties in coping with climate change.

52 The European Union – Mental Health in the EU

3.12.2 Recommendations for Action

The health service can address climate action and sustainable options in our delivery of care to individuals accessing mental health services, thus positively impacting patients' wellbeing and addressing the climate crisis.

Below is a list of recommended actions.

Health Prevention	• Promote healthy, environmentally conscious lifestyles that improve mental health while supporting climate goals. • Encourage climate-positive behaviours such as active transport (walking, cycling), which improve mood and cognition while reducing emissions. • Facilitate nature-based activities (e.g. exercising in green spaces), proven to reduce stress, depression, and anxiety. • Support healthier plant-based diets, which are associated with better mood and a lower ecological impact.
Patient Empowerment	• Provide individuals with the tools, knowledge, and agency to take meaningful action. • Foster psychological resilience by enabling patients to engage in climate-positive choices. • Reduce eco-anxiety and improve overall well-being through empowerment and participation.
Sustainable Procurement and Prescribing	• Source sustainable food for inpatients and community programs (e.g. plant-based, locally grown options). • Consider deprescribing where safe and appropriate and prioritise non-pharmaceutical therapies where possible.
Sustainability Leadership	Strong leadership should be established to set the tone for health system-wide resilience and mental health integration. Embedding sustainability leadership within the HSE will ensure that mental health is prioritised as part of a comprehensive climate response, spanning policy, operations, and care delivery. This includes normalising the integration of mental health support in climate planning such as post-disaster services and driving system-wide investment in prevention strategies like green spaces and wellness programs. **Workplace Wellbeing:** • Green hospitals and clinics (natural light, ventilation, plant-rich environments) to reduce stress and improve morale. • Engage the workforce in climate action plans to foster shared purpose and protect against burnout. • Provide resilience training and peer support networks to strengthen coping capacities among frontline workers. **Community Trust and Resilience:** • Demonstrate proactive care to reduce public uncertainty and anxiety. • Equip communities with clear guidance for mental and physical adaptation during climate challenges. • Encourage collective efficacy, a strong protective factor against mental health deterioration in crises.

Training and Staff Education	• Provide education for mental health teams to build a climate-informed workforce. • Ensure staff are proficient in understanding ecoanxiety, climate grief, such as distress, homesickness and grief caused by environmental change and deterioration of one's home environment while still living there. • Provide education on the co-benefits of green care. • Support staff to lead by example in sustainability practices.

3.13 Prevention, Health and Wellbeing, and Health Protection Programmes

3.13.1. Background and Context

Child health and child protection is of upmost importance, as effective actions here may reduce the chronic diseases of the future. The main chronic diseases affecting population health in Ireland are cardiovascular disease, T2D, and obesity. Among adults aged 58 and over, 74% are living with at least two chronic conditions. Behavioural risk factors — such as smoking, poor diet, physical inactivity, and heavy alcohol use — are responsible for over 35% of all deaths in Ireland (OECD, 2023). Chronic diseases and their complications account for up to 80% of GP visits, 60% of hospital bed days, and over half (55%) of the acute hospital budget for patients aged 35 and over.

Tobacco use, unhealthy diet, alcohol misuse, and physical inactivity contribute significantly to chronic illnesses such as heart disease, cancer, stroke, diabetes, respiratory disease, and dementia. However, lifestyle changes can have a major impact — at least 30% of cancers and 80% of heart disease and diabetes cases are preventable. HSE Health and Wellbeing services focus on life-long health promotion and disease prevention to reduce or delay the onset of chronic disease and premature mortality.

People living in deprived areas face a much higher risk of developing multiple chronic diseases, leading to increased healthcare needs and a higher risk of premature mortality. Through Sláintecare Healthy Communities, targeted interventions are being delivered to vulnerable and disadvantaged groups most at risk. Partnerships with schools, local authorities, Tusla, Sport Ireland, and the community and voluntary sector have strengthened service delivery, reduced health inequalities, and empowered communities to engage in self-care and healthier living.

Health and Wellbeing Programmes

Health and Wellbeing programmes[53] provide expertise, strategic advice, analysis and evidence, to shape and drive health improvement and address known behavioural and physiological risk factors for chronic disease. This informs the design and development of evidence-informed programmes, policies, campaigns and initiatives aligned to government policies. A national approach ensures that standardisation and consistency is maintained as programmes and initiatives are implemented and monitored across the regions. In addressing lifestyle risk factors, Health and Wellbeing programmes ensure that a focus is maintained on population and individual level interventions targeting particular risk behaviours.

A complete list of services and programmes can be found on the HSE website, but examples include the Healthy Eating and Active Living Programme, the Tobacco Free Ireland Programme, and the National Healthy Childhood Programme.

53 HSE – Health and Wellbeing Programmes

Health Service Improvement

Health Service Improvement[54] aims to strengthen population health and wellbeing by addressing the broader social and commercial determinants of health across the life course. It places a strong emphasis on equity, ensuring that those experiencing the greatest disadvantage and poorest health are prioritised. Actions are designed to improve health for all, while directing additional effort towards the most vulnerable. Health improvement therefore requires the integration of climate action with a strong focus on equity and social justice, ensuring that the transition to a sustainable future also delivers improved health outcomes for all.

Child Health and Protection

Early action in childhood is critical to reducing the risk of chronic disease and supporting long-term wellbeing. The National Healthy Childhood Programme[55] provides universal health support for all children and parents from birth, while also contributing to the reduction of health inequities.

Child protection measures safeguard children's health and welfare and aim to prevent adverse childhood experiences, which can have lasting impacts throughout life. These actions strengthen resilience and support healthier futures for children, families, and communities. By promoting lifelong health and reducing the incidence of chronic disease, early investment in child protection and wellbeing also contributes to more sustainable healthcare systems by lowering future demand for health services and resources.

Health Protection and Environmental Hazards

Protecting population health requires ongoing vigilance against infectious diseases and environmental risks. Vaccination, infection control, and safe environments have transformed health security, but climate change, biodiversity loss, and globalisation continue to increase the risk of emerging infectious diseases and new environmental hazards.

Key priorities include:

- Effective control of infectious diseases and vaccination programmes.
- Robust infection prevention and control in healthcare settings.
- Safe and secure drinking water and wastewater systems.
- Reduction of exposure to environmental hazards, including poor air quality, unsafe water, and pollution.

Protecting health in the face of climate change and biodiversity loss requires close collaboration across government departments, local authorities, and communities. Public health services are central to strengthening Ireland's preparedness, resilience, and capacity to respond to these escalating risks.

3.13.2 Recommendations for Action

- Continued investment in health protection for all, with prevention and early intervention programmes focused on healthy childhoods, reducing adverse childhood experiences, and addressing lifestyle risk factors such as diet, smoking, physical activity, and alcohol use, particularly in high-risk groups.
- Prioritise investment in community-based chronic disease management to reduce pressure on acute services and improve long-term outcomes for people living with chronic conditions.
- Strengthen cross-sectoral partnerships with statutory and voluntary organisations to address health inequalities and support community-led public health initiatives.
- Build on and expand existing health and wellbeing programmes and health protection services to increase effectiveness and reach.

54 HSE – Health Service Improvement
55 HSE – The National Healthy Childhood Programme

- Place emphasis on a "Health in All Policies" approach, advocating across government and sectors to address wider social, environmental, and commercial determinants of health.
- Embed effective primary, secondary, and tertiary prevention in all models of care.
- Monitor and evaluate the impact of preventive programmes, including assessment of cost-effectiveness and return on investment.

3.14 eHealth Initiatives

3.14.1 Background and Context

The HSE Telehealth Roadmap 2024–2027 adopts the WHO definition of telehealth as:

> *"The delivery of health care services, where service users and providers are separated by distance using ICT for the exchange of information for the diagnosis and treatment of diseases and injuries, research and evaluation, and for the continuing education of health professionals"* (WHO, 2016).

The HSE Telehealth Roadmap aims to seamlessly integrate telehealth into business-as-usual within the healthcare service, providing high quality and safe healthcare, accessible to all, no matter who they are or where they live.

By integrating virtual care where clinically appropriate, the health system can:

- Lower its carbon footprint
- Reduce resource demand
- Enhance care efficiency
- Support Ireland's broader shift towards integrated, person-centred care.

In Ireland, telehealth supports the virtual delivery of care through three key modalities:

1. Remote Consultations and Care.
2. Remote Health Monitoring.
3. Online Supports and Therapies.

Remote Consultations and Care

Remote consultations involve clinical appointments delivered via web-based video platforms, telephone, or audio solutions as part of routine care, where clinically appropriate. Under the HSE Telehealth Roadmap 2024 -2027, over 2.2 million remote video and phone consultations occurred between March 2020 and July 2024. COVID-19 Evaluation Insights (2021) revealed that 82% of patients would have travelled 32km or more (one-way) for in-person appointments. Furthermore, 95% of service users said they would recommend virtual consultations to others, demonstrating high satisfaction.

Remote Health Monitoring

Remote health monitoring uses digital technologies—such as apps, wearables, and connected medical devices—to track patients' health outside traditional clinical settings (i.e. at home). This can enable longitudinal and/or real-time tracking of vital signs and symptoms, while supporting proactive, data-driven care, in addition to reducing the dependence of in-person clinic assessments.

Key Initiative Examples:

- Virtual Wards (Established June 2024 in University Hospital Limerick and St. Vincent's University Hospital):
  - » A Virtual Ward is a safe and efficient alternative to HSE bedded care enabled by technology that facilitates patients to receive acute care from where they call home.
- Chronic Condition Support Projects:
  - » *HSE Remote Health Monitoring Seedlings Programme* (2023): 19 projects across 12 sites nationwide supporting respiratory, cardiac, stroke, oncology, and renal patients.
- *The CARE (Community Acute Respiratory Excellence)* Community Virtual Ward (Letterkenny, Co. Donegal, est. 2022):
  - » This pioneering initiative combines digital monitoring with a specialist respiratory team to support COPD patients at home, improving outcomes and reducing hospital admissions.

Online Supports and Therapies

Online support services include web-based and messaging platforms offering therapeutic interventions, peer support, and self-guided or clinician-guided care. Two key digital mental health programmes are making a significant impact in Ireland. The first, SilverCloud Guided CBT, is an online CBT programme that has been available since April 2021 through referrals from GPs, Primary Care Psychology, the National Counselling Service, and Jigsaw. As of May 2024, over 19,000 accounts have been activated. A review in August 2023 showed promising results: 49% of users with moderate to severe depression experienced reliable improvement, and 59% showed improvement in anxiety symptoms. The programme receives approximately 1,000 referrals per month, with GPs contributing around 90% of these.

The second key initiative is the SpunOut.ie Partnership[56], a one-stop shop for personalised mental health support aimed at young people in Ireland. In 2023, SpunOut resources were accessed by 700,000 young people, and their social media content reached 5.6 million views across Instagram, YouTube, and TikTok. A standout feature of this partnership is the *'Text About It'* service, which facilitates real-time mental health support via text. Since its launch in September 2019, the service has exchanged 6.6 million texts, supported 208,853 conversations, and initiated 2,598 emergency service interventions.

3.14.2 Recommendations for Action

Below is a list of recommended actions.

- **Embed telehealth modalities into routine care** across clinical pathways, making it part of standard service delivery.
- **Scale virtual wards and remote health monitoring** to support chronic disease management and hospital-at-home models.
  - » **Enhance digital access and literacy** for both staff and service users to ensure equitable use of telehealth services.
  - » **National implementation of e-prescribing** to remove need for paper-based prescriptions.

56 HSE – SpunOut

3.15 Immediate Action to Enable Change

We need to identify and baseline the emission and circular economy metrics for delivery of all clinical programmes and care pathways. Secondly, we need to identify and baseline emissions for the key pharmaceutical products and services used for the models of care delivered under the clinical programmes. Analysis of the main drivers is ongoing. The above section explores clear, tangible recommendation for action across a variety of clinical settings and carbon hotspots within the HSE. These recommendations must be prioritised, and suitable initiatives embedded across clinical programmes and strategies. An ongoing process of tracking and monitoring should be implemented to ensure that the programme remains on track, that challenges are addressed and that opportunities for further developments are not missed.

3.15.1 Organisational-Level Recommendations

Leadership

- Ensure staff are supported by senior managers and executives when taking initiative to drive positive change. Business as usual is not enough. Senior leaders must actively contribute their energy and allocate resources to advance sustainability improvements.

Climate and Sustainability Programme

- The Climate and Sustainability programme will work with regional teams to develop and deliver communication plans that encourage sustainable action among staff, patients, and visitors, and highlight the link between climate change and health, as well as the HSE's plans, actions, and progress toward a more sustainable health service.
- Continue engagement with clinical programme leads to embed sustainability.
- Assist with development and implementation of measures to track improvements made across models of care and care pathways.
- Develop and maintain a national repository of sustainable healthcare practices, education and learning opportunities, tools, and resources.
- Continue to collaborate and work with the broader health system e.g. Climate and Health Alliance and IDE
- Continue collaborating with all relevant colleges (e.g. ICGP, CAI) and professional bodies (e.g. INMO, IMO).
- Each specialist college should develop or adopt sustainability guidance or toolkits for clinicians (e.g. Green EM Playbook, Green Theatre Checklist).
- Hybrid Roles:
- Support and develop business cases for mixed clinical–sustainability roles within departments to accelerate change.
- Support and engage with regions to enable structured time allocation for sustainability work within job plans.

3.15.2 Region and Site-Specific Actions

- Green Teams:
  - » Establish a greener models of healthcare subgroup of the regional green committee with clinician participation.
  - » Establish or strengthen Green Teams at each site.

  - » Empower teams to identify, lead, and report on sustainability initiatives.
- Staff Training
  - » Facilitate access to climate and health education (e.g. HSELanD sustainability modules): senior leadership sustainability and green team mandatory continuous professional development.

3.15.3. What can Individual Staff Do?

1. Disease Prevention

- Promote public health initiatives (e.g. Healthy Ireland, smoking cessation).
- Advocate and model plant-based diets, reducing red and processed meat consumption.
- Support active travel initiatives within your site.
- Ensure the models of care you relevant to you include all cost-effective primary prevention interventions as a priority.

2. Patient-Empowered Approach

- Collaborate to develop national green, blue, and social prescribing networks.
- Incorporate climate-health conversations into routine patient education.
- Refer patients to available self-management education services (e.g. cardiac rehabilitation, pulmonary rehabilitation, diabetes self-management education) where clinically indicated.

3. Lean Pathways – care closer to home

- Use telehealth and virtual care options where clinically appropriate.
- Refer patients to integrated care pathways in community settings.
- Advocate for redesigning services to reduce unnecessary hospital attendance.
- Removal of low value care.

4. Clinical Leadership for Sustainable Practice

- Model and promote sustainable behaviours in clinical decision-making.
- Undertake education on sustainability in healthcare (e.g. HSELanD).
- Include sustainability in teaching, supervision, and clinical audits.
- Allocate and prioritise time allocation to implement and drive sustainability changes.

5. Low Carbon Alternatives

- Review and optimise prescribing practices to avoid medication waste.
- Conduct clinical audits to identify opportunities to reduce the environmental footprint of your scope of practice.

6. Operational Resource Use

- Promote and support efforts to reduce water, energy, and waste in your area of work.
- Advocate for sustainable travel policies (e.g. incentives for walking/cycling to work).
- Work with facilities to implement local recycling, reprocessing, and energy initiatives.

7. Adaptation and Resilience

- Identify and plan for local climate-related health risks (e.g. extreme heat, flooding).
- Incorporate resilience into departmental emergency preparedness.
- Engage in discussions on how services can remain accessible and effective in a changing climate.

4. Support for Implementation and Next Steps

In the immediate term, each region should focus on the below implementation enablers to build and sustain momentum.

Implementation Enabler 1

Governance: Greener Models of Healthcare Working Group

- As part of your regional green committee, establish a sustainable greener model of care sub-committee as per Regional Climate Action Implementation Structures guidance issued by the Climate and Sustainability Programme.
- Assign a lead for greener models of healthcare at regional level.
- Members of the committee should include, but not limited to:
  - » Regional clinical director
  - » Relevant clinical staff from different clinical areas
  - » Health and wellbeing staff
  - » Health promotion
  - » Healthcare assistants
  - » Ward staff
  - » Procurement staff

Implementation Enabler 2

Measurement and Assurance

- The Climate Action and Sustainability Programme will:
  - » Guide measurement plan initially to focus on 2030 target as minimum targets and all other CAP requirements. The programme will assist regions and healthcare facilities with guidance and materials on this shortly.
  - » Develop a suite of KPIs for regional reporting.

Implementation enabler 3

Communication and Training

- The Climate Action and Sustainability Programme will be supporting regions and services with:
  - » Ongoing communications materials to support action, enable shared learning and awareness in this space.
  - » Various training opportunities such as health sector specific training provided via HSELanD and other e-learning platforms, Senior Leadership Sustainability training and Green Team training.
  - » See below a tile developed as part of an internal staff campaign providing staff simple actions that they can take.

Appendix 1

Working Group Members

Name	Role	Affiliation at the time of group formation
Dr Siobhán Ní Bhriain	Chair and Steering Group Member	Clinical National Director, Integrated Care, HSE
Roisin Breen	Programme Manager HSE Climate and Sustainability Programme	
Dr Ciara Martin	Vice Chair	National Clinical Advisor and Group Lead for Children and Young People, HSE
Elaine Dobell	Team member	General Manager, Office of National Clinical Director Integrated, HSE
Bernard Duggan	Team member	Chief 1 Pharmacist, Medicines Management Programme, HSE
Prof Camilla Carroll	Co-Chair of Green Theatres Action Group Team member	Royal College of Surgeons
Dr Cathy Burke	Team member	Irish Doctors for the Environment
Dr Ana Rakovac	Chair of the Green Laboratories Workstream Team member	Irish Doctors for the Environment
Dr Ola Løkken Nordrum	Co-Chair of Green Theatres Action Group Team member	Climate Action and Sustainability Fellow, HSE College of Anaesthesiologists of Ireland Irish Doctors for the Environment
Dr Andrée Rochfort	Team member	Irish College of General Practitioners
Dr Sean Owens	Chair of Inhalers Action Group Team member	Irish College of General Practitioners Climate and Health Alliance
Prof David Cotter	Team member	College of Psychiatrists of Ireland
Prof Basil Elnazir	Team member	Faculty of Paediatrics, Royal College of Physicians of Ireland
Catherine Devaney	Team member	Clinical Advisor for Older People, National Health and Social Care Professions Office, HSE
Dr Eimear Branigan	Chair of AMR Action Group Team member	National Clinical Lead, Antimicrobial Resistance Infection Control, HSE
Loretto Grogan	Team member	National Chief Nursing and Midwifery Information Officer, HSE
Dr Sinéad Horgan	Team member	Office of Directors of Nursing, HSE

Name	Role	Affiliation at the time of group formation
Peter Smyth	Team member	Assistant National Director, Capital and Estates, HSE
Dr Daniel Creegan	Team member	Lead Non-Consultant Hospital Doctor Programme, HSE
Dr Vida Hamilton	Team member	The HSE National Sepsis Programme
Eilis Ní Chaithnía	Team member	Asthma Society of Ireland
Laura Oldacres	Team member	Nursing Student Representative
John O'Brien	Team member	Health Products Regulatory Authority
Dr Tim Keady	Team member	College of Anaesthesiologists of Ireland
Mark Murphy	Team member	Irish Heart Foundation
Dr Ina Kelly	Team member	Adaptation and Resilience Working Group, HSE
Prof Diarmuid O'Donovan	Team member	Director of National Health Improvement, HSE Public Health
Dr Regina Kiernan	Team member	Health Service Improvement, HSE Public Health
Dr Julie O'Brien	Team member	Irish Doctors for the Environment
Mr Derek Cawley	Team member	Irish Doctors for the Environment
Dr Fionnula Cooney	Team member	Area Director of Public Health for Dublin and Midlands, HSE
Kay Finn	Team member	Senior Paediatric Dietitian, HSE

Appendix 2

Terms of Reference: Greener Models of Healthcare

1. Introduction

The Chief Strategy Officer, on behalf of the Executive Management Team (EMT), has initiated the implementation of the Climate Action Strategy for the HSE (the "Strategy"). The overarching objective of the Strategy is to support the delivery of key HSE strategic goals as they relate to climate action. The programme of work to implement the Strategy (the "Programme") will be a multi-year, sustained Programme 2023-2050 (with yearly reviews and updates) that requires appropriate investment in terms of time and resources. This will involve setting up a number of work programmes, including the Greener Models of Healthcare Work Programme. The work of each Work Programme will be to drive implementation of the Strategy by setting a baseline, developing implementation plans, filling key data gaps, identifying principles for implementation and resource requirements, mapping risks associated with delivery and managing associated mitigation actions, etc. Implementation of the Strategy will be an ongoing process.

2. Scope

The Greener Models of Healthcare Work Programme is guided by a broad advisory group. The scope of the advisory group is to coordinate implementation of the activities identified to improve the sustainability of care delivery. These activities include:

- Identifying what best practice looks like in optimising the sustainable procurement, use, and disposal of medical and clinical products as well as green initiatives in theatres, primary care, preventative care, and antibiotic prescribing through desk research, peer benchmarking, and engaging with the NHS [Key Action 1].
- Developing a green initiatives repository across the Irish healthcare system to include the name of initiative, owner, objectives/targets, status (e.g., in progress), and lessons learned [Key Action 2].
- Identifying the largest areas of opportunity within the HSE and address these through national/regional programmes e.g., a green theatre programme to investigate the 90-95% leakage rate of anaesthetic gases across HSE pipelines, reporting and publishing of findings, and development of a mitigation strategy [Key Action 3].

The subject matter under the remit of the advisory group includes but not limited to:

- Medicines, chemicals, medical equipment, and devices waste.
- Digital care delivery to reduce patient travel.
- Primary care.
- Green approach to Personal Protective Equipment (PPE).
- Preventative care.

- Facilitation of the reduction of waste, with a particular focus on single-use plastics, where possible.

The items above are identified as the areas of focus for Key Actions 1-3 however, other items which are identified by the Chair as in scope during the course of the work programme may be added as required.

3. Purpose

The purpose of the Greener Models of Healthcare Work Programme's Advisory Group is to explore and coordinate implementation of opportunities to deliver our healthcare services in a more sustainable way, including opportunities to reduce greenhouse gas emissions, reduce water consumption and optimise circular economy options. The advisory group will:

- Coordinate delivery of sustainability improvement opportunities identified across key healthcare pathways, which support implementation of the HSE Climate Action Strategy (2023-2050) and the Public Sector Climate Action Mandate.
- Ensure that relevant requirements, as laid out by the Climate Action Steering Group, are met.
- Manage delivery of the agreed scope, including progress reporting, management of relevant risks and issues, identification of resource and training requirements relating to design and delivery of greener models of healthcare and dependency management.
- Coordinate stakeholder engagement (including external stakeholders) activities, as required.
- Ensure ongoing alignment with HSE and national policy.

4. Advisory Group members

The proposed membership of the Advisory Group is as follows: Rep from:

- National Lead, Integrated Care
- National Clinical Advisor(s) and Group Lead(s)
- HSE Medicines Management Programme
- RCPI
- ICGP
- College of Psychiatry
- Irish Doctors for the Environment
- CAI
- Paediatric Respiratory
- HSCP Lead, Older Persons
- Infection Prevention Control, AMRIC
- HSCP Office
- Office of Directors of Nursing
- Capital and Estates
- NCHD Representative
- Asthma Society
- Public Health Representative

- Irish Heart Foundation
- Green Labs representative, RCSI
- Public Health Medicine National Health Protection Office
- Director of Health Improvement
- Senior Paediatric Dietitian

Membership will be reviewed on an interim basis. New members may be requested to join as required. Other individuals may be invited, by the Chair, to attend advisory group meetings as needed.

Membership substitutions are only permitted in cases of short-term absences (for example annual leave or illness). In cases of longer-term absences, adjustment of membership will be required, with the transfer of role(s) formally recorded.

At a minimum, advisory group members should:

- Understand the goals, objectives and desired outcomes of the programme of work.
- Declare any conflict of interest and make all reasonable efforts to avoid conflicts of interest.
- Raise matters of concern as they arise.
- Have a good working understanding of the legislation and of the statutory implications for staff, service users and the public.
- Attend and participate in advisory group meetings as required. Where members cannot attend meetings, they are encouraged to nominate a suitable colleague to attend in their absence.
- Support open discussion and respectful debate at all Advisory Group meetings.

5. Meetings

The Greener Models of Healthcare Advisory Group will meet every 4 to 6 weeks.

6. Decisions, Approvals and Escalations

A quorum of the Greener Models of Healthcare Advisory Group is required for decision-making purposes and to ensure meetings are valid and decisions are binding. A meeting quorum will be 6 attendees. Decisions and approvals will require support from a majority of advisory group members who attend the meeting, provided there is a quorum. In cases where there is an even number of attendees, the Chair has the final decision-making authority.

Appendix 3

Contributors to Greener Models of Healthcare Framework

Expert Area	Contributor	Role and Organisation
Sustainable Medicines	Ellen Martin	Senior Antimicrobial Pharmacist, Antimicrobial Resistance and Infection Control team, HSE
	Ciara Kirke	Clinical Lead, National Medication Safety Programme. National Quality and Patient Safety, HSE
	Bernard Duggan	Chief 1 Pharmacist, Medicines Management Programme, HSE
	Muriel Pate	Chief Pharmacist, Acute Hospitals, HSE
	Dr David Hanlon	National Clinical Advisor in Primary Care, HSE
	Dr Aisling O'Leary	Senior Lecturer in Pharmacy Practice, RCSI
	Stephen James Walsh	PhD candidate in Sustainable Healthcare, School of Pharmacy, RCSI
	Dr Sean Owens	GP Irish Doctors for Environment Climate and Health Alliance Chair
Green Theatres	Prof Camilla Carroll	Royal College of Surgeons Ireland
Anaesthetic Gases	Dr Tim Keady	Consultant Anaesthesiologist College of Anaesthesiologists of Ireland
	Dr Ola Løkken Nordrum	Climate Action and Sustainability Fellow, HSE Irish Doctors for the Environment College of Anaesthesiologists of Ireland
Green Emergency Medicine	Dr Rosa McNamara	Clinical Lead for the National Emergency Medicine Programme, HSE
	Dr Orla Kelly	Consultant in Emergency Medicine Green Emergency Medicine Lead, Emergency Medicine Programme working group
	Breda Naddy	Programme Manager – National Emergency Medicine Programme, HSE
Cancer	Prof Seamus O'Reilly	Consultant Medical Oncologist, HSE

Expert Area	Contributor	Role and Organisation
Chronic Disease	Mairead Gleeson	General Manager, Office of National Clinical Advisor and Group Lead for Chronic Disease, HSE
	Dr Sarah O'Brien	National Clinical Advisor and Group Lead for Chronic Disease, HSE
Diabetes	Prof Michael O'Grady	Consultant Paediatrician and Endocrinologist
Green Labs	Dr Ana Rakovac	Chair of the Green Laboratories Network, HSE Irish Doctors for the Environment
Primary Care	Dr Andrée Rochfort	Irish College of General Practitioners
	Dr Lisa McNamee	Sustainability Lead, Irish College of General Practitioners
Prevention	Helen Deely	Assistant National Director, HSE Health and Wellbeing
Mental Health	Dr Caoimhe Clarke	Consultant Psychiatrist, Psychiatry of Old Age, HSE Irish Doctors for the Environment
Infant feeding	Clare Kennedy	Assistant Director of Midwifery, The National Women and Infants Health Programme, HSE
ICT /Telehealth	Conor Kennedy	Senior Project Manager, HSE Technology and Transformation
Radiology	Dr Julie O'Brien	Consultant Radiologist, University Hospital Limerick Irish Doctors for the Environment
Public Health	Dr Teresa O'Dowd	Spark Climate Change Fellow, HSE

Appendix 4

Best Practice Research Sources

Focus Area	References
Greener Models of Healthcare	• Tackling Climate Change – The pivotal role of clinicians: Tackling climate change: the pivotal role of clinicians | The BMJ • WHO Framework for Climate Resilient Health Systems: Operational framework for building climate resilient and low carbon health systems (who.int) • Greener Practice: Principles of sustainable healthcare – Greener Practice • Towards Green and Sustainable Healthcare: A Literature Review and Research Agenda for Green Leadership in the Healthcare Sector – PMC (nih.gov) • NHS Principles of Low Carbon Models of Care NHS: Greener NHS Areas of focus (england.nhs.uk) • Nordic Model for Sustainable Healthcare: Nordic Center for Sustainable Healthcare (nordicshc.org) • Sustainability in Healthcare: The Nordic Experience: Sustainability in healthcare: The Nordic experience (openaccessgovernment.org) • Centre for Sustainable Healthcare: Centre for Sustainable Healthcare • Call for Emergency Action to Limit Global Temperature Increases, Restore Biodiversity and Protect Health: Green Natural Project Report (ide.ie)

Focus Area	References
Inhalers	• Inhalers Use in Hospitalised Patients with COPD: Inhaler Use in Hospitalized Patients with Chronic Obstructive Pulmonary Disease or Asthma: Assessment of Wasted Doses – PubMed (nih.gov) • Hidden Costs of Multiple Dose Products: Hidden Costs of Multiple-Dose Products: Quantifying Ipratropium Inhaler Wastage in the Hospital Setting – PMC (nih.gov) • Inhalers Waste in Hospitals: Inhalers Waste in Hospitals: A Frustrating Dilemma | Consultant360 • Device Selection and Outcomes of Aerosol Based Therapy: Device Selection and Outcomes of Aerosol Therapy: Evidence-Based Guidelines: American College of Chest Physicians/American College of Asthma, Allergy, and Immunology – ScienceDirect • Clinical and cost effectiveness of inhaler devices used in routine management of chronic asthma in older children: HTA report: Asthma (older children) – inhaler devices (nice.org.uk) • Pressurised metred-dose inhalers versus all other hand-held inhalers devices - Pressurised metered-dose inhalers versus all other hand-held inhalers devices to deliver bronchodilators for chronic obstructive pulmonary disease – Ram, FSF – 2002 | Cochrane Library • Pressurised metred-dose inhalers versus all other hand-held inhalers devices - Pressurised metered dose inhalers versus all other hand-held inhaler devices to deliver beta-2 agonist bronchodilators for non-acute asthma – Ram, FSF – 2002 | Cochrane Library
Green Theatres and Anaesthetic Gases	• Shaping Surgical Practice in the era of climate change (Brigham Clinical News) - Shaping Surgical Practice in the Era of Climate Change – Brigham Clinical & Research News (bwhclinicalandresearchnews.org) • Cutting Into Climate Change: A Step Toward Global Surgical Equity: https://www.healthaffairs.org/do/10.1377/hauthor20210122.414949/full/ • Revitalising Global Health Policy in the post-Trump era: Revitalizing Global Health Policy In The Post-Trump Era | Health Affairs • From Scalpels to security – Examining the intersection of global surgery, climate change, and human security: From Scalpels to Security | Think Global Health • Scaling up surgery and Anaesthesia, post Corona virus – Expanding access to surgery and anaesthesia would be a win-win for health security and universal coverage: Scaling up Surgery and Anaesthesia, Post-Coronavirus | Think Global Health

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