



YewMaker
Making Healthcare Sustainable

Sustainable Medicines

Good for people

Good for planet

Good for business





The journey towards sustainable medicines

As the last decade faded, I grew restless. I had spent 20 years in genomics, on a fast, fabulous journey that led to many advances that made a difference. It was important and fulfilling. But as 2020 approached, new challenges began to consume me. The threat to our world from our over-consumption. The lack of progress we had made on prevention, on equal access to healthcare, on being a fairer, better, world. My modest ambition has always been to try to leave the world just a little bit better than I found it. But my generation has failed, we have ravaged the world of its riches with little thought to the mess we are leaving our children.

But it's not too late. It is never too late, to at least try.

So as the new decade started, I started to try.

“ *How wonderful it is that nobody need wait a single moment before starting to improve the world.* ”
Anne Frank

A dream of sustainable healthcare

I started with a dream to make healthcare more sustainable: better for people, better for the planet, better for the business of healthcare. This triple bottom line must work in healthcare because we will never willingly compromise on our health, as the pandemic showed. If we want healthcare to be more sustainable then we must make sustainable healthcare the best way to deliver healthcare.

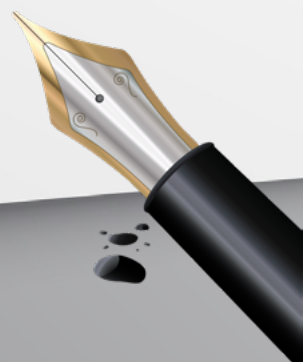
To help make this dream a reality, I founded YewMaker, a purpose-driven company dedicated to building science-based, sustainable healthcare solutions.

Building a more sustainable world can be approached from many directions. I wanted to tackle the waste endemic in healthcare. I witnessed and contributed to this waste as a doctor, despite my best intentions, and was often frustrated by outdated, unwieldy systems that hinder change. As a big pharma Non-Executive Director I learned about medicine logistics, and began to see opportunities for near-term, large-scale, practical innovations that could reduce wasted medicines and would help make healthcare more sustainable and equitable.

Reducing wasted medicines became the YewMaker mission

Over the last two years we have created a conceptual change framework known as the Pillars of Sustainable Medicines, we have formed an action collaborative of 48 organisations called the Sustainable Medicines Partnership, we have launched a 4-year Programme to deliver scalable sustainable medicine solutions aligned to our See-Measure-Reduce-Share action framework and we have secured NHS funding to build *MCF Classifier*, a suite of tools to support carbon-informed prescribing.

It's a start.



THE CHALLENGE



*4.5 trillion medicines
are made each year*

Billions are never used

The physical and mental health impacts of climate change, and other environmental incursions, are well known. The harms can be obvious, such as from extreme weather events, or hidden, such as the premature deaths caused by air pollution.

The contribution healthcare makes to the climate crisis has more recently become recognised. A 2019 study estimated healthcare contributes 4.4% of global greenhouse gas emissions, equivalent to the 5th largest emitting country ¹. Over 60 countries have now pledged to develop climate resilient, low carbon, sustainable health systems, with over 20, including the NHS, committed to delivering net zero health systems ².

Medicines play a significant role in healthcare's environmental impact, accounting for 25% of NHS emissions ³. Making medicines more sustainable is therefore a global priority and reducing wasted medicines must be our first goal.

Why do we waste medicines?

The tragic waste of medicines is due to many factors, including poor visibility in the supply chain, inadequate supply-demand forecasting, packaging and delivery failures, overly conservative expiry dates, oversized vials,

overprescribing, and more. In addition to the environmental impacts, these lead to significant costs and many negative impacts on patients.

Two billion people lack access to the medicines we destroy. Too many people are taking medicines they don't need. Too few people can access medicine information digitally, in the language and formats they want. Instead, we print billions of paper leaflets that are rarely read. Drug pollution, mostly from improper disposal of medicines, exceeds safe levels throughout the world. Medicine packaging, which is rarely collected or recycled, is another problem, exacerbated by the medicines that are made but never used.

We need sustainable medicines

Sustainable medicines maximise benefits for people while minimising harms to the environment and costs. This involves responsible development, production, delivery, use, and disposal of medicines to prioritise the well-being of people and the planet, while being operationally and financially successful.

It is possible, but requires collective stewardship, commitment, and action.

PILLARS OF SUSTAINABLE MEDICINES



Transforming large, intricate, multi-stakeholder systems is hard. Creating a compelling narrative framework is crucial to drive change. The framework must resonate with all stakeholders, balance vision and traction, be founded on principles for which there is consensus, and inspire investment of time and commitment.

YewMaker spent 18 months talking with healthcare stakeholders about the challenges of making medicines sustainable. We always asked this question:

'Are you comfortable that billions of usable medicines are wasted every year?'

'No!' was the universal reply.

To reduce the waste of medicines and from medicines became our guiding principles.

Six themes emerged through our discussions and became the Pillars of Sustainable Medicines.

- **Measurable impacts** – we need better sustainability metrics for medicines to measure, monitor, and incentivise change.
- **End-to-end visibility** – we need better tracking to know where and why medicines are being wasted.
- **Better shelf life** – we need more appropriate shelf lives as most medicines are safe and effective long after their 'expiry date' but currently must be destroyed.
- **Digital by default** – we need better digital access to medicine information to increase access and to reduce paper and packaging.
- **Every dose used** – we need to tackle root causes of waste and redistribute unused medicines wherever possible.
- **Sustainable packaging** – we need circular solutions to reduce single-use packaging.



**Measurable
impacts**

Measurable impacts

The importance of metrics and measurable impacts in achieving sustainable medicines cannot be overstated. Metrics serve as a crucial tool for tracking accountability and progress towards sustainability goals. They support evidence-based decision-making and drive continuous improvement by providing meaningful data for effectiveness assessment. Metrics and measurable impacts also provide a standard language and framework for comparisons, coordination, communication, and stakeholder engagement.

Currently, there is a shortage of suitable metrics and a lack of standardisation among the available metrics. A priority need is practical metrics to measure the carbon footprint of medicines.



**End-to-end
visibility**

End-to-end visibility

Our ability to know the status of medicine in the supply chain is surprisingly limited. Manufacturers know how many medicines they produce but not how many are consumed, which causes numerous negative consequences throughout healthcare. There is a systematic shortage of accessible, accurate, and connected information despite the millions of dollars invested in serialising medicine packages. For instance, scanning a medicine serial code does not automatically identify the product because it is not routinely linked to this information.

The lack of visibility results in substantial losses and costs, hinders forecasting and inventory optimisations and adds significant challenges to access and donation programs. For example, failures in the tracking of cold chain medicines cost an estimated \$35 billion annually ⁴.



**Better
shelf life**

Better shelf life

Most medicines remain safe and effective long after their expiration date but still need to be discarded. Studies show that, on average, 90% of medicines remain effective for five years longer than their expiry date ⁵. Implementing shelf life extension programs, where shelf life is tested and extended, is cost-effective and reduces waste. The US has been a leader in this area utilising \$2.1 billion worth of “post-expiration” medicines in 2016. Similar programs for many healthcare products were used during the pandemic, highlighting the potential to scale and standardise these systems. We should also prioritise packaging innovations, the use of prediction tools, and the creation of supportive regulatory frameworks to achieve longer shelf lives.



Digital by default

The medicine supply chain can benefit from digital solutions to enhance effective resource utilisation, cost efficiency, equity, and access. For example, each medicine pack includes a printed patient information leaflet, and it is conservatively estimated >100 billion such leaflets are printed globally, consuming 9 million trees and energy equivalent to powering 50,000 homes ⁶. However, these leaflets are not working well for patients with small unsearchable text that is hard to read or understand and is unsuitable for medicine devices like inhalers. We need digital-by-design information that is continuously updated and accessible in different languages and formats, such as audio and video. This change would reduce waste and improve patient experience, safety, and access ⁷.



Every dose used

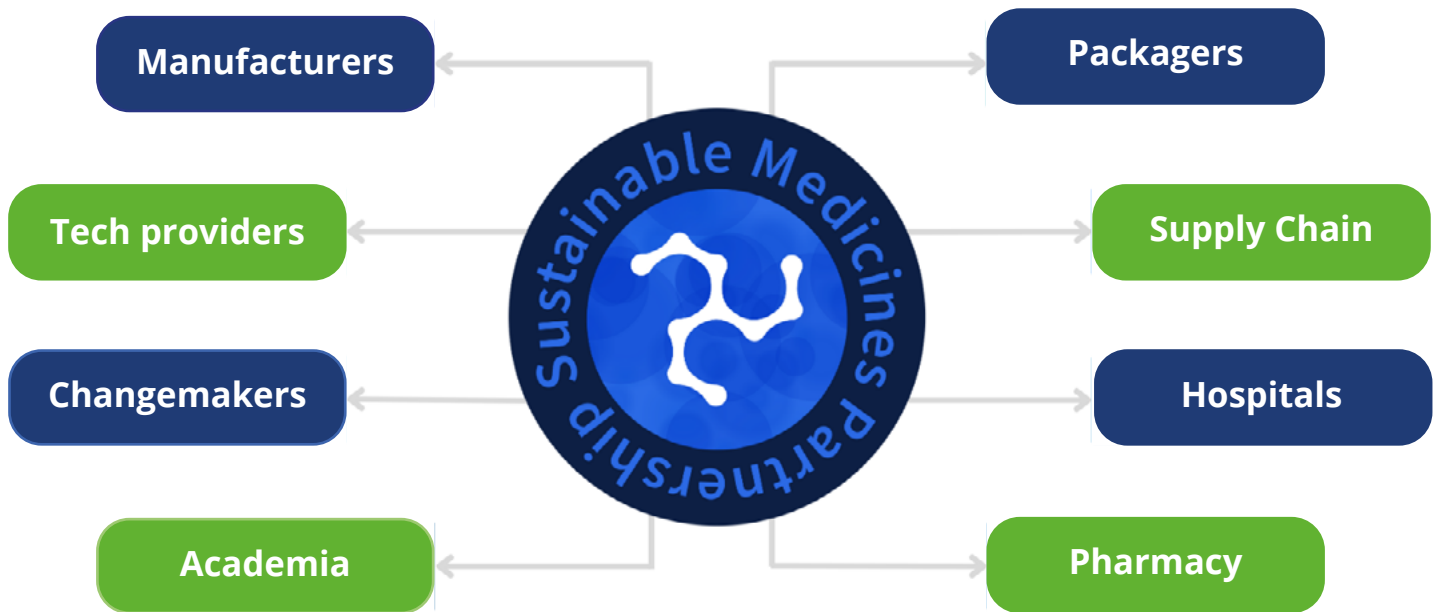
Ensuring every dose of medicine is used appropriately is a priority objective of medicine sustainability. Avoidable waste occurs throughout the supply chain, including during production, packaging, purchasing, distribution, prescription, collection, and patient use. The scale and negative economic, environmental, and societal impacts of the losses are huge. For example, it is estimated that medicines worth \$135 billion are destroyed by manufacturers annually, and 9% of prescriptions in the US are never collected ^{8,9}. Losses will be reduced by actions directed at the other Pillars to improve visibility, extend shelf life, leverage digital technologies and provide sustainability metrics. However, significant progress requires dedicated focus to comprehensively landscape the problems and prioritise, design and implement systemic and targeted cross-sector solutions.



Sustainable packaging

Pharmaceutical packaging protects and preserves drug effectiveness and communicates important information about the medicine. Serving these functions involves using various formats and materials, making improving packaging sustainability more challenging. Nevertheless, medicine packaging consumes vast amounts of energy, water, and natural resources and generates significant waste, which must be addressed. There are many opportunities for change, including reducing the amount and size of the packaging, redesigning with more sustainable materials, improving collection, and recycling the high-quality materials used. At a systems level, using recycled materials in pharmaceutical packaging is vital to increasing sustainability ¹⁰.

SUSTAINABLE MEDICINES PARTNERSHIP



In our stakeholder discussions, we met many smart, knowledgeable, dedicated people striving for change. We knew harnessing and catalysing their collective creativity and energy would be the key to scalable progress. The collaboration would need to encompass the entire healthcare ecosystem and have a flat, agile organisational structure with a singular focus on action.

We started building the Sustainable Medicines Partnership (SMP) with these passionate individuals who imparted the vision within their organisations and beyond.

It was the height of the pandemic, which accelerated the reach and relevance of our Pillars – using every vaccine dose, managing excessive packaging waste, fixing supply chain weaknesses, prolonging shelf lives, and embracing digital healthcare became pressing issues.

We announced our intention to build the SMP in October 2021. In October 2022, we launched the SMP with 42 Founding Collaborators, including pharma, generics, and retail manufacturers, packagers, distributors, supply chains, pharmacies, healthcare, hospitals, technology providers, academia, policymakers, and changemakers.



You can watch the launch presentation on the YewMaker website

[CLICK HERE](#) 

“Never doubt that a small group of thoughtful committed citizens can change the world. Indeed, it is the only thing that ever has.”

Margaret Mead



Sustainable Medicines Partnership



The Sustainable Medicines Partnership is a multi-stakeholder, not-for-profit action collaborative that currently includes 48 organisations.

SMP PROGRAMME

SMP Action Framework

Our next step was to translate the conceptual framework of the Pillars of Sustainable Medicines into the SMP action framework that we could execute. We designed a 4-year Programme of Projects aligned to four interrelated goals:

SEE - Digital information

Easy access to comprehensive, integrated, up-to-date digital information across the medicines ecosystem is foundational to delivering sustainable medicines. Our Projects focus on three areas: 1) research information, 2) product information and 3) patient information.

MEASURE - Practical metrics

Our Projects focus on three areas for which there is an urgent need for practical metrics that can be used to incentivise change and monitor progress: 1) medicine carbon footprints, 2) product impact labels and 3) wasted medicines.

REDUCE - Wasted medicines

Using the outputs of the See and Measure Projects we are driving measurable foundational change, focusing on three areas 1) over-prescription, 2) over-production and 3) wasted packaging.

SHARE - Inspiring examples

To catalyse systemic change we are sharing inspiring examples through events, spotlights and showcases, awards, and publications.

SMP Projects

Each Project is relevant to one or more Pillars and requires cross-sector collaboration to be successful. We tackle the foundational challenges that might prove difficult for less diverse partnerships.

Our Projects fall under two categories: systemic and specific.

- **Systemic:** We are building data, frameworks, and standards for improving medicine sustainability through policy change.
- **Specific:** We are conducting studies to demonstrate the real-world applicability and impact of our solutions for sustainable medicines.

We hosted virtual roundtables to define SMP project priorities, goals, and timelines. The roundtables also established the SMP cross-sector, non-hierarchical culture, with participants from various perspectives coming together in breakout groups to discuss topics ^{6,10}.



You can follow Project updates on the website
and by subscribing to our newsletter

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BUILDING SOLUTIONS

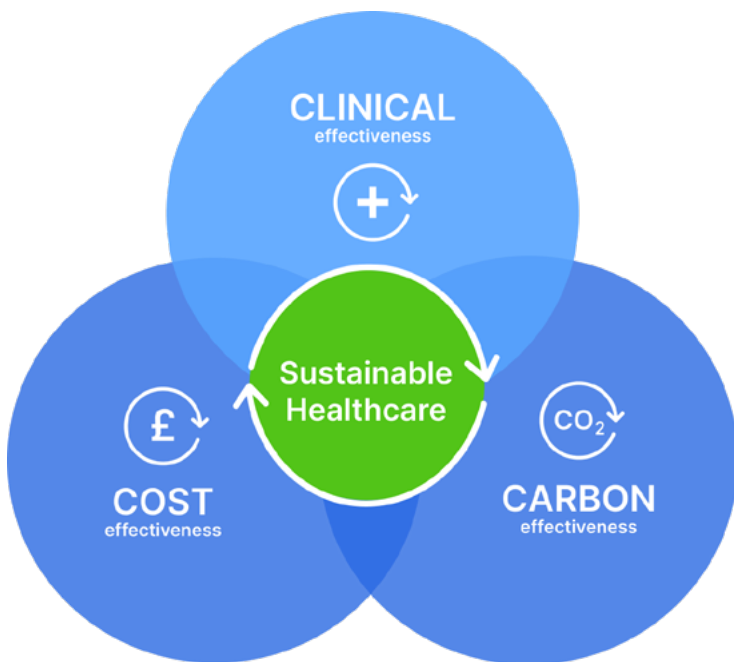
MCF Classifier

YewMaker specialises in building data-driven software solutions, and our stakeholder discussions identified a priority need for a solution that could deliver practical, scalable metrics to measure and compare the carbon footprint of medicines.



YewMaker has developed a novel approach using machine learning and green chemistry principles to estimate the global warming potential of synthetic medicines at scale. With support from SBRI Healthcare and Greener NHS, we have packaged these practical, comparable, medicine carbon footprint metrics into *MCF Classifier* (MCF = Medicine Carbon Footprint), a suite of data and support tools that is being piloted in the NHS in 2023 and will be commercially available in 2024 ¹¹.

Triple-C Framework



The integration of clinical, cost, and carbon information into the design of *MCF Classifier* was informed by our healthcare adaptation of the triple-bottom-line, which we call the Triple-C framework. The three C's are clinical effectiveness, cost effectiveness and carbon effectiveness ¹².

- **Clinical effectiveness** is a measure of how well a treatment or intervention works in improving health outcomes, such as reducing mortality or symptom severity or enhancing the quality of life.
- **Cost effectiveness** is a measure of the value for money of healthcare treatments and interventions.
- **Carbon effectiveness** refers to the extent to which a product, service or process reduces carbon emissions and mitigates climate change. It is a measure of the environmental impact of a given activity or operation.

The primary measure in the Triple-C framework should always be clinical effectiveness. The relative merits of cost and carbon effectiveness can be flexibly evaluated and weighted, as required. Triple-win interventions are those in which clinical effectiveness is also cost and carbon effective. *MCF Classifier* is designed to help identify and prioritise triple-win sustainable medicine interventions.

INSPIRING CULTURAL CHANGE

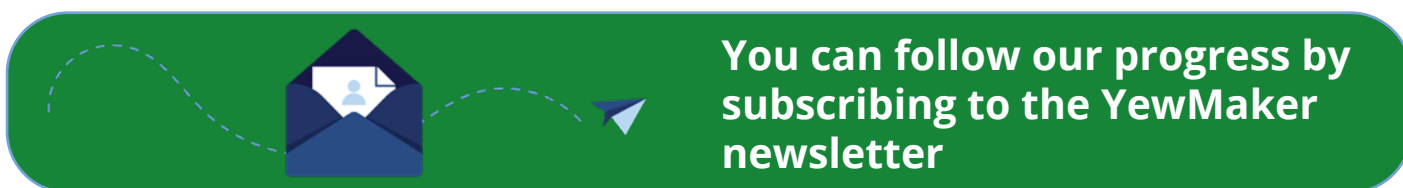


Changing the culture surrounding the production, distribution, and use of medicines is vital to making medicines more sustainable and equitable. Education and awareness are SMP priorities, and we address both the scale of the problems and the scale of the opportunities for economic, environmental, and societal benefits that change can deliver.

We are inspiring change by showcasing individuals, organisations, products, and

processes that are pioneering sustainable medicine practices.

An example is the **Sustainable Medicines Packaging Awards**. Through the awards we celebrate companies offering design innovations that reduce waste and increase sustainability of pharmaceutical packaging, and companies with innovative products and services that reduce single-use packaging and increase supply chain circularity ¹³.



Acknowledgement and Thanks

None of this would be possible without Shazia Mahamdallie, YewMaker Chief Scientific Officer and SMP Programme Manager and Haroon Taylor, YewMaker and SMP Senior Data Scientist.

Thanks to everyone who is on this journey with us. Your passion, generosity, expertise, and energy are a constant inspiration.

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