Sustainable Healthcare Coalition

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Building environmental considerations into the evaluation of health interventions

Taking a care pathway approach

A discussion paper from the Sustainable Healthcare Coalition

About this paper

This paper was developed with the contributors listed below, with drafting support from The Health Policy Partnership.

The views expressed may not represent those of individual members of the Sustainable Healthcare Coalition.

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Executive summary

The past decade has seen growing commitments across the health sector to minimise the impact of healthcare on the environment. A first step in operationalising these commitments is to develop accurate measurements of the environmental impact of health interventions, and to build them into the frameworks that govern decisions about their adoption over time.

While this will have implications across the entire spectrum of decisions related to health interventions, to date it is within the health technology assessment (HTA) community that these discussions have been most prominent. Several HTA agencies are already building environmental impact into their assessments.

There is, as of yet, no agreed methodology for integrating environmental considerations into these assessment frameworks, and several methodological issues remain. However, these evolving discussions raise important questions about how we, as a society, can integrate environmental considerations into our decisions as we shape the future of healthcare without ever compromising health outcomes or population health.

As a cross-sector collaboration seeking the greatest opportunities to inspire sustainable practices in healthcare, the Sustainable Healthcare Coalition is committed to working with HTA agencies and all stakeholders to find a feasible way forward. As with most system change, this will require an evolution in mindset from all stakeholders, time for the right approach to be found, and an open and collaborative mindset. Together, we should aim to advance feasible methodologies that contribute to achieving more environmentally sustainable healthcare, encouraging and rewarding innovation, and advancing best-practice care for all.

As we work with our partners to find a feasible way forward, we would invite HTA agencies and all stakeholders to adhere to the following key principles:

Take a care pathway approach to measurement

Environmental impact assessments of health interventions should take a care pathway approach to fully measure their environmental impact over time. Life-cycle assessment (LCA) measures of individual interventions are insufficient to assess the full environmental impact of interventions when used in practice.

Take a multi-stakeholder approach to build new methodologies and avenues for integrating environmental impact into HTA assessment

HTA agencies and academia should work closely with industry, payer organisations, patient and carer organisations and professional societies to build consistent methodologies and approaches to integrate environmental impact measures into their evaluation frameworks and test their feasibility across different countries or jurisdictions.

Monitor the feasibility of implementation

This group of stakeholders should monitor the implementation of adapted approaches to HTA to ensure they do not result in unintended consequences, such as compromising patient access or stifling innovation.

Ensure consistency and transparency

The HTA community, the Sustainable Healthcare Coalition, Health Care Without Harm and other organisations engaged in improving the environmental sustainability of healthcare should work together to ensure the consistency of approaches across health systems, as they evolve, and transparently communicate about chosen approaches to ensure they do not compromise health outcomes.

Build environmental literacy

As HTA agencies and other health system leaders evolve their decision-making frameworks, they must work together with patient organisations and professional societies to build environmental literacy across the entire health community to enable informed care choices for patients. They must also always ensure that patient interests and perspectives are appropriately reflected in their discussions about evolving methodologies.

1 Towards environmentally sustainable healthcare

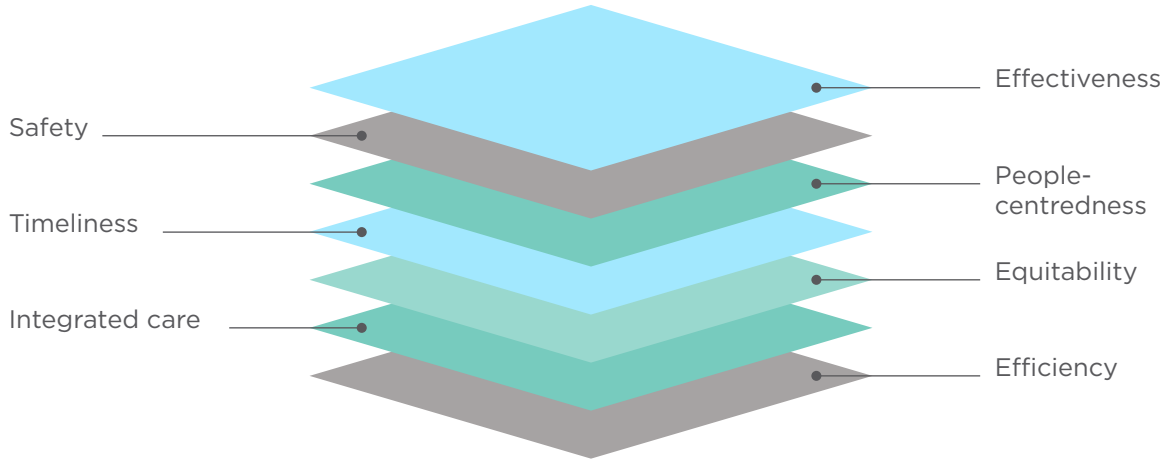
The past decade has seen growing recognition that health systems are not only vulnerable to the impact of climate change, but also contribute to it through their activities. This realisation has led to widespread commitment across the health sector to reduce its impact on the environment, with the National Health Service in England (NHS England) being the first national health service to commit to becoming net zero by 2045, embedding environmental targets into legislation.[1] The NHS Constitution is also being updated to include environmental responsibility as one of its core duties.[2] Over 70 countries have joined the Alliance for Transformative Action on Climate and Health (ATACH), spearheaded by the World Health Organization (WHO), committing to low-carbon and environmentally resilient health systems,[3] and 151 countries have endorsed the COP28 UAE Declaration on Climate and Health, recognising that stronger climate action will translate into huge benefits for human health and health systems alike.[4] Adding to this momentum, through the Science-Based Targets Initiative, 80 companies in the health sector have committed to aligning their decarbonisation initiatives with global warming limit targets. Since 2020, the number of companies involved in the initiative has doubled.[5]

Building on these commitments, there is growing recognition of the need to accurately measure the environmental impact of health interventions and build this into our choices of how we deliver care. In doing so, it is important to recognise that these choices are not just about which medicine or medical device to use, but how we deliver care, in which setting, and how we integrate the use of data to drive decisions.[6] * Our definitions and standards for what constitutes high-quality care have evolved over time, and several authors have suggested that environmental sustainability now be added to this definition (*Figure 1*).[7] [8] This integration is reflected in the WHO's definition of an environmentally sustainable health system as a system that 'improves,

* Health interventions can be defined as any test, device, medicine, vaccine, procedure, programme or system that aims to prevent, diagnose or treat medical conditions, promote health, provide rehabilitation, or organise healthcare delivery (HTA glossary).[9]

maintains or restores health, while minimising its negative impact on the environment and leveraging opportunities to restore and improve it, to the benefit of the health and wellbeing of current and future generations'.[10]

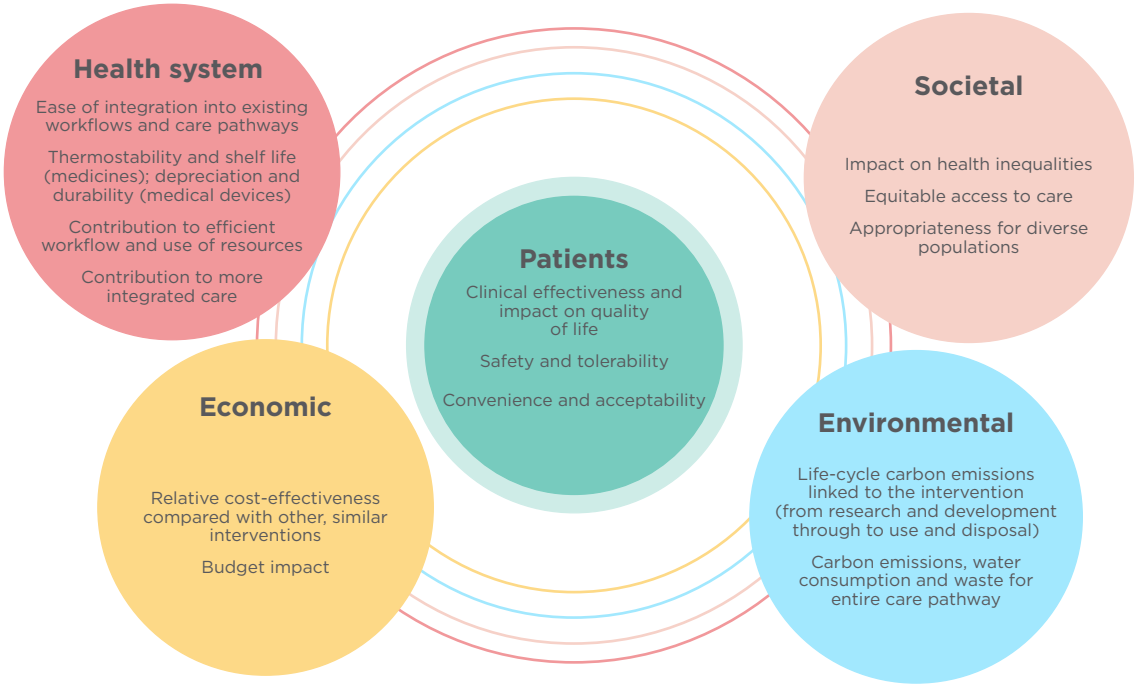
Figure 1. **Adding environmental sustainability to existing definitions of quality of care[11]**



Source: World Health Organisation (WHO) Framework on Quality of Health Care (2018)

Another way to view this is that environmental value is a component of high-value care, along with other attributes that build around the core value proposition of health interventions focused on their clinical benefits to patients (*Figure 2*). Regardless of the framework used, we should never lose sight of the fact that the primary lens through which healthcare should always be viewed is its contribution to patient outcomes and population health.

Figure 2. **A comprehensive vision of value**



To operationalise these evolving frameworks, an important first step is to ensure we have reliable metrics that provide a comprehensive assessment of the environmental impact of health interventions we wish to introduce into care. To do so, looking at the full impact of a given intervention along the entire care pathway in which it is used, including both its upstream and downstream effects, is key. Care pathways, sometimes called clinical pathways, can be defined as structured, multidisciplinary care plans that use guidelines and evidence to detail the steps of a treatment or care in a standardised way.[12] We at the Sustainable Healthcare Coalition and other organisations, such as Health Care Without Harm, have conducted considerable research to develop standardised methodologies to measure carbon emissions along entire care pathways. These emerging data and approaches are allowing us to better understand the 'hot spots' of carbon emissions along care pathways.[13 14] Contributing to this effort, the Sustainable Markets Initiative (SMI) has developed a care pathway carbon calculator tool focused on type 2 diabetes, which will allow us to better quantify the health improvements and derived carbon emissions reductions associated with different health interventions.[15 *] While these methodologies currently focus mostly on carbon emissions, they are evolving to include other components of environmental impact as well, such as the impact on water and other resources.

As these data become available, the next step is to determine how to integrate them into the frameworks that govern decisions about the adoption of new health interventions and their evolution over time. This will have implications across the entire spectrum of decisions related to health interventions (*Figure 3*). But to date it is within the health technology assessment (HTA)[10 **] community that these discussions have been most prominent, with several HTA agencies already building environmental impact into their assessments.[16] There is, however, no standardised approach as of yet to build environmental impact into HTA assessments, and several important methodological issues remain.[17-21] Nonetheless, these evolving discussions raise important questions for all decision-makers about whether we, as a society, can agree to a transparent approach that supports innovation by advancing interventions that improve health outcomes and also have a lower environmental impact, and which trade-offs will be deemed acceptable, while always prioritising the improvement of patient outcomes and population health.

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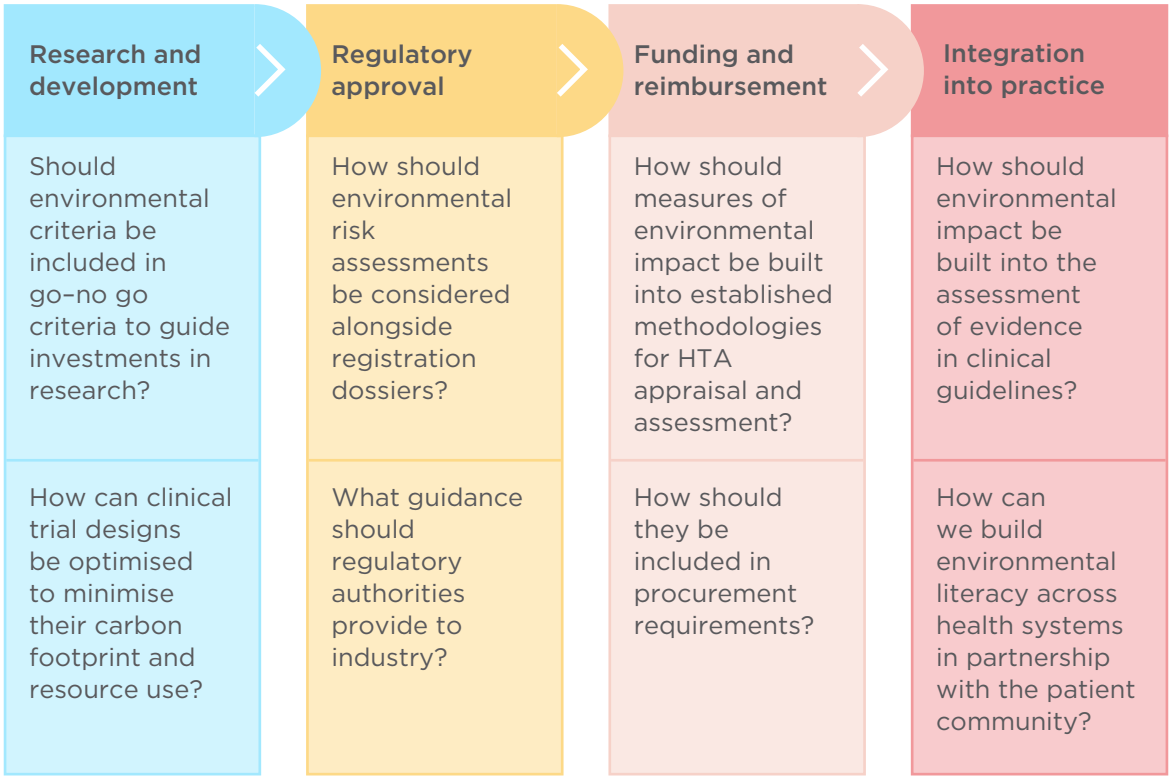
* This work is illustrative of the kinds of assessments that can be done, and is not necessarily in itself intended to be used as part of health technology assessments should they choose to include environmental considerations.

** Health technology assessment is defined as a multidisciplinary process that uses explicit methods to determine the value of a health technology at different points in its life cycle. The purpose is to inform decision-making in order to promote an equitable, efficient, and high-quality health system.[10]

The Sustainable Healthcare Coalition has developed this paper to help inform these discussions, taking HTA of health interventions as an initial point of focus. It is our hope that the considerations outlined in this paper may stimulate an open and aligned discussion among all stakeholders that will help us advance our common goals of achieving more environmentally sustainable healthcare, encouraging and rewarding innovation, and advancing best-practice care for all.

Figure 3. **Considerations for including environmental impact measurement across the spectrum of decisions related to health interventions**



Source: *Courtesy of Niels Lund, Novo Nordisk*

2 Environmental impact assessment: the need for a care pathway approach

Moving beyond intervention-level life-cycle assessment

The past few years have seen considerable efforts to establish a coherent approach to measuring the environmental impact of individual health interventions. Life-cycle assessment (LCA) is a globally recognised scientific approach to quantify resource use, emissions and the effects of interventions on the environment, and is recommended for measuring the carbon footprint of medicines, medical devices and equipment (*Box 1*).[7 22]

Box 1. Life-cycle assessment: the current standard for measuring the environmental impact of medicines and medical devices[8 23 24]

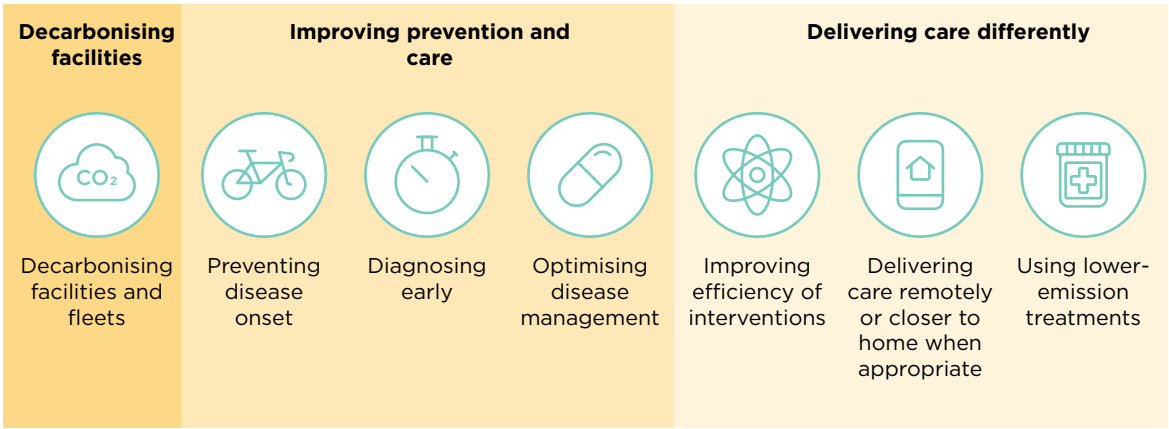
LCA takes a holistic, 'cradle to grave' approach that includes both direct and indirect emissions from a product's use downstream and upstream, covering extraction of natural resources, manufacturing, transport, use and re-use, and disposal and life-cycle management of an intervention. Taking a life-cycle approach enables a better understanding of which aspects of an intervention's development or use have the greatest environmental footprint – and allows us to target efforts on identified 'hot spots.' Although applications of LCA are somewhat fragmented and siloed at present, there are several ongoing initiatives, including by the SMI, to standardise approaches for measurement and reporting across the health sector.

Members of the SMI, including the Sustainable Healthcare Coalition, are working within the context of the Pharmaceutical Environment Group,

and with the British Standards Institute, to develop a common standard for LCAs that will enable comparable, standardised and transparent reporting on the environmental footprint of medicines, equipment and other interventions.*

Although a useful metric, intervention-level LCAs are insufficient in themselves to evaluate the full environmental impact of an intervention when used in practice.[7] To do so, one needs to consider the entire care pathway, looking at how the intervention is given in which setting of care, and how this fits into the pathway from diagnosis to long-term management. This approach is consistent with the previous work of the SMI, which identified seven levers that have the greatest impact on the carbon footprint of care pathways (*Figure 4*). Taking this comprehensive approach will allow us to understand the downstream impact of a given intervention on other resource use and associated benefits, such as avoiding hospital admissions, and can provide a full understanding of how to optimise its delivery of care. The intervention-level LCA is therefore just one component of this more comprehensive assessment of environmental impact, as illustrated in *Figure 5*.

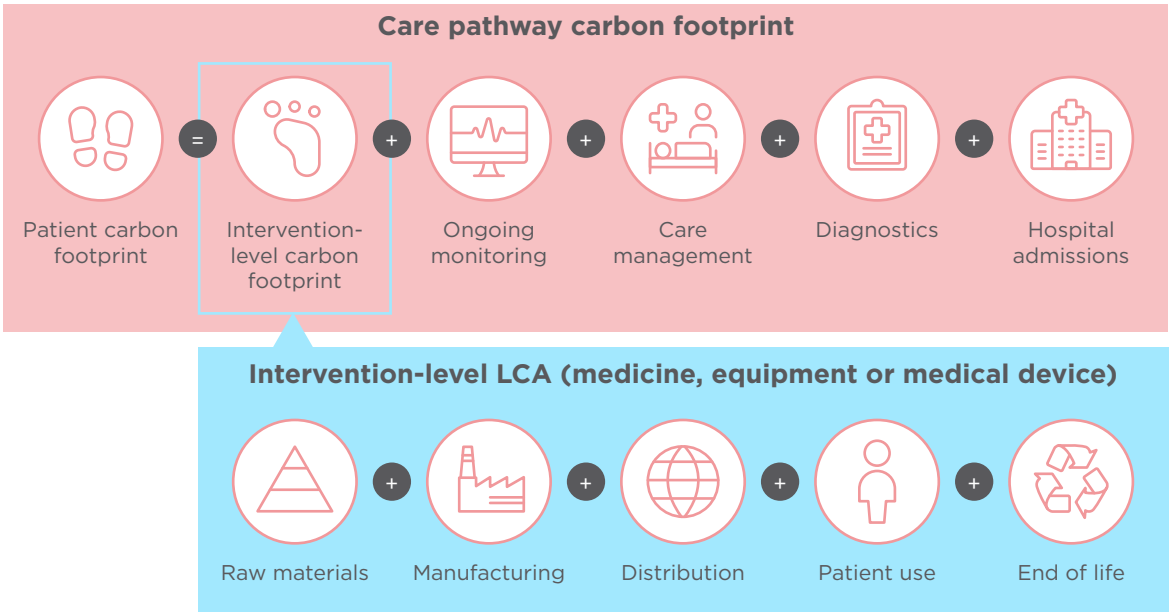
Figure 4. **Seven levers to reduce emissions in care pathways[13]**



Source: Health Care Without Harm, WHO, BCG analysis

* This work is illustrative of the kinds of assessments that can be done, and is not necessarily in itself intended to be used as part of health technology assessments should they choose to include environmental considerations.

Figure 5. **How an intervention-level LCA and care pathway carbon footprint intersect**



Source: Courtesy of Niels Lund, Novo Nordisk

Applying a care pathway approach to chronic conditions: the example of type 2 diabetes

Taking a care pathway approach is particularly important when assessing the environmental impact of interventions for chronic conditions, where health interventions may help prevent progression to later stages of disease; these later stages may be more resource-intensive and therefore have a higher carbon footprint. The importance of a care pathway approach is illustrated in the carbon footprint calculator the SMI developed for type 2 diabetes (T2DM) (*Case study 1*).[15] Long-term complications, which include cardiovascular disease, renal disease, retinal neuropathy and foot ulcers, are a major cause of morbidity and mortality from T2DM and account for less than half of total greenhouse gas emissions in care.[25 26] It follows that any assessment of the environmental impact of preventive approaches or glucose-reducing therapies for T2DM should factor in their impact on these complications to estimate their full value. The care pathway model shown in *Case study 1* does just that, looking at the effect of both prevention and disease management choices on the long-term impact of the condition. If the model had focused on just the narrow impact of the intervention (e.g. the intervention-level LCA), it may have led to different conclusions and resulted in a suboptimal choice from both a patient-outcomes and an environmental-outcomes perspective.

Case study 1. A care pathway carbon calculator for type 2 diabetes

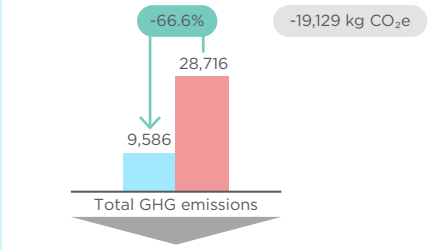
An environmental module was incorporated into the existing IQVIA Core Diabetes Model® to estimate the impact on CO_2 emissions (CO_2e) associated with T2DM clinical outcomes over a 50-year horizon. The model looked at the lifelong impact of two scenarios: 1) prevention of prediabetes from progressing to T2DM through diet and exercise vs. no intervention and natural disease progression to diabetes; 2) offering guideline-concordant treatment that could achieve good glucose control (HbA1c levels < 7%) vs. uncontrolled patients (HbA1c of 8.5–9%).

Both scenarios showed a longer life-years estimate and reduced lifetime greenhouse gas (GHG) emissions (in kg CO_2e) in the intervention cohort. The scenario that led to the greatest public health gains and had the lowest environmental impact was scenario 1, as disease progression was avoided altogether. Achieving good control of the condition through medication resulted in more life-years as well as lower emissions (2.18 additional undiscounted life-years with 23% lower CO_2e per patient over lifetime compared with uncontrolled T2DM (emissions of 14,261 kg over 23.10 years vs. 18,624 kg CO_2e over 20.92 years, respectively)).

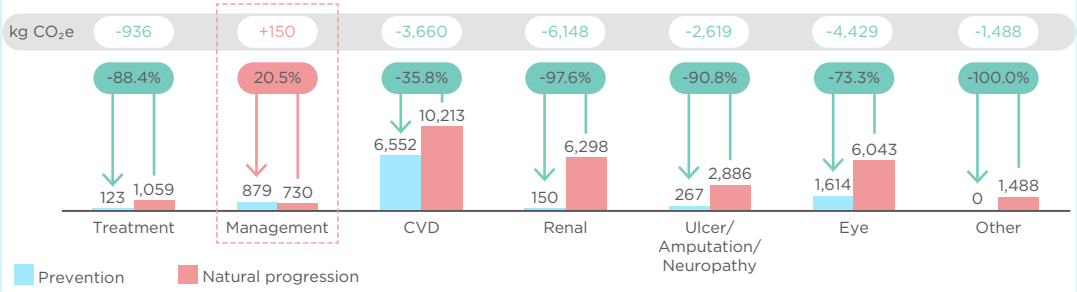
In both scenarios, the reduction in GHG emissions was mainly driven by reduced emissions for long-term complications, particularly cardiovascular disease (CVD), and renal and eye diseases.

Scenario 1. Preventing progression results in 67% reduction in GHG emissions vs. natural progression[15]

Total GHG emissions per patient over lifetime (in kg CO_2e)

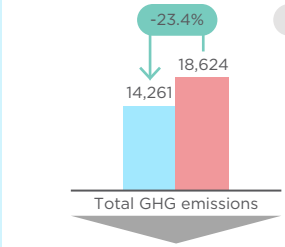


Incremental results of prevention vs. natural progression	
Incremental life years, discounted	2.8
Incremental quality-adjusted life years (QALYs), discounted	3.7
Incremental total GHG emissions (kg CO_2e), undiscounted	-19,129
ICUR (incremental kg CO_2e/ QALY)	Dominant



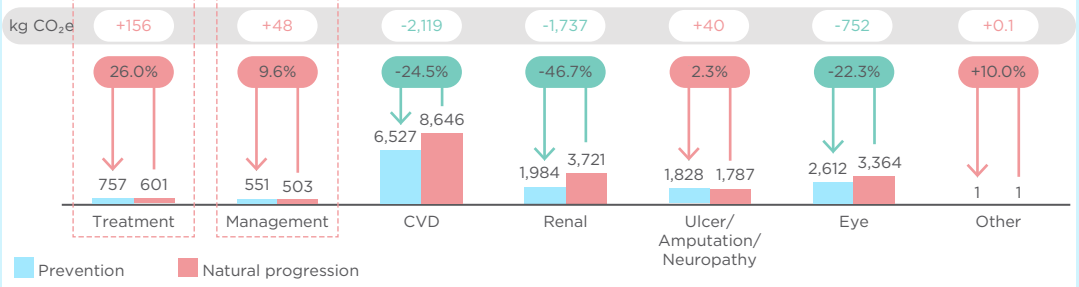
Scenario 2. Well-controlled patients achieve reduction in emissions vs. uncontrolled patient by 23%[15]

Total GHG emissions per patient over lifetime (in kg CO_2e)



-4,363 kg CO_2e

Incremental results of prevention vs. natural progression	
Incremental life years, discounted	1.0
Incremental quality-adjusted life years (QALYs), discounted	0.8
Incremental total GHG emissions (kg CO_2e), undiscounted	-4,363
ICUR (incremental kg CO_2e/ QALY)	Dominant



NB Others include non-severe hypoglycaemia rate, severe hypoglycaemia rate (not requiring medical assistance) and severe hypoglycaemia rate (requiring medical assistance). Adverse events (AE 1–3 and ketoacidosis) do not have GHG emissions associated in this scenario. Management covers products like statins, aspirins, ACE-I/ ARB, SGLT or DPP4 inhibitors, Metformin and others, which are used for secondary risks treatment.

Source: IQVIA

What this case study also illustrates is that efforts to improve patient outcomes and protect the environment are often synergistic – and adhering to evidence-based recommendations results in better patient outcomes and greater environmental sustainability at the same time.[27-29] This has also been illustrated in other chronic conditions, such as cancer (*Case study 2*) and chronic kidney disease (*Case study 3*). While not studied in depth in the T2DM model, the way an intervention is given will also have an important impact. Greenhouse gas emissions can stem from misdiagnosis, over- or inappropriate prescribing, preventable medical errors, and inefficiencies in the care pathways within which an intervention is delivered.[27 30 31] For medicines, low adherence can also be a contributing factor.[30 32]

Case study 2. Kaiser Permanente's cancer care pathways[33-35]

In 2020, Kaiser Permanente became the United States' first carbon-neutral health system. The organisation has been a pioneer of care pathways, seeking out greater efficiencies to improve the patient experience and the sustainability of care, and to eliminate unnecessary medical procedures.

A cornerstone of Kaiser Permanente's push to sustainability are its 94 cancer care pathways, which use evidence-based guidelines to develop seamless care for the patient along the entire care journey. This organisation of care focuses Kaiser's full suite of oncology tools around a personalised care plan for the entire multidisciplinary team, reducing over-treatment, unnecessary testing and other inefficient medical care. Its digitalised system also facilitates telemedicine and digital tools that can support self-care, monitoring and engagement. Care pathways are updated on a quarterly basis to ensure clinicians are always directed to the latest best-practice care for their patients.

Case study 3. Estimating the carbon footprint of treatment that prevents progression in chronic kidney disease[36]

Chronic kidney disease (CKD) causes progressive, extensive damage to people's kidneys, inhibiting normal blood filtration and allowing the accumulation of waste within the body. The Sustainable Healthcare Coalition (SHC) worked with a pharmaceutical company to estimate the carbon emissions across different stages of the CKD pathway, using the SHC Care Pathway Guidance, clinical trial data and published literature. Calculations included the impact of hospitalisations, medicines, treatments, and patient travel over time. The analysis allowed us to look at the GHG impact of prescribing medicines to delay progression of the condition, and to illustrate the potential carbon savings from this treatment approach.

The analysis found that the average impact of CKD was 0.392 kg CO_2e, though this increased with progressive stages. The largest contribution to carbon emissions came from stage 5d, where dialysis treatment was required.

The analysis showed that prescribing effective treatment for CKD could offer a 9% reduction in the carbon impact of care across a CKD patient population, and much of this reduction came from reducing the number of patients requiring dialysis and progressing to stage 5d. Understanding the GHG impact of this care pathway may help achieve a more sustainable treatment paradigm for this debilitating condition.

The impact of care pathway design

The design of care pathways will have a considerable effect on the environmental impact of interventions used within them.[13] Leaner and more efficient models of care that offer improved coordination, integration and streamlined clinical decision-making, and optimal use of data and digital health can benefit patient outcomes, resource use and the environment all at once.[14 37-41] Making care pathways more efficient in terms of patient convenience, and reducing people's need to travel or make multiple visits to hospital for their care, is also key for patient benefits, resource efficiency and environmental impact. Several non-profit organisations and healthcare provider groups have built these principles into the redesign of specific care pathways, offering powerful case studies of environmentally sustainable models that can be emulated elsewhere.[33-35 42-46] For example, adopting telemedicine and moving from in-person to virtual care where feasible can yield both environmental and clinical benefits, as well as improving the overall patient experience (*Case studies 4, 5 and 6*). Similarly, the timing of interventions, as illustrated in the case of immunisation for infants in *Case study 7*, can also have an effect on both clinical outcomes and environmental impact.

Case study 4. Reducing CO_2 emissions with telemedicine[43]

Sanitas, a private health insurer and healthcare provider that is part of Bupa Group's operations in Spain, made a significant transition to digital healthcare in 2020. It measured the environmental impact of this shift by calculating the difference in carbon emissions between digitalised care and treatment as usual.

Sanitas offered just over 3 million appointments in 2020, of which some 640,000 were conducted via telemedicine (approximately 496,000 by video and 144,000 by telephone), with an average of 3,700 digital appointments conducted each day, saving nearly 2,000 net tonnes of CO_2e during the year. Over the same time period, patients downloaded over 3 million medical reports, avoiding a net estimation of 4,700 tonnes of CO_2e, for a total of nearly 6,700 net tonnes of CO_2e saved due to lower use of paper formats.

While the average age of patients requesting a digital appointment was lower than those who used a face-to-face consultation (39 vs. 44 years), the service was used by people of all ages, with people over the age of 70 accounting for more than 18,000 video appointments that year. Patient satisfaction with digital appointments was also favourable, with an average rating of 62%.

Case study 5. Follow-up with a virtual clinic[44]

A pilot study set in Ain Shams University in Egypt examined the opportunity to lower greenhouse gas emissions by using telemedicine to provide follow-up care for people living with atopic dermatitis or asthma. The Virtual Clinic digital platform enabled various interactions between physicians and their patients, including medication reminders, historical medical report tracking and adverse event alerts.

After an in-person consultation with their physician, 108 people enrolled in the university's Virtual Clinic for follow-up. Of these, approximately 73% were travelling by private car while the remainder used public transport. By using the Virtual Clinic for follow-up, annual greenhouse gas emissions were reduced by nearly 75%, from 24 tonnes of CO_2e to just over 6 tonnes. The researchers estimate that, when scaled up, the programme could yield a reduction of up to 80% in CO_2e, depending on patients' mode of transportation.

Beyond the reduction in emissions, the Virtual Clinic also delivered improved patient outcomes by supporting better treatment adherence and follow-up, while also expanding the clinic's reach and lessening the financial impact of receiving care.

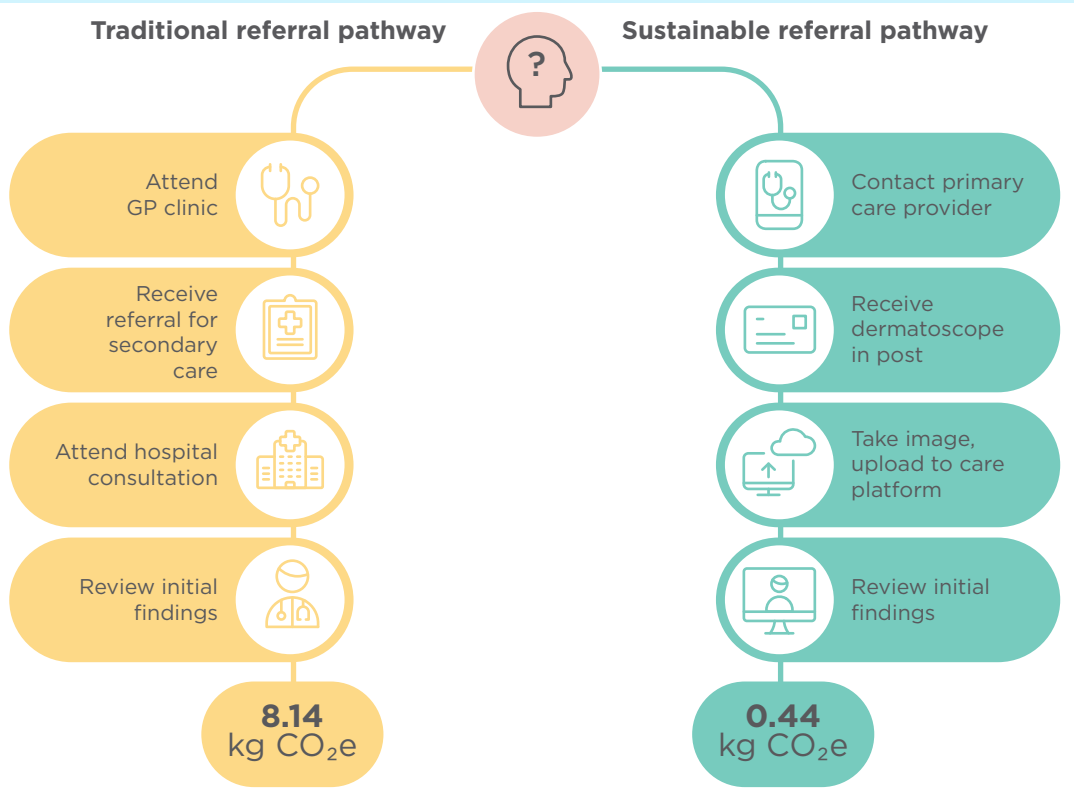
Case study 6. Carbon reduction with innovative dermatology[45 46]

Bupa's UK healthcare operations saw 23,000–26,000 patients for a mole or skin lesion in 2019. Of these, some 16,000 (70%) required no further treatment, indicating an opportunity for Bupa to redesign its dermatology care pathway to streamline patient experience and achieve environmental benefits.

Previously, patients would only see a dermatologist following a GP appointment and a referral for a consultation. Partnering with Skin Analytics, specialists in tele-dermatology, Bupa designed a more sustainable referral pathway that simplified access to dermatological care while reducing the environmental footprint of that care.

While the previous care pathway involved an estimated 8 kg of CO_2e per patient, the new pathway costs less than 500 g of CO_2e. In the first year of implementation, Bupa estimates that more than 26 tonnes of CO_2e were avoided.

Beyond the emissions avoided, nearly 50% of patients required no further follow-up. Patients were assessed an average of 19 days faster under the new pathway and rated the service an average score of 8.9/10.



Case study 7. Optimising the timing of infant vaccination against respiratory syncytial virus

Respiratory syncytial virus (RSV) is a leading cause of infant hospitalisation.[47] There is currently no universal immunisation programme for infants against RSV in the UK. Immunisation is only offered to high-risk infants and requires several doses to administer.

A UK study was developed to estimate the environmental impact of implementing a universal immunisation programme against RSV in infants using monoclonal antibodies (mAb) compared with the standard of care.[47] The patient care pathway was mapped using the RSV cost-effectiveness model and NHS emission published data, covering emissions from both immunisation and avoided care for RSV infections, in both primary and secondary care.[47] The LCA of the actual RSV immunisation was not available at the time of the study, however similar mAb LCAs were used as proxies.

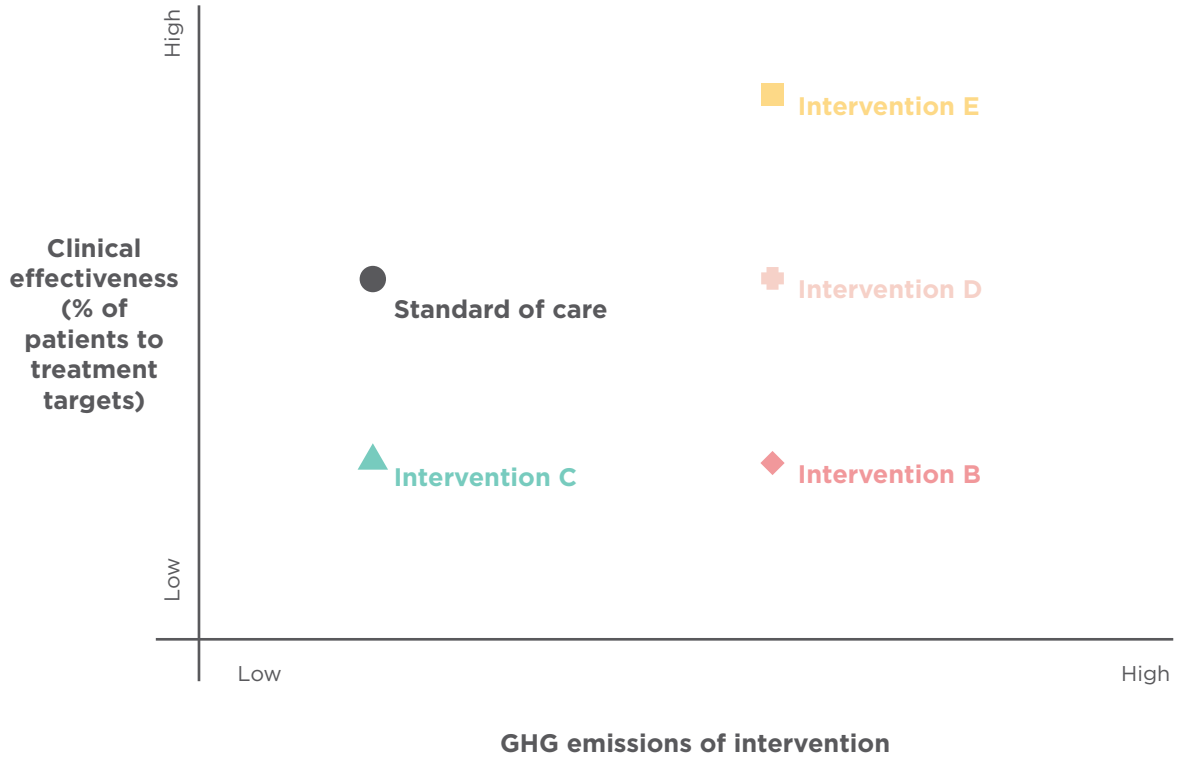
The study looked at different immunisation scenarios, all of which demonstrated that universal infant immunisation using mAb against RSV either at birth or during existing national immunisation touchpoints would lead to significant carbon savings (ranging from 2 kg to 22 kg CO_2e per year) compared with the standard of care. The greatest reduction in carbon emissions was due to the decrease in hospital admissions and primary care consultations.[47] The carbon footprint of a universal RSV immunisation programme would reach a break-even point at approximately 30 kg CO_2e avoided per patient in the care pathway. As carbon emissions from mAb vaccination are well below this threshold (between 1.5 kg and 3 kg CO_2e), this study suggests that implementing RSV immunisation in infants could significantly reduce overall GHG emissions from the UK healthcare system.

3 Building environmental considerations into our assessment of health interventions: a focus on HTA

Balancing priorities and ensuring transparency

As mentioned previously, the field of HTA is one where there are evolving discussions of how to incorporate environmental considerations into existing assessment and appraisal frameworks for health interventions. Some interventions, such as primary prevention or curative therapies, have obvious benefits for both public health and the environment. For example, one seasonal influenza vaccination programme has an estimated carbon footprint over 14 times smaller than the treatment of a single case of influenza; thus its value to health is matched by its environmental value.[48] For other interventions, however, a careful balance may be needed between different considerations; and decisions may be more complex, such as potentially not choosing interventions where the environmental impact is considered too high for the health benefits offered (*Figure 6*). As different HTA agencies and academics in this field discuss and test new approaches, transparency will be key, so that all stakeholders – most of all, patients and clinicians – can understand how different criteria are being used to guide decisions.

Figure 6. **Balancing clinical and environmental considerations for new interventions**



This figure illustrates different scenarios that could occur when comparing a new intervention with a standard of care based on their clinical effectiveness and environmental footprint, as measured by GHG emissions:

- **Intervention C** would not be preferred over the standard of care, as its clinical effectiveness is worse for the same GHG emissions.
- **Intervention B** would also not be preferred, because the clinical effectiveness is lower and the GHG emissions are higher than for the standard of care.
- **Intervention D** would also not be preferred because the clinical effectiveness is similar whereas D has higher GHG emissions.

Based on this assessment, interventions B, C and D are likely not to be preferred over the standard of care.

Which of the two interventions, E or the standard of care, is preferable depends on the relative weighing by decision-makers of health outcomes and GHG emissions over the patient care pathway.

Adapting methodologies

Different HTA agencies around the world have different approaches to assess the value of new interventions, and there are similarly different approaches being proposed to integrate environmental impact into these assessments. Two general approaches are being proposed to bring environmental considerations within the scope of HTA assessments. In the first, the environmental assessment and health technology appraisal are run separately and sequentially.[18-20] In the second, environmental assessment metrics are incorporated into existing appraisal and assessment methodologies in a single, new, combined evaluation.[18-20] In this latter approach, one would need to determine a relative weighing of each component of value and then integrate them into a single metric.[19] This assumes these different components – environmental, clinical, economic – are comparable in terms of scope and time frame, which could be challenging methodologically (see Methodological issues and key considerations, below). By contrast, performing the HTA appraisal and environmental analysis sequentially would make it possible to keep to well-established HTA methodologies without the need to modify them, and to perform a separate comprehensive environment impact assessment using a care pathway approach. The key question will then be how to use the combined findings from these two assessments to determine how different interventions compare first and foremost in terms of their relative clinical effectiveness, and then in terms of their economic value and environmental impact.

Methodological issues and key considerations

Regardless of the approach chosen, a number of methodological questions and key elements will need to be addressed when considering the potential inclusion of environmental impact into HTA assessments (*Box 2*). The first relates to the care pathway environmental impact itself, which is often challenged by the limited availability of reliable data to measure the environmental impact of different interventions. More work is needed to gather correct emissions data (not just cost conversions) for different health interventions and outcomes and to expand measurement beyond carbon emissions to obtain a complete assessment of environmental impact. More alignment in methodologies is also needed across different health organisations and systems, with – ideally – more people adopting the comprehensive perspective offered by a care pathway approach to measurement.

There are also methodological issues that arise when trying to jointly evaluate, even if in sequence, environmental, clinical and economic components of value for a given intervention (*Box 2*). The comprehensive approach – looking at environmental impact along the entire care pathway – needs to be mirrored in the way clinical, economic and other components are measured in the HTA. This was achieved to a certain extent already in the type 2 diabetes model presented in *Case study 1*, as it allowed for a simultaneous assessment of health outcomes and environmental impact of different therapeutic interventions that could be considered by an HTA agency in parallel; the model itself did not include an economic assessment. Another important consideration is that the environmental footprint of care will change over time; efforts to decarbonise different aspects of care will gradually deliver environmental improvements, and these changes need to be reflected in regular assessments.

Box 2. Key methodological considerations for integrating the environmental impact of health interventions alongside HTAs

Attribution: An intervention confers health benefits to the individual using it; however, its environmental impact affects the population at large, so attributing it to an individual intervention may be problematic. Equally, many aspects of an intervention's life cycle – such as waste management or resource use in research and development – may be difficult to attribute to an individual intervention.[5]

Setting and geographic context: Interventions are used within a given healthcare setting, with a financial and clinical impact that is localised to the country where it is used. This impact is strongly determined by a given country's infrastructure, grid emission intensities, modes of transport and other aspects. Similarly, it will vary depending on the clinical setting where it is applied – e.g. clinic, local or tertiary hospital).

Time frame for assessment: The environmental impact of interventions may take years to manifest in some instances, possibly beyond the time frame adopted for a given HTA based on available data on clinical effectiveness and economic impact. Adjusting these respective time frames will therefore be important to ensure the full impact of a given intervention is being measured.

Evolving emissions: The environmental footprint of care will change over time; therefore, estimates may need to be adapted and revisited periodically to reflect up-to-date measures of environmental impact. Some form of discounting or estimation of this evolution needs to be built into the analysis, or a review date set to ensure the evaluation is always up to date.

Putting things into practice

In addition to methodological factors, adapting HTA processes to integrate environmental considerations carries important ethical and societal implications. First and foremost, we must always ensure that advancing environmental goals does not compromise opportunities to improve patient outcomes or population health. We also need to safeguard against unintended consequences where added requirements by HTA agencies result in delays in the availability of health interventions for patients. Also, taking a flexible and nimble approach will be key. New approaches will need to be piloted as they evolve, to test their feasibility, explore the robustness of proposed frameworks, and fully understand the implications for decision-making. Taking a measured approach will also allow all stakeholders developing health interventions to adapt their data-collection efforts as needed, and for other key stakeholders – payers, insurance companies, commissioners of services – to align their approaches to ensure the most meaningful innovations can be integrated into patient care at pace. Finally, it would be ideal if the entire HTA community could join efforts with industry, payers and other relevant stakeholders to identify the most appropriate and feasible methodologies, and advance a consistent approach across different countries and jurisdictions.

As we evolve our health systems and decision frameworks to include environmental considerations, we must also ensure we build environmental literacy across the whole healthcare community so that adapted approaches are understood and well received. Clear and transparent communications and multi-stakeholder dialogue will help people understand some of the choices health system leaders are making – e.g. taking a care pathway approach – as they try to improve the sustainability of healthcare. Initiatives such as Choosing Wisely or Getting It Right First Time (GIRFT) provide a helpful precedent in this regard, as they have played an important role in creating transparency around why certain health interventions are deemed inefficient and should not be integrated into care. Similarly, GIRFT, in the UK, publishes analyses to demonstrate how proposed changes in practice make sense on clinical grounds as well as environmental ones (*Case study 8*). Professional societies also play a critical role, as has been demonstrated in the field of anaesthesiology, where the profession has shifted practices to minimise its environmental footprint while ensuring it optimises patient outcomes and patient safety (*Case study 9*). The European Network on Climate & Health Education[49] – founded by leading medical schools in Belgium, France, Germany, Ireland, Italy, Poland, Portugal, Slovenia, Sweden, Spain, Switzerland and the UK – is an important initiative in this regard as well; it will help build the environmental literacy of future clinicians to help them recognise, prevent and treat the increasing burden of the climate crisis on public health and contribute to the delivery of sustainable healthcare solutions.

Case study 8. Transitioning from inpatient to day surgery for bladder cancer – reduced environmental impact for equivalent patient outcomes[50-52]

Transurethral resection of bladder tumour (TURBT) is the gold standard operation used to treat people with bladder cancer. Performing the procedure as a day case rather than an inpatient procedure has been shown to be safe and reduce carbon emissions. Day-case rates are increasing across England, but a 2018 report from NHS England's Getting It Right First Time (GIRFT) initiative found that these rates varied considerably across the country.

GIRFT collaborated with Greener NHS programmes and published a study that showed that, while offering the same high standard of care, TURBT day surgery offers a lower carbon footprint than the same surgery performed during an inpatient stay. This aligns with GIRFT's recommendation to increase day surgery rates for urological procedures.

The study also found that, if all NHS trusts met the same day-case rates as the top 25% of trusts in England, it could lead to carbon savings of 217,599 kg CO_2e in one year – enough to power 198 homes for the same period. The authors concluded that further increases in day cases should be encouraged for eligible patients, and should always be accompanied by careful monitoring of clinical effectiveness.

Case study 9. Changing practices in anaesthesiology to reduce the environmental impact[37-39 53 54]

In anaesthesiology, life-cycle greenhouse gas emissions of inhaled drugs (e.g. desflurane, nitrous oxide) have been found to be four orders of magnitude greater than a common intravenous alternative (propofol). In recognition of this, and of the importance of reducing the health system's carbon footprint, professional societies such as the American Society of Anesthesiologists, the UK's Association of Anaesthetists and the European Society of Anaesthesiology and Intensive Care have issued recommendations to reduce or eliminate the use of potent greenhouse gases used as anaesthetics. There is growing evidence that implementing these changes will result in significant environmental and fiscal savings without compromising patient outcomes.

4 The way forward: aligning all stakeholders to drive system change

Transforming health systems to include environmental considerations in the choices of health interventions is an essential next step in realising our commitment to build environmentally sustainable health systems. Driving this change will require an evolution in mindset from all stakeholders, and each will play a role; but as with any system change, this will require an innovative and open mindset to make sure we advance it properly.

The time is right to do this, as several HTA agencies are already exploring methodologies to put in place. At the same time, we need to allow enough time to find the right approach, and to be open to learning, listening, adapting and moving forward together, in step. The early discussions pertaining to how to embed environmental considerations into HTA provide a helpful starting point. They raise important questions about how we can create a methodologically sound, transparent approach that will contribute to rewarding innovation that has a lower environmental impact, while always protecting health benefits and patient access to meaningful innovations. Notwithstanding ongoing methodological uncertainty, these discussions promote an open dialogue about how environmental impact measures could be included in existing assessments of health interventions; which measurement issues still need to be resolved; which trade-offs are being considered; and how to translate these concepts into feasible methodologies.

As we work with our partners to find a feasible way forward, we would invite HTA agencies and all stakeholders to adhere to the following key principles:

Take a care pathway approach to measurement

Environmental impact assessments of health interventions should take a care pathway approach to fully measure their environmental impact over time. Life-cycle assessment (LCA) measures of individual interventions are insufficient to assess the full environmental impact of interventions when used in practice.

Take a multi-stakeholder approach to build new methodologies and avenues for integrating environmental impact into HTA assessment

HTA agencies and academia should work closely with industry, payer organisations, patient and carer organisations and professional societies to build consistent methodologies and approaches to integrate environmental impact measures into their evaluation frameworks and test their feasibility across different countries or jurisdictions.

Monitor the feasibility of implementation

This group of stakeholders should monitor the implementation of adapted approaches to HTA to ensure they do not result in unintended consequences, such as compromising patient access or stifling innovation.

Ensure consistency and transparency

The HTA community, the Sustainable Healthcare Coalition, Health Care Without Harm and other organisations engaged in improving the environmental sustainability of healthcare should work together to ensure the consistency of approaches across health systems, as they evolve, and transparently communicate about chosen approaches to ensure they do not compromise health outcomes.

Build environmental literacy

As HTA agencies and other health system leaders evolve their decision-making frameworks, they must work together with patient organisations and professional societies to build environmental literacy across the entire health community to enable informed care choices for patients. They must also always ensure that patient interests and perspectives are appropriately reflected in their discussions about evolving methodologies.

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