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Sustainable Pathology Practice

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Sustainability Lead for Pathology Practice, RCPath

About me/disclosures

- Haematologist, Certified Lifestyle Medicine Physician, Medical examiner
- Sustainability lead for pathology practice - RCPath
- Founder & director of Plant-Based Health Professionals UK
- Education on plant-based diets and cancer at University of Winchester
- Author

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What is sustainable healthcare?

- Delivers high quality care without damaging the environment, is affordable now and in the future and delivers positive social impact.
- The most sustainable healthcare is the healthcare we do not need
- Goal 3 **Ensure healthy lives and promote well-being for all, at all ages**
- One Health initiative

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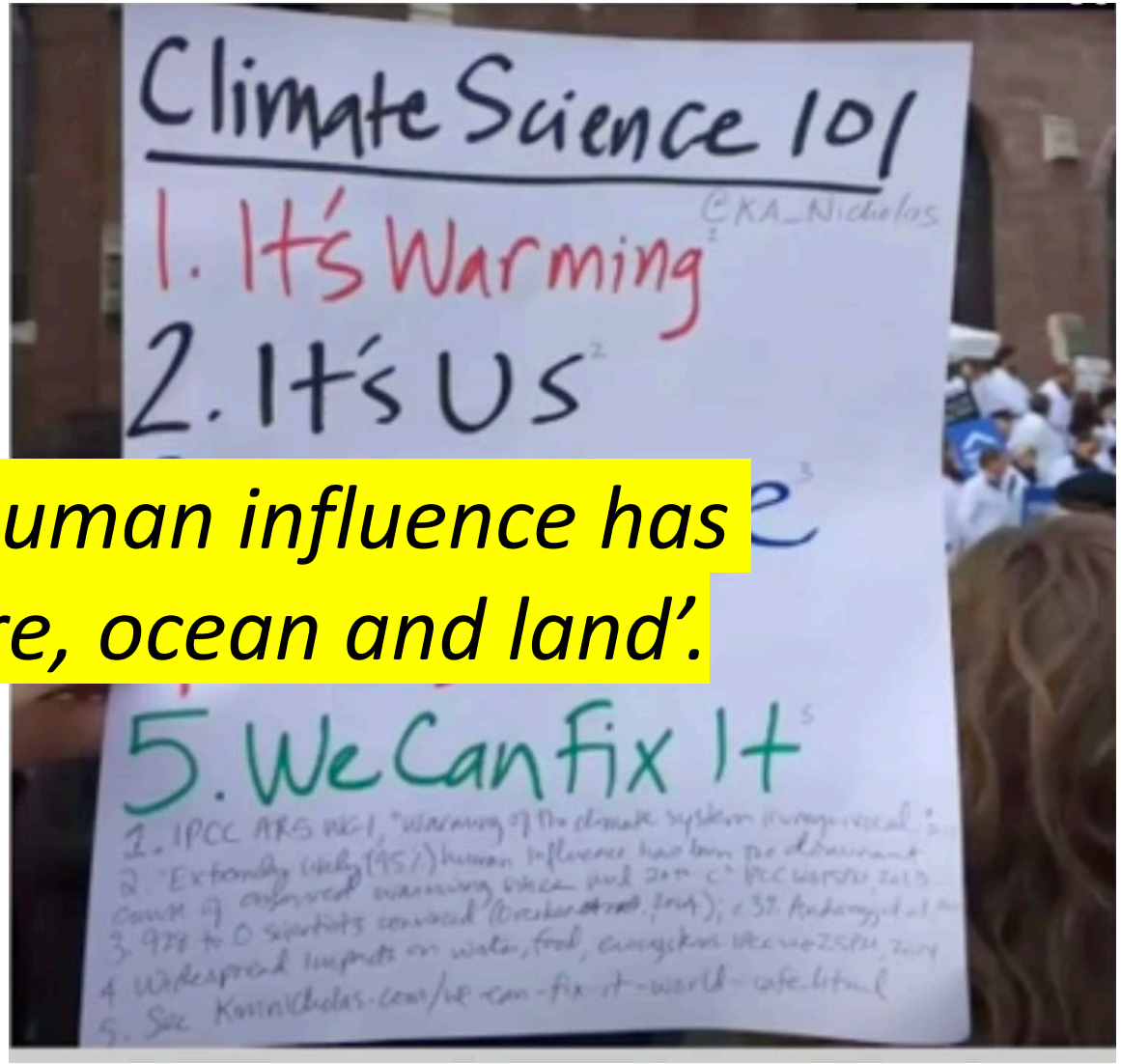
Inter-related crises

- Climate
- Ecolo
- Healt
- Ethics

'It is unequivocal that human influence has warmed the atmosphere, ocean and land'.



https://www.ipcc.ch/report/ar6/wg2/
https://www.who.int/publications/i/item/9789240090224

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Global inequalities in CO2 emissions

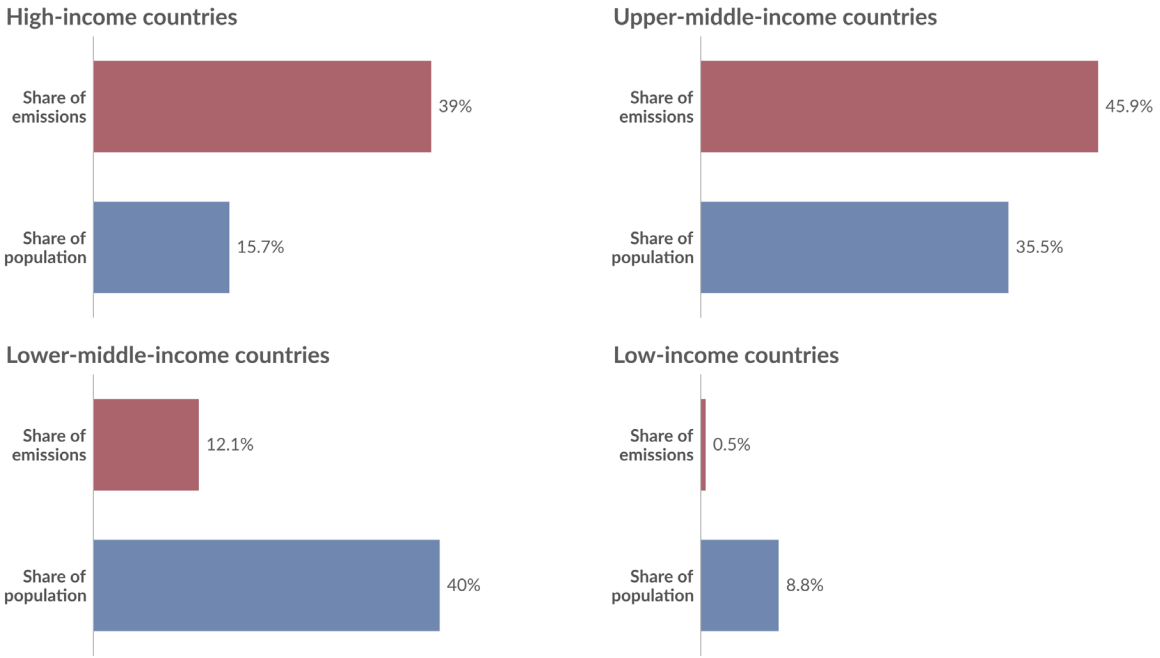
We are already experiencing impacts of climate change

There are massive differences in emissions across the world. How do income groups and regions compare?

Share of global CO_2 emissions and population, 2021

Our World in Data

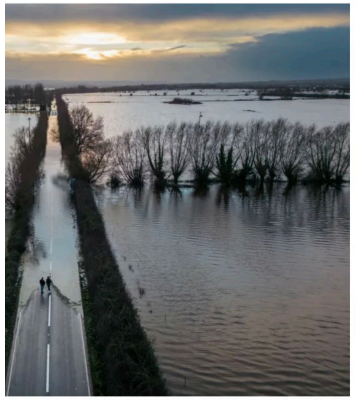
Carbon dioxide (CO_2) emissions from fossil fuels and industry[1]. Land-use change is not included.



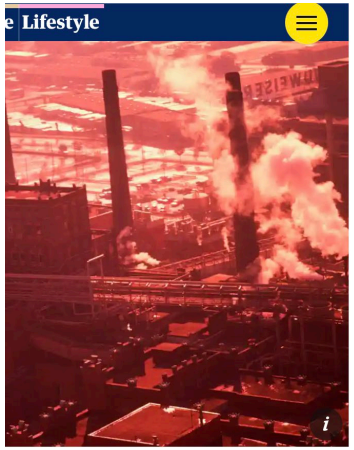
Data source: HYDE (2023); Gapminder (2022); UN WPP (2024); Global Carbon Budget (2024)
OurWorldinData.org/co2-and-greenhouse-gas-emissions | CC BY

1. Fossil emissions: Fossil emissions measure the quantity of carbon dioxide (CO_2) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production. Fossil CO_2 includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes. Fossil emissions do not include land use change, deforestation, soils, or vegetation.

les had warmest ord



becoming more likely because of climate change



els in US, UK and EU still tudy says

minute soot particles - known as PM2.5 - ease

https://ourworldindata.org/inequality-co2

BMJ commission on the Future of the NHS

Analysis » The BMJ Commission on the Future of the NHS

Stewarding a sustainable NHS is a gift beyond carbon emissions, offering an opportunity for positive systems change across all aspects of society. Taking sustainability as a lens allows a holistic approach to health that reaches beyond the clinic walls and prioritises health promotion.

Matt Morgan, honorary visiting professor, intensive care medicine consultant, adjunct clinical professor [6 7 8],
Kate Womersley, research fellow and psychiatry core trainee [9 10],
Bob Klaber, consultant paediatrician, director of strategy, research, and innovation, professor of practice (population health) [11 12],
Elaine Mulcahy, director [13], *Rachel Stancliffe, chief executive officer* [14]

Author affiliations

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Interventions that consider climate change, sustainability, and nature should be integral to health system functioning. Placing sustainability at the core of the NHS's future offers opportunities to deliver better services, support healthier populations, and save costs.

https://www.bmj.com/content/385/bmj-2024-079259

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Editorials

Time to treat the climate and nature crisis as one indivisible global health emergency

BMJ 2023 ; 383 doi: https://doi.org/10.1136/bmj.p2355 (Published 25 October 2023)
Cite this as: *BMJ* 2023;383:p2355

Article | Related content | Metrics | Responses

Kamran Abbasi, editor in chief[1], *Parveen Ali, editor in chief*[2], *Virginia Barbour, editor in chief*[3], *Thomas Benfield, editor in chief*[4], *Kirsten Bibbins-Domingo, editor in chief*[5], *Stephen Hancocks, editor in chief*[6], *Richard Horton, editor in chief*[7], *Laurie Laybourn-Langton*[8], *Robert Mash, editor in chief*[9], *Peush Sahni, editor in chief*[10], *Wadeia Mohammad Sharief, editor in chief*[11], *Paul Yonga, editor in chief*[12], *Chris Zielinski*[13]

Author affiliations

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Inju
hea

Heat-related
death, cardio
failure

Forced migr
civil conflict,
mental heal

Malnutr
diarrhe

Joint action is essential for planetary and human health

Over 200 health journals call on the United Nations, political leaders, and health professionals to recognise that climate change and biodiversity loss are one indivisible crisis and must be tackled together to preserve health and avoid catastrophe. This overall environmental crisis is now so severe as to be a global health emergency.

The world is currently responding to the climate crisis and the nature crisis as if they were separate challenges. This is a dangerous mistake. The 28th UN Conference of the Parties (COP) on climate change is about to be held in Dubai while the 16th COP on biodiversity is due to be held in Turkey in 2024. The research communities that provide the evidence for the two COPs are unfortunately largely separate, but they were brought together for a workshop in 2020 when they concluded: "Only by considering climate and biodiversity as parts of the same complex problem ... can solutions be developed that avoid maladaptation and maximize the beneficial outcomes."[1]

https://www.who.int/news
https://www.bmj.com/con

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Net Zero National Health Service

- The NHS accounts for almost 5% of UK emissions and the largest employer in the UK (1.4 million staff)
- Makes the sector (if it were a country) the fifth largest climate polluter on the planet.
- Committed to delivering the world's first net zero health service in its landmark report: Delivering a Net Zero NHS .
- Targets;
  - Net zero for emissions we control directly (NHS Carbon Footprint) by 2040, ambition to reach an 80% reduction by 2028 to 2032
  - Net zero for emissions we can influence (NHS Carbon Footprint Plus) by 2045, ambition to reach an 80% reduction by 2036 to 2039

https://www.weforum.org/agenda/2021/06/healthcare-climate-action-roadmap/

https://www.england.nhs.uk/greenernhs/wp-content/uploads/sites/51/2020/10/delivering-a-net-zero-national-health-service.pdf

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Principles of sustainable healthcare

Mortimer, F. The Sustainable Physician. Clin Med 10(2). April 1, 2010. D110-111.

https://sustainablehealthcare.org.uk/about/our-story/the-principles-of-sustainable-healthcare/

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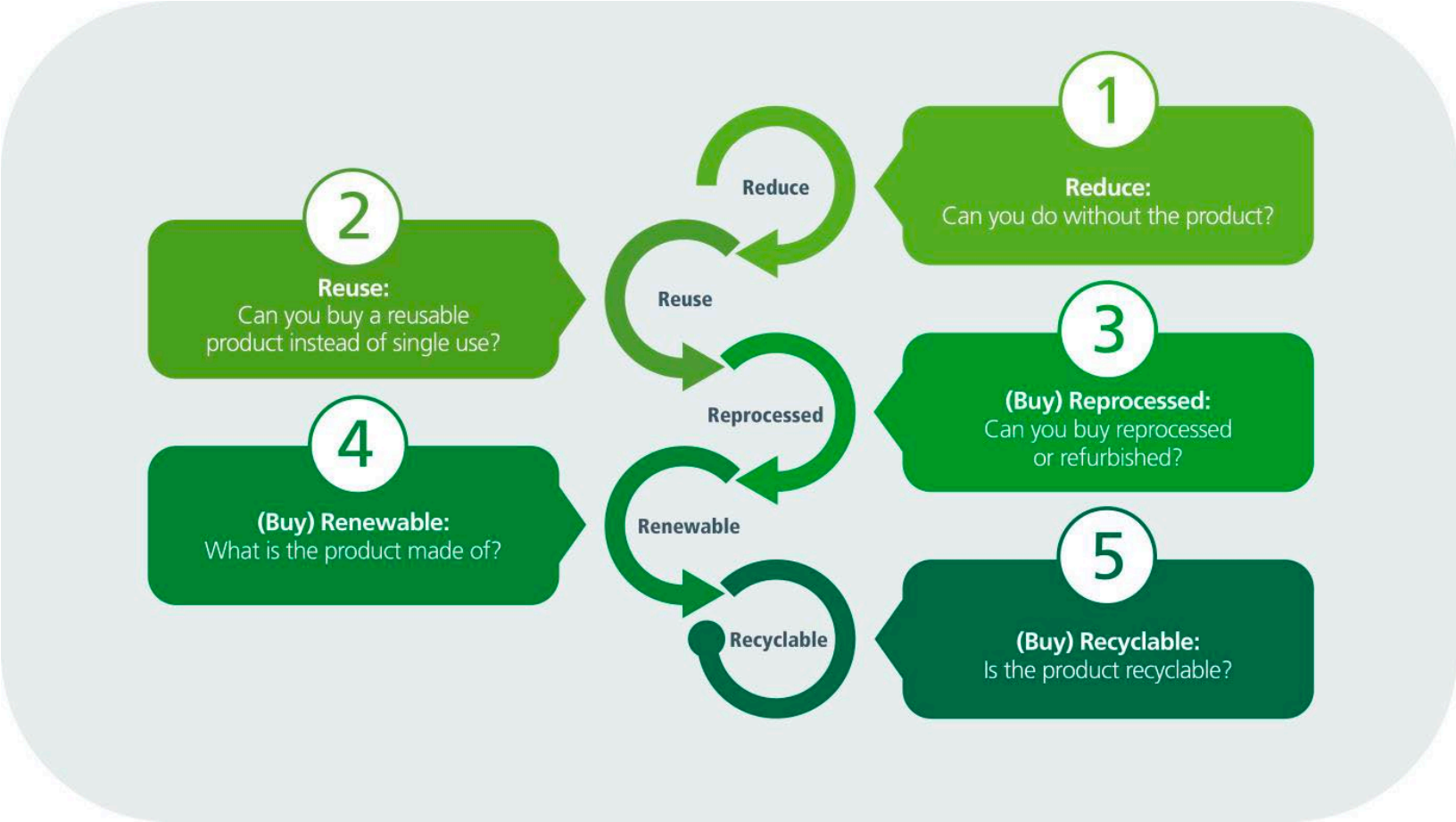
The five R's – circular economy concepts



https://www.england.nhs.uk/ahp/greener-ahp-hub/specific-areas-for-consideration/reducing-the-environmental-impact-of-equipment-medicines-and-resources/

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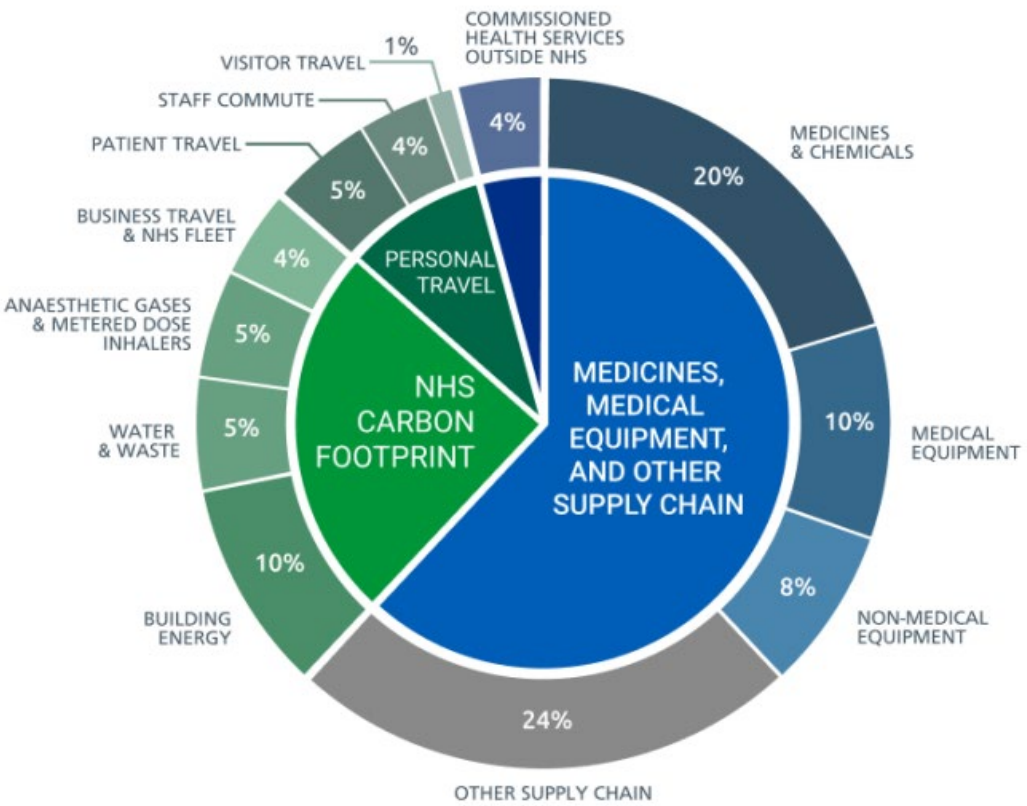
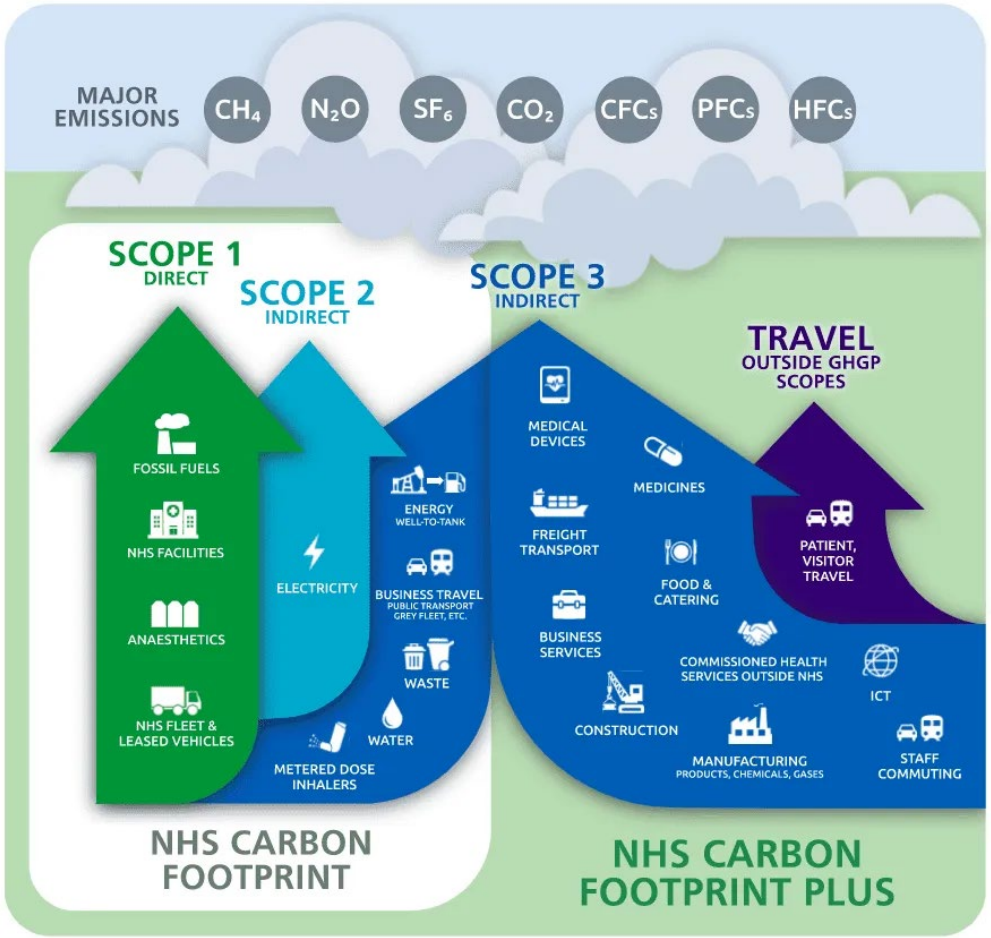
NHS England's carbon footprint





https://www.england.nhs.uk/greenernhs/wp-content/uploads/sites/51/2020/10/delivering-a-net-zero-national-health-service.pdf

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High impact healthcare actions

Action	SPA categories	Cumulative emissions savings by 2050 (Gt CO_2e)
1. Power health care with 100% clean, renewable electricity	• Scope 2: Purchased electricity including transmission, generation, and upstream supply chains	12.7
2. Invest in zero emissions buildings and infrastructure	• Scope 1: Operation of buildings (including onsite combustion) • Construction	17.8
3. Transition to zero emissions, sustainable travel, and transport	• Scope 1: Transport; • Scope 3: Travel and transport	1.6
4. Provide healthy, sustainably grown food and support climate-resilient agriculture	• Food, catering, and accommodation	0.9
5. Incentivize and produce low-carbon pharmaceuticals	• Pharmaceuticals	2.9
6. Implement circular health care and sustainable health care waste management	• Manufacture and distribution of fossil fuels • Manufactured fuels, chemicals, and gases • Plastics • Medical Instruments/equipment • Other manufactured products • Paper products • Waste, water, and sanitation • Other procurement	4.8
7. Establish greater health system effectiveness	• Business services • Information and communication technologies • System effectiveness	4.1
Total emissions saving from high impact actions		**44.8**

Table 6. Potential impact of sever
Annex A for a definition of the SP

https://healthcareclimateaction.org/roadmap

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Why pathology?

- **95% of all healthcare decisions** affecting diagnosis or treatment involve a pathology investigation

- **Over 1.2 billion** pathology investigations are carried out each year in England

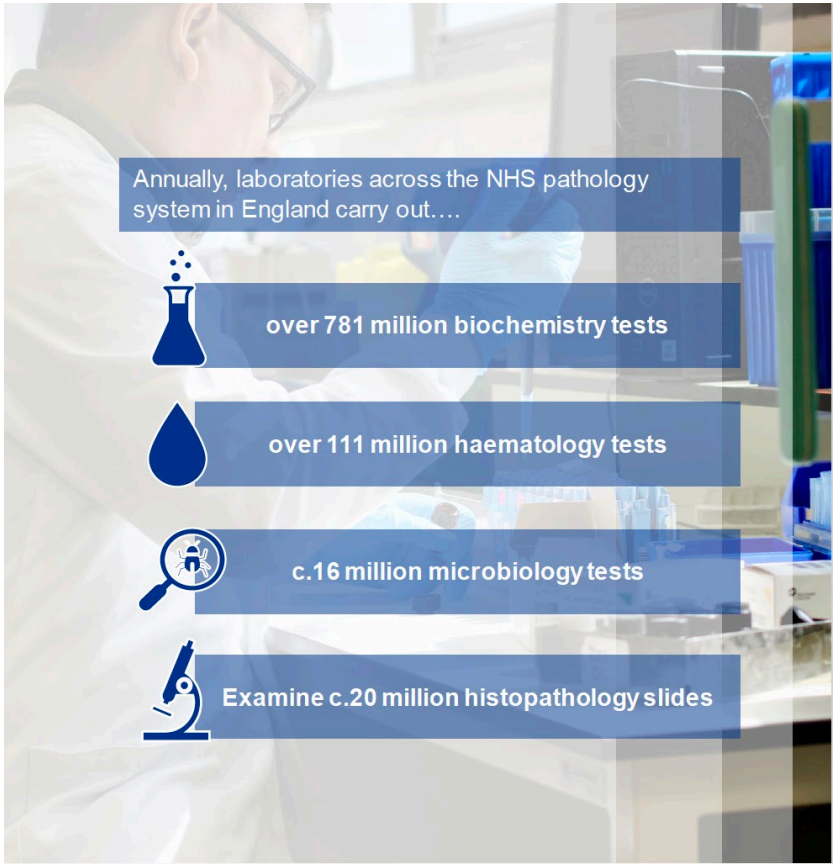
    - 20 tests per person per year, £2.2 billion of NHS funding

- **20-40% of pathology tests are unnecessary repeats**

- Laboratories are highly resource intensive and consume **3-10x more energy and more water than office spaces**

- Huge amounts of **plastic waste**

- Pathology practice is close to the **cutting edge of research and innovation**, with significant opportunities to reduce carbon.



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Key areas of focus

Energy efficiency	Reduce laboratory waste	Digital transformation	Sustainable procurement	Sustainable Specimen Transport & Logistics	Staff and staff training
Smart scheduling to minimise instrument downtime	Minimise single use plastic	Adopt digital pathology	Choose carbon-neutral suppliers	Reduce need for transport	Incorporate into induction and course curricula
Switch off idle equipment	Reusable lab materials	Use AI-powered diagnostic tools	Use biodegradable or recyclable packaging	Electric fleets	Implement green lab certification programs
Adjust ultra-low temp (ULT) freezers from 80°C to -70°C	Reprocess and Reuse Lab Equipment	Shift to paperless, audits on iPads, electronic signatures	Reduce cold-chain storage emissions	Drones	Working from home
Consolidate specimen storage and discard items that are not needed	Use less hazardous, more sustainable chemicals	Green data centres	Order in bulk		
Energy-efficient ULT freezers and use natural refrigerants	Recycling bins	Efficient data compression			
Use renewable energy					

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Pre-analytical stage

- Around 70% of the carbon footprint of common pathology tests comes from sample collection and phlebotomy stage
- At least 30% of tests performed are unnecessary
- Getting it right first time (GIRFT)

Appropriate test request
Care/order sets
Avoid unnecessary repeats
Collecting samples correctly and reduce error rates
Timely transport
Delivering results in a clinically relevant timeframe

https://www.gettingitrightfirsttime.co.uk/wp-content/uploads/2022/03/Pathology-29Mar22i.pdf
The carbon footprint of pathology testing. *Med J Aust*. 2020;212(8):377-382. doi:10.5694/mja2.50583
The landscape of inappropriate laboratory testing: a 15-year meta-analysis. PLoS One. 2013;8(11):e78962. doi:10.1371/journal.pone.0078962

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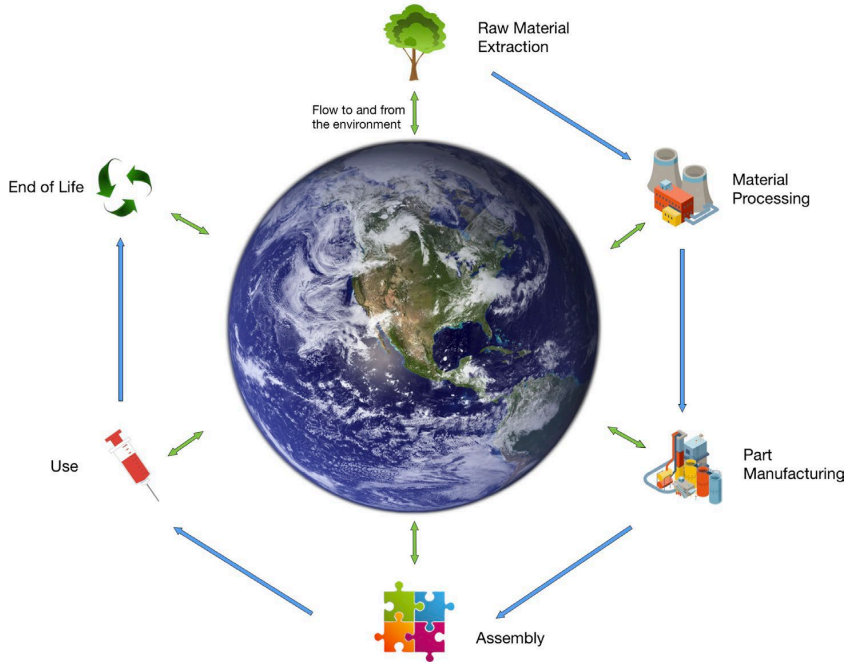
Carbon footprint of pathology tests

Lifecycle assessment

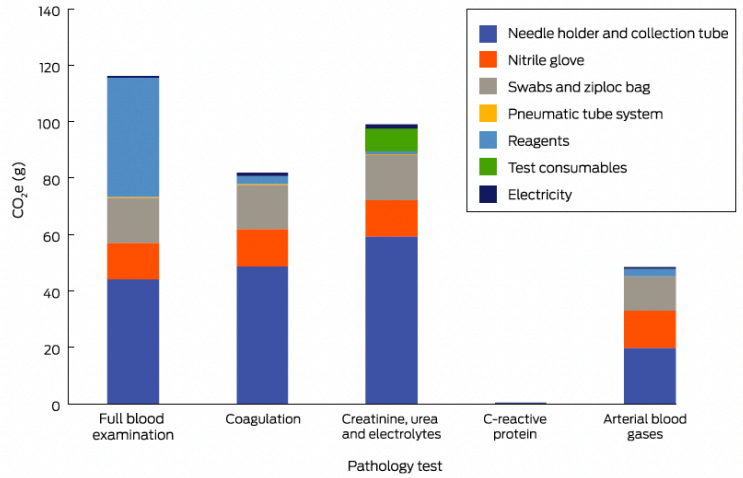


3 Carbon dioxide equivalent (CO_2e) emissions for five common hospital pathology tests, with distance driven in a standard car producing equivalent emissions

	Mean CO_2e (g) (95% CI)	Equivalent distance in car (km/1000 tests)
Full blood examination	116 (101–135)	770
Coagulation profile	82 (73–91)	540
Urea and electrolytes	99 (84–113)	650
C-reactive protein*	0.5 (0.4–0.6)	3
Arterial blood gases	49 (45–53)	320

CI = confidence interval. * Ordered in conjunction with urea and electrolyte assessment.

4 Carbon dioxide equivalent (CO_2e) emissions associated with single pathology tests, by test component



The carbon footprint of pathology testing. Med J Aust. 2020;212(8):377-382. doi:10.5694/mja2.50583

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Blood transfusion

- 7.56 kg CO_2 equivalent per unit of RBC transfused
- 75 x the emissions of a FBC
- 1.36 million units per year in England = 0.05% of total NHS emissions
- Greatest contribution from transportation, refrigeration & plastic packs
- Mitigation
  - Electric vehicles
  - Improve efficiency of refrigeration
  - Renewable energy
  - Move away from plastic packs
  - Not using incineration for disposable

Received: 21 December 2023 | Revised: 2 March 2024 | Accepted: 5 March 2024
DOI: 10.1111/trf.17786

ORIGINAL RESEARCH

TRANSFUSION

What is the environmental impact of a blood transfusion? A life cycle assessment of transfusion services across England

Stephen P. Hibbs[1] | Stephen Thomas[2] | Nikhil Agarwal[3] | Charlotte Andrews[3] | Sylvia Eskander[3] | Aaliyah Sharif Abdalla[2] | Julie Staves[4] | Matthew J. Eckelman[3] | Michael F. Murphy[2,4]

[1]Wolfson Institute of Population Health, Queen Mary University of London, London, UK
[2]NHS Blood and Transplant, London, UK
[3]Department of Civil and Environmental Engineering, Northeastern University, Boston, Massachusetts, USA
[4]Oxford University Hospitals NHS Foundation Trust, Oxford, UK

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Email: stephen.thomas@nhsbt.nhs.uk

Funding information
Wellcome Trust, Grant/Award Number: 223500/Z/21/Z

Abstract

Background: Healthcare activities significantly contribute to greenhouse gas (GHG) emissions. Blood transfusions require complex, interlinked processes to collect, manufacture, and supply. Their contribution to healthcare emissions and avenues for mitigation is unknown.

Study Design and Methods: We performed a life cycle assessment (LCA) for red blood cell (RBC) transfusions across England where 1.36 million units are transfused annually. We defined the process flow with seven categories: donation, transportation, manufacturing, testing, stockholding, hospital transfusion, and disposal. We used direct measurements, manufacturer data, bioengineering databases, and surveys to assess electrical power usage, embodied carbon in disposable materials and reagents, and direct emissions through transportation, refrigerant leakage, and disposal.

Results: The central estimate of carbon footprint per unit of RBC transfused was 7.56 kg CO_2 equivalent (CO_2eq). The largest contribution was from transportation (2.8 kg CO_2eq, 36% of total). The second largest was from hospital transfusion processes (1.9 kg CO_2eq, 26%), driven mostly by refrigeration. The third largest was donation (1.3 kg CO_2eq, 17%) due to the plastic blood packs. Total emissions from RBC transfusion are ~10.3 million kg CO_2eq/year.

Discussion: This is the first study to estimate GHG emissions attributable to RBC transfusion, quantifying the contributions of each stage of the process. Primary areas for mitigation may include electric vehicles for the blood service fleet, improving the energy efficiency of refrigeration, using renewable sources

Transfusion. 2024 Mar 20. doi: 10.1111/trf.17786

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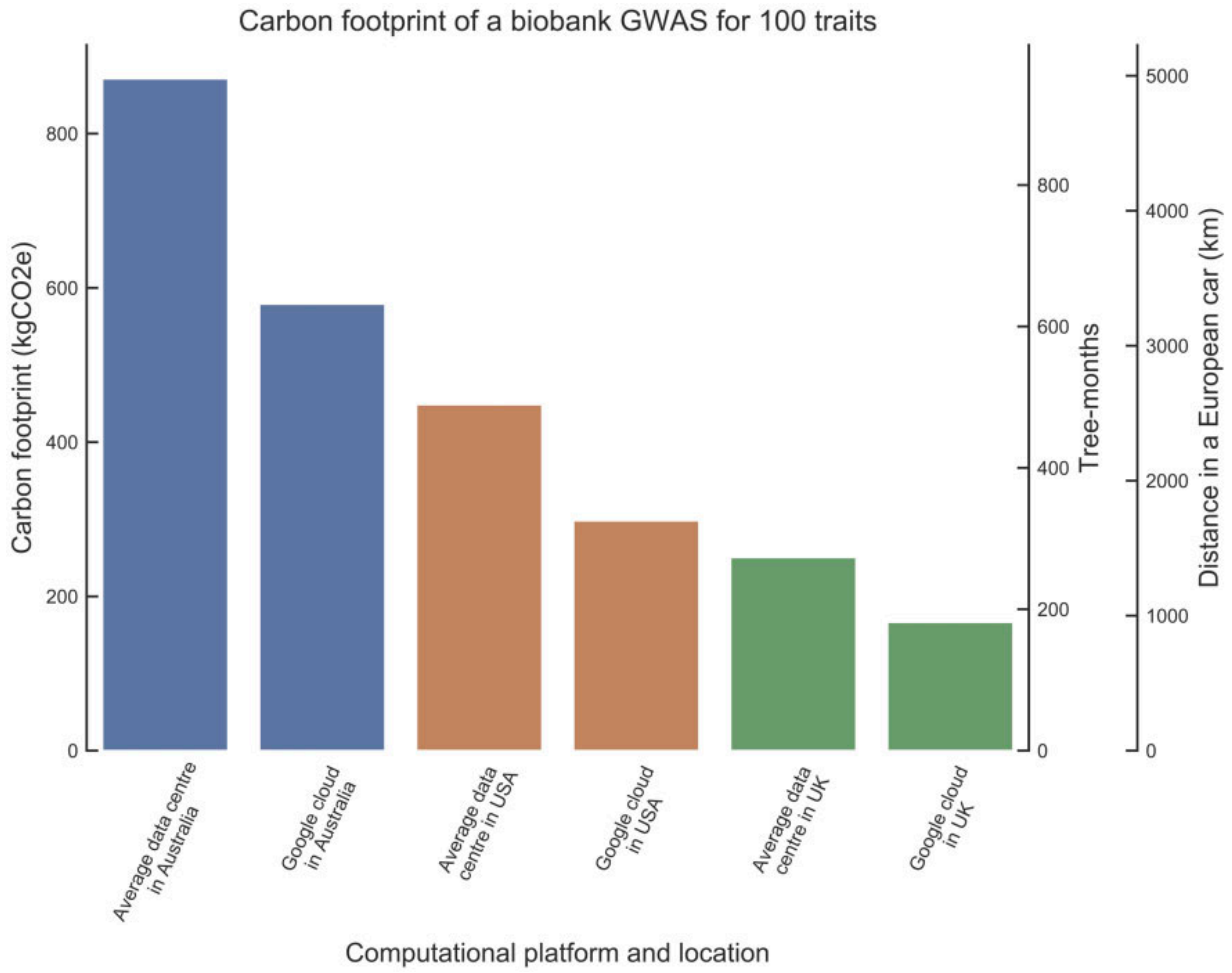
The Carbon Footprint of Bioinformatics

- Substantial CO_2 emissions
- For the same task there is great variation based on tools used, despite similar performance
- Energy efficient data centres can reduce remission by 34%
- Using most up to date software can reduce emissions by >70%



Mol. Biol. Evol. 39(3):msac034 doi:10.1093/molbev/msac034

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Gloves off: You don't have to wear gloves when...

NHS
University Hospitals Sussex
NHS Foundation Trust

Table 1. **Experime distribution in N**	
PPE item	**(1 J**
Aprons	
Eye protectors	
FFP2/3 masks	
IIR masks	
Gloves	
Gowns	

PPE = personal protective
[a]Source: Department of H

Nash C (2021) Tir , 18-20.

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Re-imagine healthcare

- Up to 20% of healthcare is of no value i.e. does not result in improvement of health
- 1 in 10 people are harmed at the point of care
- More than 10% of hospital expenditure goes to correcting preventable mistakes or hospital-acquired infections
- 10% of prescriptions are not required
- Up to 30% of admissions in older adults are due to adverse effects of prescribed medications

https://www.gov.scot/publications/delivering-value-based-health-care-vision-scotland/

Big Pharma emits more greenhouse gases than the automotive industry

Published: May 27, 2019 9.51pm BST Updated: May 27, 2019 11.21pm BST

Greenhouse gas emissions from pharmaceutical companies need to be better monitored and regulated. (Shutterstock)

Rarely does mention of the pharmaceutical industry conjure up images of smoke stacks, pollution and environmental damage.

Yet our recent study found the global pharmaceutical industry is not only a significant contributor to global warming, but it is also dirtier than the global automotive production sector.

It was a surprise to find how little attention researchers have paid to the industry's greenhouse gas emissions. Only two other studies had some relevance: one looked at the environmental impact of the U.S. health-care system and the other at the pollution (mostly water) discharged by drug manufacturers.

Our study was the first to assess the carbon footprint of the pharma sector.

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115285

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Drug manufacture

- Extracted from porcine intestinal mucosa
- 1 kg of intestinal mucosa will produce 160–260 mg of crude heparin
- The offal of around 1100 million pigs required annually
- We should be considering alternatives

Counting the carbon cost of heparin: an evolving tragedy of the commons?

Heparin, which is listed in *WHO's Model List of Essential Medicines*,[1] was discovered in 1916 and has been used as an anticoagulant since 1935, possessing potentiating effects on antithrombin. The global demand for heparin is rising, with the global heparin pharmaceutical market projected to grow from US$9·38 billion in 2021 to US$12·06 billion in 2028, and there is a possibility that demand might outstrip supply.[2] In addition to increased usage for treatment of rising cardiovascular disease and thrombosis cases in ageing populations, the demand for heparin has been exacerbated by its use during the COVID-19 pandemic for thromboprophylaxis and treatment of COVID-19-associated thromboembolic disease.

The only US Food and Drug Administration (FDA) approved source of heparin is currently porcine mucosa, given that usage of bovine heparin ceased in 1999 because of risks of possible contamination with the bovine spongiform encephalopathy agent derived from ruminant materials. To meet the rising global heparin demand, the offal of around 1100 million pigs is required annually.[3] There is a marked geographical concentration of pigs in east and southeast Asia, amounting to 95% of the pigs farmed worldwide, followed by Europe and the Americas. China alone is producing almost 50% of the global requirements of heparin, with 415·95 million pigs reported at end of March, 2021.[4] The shortage of upstream crude heparin has led to periodic supply shortages in the USA for certain heparin end products,

porcine industry estimated at 668 million tons.[6] The carbon footprint generated from the porcine industry through procurement of fresh porcine intestines indirectly contributes to the net global CO_2 emissions by the pharmaceutical industry, which was estimated as 52·0 megatonnes of CO_2 emissions in 2015—a higher value than the estimated 46·2 megatonnes of CO_2 emissions generated by the automotive industry.[7]

In the 2021 UN Climate Change Conference, a joint statement was made by principal pharmaceutical industry organisations—namely, the Association of the British Pharmaceutical Industry, the European Federation of Pharmaceutical Industries and Associations, Farmindustria, the International Medical Company, the International Federation of Pharmaceutical Manufacturers & Associations, the Japan Pharmaceutical Manufacturers Association, Les entreprises du médicament, Pharmaceutical Research and Manufacturers of America, and Verband Forschender Arzneimittelhersteller—that pledged their commitment to reducing short-term greenhouse gas emissions, claiming that 80% of the largest pharmaceutical companies have set net-zero or carbon-neutrality targets. However, this goal might be challenging in the long term for heparin, given that increased health-care demand for crude heparin will potentially drive the expansion of the porcine industry, resulting in a growing and unsustainable carbon burden.

Health-care providers have a responsibility to aim for

Lancet Haematol 2022
Published Online
June 7, 2022
https://doi.org/10.1016/
S2352-3026(22)00171-5

For the **joint industry statement** see https://www.ifpma.org/wp-content/uploads/2021/10/Joint-Statement-on-COP26_28Oct2021.pdf

Lancet Haematol 2022 Published Online June 7, 2022 https://doi.org/10.1016/ S2352-3026(22)00171-5

Treatment recommendations

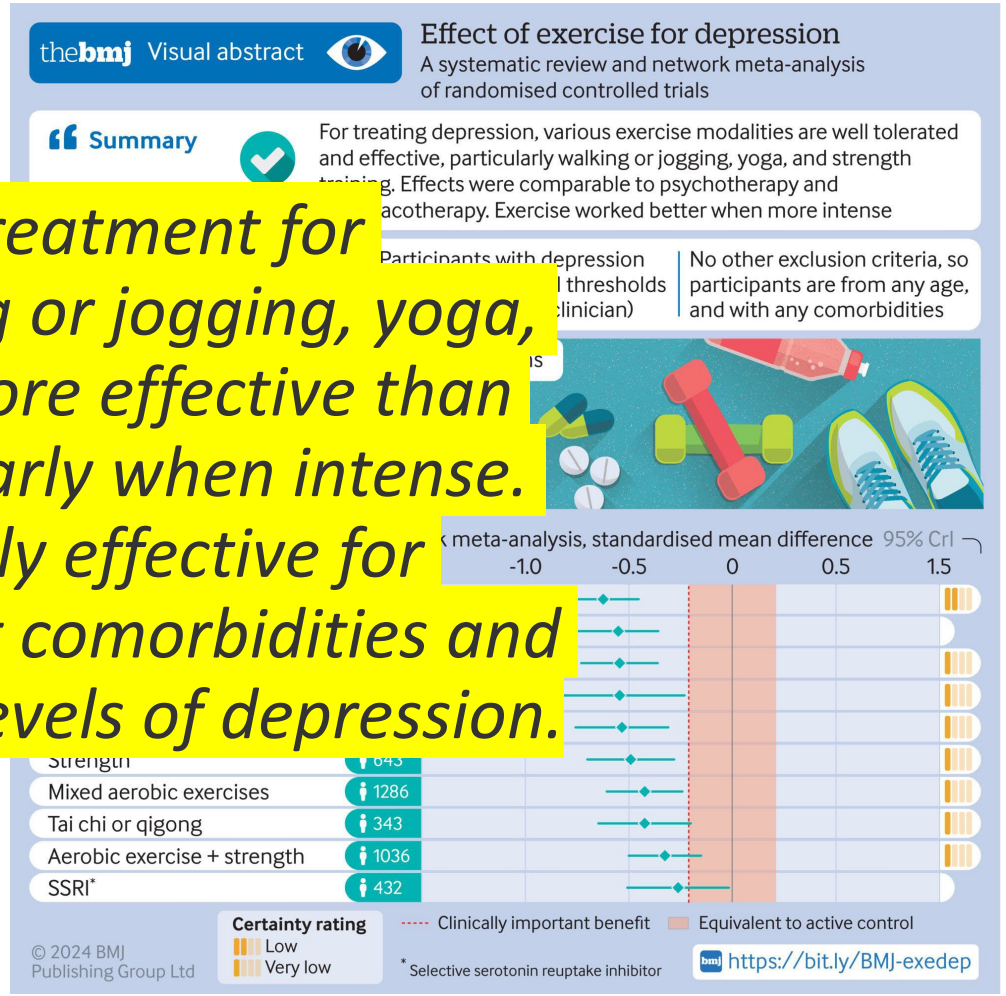
Beyond Pills All Party Parliamentary Group (APPG) launches to stop over-prescribing

In June 2022, the College of Medicine launched the Beyond P
Government intervention on over- prescribing in the NHS.

The Campaign was established in the wake of the Government's
September 2021. This found that an estimated 10% of drugs (11
inappropriate, unnecessary and could do harm, including causin

BEYOND PILLS

- *Exercise is an effective treatment for depression, with walking or jogging, yoga, and strength training more effective than other exercises, particularly when intense. Exercise appeared equally effective for people with and without comorbidities and with different baseline levels of depression.*



https://collegeofmedicine.org.uk/beyondpills/

Bricca A, et al. Br J Sports Med September 2021 Vol 55 No 18
BMJ 2024; 384 doi: https://doi.org/10.1136/bmj-2023-075847

Case studies

Electric drones from GSTT to laboratory hub

NHS drone in flight against the London skyline

Clin Med (Lond). 2021 Mar;21(2):142–146. doi: 10.7861/clinmed.2020-0250

Reducing inappropriate blood testing in haematology inpatients: A multicentre quality improvement project

Amelia Fisher [A,✉], Alvin Katumba [B], Khalid Musa [C], Shehana Wijethilleke [D], Zaibun Khan [E], Yooyun Chung [F], Waqas Akhtar [G]

Author information Copyright and License information

PMCID: PMC8002792 PMID: 33762376

Plastic bag free sample transport from GP practices – Royal Cornwall Hospital

Before

After

Microbiology team at Lancashire Teaching Hospitals (volunteered to participate in a pilot of the Laboratory Efficiency Assessment Framework (LEAF) audit tool, run by University College London

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...pport

- Laboratory Efficien
  - run from UCL,
- My Green Lab
- 'Clinical Labs Susn

https://www.ucl.ac.uk/sustai
framework
https://greenlabs.eflm.eu
https://www.mygreenlab.org

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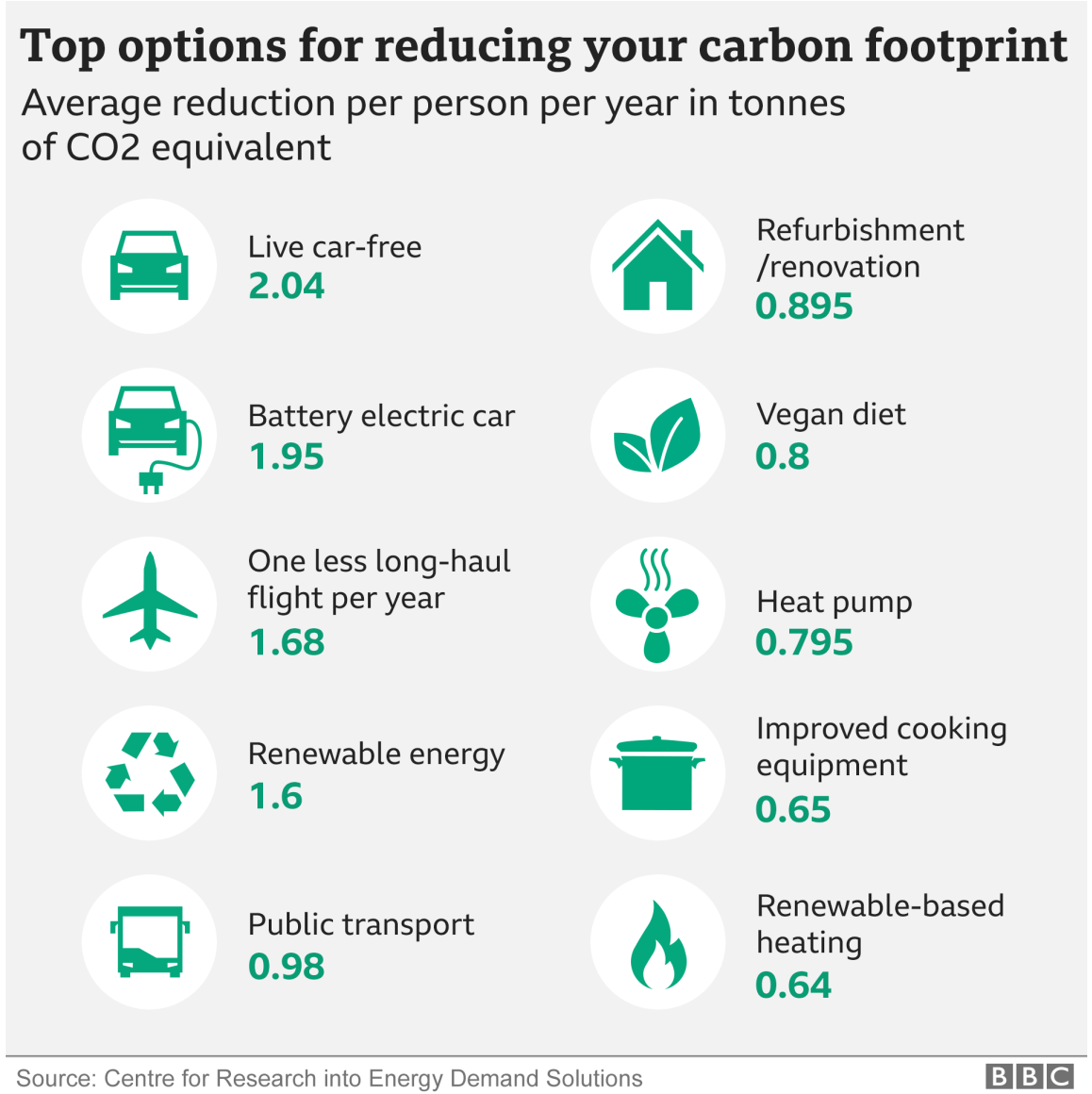
Individual actions

- Healthy, active lifestyle
- Green banking
- Renewable energy
- Plant-based diet
- Stop flying
- Reduce consumption
- Keep talking about the problem



https://www.un.org/en/actnow/ten-actions
https://www.who.int/publications/i/item/9789240090224
https://www.bbc.co.uk/news/science-environment-52719662

Health professionals are key players

‘Without decisive and urgent action, the climate crisis will increasingly undermine human health and disrupt healthcare delivery. There are both moral and practical reasons for health professionals to be at the forefront of climate action’

BMJ 2020;371:m3785