

# La soutenabilité environnementale des systèmes de santé

Bibliographie thématique

Mars 2024

Centre de documentation de l'Irdes

Marie-Odile Safon

Véronique Suhard

**Synthèses & Bibliographies**

Reproduction sur d'autres sites interdite mais lien vers le document accepté  
[www.irdes.fr/documentation/syntheses-et-dossiers-bibliographiques.html](http://www.irdes.fr/documentation/syntheses-et-dossiers-bibliographiques.html)

## Sommaire

<b>En guise d'introduction .....</b>	<b>2</b>
<b>Les revues de littérature sur la problématique.....</b>	<b>3</b>
<b>L'impact des systèmes de santé sur l'environnement .....</b>	<b>15</b>
<b>Les interventions et dispositifs mis en place pour réduire cet impact environnemental.....</b>	<b>33</b>
<b>L'exemple de la France .....</b>	<b>52</b>
Études d'ensemble sur la transition écologique.....	53
La transition écologique appliquée aux systèmes de santé .....	64
<b>Lu dans la presse .....</b>	<b>85</b>
<b>Pour aller plus loin .....</b>	<b>92</b>
Dossiers documentaires .....	92
Organismes ressources.....	92

### En guise d'introduction

Le système de santé est essentiel à l'amélioration et au maintien de la santé et du bien-être de la société et est un des facteurs clés du développement économique. Cependant, les activités du système de santé ont également des effets non négligeables sur l'environnement et contribuent au changement climatique. Elles sont responsables d'environ 5 % du total des émissions mondiales de gaz à effet de serre - une contribution qui pourrait tripler d'ici 2050, compte tenu du vieillissement de la population et des besoins de soins qui continuent à croître. Une littérature de plus en plus abondante est disponible pour comprendre les stratégies de transformation des systèmes de santé ; plusieurs études ont montré qu'il était possible de privilégier et d'améliorer simultanément la santé et l'environnement, ainsi que réaliser des économies importantes. Par conséquent, la transition environnementale du système de santé est considérée comme une nécessité. Outre la réduction de l'empreinte écologique, la soutenabilité environnementale du système de santé implique d'améliorer simultanément le bien-être sociétal et environnemental. Cependant, ce sujet a été peu développé dans les stratégies visant à faire évoluer le système de santé en France.

Réalisée dans le cadre du projet Environnement -Système de santé<sup>1</sup> dont l'objectif est d'étudier l'impact des systèmes de santé sur l'environnement, cette bibliographie rassemble de la littérature scientifique identifiée à partir de l'interrogation des bases de données et portails suivants : Medline, Irdes, Cairn, Science direct, Web of science, Google Scholar sur les aspects suivants : impact des systèmes de santé sur l'environnement et interventions mises en œuvre pour juguler ces effets négatifs.

Cette bibliographie ne prétend pas à l'exhaustivité. La version parue en avril 2023 portait sur la période 2010-2022. Cette mise à jour de mars 2024 concerne uniquement les études françaises et inclut les publications du C2DS que nous n'avons pas encore mentionnées.

[Pour une analyse approfondie, il convient de se reporter à la revue de littérature en ligne sur le site de l'Irdes :](#)

Seppanen, A. et Or, Z. (2023). [The Environmental Sustainability of Health Care Systems: A literature review on the environmental footprint of health care system and interventions aiming to reduce it: for a framework for action for France](#). Rapport (Irdes) ; 586;. Paris : Irdes, Irdes: 100p.

---

<sup>1</sup> [Projet Irdes/HCAAM « Soutenabilité des systèmes de santé »](#)

## Les revues de littérature sur la problématique

### Revues de référence

Or, Z. Seppanen, A. (2023). The Environmental Sustainability of Health Care Systems: A literature review on the environmental footprint of health care system and interventions aiming to reduce it: for a framework for action for France. Rapport (Irdes) ; 586. Paris : Irdes, Irdes.  
*Rapport en anglais et synthèse en français*

Shift, Rambaud, T., Marraud, L., et al. (2021). Décarboner la santé pour soigner durablement. Paris The Shift Project: 155.  
Cette étude a été actualisée en avril 2023.

Alshqaqeeq, F., Esmaili, M. A., Overcash, M., et al. (2020). "Quantifying hospital services by carbon footprint: <https://www.sciencedirect.com/science/article/abs/pii/S0921344919304665?via%3Dihub>

Quality patient care can be delivered by the healthcare community, but a lower carbon footprint. We found 48 studies have documented the carbon footprint reduction by improved procedures, drugs, devices, and care protocols. This progress will continue as healthcare organizations seek improved environmental sustainability, measured by carbon footprint.

Andeobu, L., Wibowo, S. et Grandhi, S. (2022). "Medical Waste from COVID-19 Pandemic-A Systematic Review of Management and Environmental Impacts in Australia." Int J Environ Res Public Health **19**(3).  
[https://mdpi-res.com/d\\_attachment/ijerph/ijerph-19-01381/article\\_deploy/ijerph-19-01381-v2.pdf](https://mdpi-res.com/d_attachment/ijerph/ijerph-19-01381/article_deploy/ijerph-19-01381-v2.pdf)

The coronavirus (COVID-19) pandemic has created a global medical emergency. The unforeseen occurrence of a pandemic of this magnitude has resulted in overwhelming levels of medical waste and raises questions about management and disposal practices, and environmental impacts. The amount of medical waste generated from COVID-19 since the outbreak is estimated to be 2.6 million tons/day worldwide. In Australia, heaps of single-use gowns, facemasks/face shields, aprons, gloves, goggles, sanitizers, sharps, and syringes are disposed everyday as a result of the pandemic. Moreover, the establishment of new home/hotel quarantine facilities and isolation/quarantine centres in various Australian states and territories have increased the risks of transmission among people in these facilities and the likelihoods of general waste becoming contaminated with medical waste. This warrants the need to examine management and disposal practices implemented to reduce the transmission and spread of the virus. This study reviews the various management and disposal practices adopted in Australia for dealing with medical waste from the COVID-19 pandemic and their impacts on public health and the environment. To achieve the aims of this study, prior studies from 2019-2021 from various databases are collected and analysed. The study focuses on generation of medical waste from COVID-19, management and disposal methods, current problems/challenges and environmental and public health impacts. Considering the enormous risks involved and the significance of appropriate handling and disposal of medical waste from COVID-19, this study provides insights on short and long term responses towards managing COVID-19 waste in Australia. The study contributes to Australia's efforts against the transmission and spread of COVID-19 and provides recommendations for the development of workable and sustainable strategies for mitigating similar pandemics in the future.

Barcellos, D. D. S., Procopiuck, M. et Bollmann, H. A. (2022). "Management of pharmaceutical micropollutants discharged in urban waters: 30 years of systematic review looking at opportunities for developing countries." Sci Total Environ **809**: 151128.  
<https://www.sciencedirect.com/science/article/abs/pii/S0048969721062069?via%3Dihub>

Pharmaceutical micropollutants' contamination of urban waters has been studied globally for decades, but the concentration of innovations in management initiatives is still in developed economies. The gap between the locus of innovations in pharmaceuticals and the relative stagnation in less developed

economies to manage waste originating in this activity seems fruitful for investigations on innovation in integrated micropollutant management strategies. These tensions allow for advances in current knowledge for environmental management and, particularly, finding solutions for the contamination by pharmaceutical micropollutants of urban water bodies in developing countries. We aim to list the main strategies for managing pharmaceutical micropollutants discussed to point out opportunities for developing countries to advance in this direction. Methodologically, we conducted a systematic literature review from 1990 to 2020, covering 3027 documents on "pharmaceutical micropollutants management." The framework formed by the macro-approach to integrated management operationalized by the dimensional micro-approaches: technical, organizational, community, and governmental allowed us to understand that (1) the management of pharmaceutical micropollutants tends to occur through a technical approach centered on the removal of aquatic matrices, green chemistry, and urine diversion; (2) management with an organizational approach has enabled removing drugs from water bodies by drug take-back program, collaborative projects, drug use reduction, and better organizational practices; (3) the community approach have helped minimize this type of pollution by reducing the consumption of medicines and the proper destination for medicines that are no longer in use. Finally, the government management approach emerges as a source of legal, economic, and informational instruments to reduce pollution by pharmaceutical micropollutants. Furthermore, these management approaches allowed us to identify 15 opportunities for possible adjustments for developing societies. These opportunities can be promising for practices and research and, in the medium term, contribute to minimizing pollution by pharmaceutical micropollutants in urban waters.

Biddle, L., Wahedi, K. et Bozorgmehr, K. (2020). "Health system resilience: a literature review of empirical research." *Health Policy Plan* 35(8): 1084-1109.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7553761/pdf/czaa032.pdf>

The concept of health system resilience has gained popularity in the global health discourse, featuring in UN policies, academic articles and conferences. While substantial effort has gone into the conceptualization of health system resilience, there has been no review of how the concept has been operationalized in empirical studies. We conducted an empirical review in three databases using systematic methods. Findings were synthesized using descriptive quantitative analysis and by mapping aims, findings, underlying concepts and measurement approaches according to the resilience definition by Blanchet et al. We identified 71 empirical studies on health system resilience from 2008 to 2019, with an increase in literature in recent years (62% of studies published since 2017). Most studies addressed a specific crisis or challenge (82%), most notably infectious disease outbreaks (20%), natural disasters (15%) and climate change (11%). A large proportion of studies focused on service delivery (48%), while other health system building blocks were side-lined. The studies differed in terms of their disciplinary tradition and conceptual background, which was reflected in the variety of concepts and measurement approaches used. Despite extensive theoretical work on the domains which constitute health system resilience, we found that most of the empirical literature only addressed particular aspects related to absorptive and adaptive capacities, with legitimacy of institutions and transformative resilience seldom addressed. Qualitative and mixed methods research captured a broader range of resilience domains than quantitative research. The review shows that the way in which resilience is currently applied in the empirical literature does not match its theoretical foundations. In order to do justice to the complexities of the resilience concept, knowledge from both quantitative and qualitative research traditions should be integrated in a comprehensive assessment framework. Only then will the theoretical 'resilience idea' be able to prove its usefulness for the research community.

Blass, A. P., da Costa, S. E. G., de Lima, E. P., et al. (2015). The Measurement of Environmental Performance in Hospitals: A Systematic Review of Literature. *Sustainable Operations Management: Advances in Strategy and Methodology*. Chiarini, A.: 75-102.

<https://www.springerprofessional.de/en/the-measurement-of-environmental-performance-in-hospitals-a-syst/2353138>

Bouzid, M., Hooper, L. et Hunter, P. R. (2013). "The effectiveness of public health interventions to reduce the health impact of climate change: a systematic review of systematic reviews." *PLoS One* **8**(4): e62041. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3636259/pdf/pone.0062041.pdf>

**BACKGROUND:** Climate change is likely to be one of the most important threats to public health in the coming years. Yet despite the large number of papers considering the health impact of climate change, few have considered what public health interventions may be of most value in reducing the disease burden. We aimed to evaluate the effectiveness of public health interventions to reduce the disease burden of high priority climate sensitive diseases. **METHODS AND FINDINGS:** For each disease, we performed a systematic search with no restriction on date or language of publication on Medline, Web of Knowledge, Cochrane CENTRAL and SCOPUS up to December 2010 to identify systematic reviews of public health interventions. We retrieved some 3176 records of which 85 full papers were assessed and 33 included in the review. The included papers investigated the effect of public health interventions on various outcome measures. All interventions were GRADE assessed to determine the strength of evidence. In addition we developed a systematic review quality score. The interventions included environmental interventions to control vectors, chemoprophylaxis, immunization, household and community water treatment, greening cities and community advice. For most reviews, GRADE showed low quality of evidence because of poor study design and high heterogeneity. Also for some key areas such as floods, droughts and other weather extremes, there are no adequate systematic reviews of potential public health interventions. **CONCLUSION:** In conclusion, we found the evidence base to be mostly weak for environmental interventions that could have the most value in a warmer world. Nevertheless, such interventions should not be dismissed. Future research on public health interventions for climate change adaptation needs to be concerned about quality in study design and should address the gap for floods, droughts and other extreme weather events that pose a risk to health.

Braithwaite, J., Zurynski, Y., Ludlow, K., et al. (2019). "Towards sustainable healthcare system performance in the 21st century in high-income countries: a protocol for a systematic review of the grey literature." *BMJ Open* **9**(1).

Burns, J., Boogaard, H., Polus, S., et al. (2020). "Interventions to reduce ambient air pollution and their effects on health: An abridged Cochrane systematic review." *Environ Int* **135**: 105400.

**BACKGROUND:** A broad range of interventions have been implemented to improve ambient air quality, and many of these have been evaluated. Yet to date no systematic review has been conducted to identify and synthesize these studies. In this systematic review, we assess the effectiveness of interventions in reducing ambient particulate matter air pollution and improving adverse health outcomes. **METHODS:** We searched a range of electronic databases across multiple disciplines, as well as grey literature databases, trial registries, reference lists of included studies and the contents of relevant journals, through August 2016. Eligible for inclusion were randomized and cluster randomized controlled trials, as well as several non-randomized study designs often used for evaluating air quality interventions. We included studies that evaluated interventions targeting industrial, residential, vehicular and multiple sources, with respect to their effect on mortality, morbidity and the concentrations of particulate matter (PM - including PM(10), PM(2.5), coarse particulate matter and combustion-related PM), as well as several criteria pollutants, including ozone, carbon monoxide, nitrogen oxides, nitrogen dioxide, nitric oxide and sulphur dioxide. We did not restrict studies based on the population, setting or comparison. Two authors independently assessed studies for inclusion, extracted data and assessed risk of bias. We assessed risk of bias using the Graphic Appraisal Tool for Epidemiological studies (GATE) for correlation studies, as modified and employed by the UK National Institute for Health and Care Excellence. We synthesized evidence narratively, as well as graphically using harvest plots. We assessed the certainty of evidence using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) system. **RESULTS:** We included 42 studies assessing 38 unique interventions. These comprised a heterogeneous mix of interventions, including those aiming to address industrial sources (n = 5; e.g. the closure of a factory), residential sources (n = 7; e.g. coal ban), vehicular sources (n = 22; e.g. low emission zones), and multiple sources (n = 4; e.g. tailored measures that target both local traffic and industrial polluters). Evidence for effectiveness was mixed.

Most included studies observed either no significant association or an association favoring the intervention, with little evidence that the assessed interventions might be harmful. **CONCLUSIONS:** Given the heterogeneity across interventions, outcomes, and methods, it was difficult to derive overall conclusions regarding the effectiveness of interventions in terms of improved air quality or health. Some evidence suggests that interventions are associated with improvements in air quality and human health, with very little evidence suggesting interventions were harmful. The evidence base highlights the challenges related to establishing the effectiveness of specific air pollution interventions on outcomes. It also points to the need for improved study design and analysis methods, as well as more uniform evaluations. The prospective planning of evaluations and an evaluation component built into the design and implementation of interventions may also be particularly beneficial.

Carino, S., Porter, J., Malekpour, S., et al. (2020). "Environmental Sustainability of Hospital Foodservices across the Food Supply Chain: A Systematic Review." *J Acad Nutr Diet* **120**(5): 825-873.

[https://www.jandonline.org/article/S2212-2672\(20\)30001-0/fulltext](https://www.jandonline.org/article/S2212-2672(20)30001-0/fulltext)

**BACKGROUND:** Hospitals have a responsibility to support human health, and given the link between human and environmental health, hospitals should consider their environmental impacts. Hospital foodservices can negatively affect the environment at every stage of the food supply chain (production/procurement, distribution, preparation, consumption, and waste management/disposal). **OBJECTIVE:** To systematically identify and synthesize the following across the hospital patient food/nutrition supply chain: environmental and associated economic impacts of foodservice; outcomes of strategies that aim to improve the environmental sustainability of foodservice; and perspectives of patients, staff, and stakeholders on environmental impacts of foodservice and strategies that aim to improve the environmental sustainability of foodservice. **METHODS:** Eight electronic databases (ie, Cumulative Index to Nursing and Allied Health Literature Plus, Embase via Ovid, Global Health, National Health Service Economic Evaluation Database, Ovid Medline, ProQuest Environmental Science Collection, Scopus, and Web of Science) were searched from database inception to November 2018 for original research conducted across any stage of the hospital food supply chain (from production/procurement to waste management/disposal) that provides food/nutrition to patients, with no restrictions on language or study design. Titles/abstracts then full texts were screened independently by two authors. The Mixed Methods Appraisal Tool was used for quality appraisal for included studies. Data were synthesized narratively. **RESULTS:** From 29,655 records identified, 80 studies met eligibility criteria. Results were categorized into production/procurement (n=12), distribution (n=0), preparation (n=6), consumption (n=49), waste management/disposal (n=8), and multiple food supply chain aspects (n=5). The environmental impact most widely explored was food waste, with many studies reporting on food waste quantities, and associated economic losses. Strategies focused on reducing food waste by increasing patients' intake through various foodservice models. Perspectives identified a shared vision for sustainable foodservices, although there are many practical barriers to achieving this. **CONCLUSION:** The literature provides examples across the hospital food supply chain that demonstrate how environmental sustainability can be prioritized and evaluated and the opportunities for credentialed nutrition and dietetics practitioners to contribute. Future studies are warranted, particularly those measuring environmental impacts and testing the effects of sustainable strategies in the distribution, preparation, and waste management stages.

Cimprich, A., Santillan-Saldivar, J., Thiel, C. L., et al. (2019). "Potential for industrial ecology to support healthcare sustainability: Scoping review of a fragmented literature and conceptual framework for future research." *Journal of Industrial Ecology* **23**(6): 1344-1352.

<https://onlinelibrary.wiley.com/doi/10.1111/jiec.12921>

Delpla, I., Diallo, T. A., Keeling, M., et al. (2021). "Tools and Methods to Include Health in Climate Change Adaptation and Mitigation Strategies and Policies: A Scoping Review." *Int J Environ Res Public Health* **18**(5).

[https://mdpi-res.com/d\\_attachment/ijerph/ijerph-18-02547/article\\_deploy/ijerph-18-02547-v2.pdf](https://mdpi-res.com/d_attachment/ijerph/ijerph-18-02547/article_deploy/ijerph-18-02547-v2.pdf)

Climate change represents a serious threat to the health and well-being of populations. Today, many countries, regions, and cities around the world are implementing policies and strategies to adapt to

climate change and mitigate its effects. A scoping review was performed to identify tools and methods that help integrate health into climate change adaptation and mitigation policies and strategies. The literature search includes scientific and grey literature. The scientific literature was conducted using PubMed, Elsevier Embase, and Web of Science databases. A grey literature web search was performed to complement the results. A total of 35 studies (28 from the scientific literature and 7 from the grey literature) were finally included. A large majority of research articles (24/28) and almost all reports (6/7) from the grey literature were published after 2010. Results show that the tools that were found most frequently are the nested models (12/35), health impact assessment (6/35), vulnerability and adaptation assessment (3/35), conceptual frameworks (3/35), and mixed methods (3/35). This review shows an increasing interest in the topic of developing tools to better manage health issues in adaptation and mitigation strategies, with a recent increase in the number of publications. Additional analyses of tools' effectiveness should be conducted in further studies.

Gan, C. C. R., Banwell, N., Pascual, R. S., et al. (2019). "Hospital climate actions and assessment tools: a scoping review protocol." *BMJ Open* 9(12): e032561.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6937036/pdf/bmjopen-2019-032561.pdf>

**INTRODUCTION:** Health and climate change are inexorably linked through the exacerbation of health risks and the contribution of the health sector to greenhouse gas emissions. Climate action in healthcare settings is critical to reduce risks and impacts of climate change through the smarter use of energy, minimising waste and enhancing disaster preparedness. Globally, hospital climate action is growing; however, the potential for further progress and impacts remains. The literature on this topic lacks synthesis, and this poses challenges for hospital leadership in tracking the impact of climate action. This scoping review will summarise the current knowledge about hospital climate action and existing tools to measure progress in this area. **METHODS AND ANALYSIS:** This scoping review will be conducted applying the six-stage protocol proposed by Arksey and O'Malley. The study includes literature of how hospitals have addressed climate change (mitigation and adaptation) since the Kyoto Protocol was signed in 1997. All identified studies indexed in Medline, Scopus, Embase and CINAHL will be examined. The search strategy will also include Google Scholar to capture relevant grey literature. Quantitative and thematic analysis will be used to evaluate and categorise the study results. **ETHICS AND DISSEMINATION:** This scoping review is part of the climate-smart healthcare initiative which will provide a valuable synthesis to aid understanding of hospitals' climate actions, and tools used to measure its implementation. As such it will contribute to mobilising and accelerating the implementation of climate action in hospitals. The findings will be disseminated with all members of the International Health Promoting Hospital and Health Services (HPH) and the Global Green and Healthy Hospital network. Dissemination will occur through peer-reviewed publications; and with the HPH and GGHH members through its annual conference and newsletter.

Ghammachi, N., Dharmayani, P. N. A., Miharshahi, S., et al. (2022). "Investigating Web-Based Nutrition Education Interventions for Promoting Sustainable and Healthy Diets in Young Adults: A Systematic Literature Review." *Int J Environ Res Public Health* 19(3).

[https://mdpi-res.com/d\\_attachment/ijerph/ijerph-19-01691/article\\_deploy/ijerph-19-01691-v2.pdf](https://mdpi-res.com/d_attachment/ijerph/ijerph-19-01691/article_deploy/ijerph-19-01691-v2.pdf)

**BACKGROUND:** Our current rapidly growing food systems are imposing a heavy burden on both environmental sustainability and human health. Sustainable and healthy diets aim to promote optimal health and have a minimal environmental impact. This study aimed to critically review and synthesise the evidence on the effectiveness of web-based nutrition education interventions aiming to promote sustainable and healthy diets among young adults. **METHODS:** A systematic search of four databases (Medline, PsycINFO, Scopus, and Embase) was conducted in March 2021. Studies were included if they used an online platform to deliver the intervention to young adults and measured at least one aspect of sustainable and healthy diets, such as plant-based food intake, food waste, and local and seasonal produce. Of the 2991 studies, a total of 221 full-text articles were assessed for eligibility of which 22 were included in the final review. **RESULTS:** A majority of the studies (82%) targeted fruit and vegetable consumption, and close to a quarter of studies (23%) targeted other aspects of a sustainable and healthy diet, such as red meat intake. Only one study included multiple aspects of a sustainable and healthy diet. Program delivery outcomes reported overall positive feedback and engagement.

**CONCLUSION:** This review suggests that web-based interventions may be effective in promoting some sustainable diet-related outcomes in young adults. However, there is a need for developing and evaluating future programs to promote sustainable diets more comprehensively in order to help young adults make healthy and sustainable food choices.

Guillaumie, L., Boiral, O., Baghdadli, A., et al. (2020). "Integrating sustainable nutrition into health-related institutions: a systematic review of the literature." *Canadian Journal of Public Health-Revue Canadienne De Sante Publique* **111**(6): 845-861.

<https://link.springer.com/article/10.17269/s41997-020-00394-3>

Harper, S. L., Cunsolo, A., Babujee, A., et al. (2021). "Climate change and health in North America: literature review protocol." *Syst Rev* **10**(1): 3.

[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7780400/pdf/13643\\_2020\\_Article\\_1543.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7780400/pdf/13643_2020_Article_1543.pdf)

**BACKGROUND:** Climate change is a defining issue and grand challenge for the health sector in North America. Synthesizing evidence on climate change impacts, climate-health adaptation, and climate-health mitigation is crucial for health practitioners and decision-makers to effectively understand, prepare for, and respond to climate change impacts on human health. This protocol paper outlines our process to systematically conduct a literature review to investigate the climate-health evidence base in North America. **METHODS:** A search string will be used to search CINAHL®, Web of Science™, Scopus®, Embase® via Ovid, and MEDLINE® via Ovid aggregator databases. Articles will be screened using inclusion/exclusion criteria by two independent reviewers. First, the inclusion/exclusion criteria will be applied to article titles and abstracts, and then to the full articles. Included articles will be analyzed using quantitative and qualitative methods. **DISCUSSION:** This protocol describes review methods that will be used to systematically and transparently create a database of articles published in academic journals that examine climate-health in North America.

Jarmul, S., Dangour, A. D., Green, R., et al. (2020). "Climate change mitigation through dietary change: a systematic review of empirical and modelling studies on the environmental footprints and health effects of 'sustainable diets'." *Environ Res Lett* **15**: 123014.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7610659/pdf/EMS120901.pdf>

The adoption of healthy diets with low environmental impact has been widely promoted as an important climate change mitigation strategy. Typically, these diets are high in plant-sourced and low in animal-sourced and processed foods. Despite the fact that their environmental impacts vary, they are often referred to as 'sustainable diets'. Here we systematically review the available published evidence on the effect of 'sustainable diets' on environmental footprints and human health. Eight databases (OvidSP-Medline, OvidSP-Embase, EBSCO-GreenFILE, Web of Science Core Collection, Scopus, OvidSP-CAB-Abstracts, OvidSP-AGRIS, and OvidSP-Global Health) were searched to identify literature (published 1999-2019) reporting health effects and environmental footprints of 'sustainable diets'. Available evidence was mapped and pooled analysis was conducted by unique combinations of diet pattern, health and environmental outcome. Eighteen studies (412 measurements) met our inclusion criteria, distinguishing twelve non-mutually exclusive sustainable diet patterns, six environmental outcomes, and seven health outcomes. In 87% of measurements (n = 151) positive health outcomes were reported from 'sustainable diets' (average relative health improvement: 4.09% [95% CI -0.10-8.29]) when comparing 'sustainable diets' to current/baseline consumption patterns. Greenhouse gas emissions associated with 'sustainable diets' were on average 25.8% [95% CI -27.0 to -14.6] lower than current/baseline consumption patterns, with vegan diets reporting the largest reduction in GHG-emissions (-70.3% [95% CI: -90.2 to -50.4]), however, water use was frequently reported to be higher than current/baseline diets. Multiple benefits for both health and the environment were reported in the majority (n = 315 [76%]) of measurements. We identified consistent evidence of both positive health effects and reduced environmental footprints accruing from 'sustainable diets'. The notable exception of increased water use associated with 'sustainable diets' identifies that co-benefits are not universal and some trade-offs are likely. When carefully designed, evidence-based, and adapted to contextual factors, dietary change could play a pivotal role in climate change mitigation, sustainable food systems, and future population health.



Li, Y. K., Pan, X. Y., Han, Y. L., et al. (2021). "Sustainable Healthcare Facilities: A Scoping Review." Journal of Construction Engineering and Management **147**(12).

<https://ascelibrary.org/doi/abs/10.1061/%28ASCE%29CO.1943-7862.0002170>

Martin, N., Sheppard, M., Gorasia, G., et al. (2021). "Awareness and barriers to sustainability in dentistry: A scoping review." J Dent **112**: 103735.

OBJECTIVES: (i) To undertake a comprehensive scoping review of the literature that addresses the research question 'What is the current state of environmental sustainability in general dental practice?' (ii) To provide an effective baseline of data that will consider general awareness, barriers and challenges for the implementation of sustainable practice. DATA & SOURCES: The scoping review was conducted for all published literature in the English language that addresses this topic up to the 31st April 2021. The method of the PRISMA-ScR (PRISMA extension for Scoping Reviews) was followed. 128 papers included in this scoping review consisted of: Commentary [Letters, editorials, communication and opinion] (n = 39); Research (n = 60); Literature reviews (n = 25); Reports [Policy and legislation] (n = 4). Each included record was analysed for emerging themes that were further classified according to their general relevance. The scoping review is considered over two manuscripts, with this first paper focusing on awareness of the problem and barriers or challenges to the implementation of sustainable care. CONCLUSIONS: Eight diverse but closely interlinked themes that influence the sustainability of oral health provision were identified: Environmental impacts (CO<sub>2</sub>e, air and water); Reduce, reuse, recycle and rethink; Policy and guidelines; Biomedical waste management; Plastics (SUPs); Procurement; Research & Education; Materials. Barriers to implementation were identified as: Lack of professional and public awareness; carbon emissions arising from patient and staff commute; challenges associated with the recovery and recycling of biomedical waste with a focus on SUPs; lack of knowledge and education into sustainable healthcare provision and; the challenges from the manufacturing, use and disposal of dental materials.

McGain, F. et Naylor, C. (2014). "Environmental sustainability in hospitals - a systematic review and research agenda." J Health Serv Res Policy **19**(4): 245-252.

[https://journals.sagepub.com/doi/10.1177/1355819614534836?url\\_ver=Z39.88-2003&rfr\\_id=ori:rid:crossref.org&rfr\\_dat=cr\\_pub%3dpubmed](https://journals.sagepub.com/doi/10.1177/1355819614534836?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed)

OBJECTIVES: Hospitals are significant contributors to natural resource depletion and environmental change. Our objective was to establish the extent to which hospital environmental sustainability has been studied and the key issues that emerge for policy, practice and research. METHODS: The PubMed, Engineering Village, Cochrane and King's Fund databases were searched for articles relating to hospital environmental sustainability published in English between 1 January 1990 and 1 October 2013. Further studies were found by review of reference lists. One hundred ninety-three relevant articles were found and 76 were selected for inclusion in the review. RESULTS: Common research themes were identified: hospital design, direct energy consumption, water, procurement, waste, travel and psychology and behaviour. Some countries (particularly the United Kingdom) have begun to invest systematically in understanding the environmental effects of hospitals. We found large variability in the extent of the evidence base according to topic. Research regarding the architectural fabric of hospital buildings is at a relatively mature stage. Similarly, there is a developed research base regarding devices and technologies used within hospitals to reduce the environmental effects of direct hospital energy and water use. Less is known about the clinical, psychological and social factors that influence how health care professionals use resources, travel to/from hospital, and interact with the buildings and technologies available. A significant part of the environmental footprint of hospitals relates to clinical practice, e.g. decisions regarding the use of pharmaceuticals and medical devices. Medical 'cradle to grave' life cycle assessment studies have been published to understand the full financial and environmental costs of hospital activities. The effects of preventive or demand management measures which avoid unnecessary hospital procedures are likely to be much greater than incremental changes to how hospital procedures are performed. CONCLUSIONS: There remain significant gaps in the evidence base on hospital sustainability. Assessments of environmental impacts and natural resource use are beginning to be produced, both at the level of individual hospitals and at

the health system level. These are an important start, but in many areas do not yet provide sufficiently detailed information to guide decision-making. There are many areas where the interests of patients and the environment coincide, but others where tensions exist. Rising resource costs and climate change mitigation measures are likely to create an increasing stimulus for research on hospital sustainability. Such research will benefit from inter-disciplinary coordination across research funders and countries.

Osama, T., Brindley, D., Majeed, A., et al. (2018). "Teaching the relationship between health and climate change: a systematic scoping review protocol." *BMJ Open* **8**(5): e020330.

<https://spiral.imperial.ac.uk/bitstream/10044/1/58442/9/e020330.full.pdf>

**INTRODUCTION:** The observed and projected impacts of climate change on human health are significant. While climate change has gathered global momentum and is taught frequently, the extent to which the relationships between climate change and health are taught remains uncertain. Education provides an opportunity to create public engagement on these issues, but the extent to which historical implementation of climate health education could be leveraged is not well understood. To address this gap, we propose to conduct a scoping review of all forms of teaching that have been used to illustrate the health effects of climate change between 2005 and 2017, coinciding with a turning point in the public health and climate change agendas following the 2005 Group of 7/8 (G7/8) Summit. **METHODS AND ANALYSIS:** Using Arksey/O'Malley's and Levac's methodological framework, MEDLINE/PubMed, Embase, Scopus, Education Resource Information Centre, Web of Science, Global Health, Health Management Information Consortium, Georef, Ebsco and PROSPERO will be systematically searched. Predetermined inclusion and exclusion criteria will be applied by two independent reviewers to determine study eligibility. Studies published in English and after 2005 only will be examined. Following selection of studies, data will be extracted and analysed. **ETHICS AND DISSEMINATION:** No ethical approval is required as exclusively secondary data will be used. Our findings will be communicated to the European Institute of Innovation & Technology Health-Knowledge and Innovation Communities to assist in the development of a FutureLearn Massive Open Online Course on the health effects of climate change.

Parker, G., Berta, W., Shea, C., et al. (2020). "Environmental competencies for healthcare educators and trainees: A scoping review." *Health Education Journal* **79**(3): 327-345.

<https://journals.sagepub.com/doi/abs/10.1177/0017896919886599>

The health-care community has a responsibility to address the environmental impact of delivering health-care services. Educational programmes present ideal fora to confer 'environmental competencies' to future health system leaders, managers, practitioners and researchers. The aim of this review is to synthesise the literature on health-care competencies, education and training of relevance to issues of environmental sustainability and climate change in the health sector.

Polisena, J., De Angelis, G., Kaunelis, D., et al. (2018). "Environmental impact assessment of a health technology : a soping review." *Int J Technol Assess Health Care* **34**(3): 317-326.

<https://www.cambridge.org/core/services/aop-cambridge-core/content/view/43FB355E3F34DA810A53DF0F9E8626C1/S0266462318000351a.pdf/div-class-title-environmental-impact-assessment-of-a-health-technology-a-scoping-review-div.pdf>

**INTRODUCTION:** The Health Technology Expert Review Panel is an advisory body to Canadian Agency for Drugs and Technologies in Health (CADTH) that develops recommendations on health technology assessments (HTAs) for nondrug health technologies using a deliberative framework. The framework spans several domains, including the environmental impact of the health technology(ies). Our research objective was to identify articles on frameworks, methods or case studies on the environmental impact assessment of health technologies. **METHODS:** A literature search in major databases and a focused gray literature search were conducted. The main search concepts were HTA and environmental impact/sustainability. Eligible articles were those that described a conceptual framework or methods used to conduct an environmental assessment of health technologies, and case studies on the application of an environmental assessment. **RESULTS:** From the 1,710 citations

identified, thirteen publications were included. Two articles presented a framework to incorporate environmental assessment in HTAs. Other approaches described weight of evidence practices and comprehensive and integrated environmental impact assessments. Central themes derived include transparency and repeatability, integration of components in a framework or of evidence into a single outcome, data availability to ensure the accuracy of findings, and familiarity with the approach used. CONCLUSIONS: Each framework and methods presented have different foci related to the ecosystem, health economics, or engineering practices. Their descriptions suggested transparency, repeatability, and the integration of components or of evidence into a single outcome as their main strengths. Our review is an initial step of a larger initiative by CADTH to develop the methods and processes to address the environmental impact question in an HTA.

Polivka, B. J. et Chaudry, R. V. (2018). "A scoping review of environmental health nursing research." *Public Health Nurs* 35(1): 10-17.

<https://onlinelibrary.wiley.com/doi/10.1111/phn.12373>

OBJECTIVE: The purpose of this scoping review was to determine the extent and focus of published environmental health nursing research. DESIGN AND SAMPLE: The search was limited to peer reviewed, English-language environmental health nursing research with at least one nursing author, published between 1995 and 2015 in a nursing journal, and catalogued in CINAHL. RESULTS: Publication of the 548 identified articles occurred in 118 different nursing journals. Annual number of publications increased from nine articles in 1995 to 50 in 2013 and 2014. Most (63%) of the studies occurred in the United States; the remaining studies took place in 33 other countries. Three primary focus areas were identified: disasters/disaster preparedness, occupational health, and the home environment. Other focus areas included environmental exposures, environmental risk perception, secondhand smoke, and environmental health education. The primary populations studied were nurses/nursing students (40%) and adults (26%). Most common research designs employed were cross-sectional (42%) and qualitative methods (20%). CONCLUSIONS: Findings from this scoping review support a global expansion of published environmental health nursing research addressing a variety of environmental health topics. Additional studies are needed that use more complex research methods and address timely topics such as climate change and sustainability.

Pradere, B., Mallet, R., de La Taille, A., et al. (2022). "Climate-smart Actions in the Operating Theatre for Improving Sustainability Practices: A Systematic Review." *Eur Urol*.

<https://www.sciencedirect.com/science/article/pii/S030228382200063X>

CONTEXT: Surgical activity contributes to global warming through the production of greenhouse gases and consumption of resources. To date, no clinical practice guidelines have been made to promote and implement climate-smart actions. OBJECTIVE: To perform a systematic review of the available actions that could limit CO<sub>2</sub> emission in the operating room (OR) and their potential benefits upon the environment, whilst preserving quality of care. EVIDENCE ACQUISITION: MEDLINE and Cochrane databases were searched from January 1, 1990 to April 2021. We included studies assessing carbon footprint (CF) in the OR and articles detailing actions that limit or reduce CF. EVIDENCE SYNTHESIS: Thirty-eight studies met the inclusion criteria. We identified six core climate-smart actions: (1) waste reduction by segregation; (2) waste reduction by recycling, reuse, and reprocessing; (3) sterilisation; (4) anaesthesia gas management; and (5) improvement of energy use. Quantitative analysis regarding the CF was not possible due to the lack of homogeneous data. For climate-smart actions, the analysis was limited by discrepancies in study scope and in the methodology of CO<sub>2</sub> emission calculation. Improvement of education and awareness was found to have an important impact on waste segregation and reduction. Waste management is the area where health care workers could have the strongest impact, whereas the main field to reduce CF in the OR was found to be energy consumption. CONCLUSIONS: This review provides arguments for many climate-smart actions that could be implemented in our daily practice. Improving awareness and education are important to act collectively in a sustainable way. Further studies are mandatory to assess the impact of these climate-smart actions in the OR. PATIENT SUMMARY: We performed a systematic review of the available scientific literature to reference all the climate-smart actions proposed to improve the sustainability of surgical activities. Waste segregation, waste reduction and recycling, reuse and reprocessing,

sterilisation, anaesthesia gas changes, and improvement of energy use in the operating room were found to be the main areas of research. There is still a long way to go to homogenise and improve the quality of our climate-smart actions.

Purohit, A., Smith, J. et Hibble, A. (2021). "Does telemedicine reduce the carbon footprint of healthcare? A systematic review." *Future Healthc J* **8**(1): e85-e91.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8004323/pdf/futurehealth-8-1-e85.pdf>

In the rapidly progressing field of telemedicine, there is a multitude of evidence assessing the effectiveness and financial costs of telemedicine projects; however, there is very little assessing the environmental impact despite the increasing threat of the climate emergency. This report provides a systematic review of the evidence on the carbon footprint of telemedicine. The identified papers unanimously report that telemedicine does reduce the carbon footprint of healthcare, primarily by reduction in transport-associated emissions. The carbon footprint savings range between 0.70-372 kg CO<sub>2</sub>e per consultation. However, these values are highly context specific. The carbon emissions produced from the use of the telemedicine systems themselves were found to be very low in comparison to emissions saved from travel reductions. This could have wide implications in reducing the carbon footprint of healthcare services globally. In order for telemedicine services to be successfully implemented, further research is necessary to determine context-specific considerations and potential rebound effects.

Rizan, C., Steinbach, I., Nicholson, R., et al. (2020). "The Carbon Footprint of Surgical Operations A Systematic Review." *Annals of Surgery* **272**(6): 986-995.

<https://pubmed.ncbi.nlm.nih.gov/32516230/>

Operating theatres are typically the most resource-intensive area of a hospital, 3-6 times more energy-intensive than the rest of the hospital and a major contributor of waste. The primary objective of this systematic review was to evaluate existing literature calculating the carbon footprint of surgical operations, determining opportunities for improving the environmental impact of surgery. Methods: A systematic review was conducted in accordance with PRISMA guidelines. The Cochrane Database, Embase, Ovid MEDLINE, and PubMed were searched and inclusion criteria applied. The study endpoints were extracted and compared, with the risk of bias determined. Results: A total of 4604 records were identified, and 8 were eligible for inclusion. This review found that the carbon footprint of a single operation ranged 6-814 kg carbon dioxide equivalents. The studies found that major carbon hotspots within the examined operating theatres were electricity use, and procurement of consumables. It was possible to reduce the carbon footprint of surgery through improving energy-efficiency of theatres, using reusable or reprocessed surgical devices and streamlining processes. There were significant methodological limitations within included studies. Conclusions: Future research should focus on optimizing the carbon footprint of operating theatres through streamlining operations, expanding assessments to other surgical contexts, and determining ways to reduce the footprint through targeting carbon hotspots.

Seifert, C., Koep, L., Wolf, P., et al. (2021). "Life cycle assessment as decision support tool for environmental management in hospitals: A literature review." *Health Care Manage Rev* **46**(1): 12-24.

**BACKGROUND:** Life cycle assessment (LCA) is an environmental accounting tool aimed at determining environmental impacts of products, processes, or organizational activities over the entire life cycle. Although this technique already provides decision-makers in other sectors with valuable information, its application in the health care setting has not yet been examined. **PURPOSE:** The aim of this study was to provide a comprehensive overview of scientific research on the application of LCA in hospitals and its contribution to management decision-making. **METHOD:** We perform a systematic literature review by searching a range of databases with synonyms of "LCA" in combination with the term "hospital" in order to identify peer-reviewed studies. The final sample of 43 studies were then subjected to a content analysis. **RESULTS:** We categorize existing research and show that single and multi-indicator LCA approaches are used to examine several products and processes in hospitals. The various approaches are favored by different scientific communities. Whereas researchers from

environmental sciences perform complex multi-indicator LCA studies, researchers from health care sciences focus on footprints. The studies compare alternatives and identify environmental impacts and harmful hotspots. PRACTICE IMPLICATIONS: LCA results can support health care managers' traditional decision-making by providing environmental information. With this additional information regarding the environmental impacts of products and processes, managers can implement organizational changes to improve their environmental performance. Furthermore, they can influence upstream and downstream activities. However, we recommend more transdisciplinary cooperation for LCA studies and to place more focus on actionable recommendations when publishing the results.

Rambaud, T., Marraud, L., et al. (2021). Décarboner la santé pour soigner durablement. Paris The Shift Project: 155.

<https://theshiftproject.org/wp-content/uploads/2021/11/211125-TSP-PTEF-Rapport-final-Sante.pdf>

Cette publication présente les principaux enjeux énergétiques et climatiques auxquels est confronté le secteur de la santé, ainsi que les leviers de décarbonation à actionner dès 2022 pour gagner en résilience. Cette étude a été actualisée en 2023. La mise à jour paraîtra en avril 2023

Seppanen, A. et Or, Z. (2023). The Environmental Sustainability of Health Care Systems: A literature review on the environmental footprint of health care system and interventions aiming to reduce it: for a framework for action for France. *Rapport (Irdes) ; 586*. Paris : Irdes, Irdes: 100p.

<https://www.irdes.fr/english/2023/report-586-the-environmental-sustainability-of-health-care-systems.html>

Rapport en anglais et synthèse en français

Global warming poses an increasing threat to health and health care systems. At the same time, health care systems have a significant effect on the environment and are major contributors to global warming. Nevertheless, the contribution of health care to global warming is largely overlooked in policy, and there is an urgent need to identify interventions that could reduce the environmental impact of health care systems and to develop strategies to improve their environmental sustainability. In this report we present the results from two complementary literature reviews: the first provides an overview of the environmental impact of the main health care sectors and sources of pollution, and the second - a scoping review - identifies a representative sample of interventions used in high-income countries to reduce the environmental footprint of health care, and their estimated impact. We pooled the results from two reviews to propose a holistic framework for action for improving the environmental sustainability of the health care system. In all care sectors, numerous "green interventions" have been reported to successfully reduce the environmental impact of health care across a range of domains, such as reducing and recycling waste, shifting to less ozone-depleting anesthetic gases and green energy sources, but these remain insufficient unless accompanied by sustainability strategies transforming the way care is provided and consumed, assuring the pertinence of care, and attenuating care need for a more sustainable care consumption. Our framework identifies a set of concrete measures to be implemented simultaneously to reduce both direct and indirect causes of environmental impact in the health care sector in France.

Siu, J., Hill, A. G. et MacCormick, A. D. (2017). "Systematic review of reusable versus disposable laparoscopic instruments: costs and safety." *ANZ J Surg* **87**(1-2): 28-33.

<https://onlinelibrary.wiley.com/doi/10.1111/ans.13856>

BACKGROUND: The quality of instruments and surgical expertise in minimally invasive surgery has developed markedly in the last two decades. Attention is now being turned to ways to allow surgeons to adopt more cost-effective and environmental-friendly approaches. This review explores current evidence on the cost and environmental impact of reusable versus single-use instruments. In addition, we aim to compare their quality, functionality and associated clinical outcomes. METHOD: The Medline and EMBASE databases were searched for relevant literature from January 2000 to May 2015. Subject headings were Equipment Reuse/, Disposable Equipment/, Cholecystectomy/, Laparoscopic/, Laparoscopy/, Surgical Instruments/, Medical Waste Disposal/, Waste Management/, Medical Waste/, Environmental Sustainability/ and Sterilization/. RESULTS: There are few objective comparative analyses between single-use versus reusable instruments. Current evidence suggests that limiting use

of disposal instruments to necessity may hold both economical and environmental advantages. Theoretical advantages of single-use instruments in quality, safety, sterility, ease of use and importantly patient outcomes have rarely been examined. Cost-saving methods, environmental-friendly methods, global operative costs, hidden costs, sterilization methods and quality assurance systems vary greatly between studies making it difficult to gain an overview of the comparison between single-use and reusable instruments. CONCLUSIONS: Further examination of cost comparisons between disposable and reusable instruments is necessary while externalized environmental costs, instrument function and safety are also important to consider in future studies.

Walker, R., Hassall, J., Chaplin, S., et al. (2011). "Health promotion interventions to address climate change using a primary health care approach: a literature review." *Health Promot J Austr* **22 Spec No**: S6-12.

ISSUE ADDRESSED: This project explored the literature in which key concepts in primary health care and health promotion are overtly applied to the problem of climate change. This paper contains a discussion of the literature relevant to health promotion principles and intervention strategies for addressing climate change mitigation and adaptation in the primary health care sector. The concept of primary health care is that used by the World Health Organization, based on the Declaration of Alma Ata and often referred to as comprehensive primary health care to differentiate it from primary medical care. METHODS: This was a review of literature identified in electronic databases using two sets of search terms. Set A consisted of 'climate change or global warming or greenhouse effect' and set B consisted of 11 key concepts in primary health care and health promotion, for example community resilience, health promotion, social change, food security and economic development. Relevant literature was identified at the intersection of search term A with a term from set B. A search was completed for each set B term. RESULTS: This paper reports a discussion of major categories of health promotion interventions, namely health communication, community building and settings approaches and uses examples drawn from literature on community resilience and summer heat. These interventions are all applicable to the primary health care sector. CONCLUSION: There is a small literature on health promotion interventions for climate change mitigation and adaptation but it is incomplete and scattered across many sources. An important area for further research is to link the logic of service provision in primary health care to the logic of mitigation and adaptation in a changing environment. Interventions that link the logic must also link diverse services to provide coherent action on local and domestic scales, the scales at which primary health care acts. Another research gap is in regard to institutional change in the primary health care sector. How do the patterns of knowledge, practice and values need to change in the array of organisations that make up comprehensive primary health care?

Wong, Y. L., Noor, M., James, K. L., et al. (2021). "Ophthalmology Going Greener: A Narrative Review." *Ophthalmology and Therapy* **10**(4): 845-857.

[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8502635/pdf/40123\\_2021\\_Article\\_404.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8502635/pdf/40123_2021_Article_404.pdf)

Yang, L., Liu, C., Hess, J., et al. (2019). "Health professionals in a changing climate: protocol for a scoping review." *BMJ Open* **9**(2): e024451.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6398618/pdf/bmjopen-2018-024451.pdf>

INTRODUCTION: Climate change will impose significant health impacts. Although we know health professionals should play a critical role in protecting human health from climate change, their preparedness to engage with these issues worldwide is unclear. This study aims to map the range and nature of existing evidence regarding health professionals' knowledge, attitudes, perceptions and practices regarding climate change and health impacts and the challenges they face, and identify knowledge gaps to guide future development of research, policy and practices. METHODS AND ANALYSIS: We will perform a scoping review based on the six-stage framework proposed by Arksey and O'Malley. Our study includes peer-reviewed literature focusing on any aspect of health professionals' work regarding climate change and health since 2002 and indexed in MEDLINE/Pubmed, Web of Science, Scopus or Embase. Identified papers will be described and assessed. Thematic analysis will be applied to evaluate and categorise the study findings. IMPLICATIONS AND DISSEMINATION: This is the first scoping review of health professionals' activities to anticipate and prepare for health

impacts attributable to climate change. It will provide evidence regarding the current situations worldwide and gaps in preparedness. The findings can be used to highlight accomplishments to date, identify gaps and further develop good practices for health professionals' engagement. The results will be published in the peer-reviewed literature and shared at health professional society meetings.

## L'impact des systèmes de santé sur l'environnement

Andrews, E., Pearson, D., Kelly, C., et al. (2013). "Carbon footprint of patient journeys through primary care: a mixed methods approach." *Br J Gen Pract* **63**(614): e595-603.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3750798/pdf/bjgp-sep2013-63-614-e595.pdf>

**BACKGROUND:** The NHS has a target of cutting its carbon dioxide (CO<sub>2</sub>) emissions by 80% below 1990 levels by 2050. Travel comprises 17% of the NHS carbon footprint. This carbon footprint represents the total CO<sub>2</sub> emissions caused directly or indirectly by the NHS. Patient journeys have previously been planned largely without regard to the environmental impact. The potential contribution of 'avoidable' journeys in primary care is significant. **AIM:** To investigate the carbon footprint of patients travelling to and from a general practice surgery, the issues involved, and potential solutions for reducing patient travel. **DESIGN AND SETTING:** A mixed methods study in a medium-sized practice in Yorkshire. **METHOD:** During March 2012, 306 patients completed a travel survey. GIS maps of patients' travel (modes and distances) were produced. Two focus groups (12 clinical and 13 non-clinical staff) were recorded, transcribed, and analysed using a thematic framework approach. **RESULTS:** The majority (61%) of patient journeys to and from the surgery were made by car or taxi; main reasons cited were 'convenience', 'time saving', and 'no alternative' for accessing the surgery. Using distances calculated via ArcGIS, the annual estimated CO<sub>2</sub> equivalent carbon emissions for the practice totalled approximately 63 tonnes. Predominant themes from interviews related to issues with systems for booking appointments and repeat prescriptions; alternative travel modes; delivering health care; and solutions to reducing travel. **CONCLUSION:** The modes and distances of patient travel can be accurately determined and allow appropriate carbon emission calculations for GP practices. Although challenging, there is scope for identifying potential solutions (for example, modifying administration systems and promoting walking) to reduce 'avoidable' journeys and cut carbon emissions while maintaining access to health care.

Azuma, T., Otomo, K., Kunitou, M., et al. (2019). "Environmental fate of pharmaceutical compounds and antimicrobial-resistant bacteria in hospital effluents, and contributions to pollutant loads in the surface waters in Japan." *Sci Total Environ* **657**: 476-484.

<https://www.sciencedirect.com/science/article/abs/pii/S0048969718347880?via%3Dihub>

Environmental fate of 58 pharmaceutical compounds (PhCs) grouped into 11 therapeutic classes in the three different waters, hospital effluent, sewage treatment plant (STP) and river water, was estimated by combination of their quantitative concentration analysis and evaluation of their extent of contribution as loading sources. At the same time, distribution of six classes of antimicrobial-resistant bacteria (AMRB) in the same water samples was estimated by screening of individual PhC-resistant microbes grown on each specific chromogenic medium. The results indicate that 48 PhCs were detected ranged from 1 ng/L (losartan carboxylic acid) to 228 µg/L (acetaminophen sulfate) in hospital effluent, and contribution of the pollution load derived from hospital effluent to STP influent was estimated as 0.1% to 15%. On the other hand, contribution of STP effluent to river water was high, 32% to 60% for antibacterials, antipertensives and X-ray contrast media. In the cases for AMRB, detected numbers of colonies of AMRB in hospital effluent ranged from 29 CFU/mL to 1805 CFU/mL, and the estimated contribution of the AMRB pollution load derived from hospital effluent to STP influent was as low as 0.1% (levofloxacin and olmesartan) to 5.1% (N-desmethyl tamoxifen). Although the contribution of STPs as loading sources of PhCs and AMRB in surface waters was large, ozonation as an advanced water treatment system effectively removed a wide range of both PhCs and AMRB in water samples. These results suggest the importance of reducing environmental pollutant loads (not only at STPs but also at medical facilities) before being discharged into the surface waters, to both

conserve water and keep the water environment safe. To our knowledge, this is the first report to show the distribution and contribution of AMRB from hospital effluent to the surface waters.

Bartlett, S. et Keir, S. (2022). "Calculating the carbon footprint of a Geriatric Medicine clinic before and after COVID-19." *Age and Ageing* **51**(2).

<https://doi.org/10.1093/ageing/afab275>

climate change is a health emergency. Central to addressing this is understanding the carbon footprint of our daily life and work, in order to reduce it effectively. The coronavirus disease of 2019 (COVID-19) pandemic has brought about rapid change to clinical practice, most notably in use of virtual clinics and personal protective equipment (PPE). to estimate the carbon footprint of a Geriatric Medicine clinic, including the effect of virtual consultation and PPE, in order to inform design of a service that addresses both the health of our patients and our environment. Data from the Greenhouse Gas Protocol, NHS Carbon Footprint Plus and UK Government were used to estimate the carbon emissions per consultation. Values were calculated for virtual and face-to-face contact and applied to actual clinics both before and during the COVID-19 pandemic. The carbon footprint of a face-to-face clinic consultation is 4.82 kgCO<sub>2</sub>e, most of which is patient travel, followed by staff travel and use of PPE. The footprint of a virtual consultation is 0.99 kgCO<sub>2</sub>e, most of which is staff travel, followed by data use. Using our hybrid model for a single session clinic reduced our annual carbon footprint by an estimated 200 kgCO<sub>2</sub>e, roughly equivalent to a surgical operation. The COVID-19 pandemic has made us deliver services differently. The environmental benefits seen of moving to a partially virtual clinic highlight the importance of thinking beyond reverting to "business as usual" —instead deliberately retaining changes, which benefit the current and future health of our community.

Belkhir, L. et Elmeligi, A. (2019). "Carbon footprint of the global pharmaceutical industry and relative impact of its major players." *Journal of Cleaner Production* **214**: 185-194.

<https://www.sciencedirect.com/science/article/abs/pii/S0959652618336084?via%3Dihub>

Blenkinsop, S., Foley, A., Schneider, N., et al. (2021). "Carbon emission savings and short-term health care impacts from telemedicine: An evaluation in epilepsy." *Epilepsia* **62**(11): 2732-2740.

<https://onlinelibrary.wiley.com/doi/10.1111/epi.17046>

<https://onlinelibrary.wiley.com/doi/pdfdirect/10.1111/epi.17046?download=true>

**OBJECTIVE:** Health systems make a sizeable contribution to national emissions of greenhouse gases that contribute to global climate change. The UK National Health Service is committed to being a net zero emitter by 2040, and a potential contribution to this target could come from reductions in patient travel. Achieving this will require actions at many levels. We sought to determine potential savings and risks over the short term from telemedicine through virtual clinics. **METHODS:** During the severe acute respiratory syndrome coronavirus 2 (SARS-2-CoV) pandemic, scheduled face-to-face epilepsy clinics at a specialist site were replaced by remote teleclinics. We used a standard methodology applying conversion factors to calculate emissions based on the total saved travel distance. A further conversion factor was used to derive emissions associated with electricity consumption to deliver remote clinics from which net savings could be calculated. Patients' records and clinicians were interrogated to identify any adverse clinical outcomes. **RESULTS:** We found that enforced telemedicine delivery for over 1200 patients resulted in the saving of ~224 000 km of travel with likely avoided emissions in the range of 35 000-40 000 kg carbon dioxide equivalent (CO<sub>2</sub> e) over a six and half month period. Emissions arising directly from remote delivery were calculated to be <200 kg CO<sub>2</sub> e (~0.5% of those for travel), representing a significant net reduction of greenhouse gas emissions. Only one direct adverse outcome was identified, with some additional benefits identified anecdotally. **SIGNIFICANCE:** The use of telemedicine can make a contribution toward reduced emissions in the health care sector and, in the delivery of specialized epilepsy services, had minimal adverse clinical outcomes over the short term. However, these outcomes will likely vary with clinic locations, medical specialties and conditions.

Brown, L. H., Canyon, D. V., Buettner, P. G., et al. (2012). "The carbon footprint of Australian ambulance operations." *Emerg Med Australas* **24**(6): 657-662.



<https://onlinelibrary.wiley.com/doi/10.1111/j.1742-6723.2012.01591.x>

**OBJECTIVE:** To determine the greenhouse gas emissions associated with the energy consumption of Australian ambulance operations, and to identify the predominant energy sources that contribute to those emissions. **METHODS:** A two-phase study of operational and financial data from a convenience sample of Australian ambulance operations to inventory their energy consumption and greenhouse gas emissions for 1 year. State- and territory-based ambulance systems serving 58% of Australia's population and performing 59% of Australia's ambulance responses provided data for the study. **RESULTS:** Emissions for the participating systems totalled 67 390 metric tons of carbon dioxide equivalents. For ground ambulance operations, emissions averaged 22 kg of carbon dioxide equivalents per ambulance response, 30 kg of carbon dioxide equivalents per patient transport and 3 kg of carbon dioxide equivalents per capita. Vehicle fuels accounted for 58% of the emissions from ground ambulance operations, with the remainder primarily attributable to electricity consumption. Emissions from air ambulance transport were nearly 200 times those for ground ambulance transport. **CONCLUSION:** On a national level, emissions from Australian ambulance operations are estimated to be between 110 000 and 120 000 tons of carbon dioxide equivalents each year. Vehicle fuels are the primary source of emissions for ground ambulance operations. Emissions from air ambulance transport are substantially higher than those for ground ambulance transport.

Carlson, L. C., Reynolds, T. A., Wallis, L. A., et al. (2019). "Reconceptualizing the role of emergency care in the context of global healthcare delivery." *Health Policy Plan* **34**(1): 78-82.

<https://academic.oup.com/heapol/article-abstract/34/1/78/5301490?redirectedFrom=fulltext>

Castres, P., Dajnak, D., Lott, M., et al. (2017). "Most London hospitals and clinics exceed air pollution limits." *Bmj* **357**: j2855.

<https://www.bmj.com/content/357/bmj.j2855.long>

Connor, A., Lillywhite, R. et Cooke, M. W. (2010). "The carbon footprint of a renal service in the United Kingdom." *Qjm* **103**(12): 965-975.

<https://academic.oup.com/qjmed/article/103/12/965/1584174>

**BACKGROUND:** Anthropogenic climate change presents a major global health threat. However, the very provision of healthcare itself is associated with a significant environmental impact. Carbon footprinting techniques are increasingly used outside of the healthcare sector to assess greenhouse gas emissions and inform strategies to reduce them. **AIM:** This study represents the first assessment of the carbon footprint of an individual specialty service to include both direct and indirect emissions. **METHODS:** This was a component analysis study. Activity data were collected for building energy use, travel and procurement. Established emissions factors were applied to reconcile this data to carbon dioxide equivalents (CO<sub>2</sub>eq) per year. **RESULTS:** The Dorset Renal Service has a carbon footprint of 3006 tonnes CO<sub>2</sub>eq per annum, of which 381 tonnes CO<sub>2</sub>eq (13% of overall emissions) result from building energy use, 462 tonnes CO<sub>2</sub>eq from travel (15%) and 2163 tonnes CO<sub>2</sub>eq (72%) from procurement. The contributions of the major subsectors within procurement are: pharmaceuticals, 1043 tonnes CO<sub>2</sub>eq (35% of overall emissions); medical equipment, 753 tonnes CO<sub>2</sub>eq (25%). The emissions associated with healthcare episodes were estimated at 161 kg CO<sub>2</sub>eq per bed day for an inpatient admission and 22 kg CO<sub>2</sub>eq for an outpatient appointment. **CONCLUSION:** These results suggest that carbon-reduction strategies focusing upon supply chain emissions are likely to yield the greatest benefits. Sustainable waste management and strategies to reduce emissions associated with building energy use and travel will also be important. A transformation in the way that clinical care is delivered is required, such that lower carbon clinical pathways, treatments and technologies are embraced. The estimations of greenhouse gas emissions associated with outpatient appointments and inpatient stays calculated here may facilitate modelling of the emissions of alternative pathways of care.

Connor, A., Lillywhite, R. et Cooke, M. W. (2011). "The carbon footprints of home and in-center maintenance hemodialysis in the United Kingdom." *Hemodialysis International* **15**(1): 39-51.

<https://onlinelibrary.wiley.com/doi/10.1111/j.1542-4758.2010.00523.x>

Copernicus (2021). Copernicus: 2020 warmest year on record for Europe; globally, 2020 ties with 2016 for warmest year recorded [Press release]. Copernicus: 9p.

[https://climate.copernicus.eu/sites/default/files/2021-02/C3S%20Annualtempdata%202020\\_final.pdf](https://climate.copernicus.eu/sites/default/files/2021-02/C3S%20Annualtempdata%202020_final.pdf)

Deblonde, T. et Hartemann, P. (2013). "Environmental impact of medical prescriptions: assessing the risks and hazards of persistence, bioaccumulation and toxicity of pharmaceuticals." *Public Health* **127**(4): 312-317.

<https://www.sciencedirect.com/science/article/abs/pii/S0033350613000668?via%3Dihub>

In the context of increasing concerns regarding sustainable development, healthcare workers must consider practices that are not harmful to the environment. 'Primum non nocere' is of great value for the residues of pharmaceuticals and biocides resulting from medical prescriptions. Stockholm County Council has developed a simple classification system covering both environmental risks and hazards of pharmaceuticals according to their persistence, bioaccumulation and toxicity. This classification, which is easy to understand and well accepted among Swedish medical doctors, could be a model for other countries and useful to general medical doctors wishing to be environmentally conscious in their prescribing. Limited information is available on both the fate and ecotoxicity of pharmaceuticals and biocides in the aquatic environment. The primary concern regarding the environmental impact of pharmaceuticals seems to be drug classes such as antibiotics, oestrogens, cytostatic agents, contrast agents and disinfectants. Performing a full ecological risk assessment of pharmaceuticals and biocides is difficult because of a lack of data on exposure scenarios, target aquatic species and dose-response relationships.

Dias-Ferreira, C., Santos, T. et Oliveira, V. (2015). "Hospital food waste and environmental and economic indicators--A Portuguese case study." *Waste Manag* **46**: 146-154.

<https://www.sciencedirect.com/science/article/abs/pii/S0956053X15301343?via%3Dihub>

This study presents a comprehensive characterization of plate waste (food served but not eaten) at an acute care hospital in Portugal and elaborates on possible waste reduction measures. Even though waste prevention is a priority in Europe, large amounts of food are still being wasted every day, with hospitals giving rise to two to three times more food waste than other foodservice sectors. For this work the plate waste arising at the ward level was audited during 8 weeks, covering almost 8000 meals, using a general hospital as case study. Weighing the food served to patients and that returned after the meal allowed calculating plate waste for the average meal, as well as for individual meal items. Comparison of food waste arising showed that differences exist among wards, with some generating more waste than others. On average each patient throws away 953 g of food each day, representing 35% of the food served. This equates to 8.7 thousand tonnes of food waste being thrown away each year at hospitals across Portugal. These tonnes of food transformed into waste represent economic losses and environmental impacts, being estimated that 16.4 thousand tonnes of CO<sub>2</sub> (equivalent) and 35.3 million euros are the annual national indicators in Portugal. This means that 0.5% of the Portuguese National Health budget gets thrown away as food waste. Given the magnitude of the food problem five measures were suggested to reduce food waste, and their potential impact and ease of implementation were discussed. Even though food waste is unavoidable the results obtained in this work highlight the potential financial and environmental savings for Portuguese hospitals, providing a basis to establish future strategies to tackle food waste.

Duane, B., Lee, M. B., White, S., et al. (2017). "An estimated carbon footprint of NHS primary dental care within England. How can dentistry be more environmentally sustainable?" *Br Dent J* **223**(8): 589-593.

<https://www.nature.com/articles/sj.bdj.2017.839.pdf>

Introduction National Health Service (NHS) England dental teams need to consider from a professional perspective how they can, along with their NHS colleagues, play their part in reducing their carbon emissions and improve the sustainability of the care they deliver. In order to help understand carbon emissions from dental services, Public Health England (PHE) commissioned a calculation and analysis of the carbon footprint of key dental procedures. Methods Secondary data analysis from Business Services Authority (BSA), Health and Social Care Information Centre (HSCIC) (now called NHS Digital,

Information Services Division [ISD]), National Association of Specialist Dental Accountants (NASDA) and recent Scottish papers was undertaken using a process-based and environmental input-output analysis using industry established conversion factors. Results The carbon footprint of the NHS dental service is 675 kilotonnes carbon dioxide equivalents (CO<sub>2</sub>e). Examinations contributed the highest proportion to this footprint (27.1%) followed by scale and polish (13.4%) and amalgam/composite restorations (19.3%). From an emissions perspective, nearly 2/3 (64.5%) of emissions related to travel (staff and patient travel), 19% procurement (the products and services dental clinics buy) and 15.3% related to energy use. The results are estimates of carbon emissions based on a number of broad assumptions. More research, education and awareness is needed to help dentistry develop low carbon patient pathways.

Eckelman, M. J. et Sherman, J. (2016). "Environmental Impacts of the U.S. Health Care System and Effects on Public Health." *PLoS One* **11**(6): e0157014.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4900601/pdf/pone.0157014.pdf>

The U.S. health care sector is highly interconnected with industrial activities that emit much of the nation's pollution to air, water, and soils. We estimate emissions directly and indirectly attributable to the health care sector, and potential harmful effects on public health. Negative environmental and public health outcomes were estimated through economic input-output life cycle assessment (EIO-LCA) modeling using National Health Expenditures (NHE) for the decade 2003-2013 and compared to national totals. In 2013, the health care sector was also responsible for significant fractions of national air pollution emissions and impacts, including acid rain (12%), greenhouse gas emissions (10%), smog formation (10%) criteria air pollutants (9%), stratospheric ozone depletion (1%), and carcinogenic and non-carcinogenic air toxics (1-2%). The largest contributors to impacts are discussed from both the supply side (EIO-LCA economic sectors) and demand side (NHE categories), as are trends over the study period. Health damages from these pollutants are estimated at 470,000 DALYs lost from pollution-related disease, or 405,000 DALYs when adjusted for recent shifts in power generation sector emissions. These indirect health burdens are commensurate with the 44,000-98,000 people who die in hospitals each year in the U.S. as a result of preventable medical errors, but are currently not attributed to our health system. Concerted efforts to improve environmental performance of health care could reduce expenditures directly through waste reduction and energy savings, and indirectly through reducing pollution burden on public health, and ought to be included in efforts to improve health care quality and safety.

Eckelman, M. J. et Sherman, J. D. (2018). "Estimated Global Disease Burden From US Health Care Sector Greenhouse Gas Emissions." *Am J Public Health* **108**(S2): S120-s122.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5922190/pdf/AJPH.2017.303846.pdf>

**OBJECTIVES:** To quantify the increased disease burden caused by US health care sector life cycle greenhouse gas (GHG) emissions of 614 million metric tons of carbon dioxide equivalents in 2013. **METHODS:** We screened for health damage factors that linked GHG emissions to disease burdens. We selected 5 factors, based on appropriate temporal modeling scales, which reflect a range of possible GHG emissions scenarios. We applied these factors to health care sector emissions. **RESULTS:** We projected that annual GHG emissions associated with health care in the United States would cause 123 000 to 381 000 disability-adjusted life-years in future health damages, with malnutrition being the largest damage category. **CONCLUSIONS:** Through their contribution to global climate change, GHG emissions will negatively affect public health because of an increased prevalence of extreme weather, flooding, vector-borne disease, and other effects. As the stewards of global health, it is important for health care professionals to recognize the magnitude of GHG emissions associated with health care itself, and the severity of associated health damages.

Eckelman, M. J., Sherman, J. D. et MacNeill, A. J. (2018). "Life cycle environmental emissions and health damages from the Canadian healthcare system: An economic-environmental-epidemiological analysis." *PLoS Med* **15**(7): e1002623.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6067712/pdf/pmed.1002623.pdf>

**BACKGROUND:** Human health is dependent upon environmental health. Air pollution is a leading cause of morbidity and mortality globally, and climate change has been identified as the single greatest public health threat of the 21st century. As a large, resource-intensive sector of the Canadian economy, healthcare itself contributes to pollutant emissions, both directly from facility and vehicle emissions and indirectly through the purchase of emissions-intensive goods and services. Together these are termed life cycle emissions. Here, we estimate the extent of healthcare-associated life cycle emissions as well as the public health damages they cause. **METHODS AND FINDINGS:** We use a linked economic-environmental-epidemiological modeling framework to quantify pollutant emissions and their implications for public health, based on Canadian national healthcare expenditures over the period 2009-2015. Expenditures gathered by the Canadian Institute for Health Information (CIHI) are matched to sectors in a national environmentally extended input-output (EEIO) model to estimate emissions of greenhouse gases (GHGs) and >300 other pollutants. Damages to human health are then calculated using the IMPACT2002+ life cycle impact assessment model, considering uncertainty in the damage factors used. On a life cycle basis, Canada's healthcare system was responsible for 33 million tonnes of carbon dioxide equivalents (CO<sub>2</sub>e), or 4.6% of the national total, as well as >200,000 tonnes of other pollutants. We link these emissions to a median estimate of 23,000 disability-adjusted life years (DALYs) lost annually from direct exposures to hazardous pollutants and from environmental changes caused by pollution, with an uncertainty range of 4,500-610,000 DALYs lost annually. A limitation of this national-level study is the use of aggregated data and multiple modeling steps to link healthcare expenditures to emissions to health damages. While informative on a national level, the applicability of these findings to guide decision-making at individual institutions is limited. Uncertainties related to national economic and environmental accounts, model representativeness, and classification of healthcare expenditures are discussed. **CONCLUSIONS:** Our results for GHG emissions corroborate similar estimates for the United Kingdom, Australia, and the United States, with emissions from hospitals and pharmaceuticals being the most significant expenditure categories. Non-GHG emissions are responsible for the majority of health damages, predominantly related to particulate matter (PM). This work can guide efforts by Canadian healthcare professionals toward more sustainable practices.

Emeryk, A. W., Sosnowski, T., Kupczyk, M., et al. (2021). "Impact of inhalers used in the treatment of respiratory diseases on global warming." *Adv Respir Med* **89**(4): 427-438.  
[https://journals.viamedica.pl/advances\\_in\\_respiratory\\_medicine/article/download/ARM.a2021.0092/64004](https://journals.viamedica.pl/advances_in_respiratory_medicine/article/download/ARM.a2021.0092/64004)

The term "carbon footprint" describes the emission of greenhouse gases into the environment as a result of human activities. The healthcare sector is responsible for 5-8% of the value of global greenhouse gas emissions, of which medical aerosols account for only 0.03% of the total emissions. The reduction of greenhouse gases, including those used for the production and use of medicinal products and medical devices, is part of the responsibilities that Poland and the respective countries should undertake in order to implement the assumptions of international law. At the level of medical law, this obligation correlates with the need to exercise due diligence in the process of providing health services, including the selection of low-emission medical products and devices (inhalers) and providing patients with information on how to handle used products and devices, with particular emphasis on those that imply greenhouse gas emissions. Pressurized metered dose inhalers (pMDI) containing the hydrofluoroalkane 134a demonstrate the largest carbon footprint, followed by a metered dose liquid inhaler and dry powder inhalers (DPI). The carbon footprint of DPI with a given drug is 13-32 times lower than it is in the case of the corresponding pMDI. Replacement of pMDI by DPI is one of the effective methods to reduce the carbon footprint of inhalers, and the replacement should be based on current medical knowledge. A recycling system for all types of inhalers must be urgently implemented.

Esmaeili, A., McGuire, C., Overcash, M., et al. (2018). "Environmental impact reduction as a new dimension for quality measurement of healthcare services." *Int J Health Care Qual Assur* **31**(8): 910-922.

**PURPOSE:** The purpose of this paper is to provide a detailed accounting of energy and materials consumed during magnetic resonance imaging (MRI). **DESIGN/METHODOLOGY/APPROACH:** The first and second stages of ISO standard (ISO 14040:2006 and ISO 14044:2006) were followed to develop life

cycle inventory (LCI). The LCI data collection took the form of observations, time studies, real-time metered power consumption, review of imaging department scheduling records and review of technical manuals and literature. FINDINGS: The carbon footprint of the entire MRI service on a per-patient basis was measured at 22.4 kg CO<sub>2</sub>eq. The in-hospital energy use (process energy) for performing MRI is 29 kWh per patient for the MRI machine, ancillary devices and light fixtures, while the out-of-hospital energy consumption is approximately 260 percent greater than the process energy, measured at 75 kWh per patient related to fuel for generation and transmission of electricity for the hospital, plus energy to manufacture disposable, consumable and reusable products. The actual MRI and standby energy that produces the MRI images is only about 38 percent of the total life cycle energy. RESEARCH LIMITATIONS/IMPLICATIONS: The focus on methods and proof-of-concept meant that only one facility and one type of imaging device technology were used to reach the conclusions. Based on the similar studies related to other imaging devices, the provided transparent data can be generalized to other healthcare facilities with few adjustments to utilization ratios, the share of the exam types, and the standby power of the facilities' imaging devices. PRACTICAL IMPLICATIONS: The transparent detailed life cycle approach allows the data from this study to be used by healthcare administrators to explore the hidden public health impact of the radiology department and to set goals for carbon footprint reductions of healthcare organizations by focusing on alternative imaging modalities. Moreover, the presented approach in quantifying healthcare services' environmental impact can be replicated to provide measurable data on departmental quality improvement initiatives and to be used in hospitals' quality management systems. ORIGINALITY/VALUE: No other research has been published on the life cycle assessment of MRI. The share of outside hospital indirect environmental impact of MRI services is a previously undocumented impact of the physician's order for an internal image.

Feo, M. L., Bagnati, R., Passoni, A., et al. (2020). "Pharmaceuticals and other contaminants in waters and sediments from Augusta Bay (southern Italy)." *Sci Total Environ* **739**: 139827.

<https://www.sciencedirect.com/science/article/abs/pii/S0048969720333477?via%3Dihub>

The contamination by pharmaceuticals products (PPs) in the marine environment is particularly relevant where wastewater treatment of urban areas on land is lacking. However, the number of studies focused on description of sources and fate of PP molecules in the marine environment remains still limited. In this study, the occurrence of 46 PPs was investigated in the marine and coastal-marine system (waters and sediments) of Augusta Bay (central Mediterranean Sea). This area is highly affected by industrial pollution and urban discharges (without wastewater treatment) and thus represents a 'natural laboratory' for exploring dynamics of multi-mixture contaminants in the marine environment. The study area is also part of the sub-region 'Central Mediterranean Sea' of the Marine Strategy Framework Directive and therefore offers an important reference site for exploring the distribution modes of PPs in the central Mediterranean Sea. In this work, samples of seawater, sediment, untreated wastewater, and marine receiving water were analysed using mass spectrometry with a target analysis for PPs and a suspect screening analysis for the presence of other contaminants. PPs concentration ranges were: 2426-67,155 ng/L for untreated wastewaters, 550-27,889 ng/L for marine receiving waters and 12-281 ng/L for seawaters. The highest concentrations were measured for the antibiotics, anti-inflammatories, cardiovascular and antihypertensive therapeutic classes. Likewise, sediments collected from untreated wastewater sewers resulted more contaminated. Ionic, non-ionic surfactants and personal care products were the most abundant compounds found in waters and sediments by suspect screening analysis. The risk associated with PPs contamination for aquatic organisms was relatively high in samples of marine receiving waters of the bay (with a risk quotient value up to 33,599). The levels of PPs in seawater and sediment compartments were generally not hazardous (RQ < 0.01), except for estrone with a calculated RQ = 2775.

Fonseca, E., Hernández, F., Ibáñez, M., et al. (2020). "Occurrence and ecological risks of pharmaceuticals in a Mediterranean river in Eastern Spain." *Environ Int* **144**: 106004.

Pharmaceuticals are biologically active molecules that may exert toxic effects to a wide range of aquatic organisms. They are considered contaminants of emerging concern due to their common presence in wastewaters and in the receiving surface waters, and the lack of specific regulations to

monitor their environmental occurrence and risks. In this work, the environmental exposure and risks of pharmaceuticals have been studied in the Mijares River, Eastern Mediterranean coast (Spain). A total of 57 surface water samples from 19 sampling points were collected in three monitoring campaigns between June 2018 and February 2019. A list of 40 compounds was investigated using a quantitative target UHPLC-MS/MS method. In order to complement the data obtained, a wide-scope screening of pharmaceuticals and metabolites was also performed by UHPLC-HRMS. The ecological risks posed by the pharmaceutical mixtures were evaluated using species sensitivity distributions built with chronic toxicity data for aquatic organisms. In this study, up to 69 pharmaceuticals and 9 metabolites were identified, out of which 35 compounds were assessed using the quantitative method. The highest concentrations in water corresponded to acetaminophen, gabapentin, venlafaxine, valsartan, ciprofloxacin and diclofenac. The compounds that were found to exert the highest toxic pressure on the aquatic ecosystems were principally analgesic/anti-inflammatory drugs and antibiotics. These were: phenazone > azithromycin > diclofenac, and to a lower extent norfloxacin > ciprofloxacin > clarithromycin. The monitored pharmaceutical mixtures are expected to exert severe ecological risks in areas downstream of WWTP discharges, with the percentage of aquatic species affected ranging between 65% and 82% in 3 out of the 19 evaluated sites. In addition, five antibiotics were found to exceed antibiotic resistance thresholds, thus potentially contributing to resistance gene enrichment in environmental bacteria. This work illustrates the wide use and impact of pharmaceuticals in the area under study, and the vulnerability of surface waters if only conventional wastewater treatments are applied. Several compounds included in this study should be incorporated in future water monitoring programs to help in the development of future regulations, due to their potential risk to the aquatic environment.

Latta, M., Shaw, C. et Gale, J. (2021). "The carbon footprint of cataract surgery in Wellington." *N Z Med J* **134**(1541): 13-21.

**INTRODUCTION:** Efforts to improve the sustainability of ophthalmic care require methods to measure its environmental impact and a baseline measurement to compare against in the future. We aimed to measure the carbon footprint of cataract surgery in Wellington. **METHODS:** We used EyeEfficiency, an application using established footprinting methods, to estimate the emissions produced by phacoemulsification surgery in two public and two private hospitals. We measured (1) power consumption, (2) procurement of disposable items and pharmaceuticals, (3) waste disposal emissions and (4) travel (other potential sources were excluded). Where possible we used New Zealand emissions coefficients. **RESULTS:** We recorded data from 142 cataract surgeries. The average emissions produced by cataract surgery in the region was estimated to be 152kg of carbon dioxide equivalent. This is equivalent to 62L of petrol and would take 45m<sup>2</sup> of forest one year to absorb. The great majority of emissions were from procurement, mostly disposable materials, and the second greatest contribution was from travel (driving). **CONCLUSION:** Estimating the carbon footprint of cataract surgery is becoming easier, but improved methods for measuring the footprint of procured supplies are needed. There are significant opportunities for emissions reduction in the most common surgical procedure in New Zealand.

Lenzen, M., Malik, A., Li, M., et al. (2020). "The environmental footprint of health care: a global assessment." *The Lancet Planetary Health* **4**(7): e271-e279.  
<https://www.sciencedirect.com/science/article/pii/S2542519620301212>

**Summary Background** Health-care services are necessary for sustaining and improving human wellbeing, yet they have an environmental footprint that contributes to environment-related threats to human health. Previous studies have quantified the carbon emissions resulting from health care at a global level. We aimed to provide a global assessment of the wide-ranging environmental impacts of this sector. **Methods** In this multiregional input-output analysis, we evaluated the contribution of health-care sectors in driving environmental damage that in turn puts human health at risk. Using a global supply-chain database containing detailed information on health-care sectors, we quantified the direct and indirect supply-chain environmental damage driven by the demand for health care. We focused on seven environmental stressors with known adverse feedback cycles: greenhouse gas emissions, particulate matter, air pollutants (nitrogen oxides and sulphur dioxide), malaria risk,

reactive nitrogen in water, and scarce water use. Findings Health care causes global environmental impacts that, depending on which indicator is considered, range between 1% and 5% of total global impacts, and are more than 5% for some national impacts. Interpretation Enhancing health-care expenditure to mitigate negative health effects of environmental damage is often promoted by health-care practitioners. However, global supply chains that feed into the enhanced activity of health-care sectors in turn initiate adverse feedback cycles by increasing the environmental impact of health care, thus counteracting the mission of health care. Funding Australian Research Council, National eResearch Collaboration Tools and Resources project.

MacNeill, A. J., Lillywhite, R. et Brown, C. J. (2017). "The impact of surgery on global climate: a carbon footprinting study of operating theatres in three health systems." *The Lancet Planetary Health* 1(9): e381-e388. <https://www.sciencedirect.com/science/article/pii/S2542519617301626>

Summary Background Climate change is a major global public health priority. The delivery of health-care services generates considerable greenhouse gas emissions. Operating theatres are a resource-intensive subsector of health care, with high energy demands, consumable throughput, and waste volumes. The environmental impacts of these activities are generally accepted as necessary for the provision of quality care, but have not been examined in detail. In this study, we estimate the carbon footprint of operating theatres in hospitals in three health systems. Methods Surgical suites at three academic quaternary-care hospitals were studied over a 1-year period in Canada (Vancouver General Hospital, VGH), the USA (University of Minnesota Medical Center, UMMC), and the UK (John Radcliffe Hospital, JRH). Greenhouse gas emissions were estimated using primary activity data and applicable emissions factors, and reported according to the Greenhouse Gas Protocol. Findings Site greenhouse gas evaluations were done between Jan 1 and Dec 31, 2011. The surgical suites studied were found to have annual carbon footprints of 5 187 936 kg of CO<sub>2</sub>e at JRH, 4 181 864 kg of CO<sub>2</sub>e at UMMC, and 3 218 907 kg of CO<sub>2</sub>e at VGH. On a per unit area basis, JRH had the lowest carbon intensity at 1702 kg CO<sub>2</sub>e/m<sup>2</sup>, compared with 1951 kg CO<sub>2</sub>e/m<sup>2</sup> at VGH and 2284 kg CO<sub>2</sub>e/m<sup>2</sup> at UMMC. Based on case volumes at all three sites, VGH had the lowest carbon intensity per operation at 146 kg CO<sub>2</sub>e per case compared with 173 kg CO<sub>2</sub>e per case at JRH and 232 kg CO<sub>2</sub>e per case at UMMC. Anaesthetic gases and energy consumption were the largest sources of greenhouse gas emissions. Preferential use of desflurane resulted in a ten-fold difference in anaesthetic gas emissions between hospitals. Theatres were found to be three to six times more energy-intensive than the hospital as a whole, primarily due to heating, ventilation, and air conditioning requirements. Overall, the carbon footprint of surgery in the three countries studied is estimated to be 9.7 million tonnes of CO<sub>2</sub>e per year. Interpretation Operating theatres are an appreciable source of greenhouse gas emissions. Emissions reduction strategies including avoidance of desflurane and occupancy-based ventilation have the potential to lessen the climate impact of surgical services without compromising patient safety. Funding None.

Malik, A., Lenzen, M., McAlister, S., et al. (2018). "The carbon footprint of Australian health care." *Lancet Planetary Health* 2(1): e27-e35. [https://www.thelancet.com/pdfs/journals/lanplh/PIIS2542-5196\(17\)30180-8.pdf](https://www.thelancet.com/pdfs/journals/lanplh/PIIS2542-5196(17)30180-8.pdf)

BACKGROUND: Carbon footprints stemming from health care have been found to be variable, from 3% of the total national CO<sub>2</sub> equivalent (CO<sub>2</sub>e) emissions in England to 10% of the national CO<sub>2</sub>e emissions in the USA. We aimed to measure the carbon footprint of Australia's health-care system. METHODS: We did an observational economic input-output lifecycle assessment of Australia's health-care system. All expenditure data were obtained from the 15 sectors of the Australian Institute of Health and Welfare for the financial year 2014-15. The Australian Industrial Ecology Virtual Laboratory (IELab) data were used to obtain CO<sub>2</sub>e emissions per AUS\$ spent on health care. FINDINGS: In 2014-15 Australia spent \$161.6 billion on health care that led to CO<sub>2</sub>e emissions of about 35 772 (68% CI 25 398-46 146) kilotonnes. Australia's total CO<sub>2</sub>e emissions in 2014-15 were 494 930 kilotonnes, thus health care represented 35 772 (7%) of 494 930 kilotonnes total CO<sub>2</sub>e emissions in Australia. The five most important sectors within health care in decreasing order of total CO<sub>2</sub>e emissions were: public hospitals (12 295 [34%] of 35 772 kilotonnes CO<sub>2</sub>e), private hospitals (3635 kilotonnes [10%]), other medications (3347 kilotonnes [9%]), benefit-paid drugs (3257 kilotonnes [9%]), and capital

expenditure for buildings (2776 kilotonnes [8%]). INTERPRETATION: The carbon footprint attributed to health care was 7% of Australia's total; with hospitals and pharmaceuticals the major contributors. We quantified Australian carbon footprint attributed to health care and identified health-care sectors that could be ameliorated. Our results suggest the need for carbon-efficient procedures, including greater public health measures, to lower the impact of health-care services on the environment. FUNDING: None.

Masino, C., Rubinstein, E., Lem, L., et al. (2010). "The impact of telemedicine on greenhouse gas emissions at an academic health science center in Canada." *Telemed J E Health* **16**(9): 973-976.

[https://www.liebertpub.com/doi/10.1089/tmj.2010.0057?url\\_ver=Z39.88-2003&rfr\\_id=ori%3Arid%3Acrossref.org&rfr\\_dat=cr\\_pub%3Dpubmed](https://www.liebertpub.com/doi/10.1089/tmj.2010.0057?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub%3Dpubmed)

OBJECTIVE: This study estimates the reduction in greenhouse gas (GHG) emissions resulting from 840 telemedicine consultations completed in a 6-month time period. Our model considers GHG emissions for both vehicle and videoconferencing unit energy use. Cost avoidance factors are also discussed. MATERIALS AND METHODS: Travel distances in kilometers were calculated for each appointment using postal code data and Google Maps™ Web-based map calculator tools. RESULTS: Including return travel, an estimated 757,234 km were avoided, resulting in a GHG emissions savings of 185,159 kg (185 metric tons) of carbon dioxide equivalents in vehicle emissions. Approximately 360,444 g of other air pollutant emissions was also avoided. The GHG emissions produced by energy consumption for videoconference units were estimated to be 42 kg of carbon dioxide equivalents emitted for this sample. CONCLUSIONS: The overall GHG emissions associated with videoconferencing unit energy is minor when compared with those avoided from vehicle use. In addition to improved patient-centered care and cost savings, environmental benefits provide additional incentives for the adoption of telemedicine services.

McGain, F., Muret, J., Lawson, C., et al. (2020). "Environmental sustainability in anaesthesia and critical care." *Br J Anaesth* **125**(5): 680-692.

[https://www.bjanaesthesia.org/article/S0007-0912\(20\)30547-X/pdf](https://www.bjanaesthesia.org/article/S0007-0912(20)30547-X/pdf)

Meier, T., von Borstel, T., Welte, B., et al. (2021). "Food Waste in Healthcare, Business and Hospitality Catering: Composition, Environmental Impacts and Reduction Potential on Company and National Levels." *Sustainability* **13**(6).

[https://mdpi-res.com/d\\_attachment/sustainability/sustainability-13-03288/article\\_deploy/sustainability-13-03288-v2.pdf](https://mdpi-res.com/d_attachment/sustainability/sustainability-13-03288/article_deploy/sustainability-13-03288-v2.pdf)

Morris, D. S., Wright, T., Somner, J. E., et al. (2013). "The carbon footprint of cataract surgery." *Eye (Lond)* **27**(4): 495-501.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3626018/pdf/eye20139a.pdf>

BACKGROUND: Climate change is predicted to be one of the largest global health threats of the 21st century. Health care itself is a large contributor to carbon emissions. Determining the carbon footprint of specific health care activities such as cataract surgery allows the assessment of associated emissions and identifies opportunities for reduction. AIM: To assess the carbon footprint of a cataract pathway in a British teaching hospital. METHODS: This was a component analysis study for one patient having first eye cataract surgery in the University Hospital of Wales, Cardiff. Activity data was collected from three sectors, building and energy use, travel and procurement. Published emissions factors were applied to this data to provide figures in carbon dioxide equivalents (CO<sub>2</sub>eq). RESULTS: The carbon footprint for one cataract operation was 181.8 kg CO<sub>2</sub>eq. On the basis that 2230 patients were treated for cataracts during 2011 in Cardiff, this has an associated carbon footprint of 405.4 tonnes CO<sub>2</sub>eq. Building and energy use was estimated to account for 36.1% of overall emissions, travel 10.1% and procurement 53.8%, with medical equipment accounting for the most emissions at 32.6%. CONCLUSIONS: This is the first published carbon footprint of cataract surgery and acts as a benchmark for other studies as well as identifying areas for emissions reduction. Within the procurement sector, dialogue with industry is important to reduce the overall carbon footprint. Sustainability should be



considered when cataract pathways are designed as there is potential for reduction in all sectors with the possible side effects of saving costs and improving patient care.

Nansai, K., Fry, J., Malik, A., et al. (2020). "Carbon footprint of Japanese health care services from 2011 to 2015." *Resources, Conservation and Recycling* **152**: 104525.

<https://www.sciencedirect.com/science/article/pii/S0921344919304318>

The carbon footprint of Japanese health care services, i.e. the domestic greenhouse gas (GHG) emissions caused by health care expenditures, including the associated fixed capital, were calculated using input-output analysis. In 2011 the total carbon footprint of these services was  $62.5 \times 10^6$  metric tons of CO<sub>2</sub> equivalent (MtCO<sub>2</sub>e), which is 4.6% of total domestic GHG emissions. Medical services involving hospitalization accounted for the greatest share, at 15.7 MtCO<sub>2</sub>e. The second highest category, Medical services without hospitalization, accounted for only slightly less: 14.2 MtCO<sub>2</sub>e. However, the difference in emissions per patient between these two categories was considerable. On average, emissions per patient for Medical services (hospitalization) were 12 tCO<sub>2</sub>e/patient, whereas for Medical services (non-hospitalization) they were only 2.1 tCO<sub>2</sub>e/patient, or 5.4 times less. In terms of type of medical condition, the greatest annual emissions were associated with cardiovascular disease (6.2 MtCO<sub>2</sub>e) and neoplasm (4.0 MtCO<sub>2</sub>e). In terms of age, emissions attributed to patients aged 65 and over accounted for more than half of total health care emissions. By 2015, the total carbon footprint had increased to 72.0 MtCO<sub>2</sub>e, a rise of over 15% in four years. Although medical care and pharmaceuticals are the main factors responsible for this increase, emissions associated with nursing services have also risen, suggesting that demographic aging may be having a significant impact on GHG emissions. As a countermeasure, the potential annual GHG mitigation achievable through avoidance of unused prescribed medicines resulting in waste was estimated at 1.24 MtCO<sub>2</sub>e, comparable with the total carbon footprint of home medicines. To safeguard planetary health, in addition to implementing technological improvements to the supply chains of health care services, it will be necessary to provide citizens further options for achieving health promotion and GHG mitigation simultaneously.

O'Flynn, D., Lawler, J., Yusuf, A., et al. (2021). "A review of pharmaceutical occurrence and pathways in the aquatic environment in the context of a changing climate and the COVID-19 pandemic." *Anal Methods* **13**(5): 575-594.

<https://pubs.rsc.org/en/content/articlelanding/2021/AY/D0AY02098B>

Active pharmaceutical ingredients (APIs) are increasingly being identified as contaminants of emerging concern (CECs). They have potentially detrimental ecological and human health impacts but most are not currently subject to environmental regulation. Addressing the life cycle of these pharmaceuticals plays a significant role in identifying the potential sources and understanding the environmental impact that pharmaceuticals may have in surface waters. The stability and biological activity of these "micro-pollutants" can lead to a pseudo persistence, with ensuing unknown chronic behavioural and health-related effects. Research that investigates pharmaceuticals predominantly focuses on their occurrence and effect within surface water environments. However, this review will help to collate this information with factors that affect their environmental concentration. This review focuses on six pharmaceuticals (clarithromycin, ciprofloxacin, sulfamethoxazole, venlafaxine, gemfibrozil and diclofenac), chosen because they are heavily consumed globally, have poor removal rates in conventional activated sludge wastewater treatment plants (CAS WWTPs), and are persistent in the aquatic environment. Furthermore, these pharmaceuticals are included in numerous published prioritisation studies and/or are on the Water Framework Directive (WFD) "Watch List" or are candidates for the updated Watch List (WL). This review investigates the concentrations seen in European Union (EU) surface waters and examines factors that influence final concentrations prior to release, thus giving a holistic overview on the source of pharmaceutical surface water pollution. A period of 10 years is covered by this review, which includes research from 2009-2020 examining over 100 published studies, and highlighting that pharmaceuticals can pose a severe risk to surface water environments, with each stage of the lifecycle of the pharmaceutical determining its concentration. This review additionally highlights the necessity to improve education surrounding appropriate use,

disposal and waste management of pharmaceuticals, while implementing a source directed and end of pipe approach to reduce pharmaceutical occurrence in surface waters.

Ortiz de García, S., García-Encina, P. A. et Irusta-Mata, R. (2017). "The potential ecotoxicological impact of pharmaceutical and personal care products on humans and freshwater, based on USEtox™ characterization factors. A Spanish case study of toxicity impact scores." *Sci Total Environ* **609**: 429-445.

<https://www.sciencedirect.com/science/article/abs/pii/S004896971731851X?via%3Dihub>

Pharmaceutical and personal care products (PPCPs) are being increasingly included in Life Cycle Assessment studies (LCAs) since they have brought into evidence both human and ecological adverse effects due to their presence in different environmental compartments, wastewater facilities and industry. Therefore, the main goal of this research was to estimate the characterization factors (CFs) of 27 PPCPs widely used worldwide in order to incorporate their values into Life Cycle Impact Assessment studies (LCIA) or to generate a toxicity impact score ranking. Physicochemical properties, degradation rates, bioaccumulation, ecotoxicity and human health effects were collected from experimental data, recognized databases or estimated using EPI Suite™ and the USEtox™ software, and were subsequently used for estimating CFs. In addition, a Spanish toxicity impact score ranking was carried out for 49 PPCPs using the 27 newly calculated CFs, and 22 CFs already available in the literature, besides the data related to the occurrence of PPCPs in the environment in Spain. It has been highlighted that emissions into the continental freshwater compartment showed the highest CFs values for human effects (ranging from  $10^{-9}$  to  $10^{-3}$  Cases·kg<sup>-1</sup>), followed by emissions into the air ( $10^{-9}$  to  $10^{-5}$  Cases·kg<sup>-1</sup>), soil ( $10^{-11}$  to  $10^5$  Cases·kg<sup>-1</sup>) and seawater ( $10^{-12}$  to  $10^{-4}$  Cases·kg<sup>-1</sup>). CFs regarding the affectation of freshwater aquatic environments were the highest of those proceeding from emissions into continental freshwater (between 1 to  $10^4$  PAF·m<sup>3</sup>·day·kg(emission)<sup>-1</sup>) due to the direct contact between the source of emission and the compartment affected, followed by soil (among  $10^{-1}$  to  $10^4$  PAF·m<sup>3</sup>·day·kg(emission)<sup>-1</sup>), and air (among  $10^{-2}$  to  $10^4$  PAF·m<sup>3</sup>·day·kg(emission)<sup>-1</sup>) while the lowest were the CFs of continental seawater (among  $10^{-28}$  to  $10^{-3}$  PAF·m<sup>3</sup>·day·kg(emission)<sup>-1</sup>). Freshwater aquatic ecotoxicological CFs are much higher than human toxicity CFs, demonstrating that the ecological impact of PPCPs in aquatic environments must be a matter of urgent attention. According to the Spanish toxicity impact score calculated, the PPCPs with the highest impact are hormones, antidepressants, fragrances, antibiotics, angiotensin receptor blockers and blood lipid regulators, which have already been found in other kinds of score rankings. These results, which were not available until now, will be useful in order to perform better LCIA studies, incorporating the micro-pollutants whose CFs have been estimated, or in order to carry out single hazard/risk environmental impact assessments.

Papagiannaki, D., Morgillo, S., Bocina, G., et al. (2021). "Occurrence and Human Health Risk Assessment of Pharmaceuticals and Hormones in Drinking Water Sources in the Metropolitan Area of Turin in Italy." *Toxics* **9**(4).

[https://mdpi-res.com/d\\_attachment/toxics/toxics-09-00088/article\\_deploy/toxics-09-00088.pdf](https://mdpi-res.com/d_attachment/toxics/toxics-09-00088/article_deploy/toxics-09-00088.pdf)

Pharmaceuticals and hormones (PhACs) enter the aquatic environment in multiple ways, posing potential adverse effects on non-target organisms. They have been widely detected in drinking water sources, challenging water companies to reassure good quality drinking water. The aim of this study was to evaluate the concentration of sixteen PhACs in both raw and treated drinking water sources in the Metropolitan Area of Turin-where Società Metropolitana Acque Torino (SMAT) is the company in charge of the water cycle management-and evaluate the potential human health risks associated to these compounds. Multivariate spatial statistical analysis techniques were used in order to characterize the areas at higher risk of pollution, taking into account the already existing SMAT sampling points' network. Health risks were assessed considering average detected concentrations and provisional guideline values for individual compounds as well as their combined mixture. As reported in the just-issued Drinking Water Directive 2020/2184/UE, in order to establish priority substances, a risk assessment of contaminants present in raw drinking water sources is required for monitoring, identifying potential health risks and, if necessary, managing their removal. The results showed negligibly low human health risks in both raw water sources and treated water.

Petre, M. A., Bahrey, L., Levine, M., et al. (2019). "A national survey on attitudes and barriers on recycling and environmental sustainability efforts among Canadian anesthesiologists: an opportunity for knowledge translation." *Can J Anaesth* **66**(3): 272-286.

<https://link.springer.com/content/pdf/10.1007/s12630-018-01273-9.pdf>

**BACKGROUND:** Anesthesia-related activities produce 25% of all operating room (OR) waste and contribute to environmental pollution and climate change. The aim of this study was to document Canadian anesthesiologists' current practice, attitudes towards, and perceived barriers regarding recycling of OR waste and environmental sustainability efforts. **METHODS:** With Research Ethics Board approval, members of the Canadian Anesthesiologists' Society (CAS) completed an online survey consisting of 25 questions assessing current environmentally sustainable practices in anesthesiology and gaps, barriers, and interest in gaining further knowledge on this topic. **RESULTS:** Four hundred and twenty-six of 2,695 (16%) CAS members responded to the questionnaire. Despite a willingness to recycle at work among most anesthesiologists (393/403, 97.5%), only 122/403 (30.2%) did so. Other sustainability efforts in Canadian ORs included donating unused medical equipment and supplies to medical missions (198/400, 49.5%) and evening shut-off of anesthesia machines and other OR equipment (185/400, 46.3%). Reported barriers to recycling in the OR included a lack of support from hospital/OR leadership (254/400, 63.5%) and inadequate information/education (251/400, 62.8%). Only 122/389 (31.4%) of respondents were aware of any efforts to expand sustainability programs at their institutions but 273/395 (69.1%) of respondents indicated an interest in obtaining further education on the topic. **CONCLUSION:** Canadian anesthesiologists appear ready to incorporate environmental sustainability in their practice but indicate that significant barriers exist. Our study highlights the need for further educational programs and implementation strategies.

Pichler, P. P., Jaccard, I. S., Weisz, U., et al. (2017). "International comparison of health care carbon footprints." *Environmental Research Letters* **14**(6).

<https://iopscience.iop.org/article/10.1088/1748-9326/ab19e1/meta>

Climate change confronts the health care sector with a dual challenge. Accumulating climate impacts are putting an increased burden on the service provision of already stressed health care systems in many regions of the world. At the same time, the Paris agreement requires rapid emission reductions in all sectors of the global economy to stay well below the 2 °C target. This study shows that in OECD countries, China, and India, health care on average accounts for 5% of the national CO<sub>2</sub> footprint making the sector comparable in importance to the food sector. Some countries have seen reduced CO<sub>2</sub> emissions related to health care despite growing expenditures since 2000, mirroring their economy wide emission trends. The average per capita health carbon footprint across the country sample in 2014 was 0.6 tCO<sub>2</sub>, varying between 1.51 tCO<sub>2</sub>/cap in the US and 0.06 tCO<sub>2</sub>/cap in India. A statistical analysis shows that the carbon intensity of the domestic energy system, the energy intensity of the domestic economy, and health care expenditure together explain half of the variance in per capita health carbon footprints. Our results indicate that important leverage points exist inside and outside the health sector. We discuss our findings in the context of the existing literature on the potentials and challenges of reducing GHG emissions in the health and energy sector.

Pollard, A. S., Paddle, J. J., Taylor, T. J., et al. (2014). "The carbon footprint of acute care: how energy intensive is critical care?" *Public Health* **128**(9): 771-776.

<https://www.sciencedirect.com/science/article/abs/pii/S0033350614001437?via%3Dihub>

**OBJECTIVES:** Climate change has the potential to threaten human health and the environment. Managers in healthcare systems face significant challenges to balance carbon mitigation targets with operational decisions about patient care. Critical care units are major users of energy and hence more evidence is needed on their carbon footprint. **STUDY DESIGN:** The authors explore a methodology which estimates electricity use and associated carbon emissions within a Critical Care Unit (CCU). **METHODS:** A bottom-up model was developed and calibrated which predicted the electricity consumed and carbon emissions within a CCU based on the type of patients treated and working practices in a case study in Cornwall, UK. **RESULTS:** The model developed was able to predict the electricity consumed within CCU with an error of 1% when measured against actual meter readings.

Just under half the electricity within CCU was used for delivering care to patients and monitoring their condition. CONCLUSIONS: A model was developed which accurately predicted the electricity consumed within a CCU based on patient types, medical devices used and working practice. The model could be adapted to enable it to be used within hospitals as part of their planning to meet carbon reduction targets.

Rammelkamp, Z., Dirnberger, J., Johnson, G., et al. (2021). "An Audit of All Waste Leaving the Operating Room: Can the Surgical Suite Be More Environmentally Sustainable?" *World Medical & Health Policy* **13**(1): 126-136. <https://onlinelibrary.wiley.com/doi/abs/10.1002/wmh3.397>

Richie, C. (2022). "Environmental sustainability and the carbon emissions of pharmaceuticals." *Journal of Medical Ethics* **48**(5): 334-337. <https://jme.bmj.com/content/medethics/48/5/334.full.pdf>

The US healthcare industry emits an estimated 479 million tonnes of carbon dioxide each year; nearly 8% of the country's total emissions. When assessed by sector, hospital care, clinical services, medical structures, and pharmaceuticals are the top emitters. For 15 years, research has been dedicated to the medical structures and equipment that contribute to carbon emissions. More recently, hospital care and clinical services have been examined. However, the carbon of pharmaceuticals is understudied. This article will focus on the carbon emissions of pharmaceuticals since they are consistently calculated to be among the top contributors to healthcare carbon and assess the factors that contribute to pharmaceutical carbon emissions. Specifically, overprescription, pharmaceutical waste, antibiotic resistance, routine prescriptions, non-adherence, drug dependency, lifestyle prescriptions, and drugs given due to a lack of preventive healthcare will be identified. Prescribing practices have environmental ramifications. Carbon reduction, when focused on pharmaceuticals, can lead to cleaner, more sustainable healthcare. All data relevant to the study are included in the article.

Rizan, C., Bhutta, M. F., Reed, M., et al. (2021). "The carbon footprint of waste streams in a UK hospital." *Journal of Cleaner Production* **286**. <https://www.sciencedirect.com/science/article/abs/pii/S0959652620354925?via%3Dihub>

Schröder, P., Helmreich, B., Škrbić, B., et al. (2016). "Status of hormones and painkillers in wastewater effluents across several European states-considerations for the EU watch list concerning estradiols and diclofenac." *Environ Sci Pollut Res Int* **23**(13): 12835-12866. [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4912981/pdf/11356\\_2016\\_Article\\_6503.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4912981/pdf/11356_2016_Article_6503.pdf)

Present technologies for wastewater treatment do not sufficiently address the increasing pollution situation of receiving water bodies, especially with the growing use of personal care products and pharmaceuticals (PPCP) in the private household and health sector. The relevance of addressing this problem of organic pollutants was taken into account by the Directive 2013/39/EU that introduced (i) the quality evaluation of aquatic compartments, (ii) the polluter pays principle, (iii) the need for innovative and affordable wastewater treatment technologies, and (iv) the identification of pollution causes including a list of principal compounds to be monitored. In addition, a watch list of 10 other substances was recently defined by Decision 2015/495 on March 20, 2015. This list contains, among several recalcitrant chemicals, the painkiller diclofenac and the hormones 17 $\beta$ -estradiol and 17 $\alpha$ -ethinylestradiol. Although some modern approaches for their removal exist, such as advanced oxidation processes (AOPs), retrofitting most wastewater treatment plants with AOPs will not be acceptable as consistent investment at reasonable operational cost. Additionally, by-product and transformation product formation has to be considered. The same is true for membrane-based technologies (nanofiltration, reversed osmosis) despite of the incredible progress that has been made during recent years, because these systems lead to higher operation costs (mainly due to higher energy consumption) so that the majority of communities will not easily accept them. Advanced technologies in wastewater treatment like membrane bioreactors (MBR) that integrate biological degradation of organic matter with membrane filtration have proven a more complete elimination of emerging pollutants in a rather cost- and labor-intensive technology. Still, most of the presently applied methods are incapable of removing critical compounds completely. In this opinion paper, the

state of the art of European WWTPs is reflected, and capacities of single methods are described. Furthermore, the need for analytical standards, risk assessment, and economic planning is stressed. The survey results in the conclusion that combinations of different conventional and advanced technologies including biological and plant-based strategies seem to be most promising to solve the burning problem of polluting our environment with hazardous emerging xenobiotics.

Shum, P. L., Kok, H. K., Maingard, J., et al. (2020). "Environmental sustainability in neurointerventional procedures: a waste audit." *J Neurointerv Surg* **12**(11): 1053-1057.  
<https://jn.is.bmj.com/content/12/11/1053.long>

**BACKGROUND:** Operating rooms contribute between 20% to 70% of hospital waste. This study aimed to evaluate the waste burden of neurointerventional procedures performed in a radiology department, identify areas for waste reduction, and motivate new greening initiatives. **METHODS:** We performed a waste audit of 17 neurointerventional procedures at a tertiary-referral center over a 3-month period. Waste was categorized into five streams: general waste, clinical waste, recyclable plastic, recyclable paper, and sharps. Our radiology department started recycling soft plastics from 13 December 2019. Hence, an additional recyclable soft plastic waste stream was added from this time point. The weight of each waste stream was measured using a digital weighing scale. **RESULTS:** We measured the waste from seven cerebral digital subtraction angiograms (DSA), six mechanical thrombectomies (MT), two aneurysm-coiling procedures, one coiling with tumour embolization, and one dural arteriovenous fistula embolization procedure. In total, the 17 procedures generated 135.3 kg of waste: 85.5 kg (63.2%) clinical waste, 28.0 kg (20.7%) general waste, 14.7 kg (10.9%) recyclable paper, 3.5 kg (2.6%) recyclable plastic, 2.2 kg (1.6%) recyclable soft plastic, and 1.4 kg (1.0%) of sharps. An average of 8 kg of waste was generated per case. Coiling cases produced the greatest waste burden (13.1 kg), followed by embolization (10.3 kg), MT (8.8 kg), and DSA procedures (5.1 kg). **CONCLUSION:** Neurointerventional procedures generate a substantial amount of waste, an average of 8 kg per case. Targeted initiatives such as engaging with suppliers to revise procedure packs and reduce packaging, digitizing paper instructions, opening devices only when necessary, implementing additional recycling programs, and appropriate waste segregation have the potential to reduce the environmental impact of our specialty.

Tauber, J., Chinwuba, I., Kleyn, D., et al. (2019). "Quantification of the Cost and Potential Environmental Effects of Unused Pharmaceutical Products in Cataract Surgery." *JAMA Ophthalmol* **137**(10): 1156-1163.  
[https://jamanetwork.com/journals/jamaophthalmology/articlepdf/2740740/jamaophthalmology\\_tauber\\_2019\\_oi\\_190052.pdf](https://jamanetwork.com/journals/jamaophthalmology/articlepdf/2740740/jamaophthalmology_tauber_2019_oi_190052.pdf)

**IMPORTANCE:** Pharmaceutical products, including unused portions, may contribute to financial and environmental costs in the United States. Because cataract surgery is performed millions of times each year in the United States and throughout the rest of the world, understanding these financial and environmental costs associated with cataract surgery is warranted. **OBJECTIVE:** To investigate the financial and environmental costs of unused pharmaceutical products after phacoemulsification surgery. **DESIGN, SETTING, AND PARTICIPANTS:** This descriptive qualitative study included 4 surgical sites in the northeastern United States (a private ambulatory care center, private tertiary care center, private outpatient center, and federally run medical center for veterans). Prices and data for use of services and pharmaceuticals were obtained for the tertiary care and outpatient centers from January 1 through April 30, 2016; for the ambulatory care center from June 1, 2017, through March 31, 2018; and the federal medical center from November 1, 2017, through February 28, 2018. Data were collected from routine phacoemulsification surgical procedures without vitreous loss or other complications. Volume or weight of medications remaining after surgery was measured. Total and mean costs of medications per case and month were calculated. Environmental effects were estimated using economic input-output life cycle assessment methods. Data were analyzed from December 1, 2017, through June 30, 2018. **MAIN OUTCOMES AND MEASURES:** Cost of unused pharmaceutical products (in US dollars) and kilogram equivalents of carbon emissions (carbon dioxide [CO<sub>2</sub>-e]), air pollution (fine particulate matter emissions of ≤10 μm in diameter [PM<sub>10</sub>-e]), and eutrophication potential (nitrogen [N-e]). **RESULTS:** A total of 116 unique drugs were surveyed among the 4 centers. Assuming unmeasured medications had no materials left unused, a cumulative mean

83 070 of 183 304 mL per month (45.3%) of pharmaceuticals were unused by weight or volume across all sites. Annual unused product cost estimates reached approximately \$195 200 per site. A larger percentage of eyedrops (65.7% by volume) were unused compared with injections (24.8%) or systemic medications (59.9%). Monthly unused quantities at the ambulatory care center (65.9% by volume [54 971 of 83 440 mL]), tertiary care center (21.3% [17 143 of 80 344 mL]), federal medical center (38.5% [265 of 689 mL]), and outpatient center (56.8% [10 691 of 18 832 mL]) resulted in unnecessary potential emissions at each center of 2135, 2498, 418, and 711 kg CO<sub>2</sub>-e/mo, respectively. Unnecessary potential air pollution between sites varied from 0.8 to 4.5 kg PM<sub>10</sub>-e/mo, and unnecessary eutrophication potential between sites varied from 0.07 to 0.42 kg N-e/mo.

CONCLUSIONS AND RELEVANCE: This study suggests that unused pharmaceutical products during phacoemulsification result in relatively high financial and environmental costs. If these findings can be substantiated and shown to be generalizable in the United States or elsewhere, reducing these costs may be of value.

Taylor, T. et Mackie, P. (2017). "Carbon footprinting in health systems: one small step towards planetary health." *The Lancet Planetary Health* **1**(9): e357-e358.

[https://doi.org/10.1016/S2542-5196\(17\)30158-4](https://doi.org/10.1016/S2542-5196(17)30158-4)

Climate change is without doubt one of the major threats facing public health. While we are already experiencing extreme weather events worldwide, the longer term impacts on health will include increased heat-related mortality, increased food-borne disease, and increased risk of vector-borne and water-borne disease.<sup>1</sup> Coupled with increasing—and mobile—populations and antimicrobial resistance, the pressures on health systems will be substantial. Is it surprising then that the Paris Agreement formally linked human and planetary health so clearly and sought to harness leadership from the health sector to achieve robust change? It is in this light that efforts to assess the carbon footprinting of different elements of health care are needed. Bottom-up studies on this have included efforts to assess the carbon footprints of renal care,<sup>2</sup> intensive care,<sup>3</sup> dentistry<sup>4</sup> and, now in *The Lancet Planetary Health*, operating theatres.<sup>5</sup> Andrea MacNeill and colleagues report the carbon footprint of surgical suites in three academic quaternary-care hospitals in Canada, the UK, and the USA to be between 3 218 907 kg and 5 187 936 kg of CO<sub>2</sub>e over a 1 year period. Substantial contributions come from the use of anaesthetic gases and energy consumption.

Thiel, C. L., Eckelman, M., Guido, R., et al. (2015). "Environmental Impacts of Surgical Procedures: Life Cycle Assessment of Hysterectomy in the United States." *Environ Sci Technol* **49**(3): 1779-1786.

<https://pubs.acs.org/doi/pdf/10.1021/es504719g>

Thiel, C. L., Park, S., Musicus, A. A., et al. (2021). "Waste generation and carbon emissions of a hospital kitchen in the US: Potential for waste diversion and carbon reductions." *PLoS One* **16**(3): e0247616.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7968671/pdf/pone.0247616.pdf>

This study measured the total quantity and composition of waste generated in a large, New York City (NYC) hospital kitchen over a one-day period to assess the impact of potential waste diversion strategies in potential weight of waste diverted from landfill and reduction in greenhouse gas (GHG) emissions. During the one-day audit, the hospital kitchen generated 1515.15 kg (1.7 US tons) of solid waste daily or 0.23 kg of total waste per meal served. Extrapolating to all meals served in 2019, the hospital kitchen generates over 442,067 kg (487 US tons) of waste and emits approximately 294,466 kg of CO<sub>2</sub>e annually from waste disposal. Most of this waste (85%, 376,247 kg or 415 US tons annually) is currently sent to landfill. With feasible changes, including increased recycling and moderate composting, this hospital could reduce landfilled waste by 205,245 kg (226 US tons, or 55% reduction) and reduce GHG emissions by 189,025 kg CO<sub>2</sub>e (64% reduction). Given NYC's ambitious waste and GHG emission reduction targets outlined in its OneNYC strategic plan, studies analyzing composition, emissions, and waste diversion potential of large institutions can be valuable in achieving city sustainability goals.

Tong, A. Y., Peake, B. M. et Braund, R. (2011). "Disposal practices for unused medications in New Zealand community pharmacies." *J Prim Health Care* **3**(3): 197-203.

**INTRODUCTION:** One of the recommended methods for households to dispose of unused medications in many countries is to return them to community pharmacies. However, such a practice will only reduce the environmental levels of pharmaceuticals if the medications are also disposed of and destroyed properly by the pharmacies. **AIM:** This study reports the results of a questionnaire sent to New Zealand community pharmacists regarding disposal practices for unused or expired medications in their workplaces. **METHODS:** A pre-tested, self-administered questionnaire was sent to 500 randomly selected community pharmacies from all areas of New Zealand. The participants were asked how they disposed of a variety of medications. In addition, participants were also asked about whether they knew how unused medications were destroyed if their pharmacy used a third-party contractor or distributor to dispose of them. **RESULTS:** Of the 265 respondents, 80.4% and 61.1% respectively reported that solid and semi-solid medications were removed by contractors. However liquid and Class B controlled drugs were predominantly disposed of down the pharmacy sink. Over 60% of the participating pharmacists indicated that they believed the contractors incinerated the collected pharmaceutical waste, and over 90% of the participating pharmacists indicated their wish for a state-run disposal and destruction system. **DISCUSSION:** Liquid medications and Class B controlled drugs, which were commonly reported to be disposed of down the sewage system, may increase the potential for environmental pollution by pharmaceuticals in New Zealand. There is a need for increased environmental awareness amongst community pharmacists in New Zealand.

Vali, M., Salimifard, K. et Chausalet, T. (2021). Carbon Footprints in Emergency Departments: A Simulation-Optimization Analysis. *Operations Research and Simulation in Healthcare*. Masmoudi, M., Jarboui, B. et Siarry, P. Cham, Springer International Publishing: 193-207.

[https://doi.org/10.1007/978-3-030-45223-0\\_9](https://doi.org/10.1007/978-3-030-45223-0_9)

It is globally accepted to act against global warming through the reduction of carbon dioxide. Carbon footprint is historically defined as the total emissions caused by an individual, event, organization, or product, expressed as carbon dioxide equivalent. Healthcare system consumes large amount of energy in order to provide health services to patients who have to pass a series of treatment processes at each care unit. These treatments require different medical equipment that consume electrical power, and the more electrical power consumption is, the more greenhouse gases specifically CO<sub>2</sub> emissions are. The discrete-event simulation has been applied to develop the model of the treatment process and the estimation of carbon dioxide in the treatment process. By the knowledge that the simulation is not an optimization method in itself, the OptQuest optimization method has been applied to reduce greenhouse gases and carbon footprint in the patients' flow in the emergency department by considering leveling off the waiting time and length of stay as constraints to leveling up patient's satisfaction. The numerical results provided by simulation and OptQuest show the efficiency of OptQuest as a technique for patient flow optimization.

Vatovec, C., Senier, L. et Bell, M. (2013). "An ecological perspective on medical care: environmental, occupational, and public health impacts of medical supply and pharmaceutical chains." *Ecohealth* **10**(3): 257-267.

<https://link.springer.com/content/pdf/10.1007/s10393-013-0855-1.pdf>

Healthcare organizations are increasingly examining the impacts of their facilities and operations on the natural environment, their workers, and the broader community, but the ecological impacts of specific healthcare services provided within these institutions have not been assessed. This paper provides a qualitative assessment of healthcare practices that takes into account the life-cycle impacts of a variety of materials used in typical medical care. We conducted an ethnographic study of three medical inpatient units: a conventional cancer ward, palliative care unit, and a hospice center. Participant observations (73 participants) of healthcare and support staff including physicians, nurses, housekeepers, and administrators were made to inventory materials and document practices used in patient care. Semi-structured interviews provided insight into common practices. We identified three major domains that highlight the cumulative environmental, occupational health, and public health impacts of medical supplies and pharmaceuticals used at our research sites: (1) medical supply procurement; (2) generation, handling, and disposal of medical waste; and (3) pharmaceutical

handling and disposal. Impacts discovered through ethnographic inquiry included occupational exposures to chemotherapy and infectious waste, and public health exposures to pharmaceutical waste. This study provides new insight into the environmental, occupational, and public health impacts resulting from medical practices. In many cases, the lack of clear guidance and regulations regarding environmental impacts contributed to elevated harms to the natural environment, workers, and the broader community.

Vidal, R., Moliner, E., Pikula, A., et al. (2015). "Comparison of the carbon footprint of different patient diets in a Spanish hospital." *J Health Serv Res Policy* **20**(1): 39-44.

<https://journals.sagepub.com/doi/10.1177/1355819614553017>

Wilkinson, J. L., Boxall, A. B. A., Kolpin, D. W., et al. (2022). "Pharmaceutical pollution of the world's rivers." *Proceedings of the National Academy of Sciences* **119**(8): e2113947119.

<https://www.pnas.org/doi/abs/10.1073/pnas.2113947119>

Environmental exposure to active pharmaceutical ingredients (APIs) can have negative effects on the health of ecosystems and humans. While numerous studies have monitored APIs in rivers, these employ different analytical methods, measure different APIs, and have ignored many of the countries of the world. This makes it difficult to quantify the scale of the problem from a global perspective. Furthermore, comparison of the existing data, generated for different studies/regions/continents, is challenging due to the vast differences between the analytical methodologies employed. Here, we present a global-scale study of API pollution in 258 of the world's rivers, representing the environmental influence of 471.4 million people across 137 geographic regions. Samples were obtained from 1,052 locations in 104 countries (representing all continents and 36 countries not previously studied for API contamination) and analyzed for 61 APIs. Highest cumulative API concentrations were observed in sub-Saharan Africa, south Asia, and South America. The most contaminated sites were in low- to middle-income countries and were associated with areas with poor wastewater and waste management infrastructure and pharmaceutical manufacturing. The most frequently detected APIs were carbamazepine, metformin, and caffeine (a compound also arising from lifestyle use), which were detected at over half of the sites monitored. Concentrations of at least one API at 25.7% of the sampling sites were greater than concentrations considered safe for aquatic organisms, or which are of concern in terms of selection for antimicrobial resistance. Therefore, pharmaceutical pollution poses a global threat to environmental and human health, as well as to delivery of the United Nations Sustainable Development Goals.



## Les interventions et dispositifs mis en place pour réduire cet impact environnemental

Birtel, J., Heimann, H., Hoerauf, H., et al. (2022). "[Sustainability in ophthalmology : Adaptation to the climate crisis and mitigation]." Ophthalmologe: 1-9.

The climate crisis is threatening the health of current and future generations and represents a particular challenge for healthcare systems. To address man-made climate change, comprehensive adaptation and mitigation strategies are crucial. Medicine and ophthalmology offer various opportunities to reduce the CO<sub>2</sub> (carbon dioxide) footprint - these should be implemented and politically encouraged. Data-driven sustainability tools may provide options to evaluate the environmental footprint and to initiate optimization strategies. Life cycle assessments are an approach to systemically measure the environmental footprint and may facilitate sustainable decisions processes. The German health system needs to develop quantifiable and holistic strategies to reduce CO<sub>2</sub>; sustainability might become a future performance indicator. This article discusses examples of adaptation to the climate crisis and mitigation in ophthalmology and beyond.

Bond, A., Jones, A., Haynes, R., et al. (2009). "Tackling climate change close to home: mobile breast screening as a model." J Health Serv Res Policy **14**(3): 165-167.

<https://journals.sagepub.com/doi/10.1258/jhsrp.2009.008154>

**OBJECTIVE:** Health services contribute significantly to carbon dioxide (CO<sub>2</sub>) emissions and, while services in the UK are beginning to address this, the focus has been on reducing energy consumption rather than road transport, a major component of emissions. We aimed to compare the distances travelled by patients attending mobile breast screening clinics compared to the distance they would need to travel if screening services were centralized. **METHODS:** Anonymized postcode records were analysed to determine driving distances potentially saved through attendance at 20 mobile breast screening clinics rather than at two centralized locations. Based on assumptions for the typical car used, the CO<sub>2</sub> emissions were calculated for the current case of decentralized service through mobile clinics compared to a hypothetical case where only centralized services are available over one complete three-year cycle of breast screening invitations. **RESULTS:** The availability of mobile breast screening clinics for the 60,675 women who underwent screening over a three-year cycle led to a return journey distance savings of 1,429,908 km. Taking into account the CO<sub>2</sub> emissions of the tractor unit used for moving the mobile clinics around, this equates to approximately 75 tonnes of CO<sub>2</sub> saved in any one year. **CONCLUSIONS:** Decentralizing health care delivery can potentially provide substantial reductions in emissions at the same time as improving the patient experience. Thus, the 'care close to home' agenda can simultaneously improve health outcomes and the environment.

Brandmayr, C., Kerber, H., Winker, M., et al. (2015). "Impact assessment of emission management strategies of the pharmaceuticals Metformin and Metoprolol to the aquatic environment using Bayesian networks." Sci Total Environ **532**: 605-616.

The issue of pharmaceuticals in the environment has caused increasing concern in the recent years and various strategies have been proposed to tackle this problem. This work describes a Bayesian network (BN)-based socio-ecological impact assessment of a set of measures aimed at reducing the entry of pharmaceuticals in the aquatic environment. The measures investigated were selected across three sectors: public health market, environmental politics and drug design innovation. The BN model was developed for two drugs, Metformin and Metoprolol, and it models the distribution of the Predicted Environmental Concentration (PEC) values as a function of different measures. Results show that the sensitivity of the PEC for the two drugs to the measures investigated reflects the distinct drug characteristics, suggesting that in order to ensure the successful reduction of a broad range of substances, a spectrum of measures targeting the entire lifecycle of a pharmaceutical should be implemented. Furthermore, evaluation of two scenarios reflecting different emission management

strategies highlights that the integrated implementation of a comprehensive set of measures across the three sectors results in a more extensive reduction of the contamination. Finally, the BN provides an initial forecasting tool to model the PEC of a drug as a function of a combination of measures in a context-specific manner and possible adaptations of the model are proposed.

Carino, S., Porter, J., Malekpour, S., et al. (2020). "Environmental Sustainability of Hospital Foodservices across the Food Supply Chain: A Systematic Review." *J Acad Nutr Diet* **120**(5): 825-873.

[https://www.jandonline.org/article/S2212-2672\(20\)30001-0/fulltext](https://www.jandonline.org/article/S2212-2672(20)30001-0/fulltext)

**BACKGROUND:** Hospitals have a responsibility to support human health, and given the link between human and environmental health, hospitals should consider their environmental impacts. Hospital foodservices can negatively affect the environment at every stage of the food supply chain (production/procurement, distribution, preparation, consumption, and waste management/disposal). **OBJECTIVE:** To systematically identify and synthesize the following across the hospital patient food/nutrition supply chain: environmental and associated economic impacts of foodservice; outcomes of strategies that aim to improve the environmental sustainability of foodservice; and perspectives of patients, staff, and stakeholders on environmental impacts of foodservice and strategies that aim to improve the environmental sustainability of foodservice. **METHODS:** Eight electronic databases (ie, Cumulative Index to Nursing and Allied Health Literature Plus, Embase via Ovid, Global Health, National Health Service Economic Evaluation Database, Ovid Medline, ProQuest Environmental Science Collection, Scopus, and Web of Science) were searched from database inception to November 2018 for original research conducted across any stage of the hospital food supply chain (from production/procurement to waste management/disposal) that provides food/nutrition to patients, with no restrictions on language or study design. Titles/abstracts then full texts were screened independently by two authors. The Mixed Methods Appraisal Tool was used for quality appraisal for included studies. Data were synthesized narratively. **RESULTS:** From 29,655 records identified, 80 studies met eligibility criteria. Results were categorized into production/procurement (n=12), distribution (n=0), preparation (n=6), consumption (n=49), waste management/disposal (n=8), and multiple food supply chain aspects (n=5). The environmental impact most widely explored was food waste, with many studies reporting on food waste quantities, and associated economic losses. Strategies focused on reducing food waste by increasing patients' intake through various foodservice models. Perspectives identified a shared vision for sustainable foodservices, although there are many practical barriers to achieving this. **CONCLUSION:** The literature provides examples across the hospital food supply chain that demonstrate how environmental sustainability can be prioritized and evaluated and the opportunities for credentialed nutrition and dietetics practitioners to contribute. Future studies are warranted, particularly those measuring environmental impacts and testing the effects of sustainable strategies in the distribution, preparation, and waste management stages.

Chèvre, N., Coutu, S., Margot, J., et al. (2013). "Substance flow analysis as a tool for mitigating the impact of pharmaceuticals on the aquatic system." *Water Res* **47**(9): 2995-3005.

<https://www.sciencedirect.com/science/article/abs/pii/S0043135413001607?via%3Dihub>

Pharmaceuticals constitute an important environmental issue for receiving waters. A holistic approach, taking into consideration the sources of these compounds (hospitals, domestic use), discharges (wastewater effluent, combined sewer overflows) and related risks to the environment, is therefore needed to develop the best protection strategy. The substance flow analysis (SFA) approach, applied, for example, to the city of Lausanne, Switzerland, is an ideal tool to tackle these issues. Four substances were considered: one antibiotic (ciprofloxacin), an analgesic (diclofenac), and two anti-epileptics (carbamazepine and gabapentin). Consumption data for the main hospital of the city (916 beds) and for the population were available. Micropollutant concentrations were measured at different points of the system: wastewater inlet and outlet (WWTP), combined sewer overflows (CSO) and in the receiving waters (Vidy Bay, Lake Geneva). Measured and predicted concentrations were in agreement, except for diclofenac, for which analytical uncertainties were expected. Seven different scenarios were considered (supplementary treatment at the WWTP, at the hospital or at both places, etc.). Based on the results obtained, the supplementary treatment at the WWTP decreases the load of

pharmaceuticals reaching surface water by a factor between 2 and 27, depending on the compound and on the technique. The treatment at the hospitals only influences the amount of ciprofloxacin reaching the environment and decreases the release by one third. The contribution of CSO to surface water pollution is low compared to that of the WWTP for the selected compounds. Regarding the risk for the receiving waters, ciprofloxacin was found to be the most problematic compound, with a risk quotient far above 1. In this particular case, a treatment at the WWTP is not sufficient to reduce the risk, and additional measures at the CSO or at the hospital should be considered. SFA is an ideal tool for developing the best strategy for pharmaceutical elimination, but its application depends on data availability and local conditions.

Croghan, S. M., Rohan, P., Considine, S., et al. (2021). "Time, cost and carbon-efficiency: a silver lining of COVID era virtual urology clinics?" *Ann R Coll Surg Engl* **103**(8): 599-603.

**INTRODUCTION:** The COVID-19 pandemic has demanded radical changes in service delivery. Our centre adopted the use of outpatient telemedicine to reduce close-contact interactions between patients and staff. We hypothesised that incidental gains may be associated with this. We evaluated financial, practical and environmental implications of substituting virtual clinics (VCs) for in-person urology outpatient appointments. **METHODS:** VCs were studied over a 3-month period. Based on patient-reported 'usual mode of transport' to the hospital, travel distance, time, petrol and parking costs, and the carbon emissions avoided by virtue of remote consultations were calculated. The underlying symptom/diagnosis and the 'effectiveness' of the VC were evaluated. **RESULTS:** Of 1,016 scheduled consultations, 736 (72.44%) were conducted by VCs over the study period. VCs resulted in an agreed treatment plan in 98.4% of a representative patient sample. The use of VCs was associated with an overall travel distance saving for patients of 31,038 miles (49,951km) over 3 months, with an average round-trip journey of 93.8 miles (151km) avoided for each rural-dwelling patient and an average financial saving of £25.91 (€28.70) per rural-dwelling car traveller. An estimated 1,257.8 hours of patient time were saved by avoidance of travel and clinic waiting times. Based on car-travelling patients alone, a 6.07-tonne reduction in carbon emissions was achieved with the use of VCs. **CONCLUSIONS:** In appropriate clinical circumstances, VCs appear to provide efficiency across a number of domains. Future healthcare may involve offering outpatients the option of telemedicine as an alternative to physical attendance.

Donahue, L. M., Hilton, S., Bell, S. G., et al. (2020). "A comparative carbon footprint analysis of disposable and reusable vaginal specula." *Am J Obstet Gynecol* **223**(2): 225.e221-225.e227.

[https://www.ajog.org/article/S0002-9378\(20\)30145-9/fulltext](https://www.ajog.org/article/S0002-9378(20)30145-9/fulltext)

**BACKGROUND:** Healthcare systems in the United States have increasingly turned toward the use of disposable medical equipment in an attempt to save time, lower costs, and reduce the transmission of infections. However, the use of disposable instruments is associated with increased solid waste production and may have negative impacts on the environment, such as increased greenhouse gas emissions. **OBJECTIVE:** The purpose of this study was to inform this discussion; we applied life cycle assessment methods to evaluate the carbon footprints of 3 vaginal specula: a single-use acrylic model and 2 reusable stainless steel models. **STUDY DESIGN:** The functional unit of the study was defined as the completion of 20 gynecologic examinations by either type of speculum. The greenhouse gas emissions (eg, carbon dioxide, methane, nitrous oxide) across all life cycle stages, which includes material production and manufacturing, transportation, use and reprocessing, and end-of-life, were analyzed with the use of SimaPro life cycle assessment software and converted into carbon dioxide equivalents. **RESULTS:** The reusable stainless steel grade 304 speculum was found to have a lesser carbon footprint over multiple model scenarios (different reprocessing techniques, autoclave loading/efficiency, and number of uses) than either the reusable stainless steel grade 316 or the disposable acrylic specula. The material production and manufacturing phase contributed most heavily to the total life cycle carbon footprint of the acrylic speculum, whereas the use and reprocessing phase contributed most to the carbon footprints of both stainless steel specula. **CONCLUSION:** The use of disposable vaginal specula is associated with increased greenhouse gas equivalents compared with reusable alternatives with no significant difference in clinical utility. These findings can be used to inform decision-making by healthcare systems, because they weigh a wide range of considerations in

making final purchase decisions; similar analytic methods can and should be applied to other components of health systems' waste streams.

Drew, J., Christie, S. D., Tyedmers, P., et al. (2021). "Operating in a Climate Crisis: A State-of-the-Science Review of Life Cycle Assessment within Surgical and Anesthetic Care." *Environ Health Perspect* **129**(7): 76001.

**BACKGROUND:** Both human health and the health systems we depend on are increasingly threatened by a range of environmental crises, including climate change. Paradoxically, health care provision is a significant driver of environmental pollution, with surgical and anesthetic services among the most resource-intensive components of the health system. **OBJECTIVES:** This analysis aimed to summarize the state of life cycle assessment (LCA) practice as applied to surgical and anesthetic care via review of extant literature assessing environmental impacts of related services, procedures, equipment, and pharmaceuticals. **METHODS:** A state-of-the-science review was undertaken following a registered protocol and a standardized, LCA-specific reporting framework. Three bibliographic databases (Scopus®, PubMed, and Embase®) and the gray literature were searched. Inclusion criteria were applied, eligible entries critically appraised, and key methodological data and results extracted. **RESULTS:** From 1,316 identified records, 44 studies were eligible for inclusion. The annual climate impact of operating surgical suites ranged between 3,200,000 and 5,200,000 kg CO<sub>2</sub>e. The climate impact of individual surgical procedures varied considerably, with estimates ranging from 6 to 1,007 kg CO<sub>2</sub>e. Anesthetic gases; single-use equipment; and heating, ventilation, and air conditioning system operation were the main emissions hot spots identified among operating room- and procedure-specific analyses. Single-use equipment used in surgical settings was generally more harmful than equivalent reusable items across a range of environmental parameters. Life cycle inventories have been assembled and associated climate impacts calculated for three anesthetic gases (2 - 85 kg CO<sub>2</sub>e/MAC-h) and 20 injectable anesthetic drugs (0.01 - 3.0 kg CO<sub>2</sub>e/gAPI). **DISCUSSION:** Despite the recent proliferation of surgical and anesthesiology-related LCAs, extant studies address a minuscule fraction of the numerous services, procedures, and products available today. Methodological heterogeneity, external validity, and a lack of background life cycle inventory data related to many essential surgical and anesthetic inputs are key limitations of the current evidence base. This review provides an indication of the spectrum of environmental impacts associated with surgical and anesthetic care at various scales. <https://doi.org/10.1289/EHP8666>.

Duane, B., Taylor, T., Stahl-Timmins, W., et al. (2014). "Carbon mitigation, patient choice and cost reduction--triple bottom line optimisation for health care planning." *Public Health* **128**(10): 920-924. <https://www.sciencedirect.com/science/article/abs/pii/S0033350614002005>

**OBJECTIVES:** Health services must provide safe, affordable clinical care whilst meeting efficiency, environmental and social targets. These targets include achieving reduced greenhouse gas emissions. A care pathway approach based on a decision-support tool can simultaneously reconfigure health services, improve productivity and reduce carbon emissions. **STUDY DESIGN:** Probabilistic modelling using secondary data analysis. **METHODS:** Estimates of carbon emitted by a health service drew on a previous carbon accounting study which integrated bottom-up assessment of carbon emissions with top-down analysis of indirect emissions by Duane et al. (2012). (1) Using human resource information, estimates were applied in a decision-support model to measure the carbon footprint and service provision of theoretical scenarios. Using this model, sites with less than 60% utilisation were theoretically reconfigured to reduce carbon emissions and improve service provision. **RESULTS:** Clinic utilisation rates improved from 50% to 78%. Human resource savings were identified which could be re-directed towards improving patient care. Patient travel for health care was halved resulting in significant savings in carbon emissions. **CONCLUSIONS:** The proposed model is an effective health care service analysis tool, ensuring optimal utilisation of health care sites and human resources with the lowest carbon footprint.

Feyen, L., Ciscar, J., Gosling, S., et al. (2020). Climate change impacts and adaptation in Europe. . *JRC PESETA IV : final report*. EUR 30180EN. Luxembourg : Office des publications européennes: 71p. <https://publications.jrc.ec.europa.eu/repository/handle/JRC119178>

The JRC PESETA IV study shows that ecosystems, people and economies in the EU will face major impacts from climate change if we do not urgently mitigate greenhouse gas emissions or adapt to climate change. The burden of climate change shows a clear north-south divide, with southern regions in Europe much more impacted, through the effects of extreme heat, water scarcity, drought, forest fires and agriculture losses. Limiting global warming to well below 2°C would considerably reduce climate change impacts in Europe. Adaptation to climate change would further minimize unavoidable impacts in a cost-effective manner, with considerable co-benefits from nature-based solutions.

Forner, D., Purcell, C., Taylor, V., et al. (2021). "Carbon footprint reduction associated with a surgical outreach clinic." *J Otolaryngol Head Neck Surg* **50**(1): 26.

**BACKGROUND:** Healthcare systems generate substantial carbon footprints that may be targeted to decrease greenhouse gas emissions. Outreach clinics may represent tools to assist in this reduction by optimizing patient related travel. Therefore, we sought to estimate the carbon footprint savings associated with a head and neck surgery outreach clinic. **METHODS:** This study was a cross-sectional survey of patient travel patterns to a surgical outreach clinic compared to a regional cancer treatment centre from December 2019 to February 2020. Participants completed a self-administered survey of 12 items eliciting travel distance, vehicle details, and ability to combine medical appointments. Canadian datasets of manufacturer provided vehicular efficiency were used to estimate carbon emissions for each participant. Geographic information systems were used for analyses. **RESULTS:** One hundred thirteen patients were included for analysis. The majority of patients (85.8%) used their own personal vehicle to travel to the outreach clinic. The median distance to the clinic and regional centre were 29.0 km (IQR 6.0-51.9) and 327.0 km (IQR 309.0-337.0) respectively. The mean carbon emission reduction per person was therefore 117,495.4 g (SD: 29,040.0) to 143,570.9 g (SD: 40,236.0). This represents up to 2.5% of an average individual's yearly carbon footprint. Fewer than 10% of patients indicated they were able to carpool or group their appointments. **CONCLUSION:** Surgical outreach clinics decrease carbon footprints associated with patient travel compared to continued care at a regional centre. Further research is needed to determine possible interventions to further reduce carbon emissions associated with the surgical care of patients.

Friedericy, H. J., Sperna Weiland, N. H., van der Eijk, A. C., et al. (2019). "[Steps for reducing the carbon footprint of the operating room]." *Ned Tijdschr Geneesk* **163**.

The healthcare sector contributes significantly to global warming due to carbon emissions; this sector is, therefore, partially responsible for the negative effects of climate change on public health. Carbon emissions by the healthcare sector amount to 7% of the total carbon footprint of the Netherlands. It is anticipated that measures to reduce carbon emissions in the operating room (OR) can make an important contribution to reducing carbon emissions in the hospital as a whole. The most important elements contributing to the carbon footprint of the OR are: energy consumption for heating, ventilation and air conditioning (HVAC); the emission of inhalation anaesthetics; the purchase of materials and equipment; and waste production. Direct carbon emissions by the OR can be reduced through the use of sustainable energy and setback of the HVAC outside office hours. Anaesthetists can dramatically reduce the carbon footprint of the OR by choosing for intravenous anaesthetics instead of inhalation anaesthetics. Indirect carbon emissions and waste production by the OR can be reduced through circular procurement, choosing reusable over disposable products and recycling.

Gao, J., Hou, H., Zhai, Y., et al. (2018). "Greenhouse gas emissions reduction in different economic sectors: Mitigation measures, health co-benefits, knowledge gaps, and policy implications." *Environ Pollut* **240**: 683-698.

To date, greenhouse gas (GHG) emissions, mitigation strategies and the accompanying health co-benefits in different economic sectors have not been fully investigated. The purpose of this paper is to review comprehensively the evidence on GHG mitigation measures and the related health co-benefits, identify knowledge gaps, and provide recommendations to promote further development and implementation of climate change response policies. Evidence on GHG emissions, abatement measures and related health co-benefits has been observed at regional, national and global levels, involving both low- and high-income societies. GHG mitigation actions have mainly been taken in five

sectors: energy generation, transport, food and agriculture, household and industry, consistent with the main sources of GHG emissions. GHGs and air pollutants to a large extent stem from the same sources and are inseparable in terms of their atmospheric evolution and effects on ecosystem; thus, GHG reductions are usually, although not always, estimated to have cost effective co-benefits for public health. Some integrated mitigation strategies involving multiple sectors, which tend to create greater health benefits. The pros and cons of different mitigation measures, issues with existing knowledge, priorities for research, and potential policy implications were also discussed. Findings from this study can play a role not only in motivating large GHG emitters to make decisive changes in GHG emissions, but also in facilitating cooperation at international, national and regional levels, to promote GHG mitigation policies that protect public health from climate change and air pollution simultaneously.

Gatenby, P. A. (2011). "Modelling the carbon footprint of reflux control." *Int J Surg* **9**(1): 72-74.

**BACKGROUND:** The NHS is responsible for approximately 30% of all public sector carbon emissions. The Climate Change Act 2008 introduced legally binding targets to cut emissions of greenhouse gases (GHGs) by at least 80% of the 1990 baseline by 2050. This paper seeks to examine two different strategies for the treatment of gastro-oesophageal reflux disease and their modelled costs and carbon emissions. **METHODS:** This study uses data from the costs of care of patients in the REFLUX study and NHS England Carbon Emissions Carbon Footprinting Report to model the carbon emissions associated with medical and surgical treatment of gastro-oesophageal reflux disease. The main outcome measures are modelled financial costs and carbon emissions for medical and surgical treatment pathways. **RESULTS:** There is a high initial cost (financially and carbon emissions) for surgery, however subsequent year-on-year financial spend and carbon emissions are lower in patients who have had surgical treatment such that the total modelled financial cost of surgery is lower in the 14th year and carbon emissions are lower in the 9th year. The model is sensitive to changes in the efficiency of pharmaceutical procurement and surgical failure rate. **CONCLUSIONS:** The model has demonstrated that in cases of equivalent clinical benefit one pathway may be preferred on the basis of other factors including carbon emissions.

Goel, H., Wemyss, T. A., Harris, T., et al. (2021). "Improving productivity, costs and environmental impact in International Eye Health Services: using the 'Eyeefficiency' cataract surgical services auditing tool to assess the value of cataract surgical services." *BMJ Open Ophthalmol* **6**(1): e000642.

**OBJECTIVE:** Though one of the most common surgeries, there is limited information on variability of practices in cataract surgeries. 'Eyeefficiency' is a cataract surgical services auditing tool to help global units improve their surgical productivity and reduce their costs, waste generation and carbon footprint. The aim of the present research is to identify variability and efficiency opportunities in cataract surgical practices globally. **METHODS AND ANALYSIS:** 9 global cataract surgical facilities used the Eyeefficiency tool to collect facility-level data (staffing, pathway steps, costs of supplies and energy use), and live time-and-motion data. A point person from each site gathered and reported data on 1 week or 30 consecutive cataract surgeries. Environmental life cycle assessment and descriptive statistics were used to quantify productivity, costs and carbon footprint. The main outcomes were estimates of productivity, costs, greenhouse gas emissions, and solid waste generation per-case at each site. **RESULTS:** Nine participating sites recorded 475 cataract extractions (a mix of phacoemulsification and manual small incision). Cases per hour ranged from 1.7 to 4.48 at single-bed sites and 1.47 to 4.25 at dual-bed sites. Average per-case expenditures ranged between £31.55 and £399.34, with a majority of costs attributable to medical equipment and supplies. Average solid waste ranged between 0.19 kg and 4.27 kg per phacoemulsification, and greenhouse gases ranged from 41 kg carbon dioxide equivalents (CO<sub>2</sub>e) to 130 kg CO<sub>2</sub>e per phacoemulsification. **CONCLUSION:** Results demonstrate the global diversity of cataract surgical services and non-clinical metrics. Eyeefficiency supports local decision-making for resource efficiency and could help identify regional or global best practices for optimising productivity, costs and environmental impact of cataract surgery.

Grimmond, T. et Reiner, S. (2012). "Impact on carbon footprint: a life cycle assessment of disposable versus reusable sharps containers in a large US hospital." *Waste Manag Res* **30**(6): 639-642.

<https://journals.sagepub.com/doi/10.1177/0734242X12450602>

Hospitals are striving to reduce their greenhouse gas (GHG) emissions. Targeting supply chain points and replacing disposable with reusable items are among recommendations to achieve this. Annually, US hospitals use 35 million disposable (DSC) or reusable sharps containers (RSC) generating GHG in their manufacture, use, and disposal. Using a life cycle assessment we assessed the global warming potential (GWP) of both systems at a large US hospital which replaced DSC with RSC. GHG emissions (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O) were calculated in metric tons of CO<sub>2</sub> equivalents (MTCO<sub>2</sub>eq). Primary energy input data was used wherever possible and region-specific conversions used to calculate the GWP of each activity. Unit process GHGs were collated into manufacture, transport, washing, and treatment and disposal. The DSC were not recycled nor had recycled content. Chemotherapy DSC were used in both systems. Emission totals were workload-normalized per 100 occupied beds-yr and rate ratio analyzed using Fisher's test with  $P \leq 0.05$  and 95% confidence level. With RSC, the hospital reduced its annual GWP by 127 MTCO<sub>2</sub>eq (-83.5%) and diverted 30.9 tons of plastic and 5.0 tons of cardboard from landfill. Using RSC reduced the number of containers manufactured from 34,396 DSC annually to 1844 RSC in year one only. The study indicates sharps containment GWP in US hospitals totals 100,000 MTCO<sub>2</sub>eq and if RSC were used nationally the figure could fall by 64,000 MTCO<sub>2</sub>eq which, whilst only a fraction of total hospital GWP, is a positive, sustainable step.

Hensher, M. (2023). "Climate change, health and sustainable healthcare: The role of health economics." *Health Econ.*

<https://www.ncbi.nlm.nih.gov/pubmed/36701185>

Healthcare systems around the world are responding with increasing urgency to rapidly evolving ecological crises, most notably climate change. This Perspective considers how health economics and health economists can best contribute to protecting health and building sustainable healthcare systems in the face of these challenges.

Hillman, T., Mortimer, F. et Hopkinson, N. S. (2013). "Inhaled drugs and global warming: time to shift to dry powder inhalers." *BMJ : British Medical Journal* **346**: f3359.

<https://www.bmj.com/content/bmj/346/bmj.f3359.full.pdf>

Holmner, A., Ebi, K. L., Lazard, L., et al. (2014). "Carbon footprint of telemedicine solutions--unexplored opportunity for reducing carbon emissions in the health sector." *PLoS One* **9**(9): e105040.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4154849/pdf/pone.0105040.pdf>

**BACKGROUND:** The healthcare sector is a significant contributor to global carbon emissions, in part due to extensive travelling by patients and health workers. **OBJECTIVES:** To evaluate the potential of telemedicine services based on videoconferencing technology to reduce travelling and thus carbon emissions in the healthcare sector. **METHODS:** A life cycle inventory was performed to evaluate the carbon reduction potential of telemedicine activities beyond a reduction in travel related emissions. The study included two rehabilitation units at Umeå University Hospital in Sweden. Carbon emissions generated during telemedicine appointments were compared with care-as-usual scenarios. Upper and lower bound emissions scenarios were created based on different teleconferencing solutions and thresholds for when telemedicine becomes favorable were estimated. Sensitivity analyses were performed to pinpoint the most important contributors to emissions for different set-ups and use cases. **RESULTS:** Replacing physical visits with telemedicine appointments resulted in a significant 40-70 times decrease in carbon emissions. Factors such as meeting duration, bandwidth and use rates influence emissions to various extents. According to the lower bound scenario, telemedicine becomes a greener choice at a distance of a few kilometers when the alternative is transport by car. **CONCLUSIONS:** Telemedicine is a potent carbon reduction strategy in the health sector. But to contribute significantly to climate change mitigation, a paradigm shift might be required where telemedicine is regarded as an essential component of ordinary health care activities and not only considered to be a service to the few who lack access to care due to geography, isolation or other constraints.

Holmner, Å., Rocklöv, J., Ng, N., et al. (2012). "Climate change and eHealth: a promising strategy for health sector mitigation and adaptation." *Global Health Action* 5(1): 18428.

<https://doi.org/10.3402/gha.v5i0.18428>

Climate change is one of today's most pressing global issues. Policies to guide mitigation and adaptation are needed to avoid the devastating impacts of climate change. The health sector is a significant contributor to greenhouse gas emissions in developed countries, and its climate impact in low-income countries is growing steadily. This paper reviews and discusses the literature regarding health sector mitigation potential, known and hypothetical co-benefits, and the potential of health information technology, such as eHealth, in climate change mitigation and adaptation. The promising role of eHealth as an adaptation strategy to reduce societal vulnerability to climate change, and the link's between mitigation and adaptation, are also discussed. The topic of environmental eHealth has gained little attention to date, despite its potential to contribute to more sustainable and green health care. A growing number of local and global initiatives on 'green information and communication technology (ICT)' are now mentioning eHealth as a promising technology with the potential to reduce emission rates from ICT use. However, the embracing of eHealth is slow because of limitations in technological infrastructure, capacity and political will. Further research on potential emissions reductions and co-benefits with green ICT, in terms of health outcomes and economic effectiveness, would be valuable to guide development and implementation of eHealth in health sector mitigation and adaptation policies.

Hu, X., Pierce, J. M. T., Taylor, T., et al. (2021). "The carbon footprint of general anaesthetics: A case study in the UK." *Resources, Conservation and Recycling* 167: 105411.

<https://www.sciencedirect.com/science/article/pii/S0921344921000185>

The UK National Health Service (NHS) aims to achieve net zero carbon emissions by 2050. One measure for reaching this target outlined in the NHS long-term plan (2019) is to reduce the carbon footprint of inhalational anaesthetic gases (IAGs). We modelled the synthesis of commonly used IAGs - sevoflurane, isoflurane, and desflurane - in comparison to intravenous propofol and estimated the carbon footprint generated throughout their lifetime, from manufacturing of raw materials to emissions of IAGs vented from operating theatres. We find that the carbon footprint of IAGs varies significantly depending on the method of chemical synthesis. Our results indicate that the carbon footprint of IAGs is minimised when using oxygen/air mix as the carrier gas at the lowest flow rate while applying a vapour capture technology (VCT). In this scenario, the carbon footprint of sevoflurane per minimum alveolar concentration hour is similar to that of propofol, which is a significant finding given that previous studies have favoured propofol as a means of carbon footprint reduction and only the active pharmaceutical ingredient of propofol was examined. Further, we show that the carbon footprint of sevoflurane used in the NHS during 2018, in the absence of VCTs, is not smaller than that of desflurane if sevoflurane is synthesised from tetrafluoroethylene. Therefore, to reduce the carbon footprint of IAGs, this study supports the continued reduction in the use of nitrous oxide and recommends a wider adoption of VCTs.

Husain, S. A. et Sidhu, M. (2021). "Realist evaluation of the implementation and impact of the NHS carbon reduction strategy in the UK." *BMJ Open* 11(9): e044259.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8413867/pdf/bmjopen-2020-044259.pdf>

OBJECTIVES: To evaluate the extent to which organisational factors facilitate or inhibit the implementation of the National Health Service (NHS) carbon reduction strategy within acute hospital settings. SETTING: A single acute NHS Trust with four satellite sites which serve more than 2 million patients annually in Central England. PARTICIPANTS: Interviews with a purposive sample of 10 stakeholders, including those who conceptualised the intervention and those who were responsible for its implementation. INTERVENTION: The NHS is a major carbon emitter and therefore developed the 'NHS carbon reduction strategy (NHSCRS)' in 2009. NHS organisations are contractually obliged to develop a local carbon reduction strategy known as a Sustainable Development Management Plan (SDMP) which details carbon reduction measures (CRM), as described in the NHSCRS. However, the organisational context within which the SDMP is implemented is likely to determine the extent of its



success. We undertook an adapted realist evaluation cycle to develop refined initial programme theories. Documents were analysed using thematic content analysis. Interview data were analysed using thematic analysis. RESULTS: CRM were most likely to be implemented if the Trust Board were sufficiently pressured by staff and reputational fears, and the potential impacts of CRM were perceived to align with wider organisational aims. Differences in implementation of CRM across hospital sites were related to logistical factors, accessibility to regional partners and contractual relationships. There were expected carbon, energy and long-term financial savings, with variability in the effectiveness of some CRM post implementation. CONCLUSIONS: Organisational factors, particularly Board leadership and internal implementation pathways, have a significant bearing on whether CRM are implemented or not. However, greater national support and guidance is needed for NHS organisations to effectively reduce their carbon emissions. Further cycles of this evaluation are necessary in multiple case study sites to illuminate the path to a net-zero NHS carbon footprint by 2045.

IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. . IPCC: 3676p.

[https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC\\_AR6\\_WGII\\_FinalDraft\\_FullReport.pdf](https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_FinalDraft_FullReport.pdf)

This Summary for Policymakers (SPM) presents key findings of the Working Group II (WGII) contribution to the Sixth Assessment Report (AR6) of the IPCC1 . The report builds on the WGII contribution to the Fifth Assessment Report (AR5) of the IPCC, three Special Reports , and the Working Group I (WGI) contribution to the AR6 cycle. This report recognizes the interdependence of climate, ecosystems and biodiversity , and human societies (Figure SPM.1) and integrates knowledge more strongly across the natural, ecological, social and economic sciences than earlier IPCC assessments. The assessment of climate change impacts and risks as well as adaptation is set against concurrently unfolding non-climatic global trends e.g., biodiversity loss, overall unsustainable consumption of natural resources, land and ecosystem degradation, rapid urbanisation, human demographic shifts, social and economic inequalities and a pandemic. The scientific evidence for each key finding is found in the 18 chapters of the underlying report and in the cross-chapter papers as well as the integrated synthesis presented in the Technical Summary (hereafter TS) and referred to in curly brackets {}. Used on scientific understanding, key findings can be formulated as statements of fact or associated with an assessed level of confidence using the IPCC calibrated language. The WGII Global to Regional Atlas (Annex I) facilitates exploration of key synthesis findings across the WGII regions.

Janson, C., Henderson, R., Löfdahl, M., et al. (2020). "Carbon footprint impact of the choice of inhalers for asthma and COPD." *75*(1): 82-84.

In the 1990s, metered dose inhalers (MDIs) containing chlorofluorocarbons were replaced with dry-powder inhalers (DPIs) and MDIs containing hydrofluorocarbons (HFCs). While HFCs are not ozone depleting, they are potent greenhouse gases. Annual carbon footprint (CO<sub>2</sub>e), per patient were 17 kg for Relvar-Ellipta/Ventolin-Accuhaler; and 439 kg for Seretide-Evohaler/Ventolin-Evohaler. In 2017, 70% of all inhalers sold in England were MDI, versus 13% in Sweden. Applying the Swedish DPI and MDI distribution to England would result in an annual reduction of 550 kt CO<sub>2</sub>e. The lower carbon footprint of DPIs should be considered alongside other factors when choosing inhalation devices.

Jennings, N. et Rao, M. (2020). "Towards a carbon neutral NHS." *Bmj* **371**: m3884.

<https://www.bmj.com/content/371/bmj.m3884.long>

Keil, M., Viere, T., Helms, K., et al. (2022). "The impact of switching from single-use to reusable healthcare products: a transparency checklist and systematic review of life-cycle assessments." *Eur J Public Health* **33**(1): 56-63.

<https://doi.org/10.1093/eurpub/ckac174>

Replacing single-use products with reusable ones may reduce the environmental impact of healthcare. This study aimed to broadly assess the environmental effects of that substitution .A systematic review of comparative cradle-to-grave life-cycle assessments (LCAs) of single-use and reusable healthcare products was conducted. The main outcomes assessed were changes in the environmental impact that

resulted after switching from single-use to reusable products. As no standardized transparency checklist was available, one was developed here using DIN ISO 14040/14044. The final checklist included 22 criteria used to appraise the included studies. After screening, 27 studies were included in the analysis. The healthcare products were assigned to four categories: invasive medical devices, non-invasive medical devices, protection equipment and inhalers. The outcomes revealed a reduction in mean effect sizes for all environmental impacts except water use. Non-invasive medical devices have greater relative mitigation potential than invasive devices. On average, information on 64% of the transparency checklist items was reported. Gaps included the reporting of data quality requirements. Switching to reusable healthcare products is likely to reduce most impacts on the environment except water use, but the effect size differs among product categories. Possible study limitations include location bias, no systematic search of the grey literature and small samples for some impacts. This study's strengths are its approach to product categories and developed transparency catalogue. This catalogue could be useful to inform and guide a future process towards creating a standardized transparency checklist for the systematic reviews of LCAs.

Langstaff, K. et Brzozowski, V. (2017). "Managing environmental sustainability in a healthcare setting." *Healthc Manage Forum* **30**(2): 84-88.

<https://journals.sagepub.com/doi/10.1177/0840470416675178>

How does a hospital sustain its journey towards environmental sustainability? To date, most hospitals have embarked on some strategies for improving environmental performance, whether it's reducing energy or landfill waste. Environmental sustainability strategies, however, can often lose momentum or stagnate if not championed by someone whose full-time role is to assess, monitor, and bring new strategies to the table. In the face of ongoing budget deficits, it is increasingly difficult to get adequate support and buy-in for this type of role unless the leadership of the organization is committed to an environmental sustainability program. This article will examine the strategies and outcomes of an environmental sustainability plan for one hospital from 2008 to present, including best strategies, lessons learned, and what lies ahead of us in the new world of capping greenhouse gas emissions.

Lewis, D., Tranter, G. et Axford, A. T. (2009). "Use of videoconferencing in Wales to reduce carbon dioxide emissions, travel costs and time." *J Telemed Telecare* **15**(3): 137-138.

<https://journals.sagepub.com/doi/10.1258/jtt.2009.003010>

In September 2005 a telemedicine service was started to assist multidisciplinary teams in Wales to improve cancer services. In October 2006 and October 2007 users of videoconferencing equipment at one site completed questionnaires. During October 2006 a total of 18,000 km of car travel were avoided, equivalent to 1696 kg of CO<sub>2</sub> emission. During October 2007 a total of 20,800 km of car travel were avoided, equivalent to 2590 kg of CO<sub>2</sub> emission. We estimate that 48 trees would take a year to absorb that quantity of CO<sub>2</sub>. The results of the surveys show that exploiting telemedicine makes better use of staff time, reduces the time spent travelling and assists in reducing climate change by limiting the emissions of CO<sub>2</sub>.

McGain, F., Moore, G. et Black, J. (2016). "Hospital steam sterilizer usage: could we switch off to save electricity and water?" *J Health Serv Res Policy* **21**(3): 166-171.

<https://www.ncbi.nlm.nih.gov/pubmed/26769573>

**OBJECTIVES:** Steam sterilization in hospitals is an energy and water intensive process. Our aim was to identify opportunities to improve electricity and water use. The objectives were to find: the time sterilizers spent active, idle and off; the variability in sterilizer use with the time of day and day of the week; and opportunities to switch off sterilizers instead of idling when no loads were waiting, and the resultant electricity and water savings. **METHODS:** Analyses of routine data for one year of the activity of the four steam sterilizers in one hospital in Melbourne, Australia. We examined active sterilizer cycles, routine sterilizer switch-offs, and when sterilizers were active, idle and off. Several switch-off strategies were examined to identify electricity and water savings: switch off idle sterilizers when no loads are waiting and switch off one sterilizer after 10:00 h and a second sterilizer after midnight on all days. **RESULTS:** Sterilizers were active for 13,430 (38%) sterilizer-hours, off for 4822 (14%) sterilizer-

hours, and idle for 16,788 (48%) sterilizer-hours. All four sterilizers were simultaneously active 9% of the time, and two or more sterilizers were idle for 69% of the time. A sterilizer was idle for two hours or less 13% of the time and idle for more than 2 h 87% of the time. A strategy to switch off idle sterilizers would reduce electricity use by 66 MWh and water use by 1004 kl per year, saving 26% electricity use and 13% of water use, resulting in financial savings of AUD\$13,867 (UK pound6,517) and a reduction in 79 tonnes of CO<sub>2</sub> emissions per year. An alternative switch-off strategy of one sterilizer from 10:00 h onwards and a second from midnight would have saved 30 MWh and 456 kl of water. CONCLUSIONS: The methodology used of how hospital sterilizer use could be improved could be applied to all hospitals and more broadly to other equipment used in hospitals.

Malakahmad, A., Abualqumboz, M. S., Kutty, S. R. M., et al. (2017). "Assessment of carbon footprint emissions and environmental concerns of solid waste treatment and disposal techniques; case study of Malaysia." *Waste Manag* **70**: 282-292.

Malaysian authorities has planned to minimize and stop when applicable unsanitary dumping of waste as it puts human health and the environment at elevated risk. Cost, energy and revenue are mostly adopted to draw the blueprint of upgrading municipal solid waste management system, while the carbon footprint emissions criterion rarely acts as a crucial factor. This study aims to alert Malaysian stakeholders on the uneven danger of carbon footprint emissions of waste technologies. Hence, three scenarios have been proposed and assessed mainly on the carbon footprint emissions using the 2006 IPCC methodology. The first scenario is waste dumping in sanitary landfills equipped with gas recovery system, while the second scenario includes anaerobic digestion of organics and recycling of recyclable wastes such as plastic, glass and textile wastes. The third scenario is waste incineration. Besides the carbon footprint emissions criterion, other environmental concerns were also examined. The results showed that the second scenario recorded the lowest carbon footprint emissions of 0.251t CO<sub>2</sub> eq./t MSW while the third scenario had the highest emissions of 0.646t CO<sub>2</sub> eq./t MSW. Additionally, the integration between anaerobic digestion and recycling techniques caused the highest avoided CO<sub>2</sub> eq. emissions of 0.74t CO<sub>2</sub> eq./t MSW. The net CO<sub>2</sub> eq. emissions of the second scenario equaled -0.489t CO<sub>2</sub> eq./t MSW due to energy recovery from the biogas and because of recycled plastic, glass and textile wastes that could replace usage of raw material. The outcomes also showed that the first scenario generates huge amount of leachate and hazardous air constituents. The study estimated that a ton of dumped waste inside the landfills generates approximately 0.88m<sup>3</sup> of trace risky compounds and 0.188m<sup>3</sup> of leachate. As for energy production, the results showed that the third scenario is capable of generating 639kWh/t MSW followed by the second scenario with 387.59kWh/t MSW. The first scenario produced 296.79kWh/t MSW. In conclusion, the outcomes of this study recommend an integrated scenario of anaerobic digestion and recycling techniques to be employed in Malaysia.

Markandya, A., Sampedro, J., Smith, S. J., et al. (2018). "Health co-benefits from air pollution and mitigation costs of the Paris Agreement: a modelling study." *The Lancet Planetary Health* **2**(3): e126-e133. [https://doi.org/10.1016/S2542-5196\(18\)30029-9](https://doi.org/10.1016/S2542-5196(18)30029-9)

Background Although the co-benefits from addressing problems related to both climate change and air pollution have been recognised, there is not much evidence comparing the mitigation costs and economic benefits of air pollution reduction for alternative approaches to meeting greenhouse gas targets. We analysed the extent to which health co-benefits would compensate the mitigation cost of achieving the targets of the Paris climate agreement (2°C and 1.5°C) under different scenarios in which the emissions abatement effort is shared between countries in accordance with three established equity criteria.

Markandya, A., Armstrong, B. G., Hales, S., et al. (2009). "Public health benefits of strategies to reduce greenhouse-gas emissions: low-carbon electricity generation." *Lancet* **374**(9706): 2006-2015. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(09\)61715-3/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(09)61715-3/fulltext)

In this report, the third in this Series on health and climate change, we assess the changes in particle air pollution emissions and consequent effects on health that are likely to result from greenhouse-gas mitigation measures in the electricity generation sector in the European Union (EU), China, and India.

We model the effect in 2030 of policies that aim to reduce total carbon dioxide (CO<sub>2</sub>) emissions by 50% by 2050 globally compared with the effect of emissions in 1990. We use three models: the POLES model, which identifies the distribution of production modes that give the desired CO<sub>2</sub> reductions and associated costs; the GAINS model, which estimates fine particulate matter with aerodynamic diameter 2.5 microm or less (PM<sub>2.5</sub>) concentrations; and a model to estimate the effect of PM<sub>2.5</sub> on mortality on the basis of the WHO's Comparative Risk Assessment methods. Changes in modes of production of electricity to reduce CO<sub>2</sub> emissions would, in all regions, reduce PM<sub>2.5</sub> and deaths caused by it, with the greatest effect in India and the smallest in the EU. Health benefits greatly offset costs of greenhouse-gas mitigation, especially in India where pollution is high and costs of mitigation are low. Our estimates are approximations but suggest clear health gains (co-benefits) through decarbonising electricity production, and provide additional information about the extent of such gains.

McGain, F., Moore, G. et Black, J. (2016). "Hospital steam sterilizer usage: could we switch off to save electricity and water?" *J Health Serv Res Policy* **21**(3): 166-171.

<https://www.ncbi.nlm.nih.gov/pubmed/26769573>

**OBJECTIVES:** Steam sterilization in hospitals is an energy and water intensive process. Our aim was to identify opportunities to improve electricity and water use. The objectives were to find: the time sterilizers spent active, idle and off; the variability in sterilizer use with the time of day and day of the week; and opportunities to switch off sterilizers instead of idling when no loads were waiting, and the resultant electricity and water savings. **METHODS:** Analyses of routine data for one year of the activity of the four steam sterilizers in one hospital in Melbourne, Australia. We examined active sterilizer cycles, routine sterilizer switch-offs, and when sterilizers were active, idle and off. Several switch-off strategies were examined to identify electricity and water savings: switch off idle sterilizers when no loads are waiting and switch off one sterilizer after 10:00 h and a second sterilizer after midnight on all days. **RESULTS:** Sterilizers were active for 13,430 (38%) sterilizer-hours, off for 4822 (14%) sterilizer-hours, and idle for 16,788 (48%) sterilizer-hours. All four sterilizers were simultaneously active 9% of the time, and two or more sterilizers were idle for 69% of the time. A sterilizer was idle for two hours or less 13% of the time and idle for more than 2 h 87% of the time. A strategy to switch off idle sterilizers would reduce electricity use by 66 MWh and water use by 1004 kl per year, saving 26% electricity use and 13% of water use, resulting in financial savings of AUD\$13,867 (UK pound6,517) and a reduction in 79 tonnes of CO<sub>2</sub> emissions per year. An alternative switch-off strategy of one sterilizer from 10:00 h onwards and a second from midnight would have saved 30 MWh and 456 kl of water. **CONCLUSIONS:** The methodology used of how hospital sterilizer use could be improved could be applied to all hospitals and more broadly to other equipment used in hospitals.

McGain, F. et Naylor, C. (2014). "Environmental sustainability in hospitals - a systematic review and research agenda." *J Health Serv Res Policy* **19**(4): 245-252.

<https://journals.sagepub.com/doi/10.1177/1355819614534836>

**OBJECTIVES:** Hospitals are significant contributors to natural resource depletion and environmental change. Our objective was to establish the extent to which hospital environmental sustainability has been studied and the key issues that emerge for policy, practice and research. **METHODS:** The PubMed, Engineering Village, Cochrane and King's Fund databases were searched for articles relating to hospital environmental sustainability published in English between 1 January 1990 and 1 October 2013. Further studies were found by review of reference lists. One hundred ninety-three relevant articles were found and 76 were selected for inclusion in the review. **RESULTS:** Common research themes were identified: hospital design, direct energy consumption, water, procurement, waste, travel and psychology and behaviour. Some countries (particularly the United Kingdom) have begun to invest systematically in understanding the environmental effects of hospitals. We found large variability in the extent of the evidence base according to topic. Research regarding the architectural fabric of hospital buildings is at a relatively mature stage. Similarly, there is a developed research base regarding devices and technologies used within hospitals to reduce the environmental effects of direct hospital energy and water use. Less is known about the clinical, psychological and social factors that influence how health care professionals use resources, travel to/from hospital, and interact with the

buildings and technologies available. A significant part of the environmental footprint of hospitals relates to clinical practice, e.g. decisions regarding the use of pharmaceuticals and medical devices. Medical 'cradle to grave' life cycle assessment studies have been published to understand the full financial and environmental costs of hospital activities. The effects of preventive or demand management measures which avoid unnecessary hospital procedures are likely to be much greater than incremental changes to how hospital procedures are performed. CONCLUSIONS: There remain significant gaps in the evidence base on hospital sustainability. Assessments of environmental impacts and natural resource use are beginning to be produced, both at the level of individual hospitals and at the health system level. These are an important start, but in many areas do not yet provide sufficiently detailed information to guide decision-making. There are many areas where the interests of patients and the environment coincide, but others where tensions exist. Rising resource costs and climate change mitigation measures are likely to create an increasing stimulus for research on hospital sustainability. Such research will benefit from inter-disciplinary coordination across research funders and countries.

Miarov, O., Tal, A. et Avisar, D. (2020). "A critical evaluation of comparative regulatory strategies for monitoring pharmaceuticals in recycled wastewater." *J Environ Manage* **254**: 109794.

Pharmaceuticals are a subset of micropollutants, present in the environment in trace concentrations. Because of their persistent nature, these chemicals are of particular concern. Little is known about how mixtures of pharmaceutical residues, found in WWTP effluents, affect the environment or public health. Yet, numerous studies show negative outcomes for both aquatic and terrestrial organisms, suggesting that they are given both to bioaccumulation and uptake in plants. Israel leads the world in effluent reuse (86%), almost exclusively utilized for purposes of agricultural irrigation. Pharmaceuticals, however, are not included in Israel's water regulatory oversight or management, essentially creating an epidemiological experiment among its citizens and environment. Globally, these compounds also are not commonly subject to monitoring or regulation. This study reviews and analyzes water policies and regulation worldwide that address the presence of pharmaceuticals in water resources, with a particular focus on Australia, Singapore, Switzerland, and the USA. Furthermore, the study investigates the reasons why these chemicals are not yet regulated in Israel. Based on a comprehensive evaluation of the data and analysis of the regulatory rationale in other countries, a list of recommended pharmaceutical standards that should be measured and monitored in Israel's wastewater treatment system is proposed. The suggested prioritization criteria should be at the heart of a new regulatory agenda for controlling pharmaceutical contamination in wastewater.

Nichols, A. et Richardson, J. (2011). "Climate change, health and sustainability: a brief survey of primary care trusts in the south west of England." *Perspect Public Health* **131**(2): 82-84.  
<https://journals.sagepub.com/doi/10.1177/1757913910379196>

With climate change threatening to present real challenges to public health, the relevant UK organizations, such as the NHS, have produced guidelines and action plans to encourage primary care trusts (PCTs) to reduce their carbon emissions and generally function in a more sustainable way. This paper presents the results of a survey designed to assess how successful this initiative has been in one part of the UK, the south west of England. While the results are promising, the PCTs surveyed are aware that commitment and leadership must come from a higher level.

Oliveira, T. C., Barlow, J., Gonçalves, L., et al. (2013). "Teleconsultations reduce greenhouse gas emissions." *J Health Serv Res Policy* **18**(4): 209-214.  
<https://journals.sagepub.com/doi/10.1177/1355819613492717>

OBJECTIVES: Health services contribute significantly to greenhouse gas emissions. New models of delivering care closer to patients have the potential to reduce travelling and associated emissions. We aimed to compare the emissions of patients attending a teleconsultation - an outpatient appointment using video-conferencing equipment - with those of patients attending a face-to-face appointment. METHODS: We estimated the total distances travelled and the direct and indirect greenhouse gas emissions for 20,824 teleconsultations performed between 2004 and 2011 in Alentejo, a Portuguese

region. These were compared to the distances and emissions that would have resulted if teleconsultations were not available and patients had to attend face-to-face outpatient appointments. Estimates were calculated using survey data on mode of transport, and national aggregate data for car engine size and fuel. A sensitivity analysis using the lower and upper quartiles for survey distances was performed. RESULTS: Teleconsultations led to reductions in distances and emissions of 95%. 2,313,819 km of travelling and 455 tonnes of greenhouse gas emissions were avoided (22 kg of carbon dioxide equivalent per patient). The incorporation of modes of transport and car engine size and fuel in the analysis led to emission estimates which were 12% smaller than those assuming all patients used an average car. CONCLUSIONS: The availability of remote care services can significantly reduce road travel and associated emissions. At a time when many countries are committed to reducing their carbon footprint, it is desirable to explore how these reductions could be incorporated into technology assessments and economic evaluations.

OMS (2017). Environmentally sustainable health systems: a strategic document. Copenhagen : OMS: 27p.  
<https://www.who.int/publications/i/item/WHO-EURO-2017-2241-41996-57723>

OMS (2022). Tonnes of COVID-19 health care waste expose urgent need to improve waste management systems [Press release]. Copenhagen : OMS.  
<https://www.who.int/news/item/01-02-2022-tonnes-of-covid-19-health-care-waste-expose-urgent-need-to-improve-waste-management-systems>

Tens of thousands of tonnes of extra medical waste from the response to the COVID-19 pandemic has put tremendous strain on health care waste management systems around the world, threatening human and environmental health and exposing a dire need to improve waste management practices, according to a new WHO report. The WHO Global analysis of health care waste in the context of COVID-19: status, impacts and recommendations bases its estimates on the approximately 87,000 tonnes of personal protective equipment (PPE) that was procured between March 2020- November 2021 and shipped to support countries' urgent COVID-19 response needs through a joint UN emergency initiative. Most of this equipment is expected to have ended up as waste.

Pencheon, D. (2015). "Making health care more sustainable: the case of the English NHS." *Public Health* **129**(10): 1335-1343.  
<https://www.sciencedirect.com/science/article/abs/pii/S0033350615003297>

The NHS is the most revered organisation in Britain: 'the proudest achievement of our modern society'. It is certainly the largest, although since its inception in 1948 it has operated in a government-funded environment of restricted resources. Nevertheless, it has also benefitted from a generally effective model of intervention centred on a hospital care system integrating specialist and emergency care and a primary care system which functions as both a source of treatment and a gatekeeper to specialist care. New circumstances, including environmentally-generated risk and a shifting disease reality, challenges the adequacy of this model. This paper argues that these new circumstances, some of which have seen a legislative response by government, mean that the NHS has to apply sustainable development thinking programmatically throughout its management and operations. It is also argued that the organisation needs to refocus towards prevention particularly in order to stem the rising tide of non-communicable disease. This paper sets out the thinking and actions of the Sustainable Development Unit, which has the task of developing and implanting sustainability concepts in the NHS. It is argued that the cause of sustainable development calls for a mix of cultural and technological shifts, new incentives and a rolling programme of innovative change. Some examples of success are presented.

Pollard, A. S., Taylor, T. J., Fleming, L. E., et al. (2013). "Mainstreaming carbon management in healthcare systems: a bottom-up modeling approach." *Environ Sci Technol* **47**(2): 678-686.  
<https://pubs.acs.org/doi/10.1021/es303776g>

Increasing greenhouse gas emissions threaten human health and the environment. In response, healthcare managers face significant challenges in balancing operational decisions about patient care

with carbon mitigation targets. We explore a bottom-up modeling framework to aid in the decision-making for both carbon and cost in healthcare, using data from a case study in Cornwall, UK. A model was built and run for secondary healthcare, specifically outpatient clinics, theater lists, beds, and diagnostic facilities. Five scenarios were tested: business-as-usual; service expansion; site closure; water temperature reduction; and theater optimization. The estimated emissions from secondary healthcare in Cornwall ran to 5787 T CO<sub>2</sub>eq with patient travel adding 2215 T CO<sub>2</sub>eq. Closing selected sites would have reduced this by 4% (261 T CO<sub>2</sub>eq), a reduction less than the resulting increases in patient transport emissions. Reducing hot water temperatures by 5 °C and improving theater usage would lower the footprint by 0.7% (44 T CO<sub>2</sub>eq) and 0.08% (5 T CO<sub>2</sub>eq), respectively. We consider bottom-up models important tools in the process of estimating and modeling the carbon footprint of healthcare. For the carbon reduction targets of the healthcare sector to be met, the use of these bottom-up models in decision making and forward planning is pivotal.

Qin, R. X., Velin, L., Yates, E. F., et al. (2022). "Building sustainable and resilient surgical systems: A narrative review of opportunities to integrate climate change into national surgical planning in the Western Pacific region." *Lancet Reg Health West Pac* **22**: 100407.

Five billion people lack access to surgical care worldwide; climate change is the biggest threat to human health in the 21st century. This review studies how climate change could be integrated into national surgical planning in the Western Pacific region. We searched databases (PubMed, Web of Science, and Global Health) for articles on climate change and surgical care. Findings were categorised using the modified World Health Organisation Health System Building Blocks Framework. 220 out of 2577 records were included. Infrastructure: Operating theatres are highly resource-intensive. Their carbon footprint could be reduced by maximising equipment longevity, improving energy efficiency, and renewable energy use. Service delivery Tele-medicine, outreaches, and avoiding desflurane could reduce emissions. Robust surgical systems are required to adapt to the increasing burden of surgically treated diseases, such as injuries from natural disasters. Finance: Climate change adaptation funds could be mobilised for surgical system strengthening. Information systems: Sustainability should be a key performance indicator for surgical systems. Workforce: Surgical providers could change clinical, institutional, and societal practices. Governance: Planning in surgical care and climate change should be aligned. Climate change mitigation is essential in the regional surgical care scale-up; surgical system strengthening is also necessary for adaptation to climate change.

Redvers, N. (2021). "Patient-Planetary Health Co-benefit Prescribing: Emerging Considerations for Health Policy and Health Professional Practice." *Front Public Health* **9**: 678545.

In addition to the importance of fostering and developing measures for better health-system resilience globally from the effects of climate change, there have been increasing calls for health professionals, as well as public health and medical education systems, to become partners in climate change mitigation efforts. Direct clinical practice considerations, however, have not been adequately fostered equitably across all regions with an often-confusing array of practice areas within planetary health and sustainable healthcare. This article calls for a more coordinated effort within clinical practice spaces given the urgency of global environmental change, while also taking lessons from Indigenous traditional knowledge systems—a viewpoint that is rarely heard from or prioritized in public health or medicine. Simpler and more coordinated messaging in efforts to improve patient and planetary health are needed. The creation of unifying terminology within planetary health-rooted clinical and public health practice has been proposed with the potential to bring forth dialogue between and within disciplinary offshoots and public health advocacy efforts, and within clinical and health-system policy spaces.

Richie, C. (2022). "Environmental sustainability and the carbon emissions of pharmaceuticals." *Journal of Medical Ethics* **48**(5): 334-337.  
<https://jme.bmj.com/content/medethics/48/5/334.full.pdf>

The US healthcare industry emits an estimated 479 million tonnes of carbon dioxide each year; nearly 8% of the country's total emissions. When assessed by sector, hospital care, clinical services, medical

structures, and pharmaceuticals are the top emitters. For 15 years, research has been dedicated to the medical structures and equipment that contribute to carbon emissions. More recently, hospital care and clinical services have been examined. However, the carbon of pharmaceuticals is understudied. This article will focus on the carbon emissions of pharmaceuticals since they are consistently calculated to be among the top contributors to healthcare carbon and assess the factors that contribute to pharmaceutical carbon emissions. Specifically, overprescription, pharmaceutical waste, antibiotic resistance, routine prescriptions, non-adherence, drug dependency, lifestyle prescriptions, and drugs given due to a lack of preventive healthcare will be identified. Prescribing practices have environmental ramifications. Carbon reduction, when focused on pharmaceuticals, can lead to cleaner, more sustainable healthcare. All data relevant to the study are included in the article.

Rizan, C., Bhutta, M. F., Reed, M., et al. (2021). "The carbon footprint of waste streams in a UK hospital." *Journal of Cleaner Production* **286**.

<https://www.sciencedirect.com/science/article/abs/pii/S0959652620354925>

A number of studies have estimated the carbon footprint of healthcare provision in a variety of contexts, but the emission factors used to account for associated waste vary widely and are not healthcare specific. The aim of this study was to estimate and compare the carbon footprint of hospital waste streams. A process-based carbon footprint of hospital waste was estimated in accordance with the Greenhouse Gas Accounting Sector Guidance for Pharmaceutical Products and Medical Devices, using activity data based on waste streams found at three hospitals in one UK National Health Service organisation. This study estimates that the carbon footprint per t of hospital waste was lowest when it is recycled (21–65 kg CO<sub>2</sub>e), followed by low temperature incineration with energy from waste (172–249 kg CO<sub>2</sub>e). When the waste was additionally decontaminated using an autoclave prior to low temperature incineration with energy from waste, the carbon footprint was increased to 569 kg CO<sub>2</sub>e. The highest carbon footprint was associated with the disposal of waste via high temperature incineration (1074 kg CO<sub>2</sub>e/ t). NHS data show that the financial cost of waste streams mirror that of the carbon footprint. In conclusion, it is possible to use the carbon footprint of hospital waste streams to derive emission factors for specific waste disposal options. This may inform the optimal processing of healthcare waste in the future.

Rizan, C., Brophy, T., Lillywhite, R., et al. (2022). "Life cycle assessment and life cycle cost of repairing surgical scissors." *The International Journal of Life Cycle Assessment* **27**(6): 780-795.

<https://doi.org/10.1007/s11367-022-02064-7>

The primary objective of this study was to evaluate the environmental impact and financial cost of repairing surgical scissors.

Rizan, C., Lillywhite, R. et Reed, M. (2022). "Minimising carbon and financial costs of steam sterilisation and packaging of reusable surgical instruments." **109**(2): 200-210.

**BACKGROUND:** The aim of this study was to estimate the carbon footprint and financial cost of decontaminating (steam sterilization) and packaging reusable surgical instruments, indicating how that burden might be reduced, enabling surgeons to drive action towards net-zero-carbon surgery.

**METHODS:** Carbon footprints were estimated using activity data and prospective machine-loading audit data at a typical UK in-hospital sterilization unit, with instruments wrapped individually in flexible pouches, or prepared as sets housed in single-use tray wraps or reusable rigid containers. Modelling was used to determine the impact of alternative machine loading, opening instruments during the operation, streamlining sets, use of alternative energy sources for decontamination, and alternative waste streams. **RESULTS:** The carbon footprint of decontaminating and packaging instruments was lowest when instruments were part of sets (66-77 g CO<sub>2</sub>e per instrument), with a two- to three-fold increase when instruments were wrapped individually (189 g CO<sub>2</sub>e per instrument). Where 10 or fewer instruments were required for the operation, obtaining individually wrapped items was preferable to opening another set. The carbon footprint was determined significantly by machine loading and the number of instruments per machine slot. Carbon and financial costs increased with streamlining sets. High-temperature incineration of waste increased the carbon footprint of single-use



packaging by 33-55 per cent, whereas recycling reduced this by 6-10 per cent. The absolute carbon footprint was dependent on the energy source used, but this did not alter the optimal processes to minimize that footprint. CONCLUSION: Carbon and financial savings can be made by preparing instruments as part of sets, integrating individually wrapped instruments into sets rather than streamlining them, efficient machine loading, and using low-carbon energy sources alongside recycling.

Roschnik, S., Lomax, R. et Tennison, I. (2019). "[The transformation to environmentally sustainable health systems: The National Health Service example in England]." *Lakartidningen* **116**.

This article provides insight from the Sustainable Development Unit, a top down policy, monitoring and delivery unit to support a large complex health system, the National Health Service, to embed sustainable development. The dedicated unit nurtured and supported bottom up action through top down change, it translated legal requirements, embedded good governance and engaged with stakeholders. By identifying a specific and manageable topic area the unit created an entry point to broader change and enabled action, in this case the unit started with carbon footprinting and reduction. Engagement of stakeholders was a mandate for strong governance and provided feedback of successes and future challenges. Progress was monitored through carbon reduction (18.5% over ten years), with over £1.8bn energy related savings, board approved Sustainable Development Measurement Plans (71% of trusts), and public annual sustainability reporting (85% of Clinical Commissioning Groups and trusts).

Siu, J., Hill, A. G. et MacCormick, A. D. (2017). "Systematic review of reusable versus disposable laparoscopic instruments: costs and safety." *ANZ J Surg* **87**(1-2): 28-33.  
<https://onlinelibrary.wiley.com/doi/10.1111/ans.13856>

BACKGROUND: The quality of instruments and surgical expertise in minimally invasive surgery has developed markedly in the last two decades. Attention is now being turned to ways to allow surgeons to adopt more cost-effective and environmental-friendly approaches. This review explores current evidence on the cost and environmental impact of reusable versus single-use instruments. In addition, we aim to compare their quality, functionality and associated clinical outcomes. METHOD: The Medline and EMBASE databases were searched for relevant literature from January 2000 to May 2015. Subject headings were Equipment Reuse/, Disposable Equipment/, Cholecystectomy/, Laparoscopic/, Laparoscopy/, Surgical Instruments/, Medical Waste Disposal/, Waste Management/, Medical Waste/, Environmental Sustainability/ and Sterilization/. RESULTS: There are few objective comparative analyses between single-use versus reusable instruments. Current evidence suggests that limiting use of disposal instruments to necessity may hold both economical and environmental advantages. Theoretical advantages of single-use instruments in quality, safety, sterility, ease of use and importantly patient outcomes have rarely been examined. Cost-saving methods, environmental-friendly methods, global operative costs, hidden costs, sterilization methods and quality assurance systems vary greatly between studies making it difficult to gain an overview of the comparison between single-use and reusable instruments. CONCLUSIONS: Further examination of cost comparisons between disposable and reusable instruments is necessary while externalized environmental costs, instrument function and safety are also important to consider in future studies.

The Lancet Countdown (2021). The Lancet Countdown on Health and Climate Change: Responding to the health risks of climate change in Europe.  
<https://www.lancetcountdown.org/responding-to-the-health-risks-of-climate-change-in-europe/>

The Lancet Countdown (2022). The 2022 Global Report. TheLancetCountdown: 36p.  
[https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(22\)01540-9/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(22)01540-9/fulltext)

People around the world are increasingly feeling the impact of climate change on their health and wellbeing and these compounding crises are amplifying those harms. Yet governments and companies in both high- and low-income countries continue to prioritise fossil fuel interests. This year's report launches as countries and health systems grapple with the health, social and economic implications of

climate change, which now compound the impacts of the the global energy crisis, and the ongoing COVID-19 pandemic. The 2022 Report tracks the relationship between health and climate change across five key domains and 43 indicators, revealing that the world is at a critical juncture.

Thiel, C. L., Schehlein, E., Ravilla, T., et al. (2017). "Cataract surgery and environmental sustainability: Waste and lifecycle assessment of phacoemulsification at a private healthcare facility." *J Cataract Refract Surg* **43**(11): 1391-1398.

**PURPOSE:** To measure the waste generation and lifecycle environmental emissions from cataract surgery via phacoemulsification in a recognized resource-efficient setting. **SETTING:** Two tertiary care centers of the Aravind Eye Care System in southern India. **DESIGN:** Observational case series. **METHODS:** Manual waste audits, purchasing data, and interviews with Aravind staff were used in a hybrid environmental lifecycle assessment framework to quantify the environmental emissions associated with cataract surgery. Kilograms of solid waste generated and midpoint emissions in a variety of impact categories (eg, kilograms of carbon dioxide equivalents). **RESULTS:** Aravind generates 250 grams of waste per phacoemulsification and nearly 6 kilograms of carbon dioxide-equivalents in greenhouse gases. This is approximately 5% of the United Kingdom's phaco carbon footprint with comparable outcomes. A majority of Aravind's lifecycle environmental emissions occur in the sterilization process of reusable instruments because their surgical system uses largely reusable instruments and materials. Electricity use in the operating room and the Central Sterile Services Department (CSSD) accounts for 10% to 25% of most environmental emissions. **CONCLUSIONS:** Surgical systems in most developed countries and, in particular their use of materials, are unsustainable. Results show that ophthalmologists and other medical specialists can reduce material use and emissions in medical procedures using the system described here.

Thiel, C. L., Woods, N. C. et Bilec, M. M. (2018). "Strategies to Reduce Greenhouse Gas Emissions from Laparoscopic Surgery." *Am J Public Health* **108**: S158-S164.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5922216/pdf/AJPH.2018.304397.pdf>

**Objectives.** To determine the carbon footprint of various sustainability interventions used for laparoscopic hysterectomy. **Methods.** We designed interventions for laparoscopic hysterectomy from approaches that sustainable health care organizations advocate. We used a hybrid environmental life cycle assessment framework to estimate greenhouse gas emissions from the proposed interventions. We conducted the study from September 2015 to December 2016 at the University of Pittsburgh (Pittsburgh, Pennsylvania). **Results.** The largest carbon footprint savings came from selecting specific anesthetic gases and minimizing the materials used in surgery. Energy-related interventions resulted in a 10% reduction in carbon footprint per case but would result in larger savings for the whole facility. Commonly implemented approaches, such as recycling surgical waste, resulted in less than a 5% reduction in greenhouse gases. **Conclusions.** To reduce the environmental emissions of surgeries, health care providers need to implement a combination of approaches, including minimizing materials, moving away from certain heat-trapping anesthetic gases, maximizing instrument reuse or single-use device reprocessing, and reducing off-hour energy use in the operating room. These strategies can reduce the carbon footprint of an average laparoscopic hysterectomy by up to 80%. Recycling alone does very little to reduce environmental footprint. **Public Health Implications.** Health care services are a major source of environmental emissions and reducing their carbon footprint would improve environmental and human health. Facilities seeking to reduce environmental footprint should take a comprehensive systems approach to find safe and effective interventions and should identify and address policy barriers to implementing more sustainable practices.

Vaccari, M., Montasser, W., Tudor, T., et al. (2017). "Environmental audits and process flow mapping to assess management of solid waste and wastewater from a healthcare facility: an Italian case study." *Environ Monit Assess* **189**(5): 239.

<https://link.springer.com/content/pdf/10.1007/s10661-017-5940-4.pdf>

<https://core.ac.uk/download/84585829.pdf>

In Europe, there are an increasing number of policy and legislative drivers for a more sustainable approach to the management of natural resources as well as for the mitigation of environmental health risks. However, despite significant progress in recent years, there is still some way to go to achieve circularity of process, as well as risk mitigation within organisations. Using a case study of the Gardone Val Trompia hospital in northern Italy, this manuscript offers a novel holistic examination of strategies to enhance resource efficiency and environmental health within a key sector, i.e. the healthcare sector. Through the use of environmental audits and process flow mapping, trends in waste and wastewater arisings and the associated financial and environmental costs and risks were identified. Recommendations for developing more resource efficient approaches as well as mitigating the environmental and public health risks are suggested. These include strategies for improved resource efficiency (including reduction in the hazardous waste) and reduced environmental impacts during the containment, transport and treatment of the waste.

Walker, R., Hasall, J., Chaplin, S., et al. (2011). "Health promotion interventions to adress climate change using a primary health care approach: a literature review." *Health Promotion Journal of Australia* **22**(Special issue) <https://pubmed.ncbi.nlm.nih.gov/22518912/>

This project explored the literature in which key concepts in primary health care and health promotion are overtly applied to the problem of climate change. This paper contains a discussion of the literature relevant to health promotion principles and intervention strategies for addressing climate change mitigation and adaptation in the primary health care sector. The concept of primary health care is that used by the World Health Organization, based on the Declaration of Alma Ata and often referred to as comprehensive primary health care to differentiate it from primary medical care. Methods: This was a review of literature identified in electronic databases using two sets of search terms. Set A consisted of 'climate change or global warming or greenhouse effect' and set B consisted of 11 key concepts in primary health care and health promotion, for example community resilience, health promotion, social change, food security and economic development. Relevant literature was identified at the intersection of search term A with a term from set B. A search was completed for each set B term. Results: This paper reports a discussion of major categories of health promotion interventions, namely health communication, community building and settings approaches and uses examples drawn from literature on community resilience and summer heat. These interventions are all applicable to the primary health care sector. Conclusion: There is a small literature on health promotion interventions for climate change mitigation and adaptation but it is incomplete and scattered across many sources. An important area for further research is to link the logic of service provision in primary health care to the logic of mitigation and adaptation in a changing environment. Interventions that link the logic must also link diverse services to provide coherent action on local and domestic scales, the scales at which primary health care acts. Another research gap is in regard to institutional change in the primary health care sector. How do the patterns of knowledge, practice and values need to change in the array of organisations that make up comprehensive primary health care?

Wennmalm, A. et Gunnarsson, B. (2009). "Pharmaceutical management through environmental product labeling in Sweden." *Environ Int* **35**(5): 775-777.

There is an increased awareness that medicinal products for human use may cause negative effects in the environment. In Sweden a voluntary environmental classification system for drugs has been established in collaboration between producers, authorities and the public health care, and used for five years. The idea is to enhance the market demand for medicines with less environmental impact, which in turn will stimulate the producers to design future medicines to be more environmentally friendly. The system is open to the public and based on assessment of the active ingredient in the medicinal product into several classes of risk and hazard, respectively. It is closely related to the EMEA guidelines. Risk is expressed as the ratio between the predicted environmental concentration (PEC) of the active ingredient (AI) and its predicted no effect concentration (PNEC). The hazard is expressed in terms of the AI's persistence, potential to bioaccumulation, and eco-toxicity. Drug data for the classification are delivered by the respective producers. Hitherto more than 300 AI, representing more than 50% of the Swedish volume of drug use, have been classified. Data for risk assessment were missing in 47% of AI. Among drugs with data 7% had a PEC/PNEC ratio >1, and another 7% had a ratio

between 0.1 and 1. The AIs with highest ratio (>10) were two estrogens. Data for hazard assessment were lacking in 16% of the AI. Among drugs with environmental data 92% were not ready biodegradable, 23% had potential to bioaccumulation, and 61% were toxic to aquatic organisms at a concentration below 1 mg/l. These data are utilized by regional pharmaceutical expert groups when selecting substances to be recommended in public health care in Sweden. They may also be used by prescribing doctors who want to identify the environmentally most favourable substance among several with equivalent medical effect. We conclude that environmental data on human medicinal products are often missing, or reveal unfavourable environmental properties. A proper judgement of the environmental impact of an AI requires a joint evaluation of its risk and hazard. We suggest that the pharmaceutical producers should highlight environmental precaution when designing new AIs, and that the environmental data should be transparent to the general public.

Wilkinson, E. (2021). "Reaching net zero carbon emissions in health systems." *Lancet* **398**(10315): 1953-1954. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(21\)02642-8/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(21)02642-8/fulltext)

Wong, Y. L., Noor, M., James, K. L., et al. (2021). "Ophthalmology Going Greener: A Narrative Review." *Ophthalmol Ther* **10**(4): 845-857.

The combined effects of fossil fuel combustion, mass agricultural production and deforestation, industrialisation and the evolution of modern transport systems have resulted in high levels of carbon emissions and accumulation of greenhouse gases, causing profound climate change and ozone layer depletion. The consequential depletion of Earth's natural ecosystems and biodiversity is not only a devastating loss but a threat to human health. Sustainability-the ability to continue activities indefinitely-underpins the principal solutions to these problems. Globally, the healthcare sector is a major contributor to carbon emissions, with waste production and transport systems being amongst the highest contributing factors. The aim of this review is to explore modalities by which the healthcare sector, particularly ophthalmology, can reduce carbon emissions, related costs and overall environmental impact, whilst maintaining a high standard of patient care.

## L'exemple de la France

### Quelques chiffres-clefs

Selon l'étude actualisée du Shift project<sup>2</sup>, l'empreinte carbone de la santé représente toujours en moyenne 8% du total national. Le périmètre d'étude est élargi par rapport à celui retenu pour l'étude de 2021<sup>3</sup> et des changements sont notables selon les postes d'émissions. L'empreinte carbone du secteur de la santé est estimée de 39 à 61 millions de tonnes équivalent CO (eqCO), avec 95% de certitude. Ces nouvelles données du Shift projet ont été présentées le 10 mars lors de la journée de la transformation écologique en santé organisée par la FHF<sup>4</sup>. Les résultats définitifs sortiront mi-avril, précise Laurie Marraud, experte santé durable à l'Agence nationale d'appui à la performance des établissements de santé et médico-sociaux (Anap) et initiatrice au sein du think tank The Shift project (1) du travail sur le système de santé, le climat et l'énergie. 39 à 61 millions de tonnes eqCO représentent entre 6,6 et 10% de l'empreinte nationale. Soit une moyenne à 8%, ce qui correspond aux chiffres de la première version (V1) du rapport. Cette dernière faisait état de plus de 46 millions de tonnes eqCO pour le système de santé français, soit plus de 7,5% des émissions françaises de gaz à effet de serre dues au secteur de la santé. Laurie Marraud indique que plus de 86% sont des émissions indirectes et qu'entre 35 et 50% des gaz à

<sup>2</sup> Les résultats définitifs de cette étude paraîtront en avril 2023.

<sup>3</sup> Rambaud, T., Marraud, L. (2021). [Décarboner la santé pour soigner durablement](#). Paris : The Shift project.

<sup>4</sup> [Le Shift project actualise son étude sur les émissions des gaz à effet de serre en santé](#). Hospimédia, 21 mars 2023 (Accès abonnés)

effet de serre sont dûs à l'achat des médicaments et des dispositifs médicaux. Les incertitudes liées aux médicaments et aux dispositifs médicaux sont le fait de "soutenabilité de facteurs d'émissions".

## ÉTUDES D'ENSEMBLE SUR LA TRANSITION ÉCOLOGIQUE

Ademe (2021). Transition(s) 2050 : choisir maintenant. Agir pour le climat. Paris : Ademe  
<https://transitions2050.ademe.fr/>

Ce rapport propose quatre scénarios « types » qui présentent de manière volontairement contrastée des options économiques, techniques et de société pour atteindre la neutralité carbone en France en 2050. Ils visent à articuler les dimensions technico-économiques avec des réflexions sur les transformations de la société qu'elles supposent ou qu'elles suscitent. Les secteurs suivants y sont détaillés : ceux qui relèvent de la consommation (l'aménagement du territoire, le bâtiment, la mobilité et l'alimentation) ; ceux qui constituent le système productif (l'agriculture, l'exploitation des forêts et l'industrie), ceux qui forment l'offre d'énergie (le gaz, le froid et la chaleur, la biomasse, les carburants liquides et l'hydrogène) ; ceux qui constituent des ressources (la biomasse et les déchets) et les puits de carbone. Ces secteurs sont également analysés au regard de leurs impacts, lorsque cela a été possible, sur l'eau, les sols, les matériaux et la qualité de l'air.

Barrau, C. (2012). "Enjeux de la ventilation. Performance énergétique et qualité de l'air intérieur dans les bâtiments performants." Techniques Hospitalières(733): 33-35

[BDSP. Notice produite par EHESP mAIR0xkC. Diffusion soumise à autorisation]. Si le système de ventilation est important pour assurer une bonne qualité de l'air intérieur aux occupants du bâtiment, il doit également être bien maîtrisé afin d'éviter l'augmentation des dépenses énergétiques. Pour cela, on peut concevoir un système économe en modulant les débits, en optimisant la consommation des ventilateurs ou en distribuant l'air sans pertes. On peut aussi récupérer l'énergie de l'air, soit pour préchauffer l'air entrant soit pour chauffer l'eau.

Bertezene, S., Paret, P., Leroux, V., et al. (2016). "La responsabilité sociale des entreprises. Dossier." Gestions Hospitalières(556): 276-319

[BDSP. Notice produite par EHESP I9R0xB7C. Diffusion soumise à autorisation]. De nombreuses démarches de responsabilité sociétale (ou sociale) des entreprises sont mises en œuvre de manière fructueuse dans bon nombre d'organisations, y compris dans le secteur de la santé. Pourquoi des dirigeants se lancent-ils dans une telle démarche ? La RSE est-elle un outil du marketing ou un levier de performance ? Quelles sont les démarches menées par les établissements ? Ce dossier fait cohabiter analyses de spécialistes de la RSE et exemples d'actions concrètes. Ces actions sont menées dans différentes structures (CHU, Ifsi, établissement médicosocial.) et concernent plusieurs thématiques, de l'achat de dispositifs médicaux à l'amélioration du cadre de vie en passant par la lutte contre la discrimination et le partenariat médecins/directeurs.

Bitaud, J.-R., Barreau, P., Rouby, C., et al. (2013). "Dossier. Ressources humaines. Innovations et développement durable." Gestions Hospitalières(524): 138-188

[BDSP. Notice produite par EHESP pR0xk8kq. Diffusion soumise à autorisation]. La gestion des ressources humaines à l'hôpital est tout particulièrement d'actualité depuis que le ministre des Affaires sociales et de la Santé, Marisol Touraine, a confié à Edouard Couty, conseiller maître à la Cour des comptes, ancien directeur des hôpitaux et président de la Fédération hospitalière de France (FHF) Rhône-Alpes, la responsabilité d'une concertation destinée à rétablir un "pacte de confiance pour l'hôpital". Cette concertation aborde plusieurs thématiques, dont le dialogue social à l'hôpital. L'occasion de mettre en lumière plusieurs expériences, qu'il s'agisse de mesures visant au développement durable des ressources humaines ou de projets innovants. L'objectif annoncé du pacte

est de rétablir la confiance des citoyens dans le service hospitalier public français. Souhaitant proposer des réflexions théoriques tout autant que des retours de terrain, nous avons donné la parole à des intervenants extérieurs au domaine sanitaire public, à des spécialistes en ressources humaines dans l'entreprise, ainsi qu'à un psychanalyste connu pour ses réflexions sur la fonction de direction. Pilotage des risques professionnels, gestion de l'inaptitude, organisation apprenante, où en sommes-nous ? Parcours de management, mythe ou réalité ? Le coaching, quels résultats ? Notre contemporanéité serait celle d'une vision horizontale des enjeux sociaux pour les nouvelles générations, la fameuse génération Y. Comment insérer cette contrainte, ou ce florilège d'exigences nouvelles, dans des hiérarchies issues d'une architecture verticale des organigrammes et des chaînes de commandements ?

Bley, D., Marano, F. et Squinazi, F. (2022). "Santé-environnement : quinze ans de politiques publiques : Dossier." Actualite Et Dossier En Sante Publique(120): 14-68.

Ce sont les crises sanitaires à répétition de l'ère industrielle depuis la fin du XIXe siècle qui ont contribué à l'émergence du concept de santé environnementale ou santé - environnement. Ce dossier fait le point sur quinze années de politiques publiques en France.

Brunel, L., Astruc, A. et Pasquet, J. M. (2021). Les politiques du développement durable : L'essentiel à connaître. Levallois-Perret : Studyrama

Ce guide synthétique apporte les connaissances nécessaires pour comprendre les fondements du développement durable dans le contexte des politiques publiques, tout en offrant des pistes de réflexion pour agir à différentes échelles au sein des territoires. À travers une présentation des principaux acteurs et des débats actuels, il permet de cerner les défis climatiques, économiques et sociaux de notre époque et tient compte des premiers enseignements de la COVID-19, notamment en matière de transition écologique. Il présente : -Un état des lieux du développement durable -Les principaux enjeux (changement climatique, biodiversité, pollution...) - Les acteurs (État, collectivités, Union européenne, ONG...) -Les politiques publiques en actions -La conception et la mise en œuvre des politiques publiques -Des fiches « actualité » sur les sujets en débat (environnement, déchets, énergie...).

Cabrespines, J. L. (2020). Quelle conception des politiques publiques pour accompagner les transitions en cours et à venir ? : Etude présentée au nom de la Délégation à la prospective et à l'évaluation des politiques publiques. Paris : Cese

<https://www.lecese.fr/travaux-publies/quelle-conception-des-politiques-publiques-pour-accompagner-les-transitions-en-cours-et-venir>

Imaginer une économie et un modèle de développement soutenable, fondamentalement différent de l'actuel nécessite de résoudre les contradictions entre l'impératif écologique et la logique économique dominante. Comme le résume Bernard Perret6:«il est devenu vital de réunifier les univers parallèles de l'économie et de l'écologie, et de bâtir un cadre social pour l'action rationnelle qui intègre pleinement la finitude du monde». Dans ce contexte, la conception des politiques publiques est soumise à de nombreuses tensions pour accompagner les profonds bouleversements sociétaux suscités par les transitions en cours et à venir.

Cartron, E., Jovic, L. et Lecordier, D. (2021). "La santé environnementale au cœur des préoccupations infirmières : une nécessité identifiée et des actions à entreprendre." Recherche en soins infirmiers **147**(4): 5-6. <https://www.cairn.info/revue-recherche-en-soins-infirmiers-2021-4-page-5.htm>

Castellano, S., Menvielle, L., Druy, F., et al. (2012). "Développement durable et santé publique. Vers un nouveau modèle d'une santé égalitaire ?" La Revue des Sciences de Gestion **253**(1): 107-113. <https://www.cairn.info/revue-des-sciences-de-gestion-2012-1-page-107.htm>

Les réformes du secteur hospitalier remettent en cause les principes mêmes du système de santé publique, donc l'objectif est l'amélioration du bien-être social. Deux logiques s'affrontent quant à l'établissement d'une santé équitable, l'une axée sur le maintien du principe de service public, et

l'autre sur une allocation efficiente des ressources, notamment financières. Nous montrerons que le développement durable, appliqué au secteur hospitalier où l'éthique joue un rôle prépondérant, permet de réconcilier ces deux logiques.

Cauli, M. et Pestiaux, D., Deneff, J.F. (2021). "La responsabilité sociale en santé : évolution d'un concept. De l'implication individuelle aux enjeux du développement durable." *Pédagogie médicale* **22**: 34-42.  
<https://www.pedagogie-medecale.org/articles/pmed/abs/2021/01/pmed200028/pmed200028.html>

Contexte et problématique : Le concept de responsabilité sociale en santé (RSS) prend une importance majeure au moment où les systèmes de santé, comme la société en général, vivent un bouleversement inédit sous l'effet d'une pandémie qui remet au centre de nos préoccupations un nécessaire changement de paradigme. Objectif : Cet article offre une courte rétrospective de ce concept en repartant de l'origine et de l'évolution du concept de RS dans l'entreprise, et réinterroge sous l'éclairage des sciences humaines (philosophie, anthropologie, sociologie) la notion de la responsabilité en tant que telle, mais aussi au sein de l'exercice professionnel en santé. Exégèse : Comment intégrer les préoccupations sociales et environnementales dans la pratique médicale au quotidien sans accabler le professionnel de santé du poids d'une responsabilité déjà prégnante ? Plusieurs hypothèses conditionnent ce processus, parmi lesquelles l'instauration d'une pensée systémique, qui rend seule possible une action transformative, un engagement porté sur les valeurs, une co-gestion de l'ensemble des acteurs de santé avec les parties prenantes. Ces hypothèses dessinent les contours d'une définition élargie de la RSS.

Cese (2022). Pour une politique publique nationale de santé-environnement au cœur des territoires. *Les avis du Cese*. Paris Cese: 102.  
[https://www.lecese.fr/sites/default/files/pdf/Avis/2022/2022\\_08\\_sante\\_environnement.pdf](https://www.lecese.fr/sites/default/files/pdf/Avis/2022/2022_08_sante_environnement.pdf)

Les conséquences des dégradations de l'environnement sur la santé s'aggravent et sont de plus en plus documentées : 7 millions de morts prématurées dans le monde chaque année sont ainsi attribuées à la pollution de l'air selon l'OMS. En cause, les activités humaines qui contribuent à dégrader nos écosystèmes, parmi lesquelles la surexploitation des ressources naturelles, la déforestation, l'artificialisation des sols, l'étalement urbain, les activités industrielles ou encore le tourisme de masse. Si l'ensemble de la population est touchée, les populations les plus précaires sont les plus exposées aux risques environnementaux, et sont celles qui accèdent le plus difficilement aux soins et aux actions de prévention sanitaire. En dépit de ces constats, l'action des pouvoirs publics reste fragmentée et sectorielle. Le CESE plaide pour dépasser l'approche de la santé fondée sur les soins et les maladies, au profit d'une action préventive globale : sanitaire, environnementale, mais aussi économiques et sociale.

Commissariat général au développement durable (2021). *Plan national pour des achats durables 2021-2025*. Paris : Commissariat général au développement durable  
[http://www.consultations-publiques.developpement-durable.gouv.fr/IMG/pdf/pnad\\_2021-25.pdf](http://www.consultations-publiques.developpement-durable.gouv.fr/IMG/pdf/pnad_2021-25.pdf)

Les achats publics durables permettent aux personnes publiques d'assumer leur responsabilité environnementale, sociale et économique, tout en apportant des gains à leur structure. Les achats publics durables constituent un levier majeur pour orienter les marchés vers une meilleure prise en compte du développement durable. Ce rapport doit permettre une accélération de la prise en compte des objectifs de développement durable (ODD) en développant la sensibilisation des acteurs à ces enjeux, en développant la communication autour des bonnes pratiques ainsi que les relations avec les fédérations et filières professionnelles.

Dab, W. (2020). *Santé et environnement*. Paris : PUF

« Chacun a le droit de vivre dans un environnement équilibré et favorable à sa santé », énonce l'article premier de notre Charte de l'Environnement. Mais comment mettre en œuvre un tel principe ? Car si l'effet de l'environnement sur la santé est avéré, l'évaluation des conséquences des expositions aux divers facteurs environnementaux n'est pas chose aisée dans notre monde de nouveaux risques. Ces

risques ne sont pas directement observables. Pour les mesurer, il faut des outils scientifiques spécialisés. William Dab présente les méthodes qui permettent d'évaluer les risques liés à l'environnement et de les gérer dans un contexte d'incertitude des connaissances. Il montre comment, au-delà des périodes médiatisées de crises sanitaires, une politique de santé environnementale fondée sur une approche rationnelle du principe de précaution est possible et nécessaire.

Dervaux, B. et Rochaix, L. (2022). L'évaluation socioéconomique des effets de santé des projets d'investissement public : Rapport de France stratégie. Paris France stratégie

<https://www.strategie.gouv.fr/publications/levaluation-socioeconomique-effets-de-sante-projets-dinvestissement-public-0>

La prise en compte des effets sur la santé dans les évaluations est souvent réduite à des tentatives isolées et exploratoires. Le manque d'outils ou de valeurs monétaires permettant d'évaluer et de valoriser les effets relatifs à la santé des personnes. Dans ce contexte, mais également pour encourager le transfert des avancées méthodologiques du secteur de la santé vers d'autres secteurs et rendre explicite un coût de l'inaction, le Comité d'experts des méthodes d'évaluation socioéconomique, a lancé un groupe de travail sur l'évaluation socioéconomique des effets de santé des projets d'investissement public. Ce groupe a cherché à établir une méthodologie d'estimation des coûts tangibles et intangibles des effets de santé qui puisse être appliquée à différents secteurs, dont quatre en particulier, pour lesquels des valeurs monétaires sont proposées, pouvant être utilisés dans les évaluations socio-économiques : dommages psychologiques des inondations, bénéfices de santé des rénovations énergétiques des logements, gêne liée au bruit de chantier et bénéfices de santé de l'activité physique dans l'espace public.

Dubigeon, O. (2008). "Une démarche de responsabilité RSE en réponse à l'enjeu d'un développement soutenable." *Gestions Hospitalières*(476): 326-328.

[BDSP. Notice produite par EHESP R0xHn8J7. Diffusion soumise à autorisation]. Le développement soutenable repose sur une vision globale et systématique. Les organisations sont interpellées désormais sur les impacts que la conduite de leur activité génère sur le "patrimoine commun". Elles sont attendues sur la qualité de la réponse qu'elles apportent. Cette réponse, appelée RSE, est avant tout un chemin d'apprentissage et d'amélioration continu, qui se conduit pas à pas.

Elbaum, M. (2022). La protection sociale française est-elle en capacité de répondre à la montée des risques environnementaux et aux implications de la transition écologique ? *Sciences PO Ofce Working paper; 17/2022*. Paris Ofce: 51.

<https://www.ofce.sciences-po.fr/pdf/dtravail/OFCEWP2022-17.pdf>

Face à la montée des risques environnementaux, en particulier ceux liés au changement climatique, les politiques de protection sociale sont questionnées quant à leur pertinence et leur efficacité. Alors que les politiques de transition écologique pourraient n'ébranler que de façon limitée la dynamique tendancielle de financement de la protection sociale, la mise en œuvre indispensable d'une « stratégie d'adaptation » implique d'examiner tant la couverture « usuelle » des risques sociaux que les fonds particuliers d'urgence ou de solidarité qui lui sont parfois adossés (amiante, pesticides), ainsi que les dispositifs d'assurance privée articulés à des mécanismes de réassurance ou de solidarité publics (catastrophes naturelles ou perte de récoltes). Ces couvertures demeurant à ce stade partielles et fragmentées, les principes et la logique économique de la protection sociale pourraient inspirer leur adaptation, quantitative et qualitative, à l'extension et à la diversification probables des risques environnementaux. Une réflexion est aussi nécessaire sur l'appui possible de la protection sociale aux « stratégies d'atténuation » des émissions de gaz à effet de serre ou d'autres risques d'origine environnementale (pesticides, qualité de l'alimentation, pollutions...). Cette réflexion questionne les modalités de soutien aux emplois contribuant à la transition, les dispositifs d'accompagnement social des restructurations, ainsi que, au premier chef, l'adaptation des politiques de redistribution à des formes possiblement renouvelées d'inégalités sociales et de pauvreté, notamment en termes de « restes à vivre » et de conditions de vie.



Elbaum, M. (2022). "La protection sociale française est-elle en capacité de répondre à la montée des risques environnementaux et aux implications de la transition écologique ? 1e partie." Revue De Droit Sanitaire Et Social(6): 1098-1117.

Face à la montée des risques environnementaux, en particulier ceux liés au changement climatique, les politiques de protection sociale sont questionnées quant à leur pertinence et leur efficacité. Alors que les politiques de transition écologique pourraient n'ébranler que de façon limitée la dynamique tendancielle de financement de la protection sociale, la mise en œuvre indispensable d'une « stratégie d'adaptation » implique d'examiner tant la couverture « usuelle » des risques sociaux que les fonds particuliers d'urgence ou de solidarité qui lui sont parfois adossés (amiante, pesticides), ainsi que les dispositifs d'assurance privée articulés à des mécanismes de réassurance ou de solidarité publics (catastrophes naturelles ou perte de récoltes). Ces couvertures demeurant à ce stade partielles et fragmentées, les principes et la logique économique de la protection sociale pourraient inspirer leur adaptation, quantitative et qualitative, à l'extension et à la diversification probables des risques environnementaux. Une réflexion est aussi nécessaire sur l'appui possible de la protection sociale aux « stratégies d'atténuation » des émissions de gaz à effet de serre ou d'autres risques d'origine environnementale (pesticides, qualité de l'alimentation, pollutions...). Cette réflexion questionne les modalités de soutien aux emplois contribuant à la transition, les dispositifs d'accompagnement social des restructurations, ainsi que, au premier chef, l'adaptation des politiques de redistribution à des formes possiblement renouvelées d'inégalités sociales et de pauvreté, notamment en termes de « restes à vivre » et de conditions de vie.

Elbaum, M. (2023). "La protection sociale française est-elle en capacité de répondre à la montée des risques environnementaux et aux implications de la transition écologique ? 2e partie." Revue De Droit Sanitaire Et Social(1): 133-150.

Parallèlement aux "stratégies d'adaptation" en tout état de cause nécessaires, une réflexion doit être aussi conduite sur l'appui possible de la protection sociale aux "stratégies d'atténuation" de émissions de gaz à effet de serre et autres risques d'origine environnementale (pesticides, qualité de l'alimentation, pollutions...). Cette réflexion questionne les modalités de soutien aux emplois contribuant à la transition, les dispositifs d'accompagnement social des restructurations, les dispositifs d'accompagnement social des restructurations ainsi que du premier chef, l'adaptation des politiques de redistribution à des formes possiblement renouvelées d'inégalités sociales et de pauvreté notamment en termes de "restes à vivre" et de conditions de vie.

Fnors (2022). Environnement, un déterminant pour la santé Indicateurs territoriaux. Paris Fnors [https://www.fnors.org/wp-content/uploads/2022/09/Environnement\\_Un-determinant-pour-la-sante\\_Indicateurs-territoriaux.pdf](https://www.fnors.org/wp-content/uploads/2022/09/Environnement_Un-determinant-pour-la-sante_Indicateurs-territoriaux.pdf)

Depuis plusieurs années, l'Organisation mondiale de la santé (OMS) reconnaît comme prioritaire la prise en compte de l'impact des risques environnementaux sur la santé. Aussi, parler de santé - environnement c'est mettre en relation l'environnement des individus constitué, entre autres, par l'ensemble des agents physiques, chimiques ou biologiques extérieurs à l'individu ou exogènes constituant son exposition, et son impact sur leur santé. Une augmentation de différentes maladies chroniques pour lesquelles les liens avec l'environnement sont suspectés est constatée : il s'agit notamment des cancers, des maladies cardiovasculaires, des maladies respiratoires dont l'asthme, des dérèglements hormonaux, des désordres neurologiques, des troubles de la fertilité ou du diabète. Cette publication, organisée autour de quatre chapitres (cadre de vie, contexte environnemental et activités, milieux d'exposition, maladies en lien avec l'environnement), valorise une partie de nouveaux indicateurs élaborés par la Fnors au travers de chiffres clés et d'illustrations commentées.

Fosse, J., Salesses, C. et Viennot, M. (2022). Inégalités environnementales et sociales se superposent-elles ?, Paris : France stratégie [https://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/atoms/files/fs-2022-na-112-inegalites\\_environmentales-septembre\\_0.pdf](https://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/atoms/files/fs-2022-na-112-inegalites_environmentales-septembre_0.pdf)

Les effets sanitaires des combinaisons de polluants chez des populations particulières constituent une préoccupation de santé publique majeure. Des travaux de cartographie croisée des pollutions sont nécessaires pour dresser le panorama de ces combinaisons, préalable à l'examen des inégalités d'exposition des populations aux pollutions des milieux. Leur réalisation se heurte néanmoins à plusieurs obstacles méthodologiques.

Halley Desfontaines, V., Valentini, H., Le Moal, J., et al. (2010). "Environnement et santé publique : dossier." Sante Publique **22**(3): 279-351.

[BDSP. Notice produite par EHESP F9CtkR0x. Diffusion soumise à autorisation]. Ce dossier est consacré à la relation entre environnement et santé publique. Il présente six articles dont certains ont une approche prospective sur les relations entre environnement, santé environnementale et santé publique, tandis que d'autres présentent des réalisations concrètes. Pour les premiers, on questionne le présent et le futur : la santé environnementale est-elle l'avenir de la santé publique ? Les aventures du "Syndrome du Bâtiment Malsain" ; Les résidus de médicaments présentent-ils un risque pour la santé publique ? Santé et Environnement : la 2e révolution de Santé publique. Pour les autres, on aborde des recherches et des systèmes mis en place : recherche, impacts et adaptations de santé publique au nouveau climat du Québec et mobilisation sanitaire face à un agrégat de cancers : le rôle des médecins généralistes.

Haut Conseil de la Santé Publique (2022). Évaluation globale des plans nationaux santé – environnement (2004-2019). Avis et rapports. Paris HCSP

<https://www.hcsp.fr/explore.cgi/avisrapportsdomaine?clefr=1223>

Ce rapport évalue les trois premières générations de plans nationaux santé environnement (PNSE) (2004 - 2019) et de leurs déclinaisons régionales sous la forme de plans régionaux santé environnement (PRSE). Quatre thématiques ont été retenues pour l'analyse : Les polluants dans l'air extérieur : ceux du domaine réglementaire et les pollens ; L'environnement intérieur : qualité de l'air dans les écoles et les crèches, habitat dégradé, radon, légionellose ; Les risques dits émergents : nanomatériaux, ondes électromagnétiques, perturbateurs endocriniens ;

Haut Conseil du Climat (2022). Dépasser les constats, mettre en œuvre les solutions. Paris Haut Conseil pour le climat:

<https://www.hautconseilclimat.fr/wp-content/uploads/2022/06/Rapport-annuel-Haut-conseil-pour-le-climat-29062022.pdf>

Ce rapport dresse une analyse des impacts du changement climatique en France, des budgets carbone, du suivi de la SNBC2 (Stratégie nationale bas carbone 2) et des politiques associées, et présente les recommandations du HCC pour un renforcement coordonné au niveau du Premier ministre de l'action climatique territoriale, nationale et internationale.

Hendriks, P., Mouchard, A., Clouet, N., et al. (2023). Moyens et gouvernance de la politique de santé environnement. Paris Igas: 2 vol.

Ce rapport interinspections dresse un inventaire des moyens consacrés à la politique de santé-environnement par l'Etat, les collectivités territoriales et l'Union européenne et formule des propositions pour renforcer la gouvernance de cette politique. Selon l'Organisation mondiale de la santé, la santé environnement comprend les aspects de la santé humaine, dont la qualité de la vie, déterminés par les facteurs physiques, chimiques, biologiques, sociaux, psychosociaux et esthétiques de notre environnement. Dans ce rapport, l'approche « une seule santé » a été favorisée. Issue du Plan national santé environnement 2021-2025 (PNSE), celle-ci intègre les liens étroits entre la santé, la santé animale et la santé des écosystèmes. Mais, définir le périmètre des facteurs environnementaux devant être pris en compte dans le cadre des politiques publiques de préservation et d'amélioration de la santé des populations constitue un exercice complexe, qui devra être poursuivi, au-delà de la première approche retenue par le rapport.

Jouez, J. (2022). Sensibiliser et former aux enjeux de la transition écologique et du développement durable dans l'enseignement supérieur. Paris Ministère chargé de l'Enseignement  
<https://www.enseignementsup-recherche.gouv.fr/sites/default/files/2022-02/sensibiliser-et-former-aux-enjeux-de-la-transition-ecologique-dans-l-enseignement-sup-rieur-16808.pdf>

Préparer tous les citoyens à la Transition écologique, entendue comme la transformation de la société afin de rétablir la viabilité de la planète par la mise en œuvre des objectifs du développement durable, relève des missions de l'Enseignement supérieur. L'objectif de former tous les apprenants passant par l'Enseignement supérieur aux enjeux de la Transition écologique nécessite la mobilisation et l'évolution de tous les cursus, en formation initiale comme en formation continue, qu'ils conduisent à des concours, des diplômes nationaux, des diplômes d'Etat, des diplômes d'établissement ou des diplômes professionnels. Les formations supérieures des établissements privés ou hors de la tutelle du MESRI sont incluses dans cette mobilisation générale. Dans cette perspective, ce rapport décrit une démarche à décliner par les équipes enseignantes, dans le respect de leur liberté pédagogique et de l'autonomie des établissements. Cette démarche est impulsée et soutenue nationalement. Elle s'organise à l'échelle des établissements et pourra s'appuyer sur une mutualisation à l'échelle des sites élargis. Elle s'inscrit dans des espaces d'échanges nationaux et européens. La révision ou l'élaboration des programmes et des maquettes co-construites par les responsables de formations, les équipes enseignantes, les conseils de perfectionnement et les apprenants, ainsi que d'une évolution des dispositifs d'évaluation des acquis.

Kerbach, S., Marraud, L., Rambaud, T., et al. (2021/02). "RSE : développement durable et santé." Regards : les dossiers de la FHP(52): 6-46

Lebodo, Y., Lefébure, A. et Thiel, M. J. (2022). Santé publique en transition : Petits manuels de la grande transition. Rennes : Editions Ehesp  
<https://www.presses.ehesp.fr/produit/sante-publique-transition/>

Désormais, le lien entre « santé humaine » et « santé environnementale » est à restaurer. Les dynamiques sociales, territoriales, environnementales, politiques et psychologiques affectent l'état de santé des populations. Faire de la place à la santé publique dans le débat démocratique, repenser l'organisation du care, intégrer les technologies du numérique sont autant de questions essentielles ouvrant des voies de transitions.

Lebrun Merrant, F. (2009). "Bâtiment et développement durable. Réglementation et labels." Techniques Hospitalières(717): 54-58

[BDSP. Notice produite par EHESP C8kAR0xr. Diffusion soumise à autorisation]. Du 10 au 12 juin 2009, l'association des ingénieurs hospitaliers de France (IHF) organisait ses 49èmes journées d'études et de formation à Paris, journées qui proposaient des ateliers en adéquation avec l'actualité : nanotechnologies, développement durable, gestion des risques... Cet article synthétise les éléments abordés lors de la thématique bâtiment et développement durable : réglementation thermique et énergétique applicable aux établissements existants et neufs, existence de labels d'efficacité énergétique et de labels de haute qualité environnementale (HQE), expériences menées dans certains centres hospitaliers.

Maes, C., Vernet, B., Daniel, X., et al. (2010). "Développement durable. Dossier." Techniques Hospitalières(719): 47-56.

[BDSP. Notice produite par EHESP GrR0xJDB. Diffusion soumise à autorisation]. La France a intégré les droits et devoirs définis dans la Charte de l'environnement dans le préambule de la Constitution en 2005. Les participants au Grenelle de l'environnement (2007) ont rendu leurs conclusions en 2008. Les ambitions : réduire les gaz à effet de serre, économie d'énergie et une politique volontariste d'achats durables. Ainsi les professionnels des établissements de santé (soit plus d'un million de salariés pour 3000 établissements) sont-ils sensibilisés depuis plusieurs années aux différents aspects du développement durable. Les actions actuellement mises en œuvre par les établissements de santé

publics et privés sont liées aux normes, et au développement des vigilances et de la sécurité sanitaire. La gestion des déchets hospitaliers fait l'objet depuis 75 d'une réglementation très précise que les établissements doivent respecter. Le référentiel "V 2010" de la certification comporte un volet management du développement durable. Le décret n°2009-1414 du 19/11/09 prévoit de légères simplifications administratives pour le développement de projets de centrales photovoltaïques. Il modifie aussi le contenu de la demande d'autorisation et de déclaration d'exploiter des installations de production d'électricité. Après une longue période d'études préliminaires l'association Qualitel a mis au point la certification Habitat & environnement dédié aux Ehpa-Ehpad. Elle s'applique à deux niveaux : concernant l'environnement intérieur, l'environnement extérieur. Explications.

Marrauld, L., Lefébure, A. et Baurès, E. (2021). "Comprendre l'impact environnemental du secteur de la santé : pour un leadership partagé en faveur d'un système de santé durable et résilient." La Presse Médicale Formation 2(6): 628-633.

<https://www.sciencedirect.com/science/article/pii/S2666479821002743>

Résumé Le réchauffement climatique—de par l'augmentation en fréquence et en intensité des extrêmes (vagues de chaleur, inondations...) météorologiques—à une influence considérable à court et à long terme sur notre environnement de vie et notre santé. Ce processus de changement global aggrave les risques sanitaires existants et modifie plus généralement l'environnement, favorisant ainsi la pollution de l'air et des eaux, l'insécurité alimentaire, la survenue de maladies vectorielles. Ainsi, le moustique tigre, vecteur de maladies tropicales comme le Chikungunya, la dengue et le Zika est désormais présent sur l'ensemble des départements français. et la dégradation de la santé mentale (Rapports du Lancet Countdown 2019 et 2020). Or le système de santé lui-même, par ses activités de production de soins, participe à ce réchauffement. L'article expose le besoin de formation des professionnels de santé sur les enjeux santé et environnement dans le but de leur permettre de participer activement à la transition écologique de la santé.

Masson-Delmotte, V., Charlier, A., Phalkey, R., et al. (2023). La santé comme levier d'action face au changement climatique : actes du colloque, Saint-Maurice : SFF

<https://www.santepubliquefrance.fr/les-actualites/2023/la-sante-comme-levier-d-action-face-au-changement-climatique-actes-du-colloque>

Le 8 avril 2022, dans le cadre de la présidence française de l'Union Européenne, Santé publique France et l'Association Internationale des Instituts Nationaux de Santé publique (IANPHI) organisaient une journée d'échanges sur la santé comme levier d'action face au changement climatique. Les intervenants ont proposé un tour d'horizon des connaissances scientifiques les plus récentes sur les liens entre climat, biodiversité et santé, et échangé sur les actions existantes pour protéger et promouvoir la santé en s'adaptant et en atténuant le changement climatique. Cette publication rassemble les actes de cette journée.

Ministère de la Transition Ecologique (2021). Loi climat et résilience. Décryptage de la loi promulguée et publiée au Journal officiel le 24 août 2021. Dossier de presse. Paris : Ministère de la transition écologique

<https://www.ecologie.gouv.fr/loi-climat-resilience>

Issue des travaux de la Convention citoyenne pour le climat, la loi portant lutte contre le dérèglement climatique et le renforcement de la résilience face à ses effets a été promulguée et publiée au Journal officiel le 24 août 2021. Ce texte vise à faire ancrer l'écologie dans la société française à différents niveaux : consommation, école, services publics, logement et urbanisme, publicité, mobilité, justice... Ce dossier de presse détaille la majorité des mesures et présente un sommaire exhaustif des près de 300 articles de la loi. Parmi les mesures clés : Création d'un écoscore pour afficher l'impact sur l'environnement des biens et services, interdiction de la publicité pour les énergies fossiles et régulation de la publicité, obligation de 20 % de la surface de vente consacrée à la vente en vrac d'ici 2030 dans les grandes et moyennes surfaces, verdissement de la commande publique, division par 2 du rythme d'artificialisation des sols, utilisation des toits pour végétaliser et produire de l'énergie solaire, promotion des alternatives à la voiture individuelle et à la transition vers un parc de véhicules plus propres, rénovation massive des bâtiments, Soutien d'une alimentation saine et durable peu

émettrice de gaz à effet de serre pour tous avec notamment l'obligation d'un choix quotidien d'un menu végétarien dans les cantines de l'État et des universités, création d'un délit de mise en danger de l'environnement.

Nething, O., Weck, V. et Pascal, F. (2021). "Engager la redirection écologique dans les organisations et les territoires. Dossier (2021)." Horizons publics

Onerc (2022). La prospective au service de l'adaptation au changement climatique. Rapport au Premier ministre et au Parlement. Paris Onerc

Publié le 8 mars 2022, le rapport de l'Onerc est consacré à « La prospective au service de l'adaptation au changement climatique ». La prospective permet de répondre aux inquiétudes des acteurs publics et privés (ministère, territoire, commune, entreprise, citoyen...) face à la complexité des solutions à mettre en œuvre pour limiter les impacts du changement climatique. Elle permet aussi de développer des pistes d'actions adaptées à chaque cas.

Ovaguimian, O., Faustini, A., Danilo, A., et al. (2011). "Développement durable. Dossier." Techniques Hospitalières(728): 11-74.

[BDSP. Notice produite par EHESP s7IR0xnl. Diffusion soumise à autorisation]. Le dossier propose en première partie des articles théoriques sur la notion de développement durable appliquée en établissement de santé, ainsi que le compte-rendu du quatrième 'Baromètre du développement durable en établissement de santé'. Une seconde partie propose des témoignages de mise en œuvre de politique durable en établissement sanitaire. Voici le détail des différents articles : Le baromètre du développement durable en établissement de santé couvre l'ensemble des secteurs sanitaires et médico-sociaux/Développement durable : quelles conséquences et quelles implications pour l'hygiéniste ?/De la responsabilité sociétale à la performance durable/Hygiène et protection du corps : acheter durablement avec profit/Comment intégrer l'ISO 26000 de manière crédible ?/Anap et développement durable/L'éco-responsabilité au sein des établissements de soin : apports de l'Ademe. En seconde partie, les centres hospitaliers de Bordeaux, Aix-en-Provence, Felleries-Liessies, Plaisir-Grignon, Dole, Trith-Saint-Léger nous font part de leurs expériences en matière de politique de développement durable (politique globale, politique achat, ressources humaines, déchet hospitalier, politique énergétique, architecture hospitalière...).

Pappalardo, M., Varnier, F., Lacroix, T., et al. (2006). "Dossier environnement et développement durable." Techniques Hospitalières(697): 37-54.

[BDSP. Notice produite par ENSP 6pR0xGM4. Diffusion soumise à autorisation]. Ce dossier réalisé à l'occasion des journées "Hôpital Expo-intermedica 2006" rassemble des articles autour du thème de l'environnement et du développement durable. Sont abordés successivement : - les actions développées par l'Agence de l'environnement et de la maîtrise de l'énergie en direction du secteur hospitalier (maîtrise de l'énergie, gestion des déchets) - la place de l'hôpital dans la mise en œuvre d'une politique de développement durable - la certification Haute Qualité Environnementale (HQE) applicable dans les bâtiments tertiaires - l'engagement du centre hospitalier d'Alès dans un projet pilote HQE avec le concours de l'Agence de l'environnement et de la maîtrise de l'énergie et le centre scientifique et technique du bâtiment - la démarche de développement durable adoptée par l'éco-clinique Champeau de Béziers.

Pascal, M., Paquet, C., Jourdain, F., et al. (2019). "Climat et santé." Sève : Les Tribunes De La Santé(61): 23-88

Ce numéro propose un dossier consacré aux questions majeures posées par les évolutions du climat et les bouleversements de l'environnement.

Provendier, F. (2022). ODD tout est lié : rapport autour des objectifs de développement durable. . Paris : Ministère de la transition écologique

[https://www.ecologie.gouv.fr/sites/default/files/23.02.2022\\_Rapport\\_mission\\_temporaire\\_autour\\_des\\_ODD.pdf](https://www.ecologie.gouv.fr/sites/default/files/23.02.2022_Rapport_mission_temporaire_autour_des_ODD.pdf).

Salines, G., Marano, F., Andre, J. C., et al. (2022). Year book 2022 : Santé et Environnement. Arcueil John Libbey Eurotext

<https://www.yearbook-ers.jle.com/>

Ce recueil rassemble près de 50 articles commentés issus de la littérature internationale dans le domaine de la santé environnementale divisé en chapitres : pathologies, contaminants, milieu de vie et fondements scientifiques.

Santé Publique France (2022). Santé environnementale : une priorité de santé publique, Saint-Maurice : Santé Publique France

<https://www.santepubliquefrance.fr/presse/2022/sante-environnementale-une-priorite-de-sante-publique>

D'après l'OMS, la santé environnementale comprend les aspects de la santé humaine, y compris la qualité de la vie, déterminés par les facteurs physiques, chimiques, biologiques, sociaux, psychosociaux et esthétiques de notre environnement. Elle concerne également la politique et les pratiques de gestion, de résorption, de contrôle et de prévention des facteurs environnementaux susceptibles d'affecter la santé des générations actuelles et futures. L'OMS a montré qu'en Europe les facteurs environnementaux qui pourraient être évités ou supprimés provoquent 1,4 million de décès par an, soit au moins 15% des décès.

Tizio, S. (2005). "La contribution des politiques de santé au développement durable." Problèmes Economiques(2877): 39-44.

Depuis les années 1990, les organisations internationales ont mis l'accent sur le rôle primordial que jouent dans le développement durable les systèmes de soins et les politiques de santé. Les analyses économiques ont en effet montré depuis fort longtemps que l'état sanitaire d'une population est un facteur déterminant de la croissance économique à long terme et du développement humain. Aussi, la commission Macroéconomie et santé de l'Organisation mondiale de la santé (OMS) préconise-t-elle, depuis plusieurs années, une augmentation substantielle de l'aide fournie par les bailleurs de fonds bilatéraux et multilatéraux, afin de soutenir de manière plus efficace les politiques sanitaires mises en œuvre dans les pays en développement. Cet article reprend partiellement celui paru dans la revue Mondes en développement, n° 127, 2004/03 : Etat de santé et systèmes de soins dans les pays en voie de développement : la contribution des politiques de santé au développement durable.

Weimann, E. et Patel, B. (2016). "Tackling the climate targets set by the Paris Agreement (COP 21): Green leadership empowers public hospitals to overcome obstacles and challenges in a resource-constrained environment." S Afr Med J **107**(1): 34-38.

<http://www.samj.org.za/index.php/samj/article/download/11768/7916>

The healthcare sector itself contributes to climate change, the creation of hazardous waste, use of toxic metals such as mercury, and water and air pollution. To mitigate the effect of healthcare provision on the deteriorating environment and avoid creating further challenges for already burdened health systems, Global Green Hospitals was formed as a global network. Groote Schuur Hospital (GSH), as the leading academic hospital in Africa, joined the network in 2014. Since then, several projects have been initiated to reduce the amount of general waste, energy consumption and food waste, and create an environmentally friendlier and more sustainable hospital in a resource-constrained public healthcare setting. We outline the various efforts made to reduce the carbon footprint of GSH and reduce waste and hazardous substances such as mercury and polystyrene, and elaborate how obstacles and resistance to change were overcome. The hospital was able to halve the amount of coal and water used, increase recycling by 50% over 6 months, replace polystyrene cups and packaging with Forest Stewardship Council recyclable paper-based products, reduce the effect of food wastage by making use of local farmers, and implement measures to reduce the amount of expired pharmaceutical drugs. To improve commitment from all involved roleplayers, political

leadership, supportive government policies and financial funding is mandatory, or public hospitals will be unable to tackle the exponentially increasing costs related to climate change and its effects on healthcare.

**Pour aller plus loin : consulter sur le site de la documentation de l'Ehesp**

## LA TRANSITION ECOLOGIQUE APPLIQUEE AUX SYSTEMES DE SANTE

**Études clés**

Or, Z. Seppanen, A. (2023). The Environmental Sustainability of Health Care Systems: A literature review on the environmental footprint of health care system and interventions aiming to reduce it: for a framework for action for France. Rapport (Irdes) ; 586. Paris : Irdes, Irdes.

*Rapport en anglais et synthèse en français*

Shift, Rambaud, T., Marraud, L., et al. (2021). Décarboner la santé pour soigner durablement. Paris The Shift Project: 155.

[Une mise à jour paraîtra en avril 2023<sup>5</sup>.](#)

(2007). "La pollution des eaux par les médicaments." [Revue Prescrire](#)(284): 460-464.

Plusieurs milliers de tonnes de substances pharmaceutiques à usage humain ou vétérinaire sont utilisées chaque année dans le monde. Lorsqu'elles sont consommées, ces substances sont éliminées par voie fécale ou urinaire, parfois sous forme active. Certains modes d'élimination des médicaments inutilisés entraînent une pollution des eaux de surface et souterraines. Des concentrations très faibles de nombreuses substances pharmaceutiques sont retrouvées à la sortie des stations d'épuration des eaux usées, dans les eaux de surface et souterraines, et dans certains échantillons d'eau de boisson. Cette micropollution peut induire des effets biologiques sur certaines espèces aquatiques. Les effets sur les humains sont inconnus. Mieux vaut prendre des mesures de prévention sans attendre les résultats de l'évaluation des risques écologiques et sanitaires.

(2019). "Résidus de médicaments dans les eaux : une pollution diffuse et complexe." [Revue Prescrire](#) **39**(432): 779-781.

Ademe (2020). [Réalisation d'un bilan des émissions de gaz à effet de serre : secteurs établissements sanitaires et médico-sociaux](#). Paris : Ademe

<https://librairie.ademe.fr/changement-climatique-et-energie/764-realisation-d-un-bilan-des-emissions-de-gaz-a-effet-de-serre-secteurs-etablissements-sanitaires-et-medico-sociaux.html>

Les établissements sanitaires et médico- sociaux sont concernés par les enjeux du développement durable en tant qu'acteurs sociaux et de santé publique mais également en tant que structures consommatrices de ressources et émettrices de Gaz à Effet de Serre. Le secteur de la santé représente 2 % de la consommation énergétique nationale (ADEME, 2019) et pourtant les postes d'émissions les plus importants sont les achats et les déplacements. Ce guide sectoriel répond aux besoins des établissements souhaitant réaliser leur bilan Gaz à Effet de Serre aussi bien dans une démarche volontaire que réglementaire. Il contient des éléments d'informations pour affiner l'évaluation des émissions d'établissements de ce secteur avec des méthodes spécifiques. Il propose des témoignages, des actions efficaces de réduction d'émissions de GES et des leviers de changement potentiels.

Alcaraz, J.-P., Le Coq, L., Pourchez, J., et al. (2022). "Reuse of medical face masks in domestic and community settings without sacrificing safety: Ecological and economical lessons from the Covid-19 pandemic."

[Chemosphere](#) **288**: 132364.

<https://www.sciencedirect.com/science/article/pii/S0045653521028368>

The need for personal protective equipment increased exponentially in response to the Covid-19 pandemic. To cope with the mask shortage during springtime 2020, a French consortium was created

<sup>5 5</sup> Mise en ligne prévue en avril 2023



to find ways to reuse medical and respiratory masks in healthcare departments. The consortium addressed the complex context of the balance between cleaning medical masks in a way that maintains their safety and functionality for reuse, with the environmental advantage to manage medical disposable waste despite the current mask designation as single-use by the regulatory frameworks. We report a Workflow that provides a quantitative basis to determine the safety and efficacy of a medical mask that is decontaminated for reuse. The type IIR polypropylene medical masks can be washed up to 10 times, washed 5 times and autoclaved 5 times, or washed then sterilized with radiations or ethylene oxide, without any degradation of their filtration or breathability properties. There is loss of the anti-projection properties. The Workflow rendered the medical masks to comply to the AFNOR S76-001 standard as "type 1 non-sanitary usage masks". This qualification gives a legal status to the Workflow-treated masks and allows recommendation for the reuse of washed medical masks by the general population, with the significant public health advantage of providing better protection than cloth-tissue masks. Additionally, such a legal status provides a basis to perform a clinical trial to test the masks in real conditions, with full compliance with EN 14683 norm, for collective reuse. The rational reuse of medical mask and their end-of-life management is critical, particularly in pandemic periods when decisive turns can be taken. The reuse of masks in the general population, in industries, or in hospitals (but not for surgery) has significant advantages for the management of waste without degrading the safety of individuals wearing reused masks.

Amory, A. et Gaubert, Y. (2009). "Taxe carbone. Impact sur les établissements de santé." Techniques Hospitalières(718): 9-.

[BDSP. Notice produite par EHESP HrnGqR0x. Diffusion soumise à autorisation]. La taxe carbone entrera en vigueur dès le 1er janvier 2010. Cette mesure vise à réduire les émissions de CO2 et s'appliquera uniquement aux énergies fossiles (pétrole, gaz, charbon, GPL). Les établissements publics de santé, mais également les établissements sociaux et médico-sociaux sont donc concernés par ce nouvel impôt. Calculée sur la base de 17 euros la tonne de CO2 émise, la taxe carbone représentera une charge supplémentaire pour ces établissements. Explications.

Aulagnon, A., Llobet, E., Gelmini, D. (2020). 5 clés pour faire entrer les EHPAD dans la transition écologique. <https://aurelie-aulagnon.com/wp-content/uploads/2020/11/Livre Blanc 5 cles pour accompagner les ehpad dans la transition ecologique.pdf>

Si la transition écologique est désormais un sujet au cœur de nombreuses politiques publiques, la prise en compte de la transition démographique reste très confidentielle quel que soit le domaine. Il est pourtant acté depuis des décennies que la pyramide des âges est en train de subir une transformation, avec une augmentation de la proportion des plus de 75 ans de 9,3% de la population française en 2020 à 13,5 en 2035. Cet accroissement ne sera pas sans impact dans la vie de toutes et tous : emplois, santé, mobilité, logements... Avec le vieillissement de sa population, la France verra également la part des personnes âgées dépendantes grandir. Si le maintien à domicile reste le choix principal, la nécessité d'emménager dans un Etablissement d'Hébergement pour Personnes Agées Dépendantes (EHPAD) est parfois nécessaire. Il existe actuellement 7200 EHPAD en France, dont près de la moitié sont publics. Ces lieux particuliers, ni vraiment un domicile à part entière, ni un lieu d'habitation collectif, ont tous leur rôle à jouer dans la démarche écologique. Ces établissements où gravitent une multitude d'acteurs - résidents, agents, familles...- peuvent être de formidables leviers d'action de développement durable au cœur de leurs territoires...

Autard, M.-L. (2010). "Développement durable. Des comportements citoyens à l'hôpital." Gestions Hospitalières(498): 457-462.

[BDSP. Notice produite par EHESP Br9R0xk9. Diffusion soumise à autorisation]. Prendre soin, améliorer le quotidien et la qualité de vie, prévenir et guérir, penser à l'avenir, s'occuper de tous sans discrimination... voilà quelques-uns des piliers du système de soins français. Comme un prolongement naturel, ces thématiques ressemblent à celles du développement durable : santé et environnement sont donc largement compatibles. Le CHU-Hôpitaux de Rouen, premier employeur de la région

Normandie, a des responsabilités écologiques, et réduire l'impact de ses activités sur l'environnement est devenu une de ses priorités. En 2008, l'établissement a décidé de mettre en oeuvre le développement durable au sein de ses services et de tous ces sites.

Bachelin, F. (2008). "Certification environnementale de la blanchisserie du CHU de Nice." Techniques Hospitalières(711): 36-39

[BDSP. Notice produite par EHESP 9R0xoCn7. Diffusion soumise à autorisation]. La blanchisserie centrale du centre hospitalier universitaire de Nice assume la collecte, le traitement et la livraison du linge du CHU et a obtenu la certification qualité ISO 9001 en novembre 2000 pour l'ensemble de sa prestation. En 2007, elle s'est lancée un nouveau défi : obtenir la certification environnementale ISO 14001 afin d'assurer le développement durable de l'activité.

Baras, A. (2021). Guide du cabinet de santé écoresponsable : Prendre soin de l'environnement pour la santé de chacun, Rennes : Presses de l'Ehesp

Les professionnels de santé sont toujours plus nombreux à prendre la mesure des changements environnementaux et à reconnaître à quel point les enjeux écologiques se répercutent sur la santé publique. L'environnement étant un déterminant majeur de santé, il est naturel d'intégrer sa préservation au sein des structures de santé. Ce Guide a pour ambition d'approfondir les connaissances des professionnels de santé sur les liens entre environnement et santé, et plus encore, de proposer des pistes de réflexions et d'actions concrètes propres à favoriser l'intégration des considérations environnementales au cœur des pratiques de santé. Structuré en 22 fiches pratiques réparties au sein de 6 thèmes (management et intégration de la démarche écoresponsable, maîtrise de la consommation d'énergie et des émissions de gaz à effet de serre, achats responsables, sobriété chimique, gestion des déchets, renforcement de la démarche et résilience), il invite les professionnels de santé à s'approprier les outils proposés, selon leurs contraintes, pour concrétiser une vision intégrant de concert les enjeux sanitaires et écologiques (4<sup>e</sup> de couv.)

Baurès, E., Blanchard, O., Mercier, F., et al. (2018). "Indoor air quality in two French hospitals: Measurement of chemical and microbiological contaminants." Sci Total Environ **642**: 168-179.

<https://www.sciencedirect.com/science/article/abs/pii/S0048969718321156?via%3Dihub>

In addition to being influenced by the environment, the indoor air pollution in hospitals may be associated with specific compounds emitted from various products used, health care activities and building materials. This study has enabled assessment of the chemical and microbiological concentrations of indoor air in two French hospitals. Based on an integrated approach, the methodology defined aims to measure concentrations of a wide range of chemical compounds (>50 volatile and semi-volatile organic compounds), particle concentrations (PM(10) and PM(2.5)), microorganisms (fungi, bacteria and viruses) and ambient parameters (temperature, relative humidity, pressure and carbon dioxide). Chemical and microbiological air concentrations were measured during two campaigns (winter and summer) and across seven rooms (for spatial variability). The results have shown that indoor air contains a complex mixture of chemical, physical and microbiological compounds. Concentrations in the same order of magnitude were found in both hospitals. Compared to dwelling indoor air, our study shows low, at least equivalent, contamination for non-hospital specific parameters (aldehydes, limonene, phthalates, aromatic hydrocarbons), which is related to ventilation efficiency. Chemical compounds retrieved at the highest concentration and frequencies are due to healthcare activities, for example alcohol - most commonly ethanol - and hand rubbing (median concentration: ethanol 245.7 µg/m<sup>3</sup>) and isopropanol 13.6 µg/m<sup>3</sup>); toluene and staining in parasitology (highest median concentration in Nancy laboratory: 2.1 µg/m<sup>3</sup>)).

Benhamou, D., Constant, I., Longrois, D., et al. (2015). "Use of volatile anaesthetic agents in anaesthesia: A survey of practice in France in 2012." Anaesth Crit Care Pain Med **34**(4): 205-209.

<https://www.sciencedirect.com/science/article/abs/pii/S2352556815000600?via%3Dihub>

Volatile anaesthetic agents are used in the vast majority of general anaesthetics performed in France. We assessed the degree of understanding of French anaesthetists with regard to the general pharmacology of these products and their understanding of the factors that govern selection of the different agents available for use in adults. A validated 13-item questionnaire was sent electronically in 2012 using files from the Société française d'anesthésie et de réanimation (Sfar). It covered four categories: general characteristics of the respondent; practical aspects of anaesthesia with volatile agents; pharmacological properties and criteria for choosing a volatile agent; risk of intra-operative awareness. Among the 981 respondents, the anaesthetic technique used by 50% was that of an intravenous induction followed by maintenance with sevoflurane. The concepts relating to the practical use of these products are well known. A fresh gas flow of less than 2 L/min is used by 96% of the respondents. However, knowledge levels are often inadequate (rate of correct answers often <50%). This lack of knowledge pertains to current themes (climate pollution), those of debatable clinical significance, e.g. pre-conditioning, hypoxic vasoconstriction and those that concern scientific theory (medullary action). However, a lack of knowledge is also observed with regard to basic pharmacology (respiratory, vascular, neurological or pharmacokinetic effects). There is no significant difference in the mode of practice. The experience of the anaesthetist (measured by number of years post diploma) resulted in a number of differences in response to many aspects of the questionnaire but these were minor. These results suggest the need for an improvement both in the initial and continued training of anaesthetists with respect to volatile anaesthetic agents.

Bernard, N. (2021). L'hôpital en transition. Concilier l'Humain, l'écologie et l'économie : Une femme médecin témoigne, Saint-Denis : Afnor

La Transition devient impérieuse dans tous les champs de nos sociétés y compris celui de la santé. La crise écologique et sanitaire que nous vivons ne fait que confirmer que nous devons changer de modèle. Partant de son expérience de terrain, Noëlle Bernard, médecin hospitalier au CHU, nous raconte ce qu'elle vit en équipe : ces ajustements du quotidien pour être au plus près des besoins des patients, mais aussi comment l'équipe, ce fantastique organisme vivant, a besoin d'être nourrie pour accueillir la souffrance de l'autre. Son constat : le temps est venu de penser d'autres formes d'organisation. Laisser la place à l'autonomie et à la créativité des soignants, limiter les tâches accumulées pour prioriser les soins et simplement retrouver de la confiance et du sens. Dans une vision plus globale, en cette période charnière, l'auteure propose des actions très concrètes pour limiter l'impact des Hôpitaux sur l'environnement : soins, alimentation, consommation d'énergie, transports... De nouvelles pratiques sont à explorer avec un fort potentiel d'économies intelligentes et écologiques à la fois. Concilier l'Humain, l'écologie et l'économie : nous sommes tous concernés, professionnels du soin, décideurs, mais aussi usagers ! Ce témoignage montre qu'il est possible d'agir au quotidien pour faire évoluer son entreprise, en l'occurrence ici l'Hôpital, avec une mise en cohérence de ses engagements personnel et professionnel. (4ème couv.)

Bervily-Itasse, E. (2021). Les enjeux du développement durable dans la santé : Extrait du rapport. Paris Les Echos: 13.

<https://www.lesechos-etudes.fr/boutique/enjeux-developpement-durable-sante-1126>

Cette étude s'articule autour des trois thématiques suivantes : Les enjeux et les leviers de la transition écologique et de l'économie circulaire pour les acteurs de la santé ; Le degré de maturité des industriels et des distributeurs ainsi que leurs projets en matière de développement durable ; L'émergence de nouveaux écosystèmes et modèles de croissance verte.

Bidart, A. M. (2012). "[Eco-innovations in a dialysis center]." *Rev Infirm*(182): 17.

In the Barn region, the nursing and management teams of the Dialysis Centre incorporate their daily practice into an environmentally-responsible approach for the joint improvement of the quality of healthcare, prevention, safety and professional efficiency, combined with the holistic care of the patient. This healthcare centre was rebuilt in accordance with High Environmental Quality standards in 2008.

Bourdon, D. (2018). Chapitre 41. Le développement durable et le cahier des charges pour l'architecture hospitalière. *Architecture et ingénierie à l'hôpital*. Rennes, Presses de l'EHESP: 305-309.

<https://www.cairn.info/architecture-et-ingenierie-a-l-hopital--9782810907113-page-305.htm>

La flexibilité architecturale est désormais une notion clé dès lors qu'il s'agit de construire un hôpital, de le rénover, ou de convertir un site hospitalier. Confrontés au rythme effréné des innovations technologiques, l'architecture des ouvrages hospitaliers doivent s'adapter constamment, dans un contexte de maîtrise des dépenses. Les capacités de réflexion des décideurs sont ainsi mises à rude épreuve tant les problématiques sont diverses et tout à la fois cruciales : est-il plus sage de construire des bâtiments en réservant des espaces pour de nouvelles techniques médicales inconnues à ce jour? Faut-il miser sur une grande longévité de l'immobilier ou au contraire en réduire les cycles de vie? Comment mieux organiser l'offre de soins sur les territoires de santé, grandes villes ou zones rurales? Quelle part donner au caractère industriel de l'hôpital et à celui des soins de proximité? Dans cet ouvrage, qui présente de nombreuses réalisations et projets architecturaux en France et à l'étranger, des professionnels (directeurs d'hôpital, ingénieurs, architectes...) et universitaires les plus compétents dans leur domaine décrivent leur cœur de métier et font part de leur expérience. Ces regards croisés nourrissent, de manière décloisonnée, une réflexion collective sur la conception de l'hôpital de demain. ✓ Une mine d'informations pour tous les directeurs, chefs de pôle, ingénieurs hospitaliers, architectes, décideurs publics et privés, et étudiants se destinant à une carrière hospitalière.

Bouraly, V. et Bonnebond, H. (2022). "Préoccupation écologique et médecine libérale sont-elles compatibles ?" *Médecine : De La Médecine Factuelle à Nos Pratiques* **18**(4): 165-170.

[https://www.jle.com/fr/revues/med/e-docs/preoccupation-ecologique-et-medecine-liberale-sont-elles-compatibles\\_322676/article.phtml](https://www.jle.com/fr/revues/med/e-docs/preoccupation-ecologique-et-medecine-liberale-sont-elles-compatibles_322676/article.phtml)

Alors que le système de santé s'avère très polluant, la préoccupation écologique est quant à elle de plus en plus ancrée parmi les professionnels de santé. Comment allier la limitation de l'empreinte écologique et l'exercice de la médecine libérale ? Cette étude qualitative suggère plusieurs pistes : repenser la construction des infrastructures de santé, réorganiser les cabinets médicaux, promouvoir le concept de santé planétaire grâce à Internet ou à des associations.

Bouret, L. (2009). "Dasri, pourquoi s'en préoccuper." *Techniques Hospitalières*(716): 69-71.

[BDSP. Notice produite par EHESP AR0xH978. Diffusion soumise à autorisation]. L'article aborde la question de l'élimination des déchets d'activités de soins à risque infectieux et de leurs modes de traitement. Les références réglementaires sont citées.

Bouvier, M., Durand, F. et Guillet, R. (2010). Médicament et environnement. La régulation du médicament vis-à-vis du risque environnemental. Paris Conseil Général de l'Environnement et du Développement Durable: 118.

[http://www.cgedd.developpement-durable.gouv.fr/IMG/pdf/007058-01\\_rapport\\_cle2ef48b.pdf](http://www.cgedd.developpement-durable.gouv.fr/IMG/pdf/007058-01_rapport_cle2ef48b.pdf)

Après un rappel de notions de base sur les résidus de médicaments dans l'environnement, le présent rapport met en œuvre une méthodologie fondée sur une série de questions élémentaires : Dispose-t-on, afin de prévenir les risques éventuels dus aux résidus de médicaments, d'une connaissance satisfaisante de leurs effets sur et par l'environnement ? Dans la négative, comment améliorer cette connaissance ? Est-il pertinent de diminuer la pression des résidus de médicaments sur l'environnement ? Et dans l'affirmative, comment diminuer cette pression ?

Cazorla, F., Graveleau, S. et Rigal, M. (2009). "Baromètre du développement durable en établissements de santé. Résultats 2009." *Techniques Hospitalières*(716): 64-68.

[BDSP. Notice produite par EHESP noFCAR0x. Diffusion soumise à autorisation]. L'étude lancée en 2008 sur le développement durable dans les établissements publics de santé et confiée à l'association des élèves de l'EHESP a été reconduite en 2009 et intégrée à l'organisation d'une manifestation intitulée "Grenelle de l'environnement et hôpital : quels enjeux ? Quelle mise en œuvre ?". Cet article

présente les données recueillies par le questionnaire diffusé en décembre 2008 auquel 170 établissements ont répondu.

Chevillard, C. (2009). "La formation. Une réponse au service du développement durable." Gestions Hospitalières(483): 99-100.

[BDSP. Notice produite par EHESP I9oHJR0x. Diffusion soumise à autorisation]. L'Association nationale pour la formation continue des hospitaliers (ANFH) se mobilise autour de la problématique du développement durable en organisant des journées d'information, des actions de formation pour les professionnels de santé et des séminaires. Preuve que la formation a tout son rôle à jouer en la matière.

Chouvel, R. et Coplo, M. (2019). "Gestion des déchets : un CHU et un CH récompensés (2019)." Gestions Hospitalières(590): 550-552.

Pour leurs marchés des déchets innovants, le CHU de Clermont-Ferrand – catégorie Performance de l'achat – et le CH de Douai – catégorie Achat durable – ont remporté les Trophées de la commande publique 2018 pour la fonction publique hospitalière, remis par Brune Poirson, secrétaire d'État auprès du ministre de la Transition écologique et solidaire, le 22 novembre 2018. Par ailleurs, le marché du CH de Douai a obtenu le Trophée des achats hospitaliers, remis par le Resah le 29 novembre 2018.

Chouvel, R., Fleckstein, R., Meilleur, L., et al. (2022/01). "Transition écologique : dossier." Gestions Hospitalières(612): 16-64.

Chouvel, R. (2022). Transition écologique : obligations des hôpitaux et ESMS publics concernant les mobilités : note juridique, Paris : Fédération hospitalière de France  
[https://www.fhf.fr/sites/default/files/2022-12/Note\\_Trans\\_Eco\\_Mobilite5.pdf](https://www.fhf.fr/sites/default/files/2022-12/Note_Trans_Eco_Mobilite5.pdf)

Cette note a pour objet de présenter de façon synthétique les principales obligations applicables aux établissements sanitaires et médico-sociaux publics en matière de transition écologique. Il ne s'agit ni d'une présentation détaillée du cadre réglementaire (la référence aux articles permet de consulter à la source les dispositions applicables) ni d'une réflexion sur ces obligations.

Cintrat, M. et Siranyan, V. (2022). "Environnement et produits de santé : prévention et traitement des déchets." Revue De Droit Sanitaire Et Social: 529-539.

La prise en compte de l'environnement devient progressivement un élément nécessaire pour la construction d'une politique de santé publique renouvelée. En effet, la pollution générée par l'accroissement du nombre de déchets issus des activités de prévention et de soins impose une réaction urgente tant des professionnels de santé que des acteurs institutionnels. A une optimisation la gestion des déchets s'ajoutent des dispositifs comme la revalorisation de produits de santé déjà utilisés ou encore la délivrance à l'unité des médicaments.

Comité pour le Développement Durable en Santé. (2015). Guide des pratiques vertueuses en développement durable des établissements sanitaires et sociaux. Amboise : C2DS

Le secteur hospitalier et médico-social avance à grands pas dans leur démarche de développement durable et présentent des résultats probants de lutte contre le réchauffement climatique, à la veille de l'ouverture de la 21e conférence sur les changements climatiques (COP21). Cette 4ème édition vise à exposer les enjeux pertinents au regard de la lutte contre le réchauffement climatique et présente une photographie partielle des réalisations dans les établissements sanitaires et médico-sociaux du territoire français. Sont présentés notamment des démarches dans le domaine de : l'économie d'énergie, l'achat responsable, la gestion des déchets, l'écoconstruction, ou bien encore, l'écomobilité

Courtivron, C., Gaudin, A., Paubel, P., et al. (2015). "Développement durable et achats de produits de santé." Gestions Hospitalières(546): 279-284

[BDSP. Notice produite par EHESP EnoR0x9r. Diffusion soumise à autorisation]. Si les hôpitaux s'inscrivent de plus en plus dans des démarches de développement durable, les achats pharmaceutiques restent un domaine où ce dernier est peu pris en compte, et ce malgré l'exigence du code des marchés publics de l'intégrer aux appels d'offres. Les auteurs présentent ici un aperçu complet des exigences que peuvent avoir les pharmaciens concernant le développement durable chez leurs fournisseurs pour adapter au mieux leurs questionnaires d'appels d'offres. (introd.).

d'Aranda, E., Derkenne, C., Bonnet, L., et al. (2021). "Aspects pratiques du développement durable en santé." Le Praticien en Anesthésie Réanimation 25(4): 181-189.

<https://www.sciencedirect.com/science/article/pii/S1279796021000814>

<https://www.sciencedirect.com/science/article/abs/pii/S1279796021000814?via%3Dihub>

Résumé Le réchauffement climatique est un fait scientifique indiscutable ; les systèmes de santé y contribuent pour partie et en sont également victimes. Pour autant, les établissements de santé s'impliquent de manière très variable dans une démarche de développement durable, et ce malgré les impulsions institutionnelles et humaines. Au sein des hôpitaux, le développement durable associe une dynamique ascendante avec la prise en compte de la problématique environnementale par les soignants, mais également descendante en raison des orientations prises par la direction vers les services. Cet article expose de manière résolument pragmatique l'établissement d'une démarche éco-responsable dans un service puis un établissement de santé afin de développer une écoconception des soins pour assurer aujourd'hui une médecine de qualité à moindre impact ainsi qu'une santé préservée aux générations futures.

Dalmas, J.-L., Duhayon, S., Croze, A., et al. (2010). "Le nouveau pôle hospitalier Euroméditerranée à Marseille : un hôpital privé sous le label HQE." Techniques Hospitalières(721): 52-57

[BDSP. Notice produite par EHESP 9rkJR0xs. Diffusion soumise à autorisation]. Issu du regroupement des hôpitaux Ambroise-Paré et Paul-Desbief à Marseille, le nouvel hôpital Euroméditerranée est l'un des premiers établissements de santé privé à s'être soumis à la nouvelle norme HQE Bâtiment tertiaire - Établissement de santé. Ce projet original, en cours de construction, dans le cadre du programme Hôpital 2012, ouvrira ses portes en 2013. Au-delà des raisons motivant la recherche d'une labellisation HQE, le présent article propose de revenir sur les pré-requis méthodologiques, ainsi que sur le contenu de trois des quatorze cibles de la démarche HQE : les relations du bâtiment avec l'environnement, la gestion de l'énergie, la gestion de l'eau.

Damour, B. et Kefi, H. (2009). "Stratégie énergétique." Techniques Hospitalières(717): 47-52, fig.

[BDSP. Notice produite par EHESP q7G9FR0x. Diffusion soumise à autorisation]. Ce document synthétise la politique d'économie d'énergie électrique du centre hospitalier Félix-Guyon du CHR de la Réunion de 1997 à 2007 et acte la démarche mise en place pour définir la future politique énergétique jusqu'en 2012.

De Gaulle, L. (2008). "Vous avez dit "développement durable" ?" Gestions Hospitalières(476): 316-317.

[BDSP. Notice produite par EHESP R0xIBCkm. Diffusion soumise à autorisation]. L'hôpital est bien un lieu de vie. Un espace de travail, où s'exercent toutes les compétences : l'hôpital est donc bien un cadre où tout le monde fait du développement durable sans le savoir. C'est aussi un ensemble où chacun mesure la fulgurance de la vie dans ce qu'elle a de trop bref ou de très long ; dans ce qu'elle recèle de mystère et de miracle. C'est aussi un espace économique organisé, avec sa structure, sa hiérarchie, ses contraintes et ses possibilités toujours surprenantes. Chacun peut, à chaque instant, y adopter un comportement développement durable (DD) par son implication.

De Montleau, B. (2008). "Introduire le développement durable à l'hôpital. Un nouveau souffle." Gestions Hospitalières(476): 318-320.

[BDSP. Notice produite par EHESP 8sR0xC89. Diffusion soumise à autorisation]. Pour l'auteur, il convient d'agir sur les trois volets intimement liés dans la gestion et le fonctionnement d'un hôpital : sociétal, économique et environnemental. Les enjeux budgétaires sont majeurs mais l'approche développement durable devrait permettre de tout gérer mieux sans pour autant augmenter les enveloppes nécessaires.

Delacourt, G. (2015). "Démarche régionale de développement durable. ARS-ADEME en Basse-Normandie." Revue Hospitalière De France(564): 72-73, carte.

[BDSP. Notice produite par EHESP 987R0xrk. Diffusion soumise à autorisation]. L'article présente la démarche régionale de développement durable engagée en Basse-Normandie dans les établissements de santé, sociaux et médico-sociaux. La démarche, copilotée par l'Agence régionale de santé et l'Agence de l'environnement et de la maîtrise de l'énergie, s'inscrit également dans le schéma régional air climat énergie. Elle propose aux établissements plusieurs objectifs, comme la réduction des gaz à effet de serre, le développement des achats responsables, la réduction des consommations d'énergie. Plusieurs opérations ont vu le jour, soutenues par des ingénieurs de l'Ademe, un ingénieur sanitaire et la directrice des soins-conseillère technique régionale pour l'ARS.

Délégation Interministérielle du Numérique en Santé (2021). L'impact environnemental du numérique en santé. Paris : Délégation Interministérielle du Numérique en Santé.

[https://esante.gouv.fr/sites/default/files/media\\_entity/documents/rapport\\_gt6\\_210517-2.pdf](https://esante.gouv.fr/sites/default/files/media_entity/documents/rapport_gt6_210517-2.pdf)

La cellule éthique de la Délégation s'est mobilisée pour élaborer un rapport qui apporte la première déclinaison sectorielle de l'impact environnemental du numérique et propose trois principes d'action : Une réflexion en profondeur sur nos besoins et une lutte contre toute forme de « numérique inutile » ; La pertinence des soins (éco-soin) comme levier de sobriété numérique car elle entraîne mécaniquement une diminution du recours aux services numériques ; L'écoconception des services numériques de santé pour répondre aux besoins des utilisateurs en utilisant le minimum de ressources informatiques et sans dégrader le service rendu. (extrait éditeur)

Dubaele, J.-M. et Dourlens, F. (2010). "Dispositifs médicaux métalliques stériles à usage unique : le choix du recyclage." Techniques Hospitalières(721): 39-43

[BDSP. Notice produite par EHESP R0xjJ9D9. Diffusion soumise à autorisation]. La centralisation des activités de stérilisation et le coût de retraitement de dispositifs médicaux réutilisables amènent les établissements de santé à se positionner sur la décision d'achat de dispositifs médicaux à usage unique stériles (DM UUS) métalliques. Cet article nous présente la démarche adoptée par le CHU d'Amiens qui a opté pour l'utilisation de ces dispositifs médicaux et la mise en place d'un circuit spécifique pour leur recyclage.

Dusautoir, C., Dupuy, C. et Mameri, A. (2010). "Certification ISO 9001 du service restauration du centre hospitalier du Chinonais (37)." Techniques Hospitalières(724): 44-47.

[BDSP. Notice produite par EHESP R0xAkApB. Diffusion soumise à autorisation]. Depuis l'emménagement dans ses nouveaux locaux en 2005 du service restauration du centre hospitalier du Chinonais, la réflexion en matière d'amélioration de la qualité n'a cessé de progresser. Ces efforts lui ont valu d'être certifié ISO 9001 v2008 en 2010. Cet engagement est le fruit d'un long travail collaboratif qui a permis de repenser l'organisation du service restauration afin de répondre au mieux aux attentes de la personne hospitalisée et du résident. Reportage.

Faure, N. et Morin, F. (2022). "Santé planétaire : en quoi les calculateurs d'empreinte carbone peuvent-ils être utiles aux médecins ?" Médecine 18(5): 196-197.

Les efforts de réduction des émissions de CO<sub>2</sub> dans la société doivent être considérables pour répondre à la crise climatique. Des calculateurs disponibles en ligne permettent d'estimer une empreinte carbone individuelle et pourraient aider à mieux comprendre les enjeux et à maintenir les efforts dans le temps. Des recommandations des autorités de santé et des sociétés savantes seront nécessaires. Elles aideront les professionnels de santé qui souhaitent évaluer leur empreinte à recourir à un calculateur fiable et performant.

Ferrero, A., Thouvenin, R., Hoogewoud, F., et al. (2022). "The carbon footprint of cataract surgery in a French University Hospital." *J Fr Ophtalmol* **45**(1): 57-64.

<https://www.sciencedirect.com/science/article/abs/pii/S0181551221005386>

**PURPOSE:** To assess the carbon footprint of cataract surgery in a French university hospital. **SETTING:** Operating room of Cochin University Hospital, Paris, France. **DESIGN:** Single-center component analysis. **METHODS:** One day of surgery was used as a reference. Greenhouse gases (GHG) related to patient and staff transportation were calculated based on the distance travelled and the means of transportation used. The annual consumption of energy (heating and electricity) of our building was converted in kg equivalent of carbon dioxide (CO<sub>2</sub>eq), and the principle of proportionality was used to calculate what was used for a single cataract procedure. GHG emissions related to the life cycle assessment (LCA) of the equipment used and the sterilization process were calculated. **RESULTS:** The LCA of disposable items accounted for 59.49kg (73.32%) of CO<sub>2</sub>eq for each procedure. A single procedure generated 2.83±0.10kg of waste. The average CO<sub>2</sub>eq produced by the transportation of the patients to and from our center, adjusted for one procedure, was 7.26±6.90kg (8.95%) of CO<sub>2</sub>eq. The CO<sub>2</sub>eq produced by the sterilization of the phacoemulsifier handpiece was 2.12kg (2.61%). The energy consumption of the building and staff transportation accounted for the remaining CO<sub>2</sub>eq emissions, 0.76kg (0.93%) and 0.08kg (0.10%) respectively. Altogether, the carbon footprint of one cataract procedure in our center was 81.13kg CO<sub>2</sub>eq - the equivalent of an average car driving 800km. **CONCLUSION:** Our data provide a basis to quantify cataract surgery as a source of GHG and suggests that reductions in emissions can be achieved.

Fédération Hospitalière de France (2020). 50 propositions pour soutenir la transition écologique des hôpitaux et des établissements médico-sociaux. Paris : FHF

<https://www.fhf.fr/>

Filfilan, A., Anract, J., Chartier-Kastler, E., et al. (2021). "Positive environmental impact of remote teleconsultation in urology during the Covid-19 pandemic in a highly populated area." *Prog Urol* **31**(16): 1133-1138.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8387203/pdf/main.pdf>

**INTRODUCTION:** Greenhouse gas (GHG) emissions are a serious environmental issue. The healthcare sector is an important emitter of GHGs. Our aim was to assess the environmental cost of teleconsultations in urology compared to face-to-face consultations. **MATERIALS AND METHODS:** Prospective study of all patients who had a remote teleconsultation over a 2-week period during COVID-19 pandemic. Main outcome was the reduction in CO<sub>2</sub>e emissions related to teleconsultation compared to face-to-face consultation and was calculated as: total teleconsultation CO<sub>2</sub>e emissions - total face-to-face consultation CO<sub>2</sub>e emissions. Secondary outcome measures were the reduction in travel distance and travel time related to teleconsultation. **RESULTS:** Eighty patients were included. Face-to-face consultations would have resulted in 6699km (4162 miles) of travel (83.7km (52 miles) per patient). Cars were the usual means of transport. CO<sub>2</sub>e avoided due to lack of travel was calculated at 1.1 tonnes. Teleconsultation was responsible for 1.1kg CO<sub>2</sub>e while face-to-face consultation emitted 0.5kg of CO<sub>2</sub>e. Overall, the total reduction in GHGs with teleconsultation was 1141kg CO<sub>2</sub>e, representing a 99% decrease in emissions. Total savings on transport were 974 € and savings on travel time were 112h (1.4h/patient). **CONCLUSIONS:** Teleconsultation reduces the environmental impact of face-to-face consultations. The use of teleconsultation in our urology departments resulted in the avoidance of more than 6000km of travel, equivalent to a reduction of 1.1 tonnes of CO<sub>2</sub>e. Teleconsultation should be considered for specific indications as the healthcare system attempts to become greener..



Gabet, V., Miege, C., Choubert, J.-M., et al. (2009). "Devenir d'oestrogènes et de bêtabloquants dans les filières eau de dix stations d'épuration biologiques des eaux résiduaires urbaines françaises." Techniques Hospitalières(717): 61-66

[BDSP. Notice produite par EHESP R0xG7ltl. Diffusion soumise à autorisation]. Cette étude complète le dossier "effluents liquides" parus en deux parties dans les numéros 714 et 715 de Techniques hospitalières. Elle s'attache à analyser cinq hormones oestrogéniques et dix bêtabloquants dans les eaux de dix stations d'épuration de type épuration biologique.

Gaudin, F. (2008). "La démarche Haute Qualité environnementale. Les conditions d'une mise en oeuvre opérationnelle." Gestions Hospitalières(476): 329-332.

[BDSP. Notice produite par EHESP Ft7FkR0x. Diffusion soumise à autorisation]. L'expérimentation de la démarche Haute Qualité environnementale (HQE) appliquée à la construction par les établissements de santé d'Alès, de Douai ou de Nice, sur la base du référentiel HQE tertiaire, pose la question de la nécessité d'un référentiel spécifiquement hospitalier. Si toute modélisation semble impossible du fait de la grande diversité des constructions hospitalières, certaines thématiques méritent d'être traitées au premier plan, tels la gestion de l'énergie ou l'entretien et la maintenance, grâce au raisonnement en coût global. Mais la HQE doit être comprise beaucoup plus largement que sous l'angle économique : elle doit dépasser toute tentation réglementaire et rendre le maître d'ouvrage hospitalier responsable vis-à-vis de la collectivité et des patients, en lui laissant la liberté de ses choix constructifs à chaque étape de son projet, de la programmation à la réception de son bâtiment.

Giraud, J. S., Hamidou, F., Hassani, Y., et al. (2022). "Prise en compte des critères environnementaux dans la commande publique des produits de santé." Annales Pharmaceutiques Françaises **80**(2): 216-226.  
<https://www.sciencedirect.com/science/article/pii/S0003450921000948>

Objectifs Les produits de santé (PDS) ont une empreinte environnementale qu'il convient réglementairement de prendre en compte dans la politique d'achat. Un état des lieux national de l'intégration de critères environnementaux (CE) dans la commande publique des PDS à l'hôpital a été réalisé. Méthodes Trente CE ont été identifiés dans la littérature. Deux questionnaires ont été proposés : aux acheteurs qui analysent le niveau d'« importance » et d'« applicabilité » des CE dans les appels d'offres (AO), et aux fournisseurs qui déclarent leurs engagements et communiquent des éléments de preuves (EDP). Résultats Six acheteurs régionaux et 28 fournisseurs ont participé. Les acheteurs reconnaissent l'« importance » du développement durable (DD) mais sont réticents sur l'« applicabilité » des CE dans les AO. La cotation environnementale reste faible : en moyenne 4,38 (0,25–10,00) % de la cotation totale. Seuls 12 CE sont retrouvés dans les AO des acheteurs ayant répondu. Les fournisseurs déclarent un engagement important et diversifié dans le DD : 18 fournisseurs ont envoyé 474 EDP. Les points de vue des acheteurs et des fournisseurs convergent sur l'optimisation des conditionnements primaires et l'instauration d'un minimum de commande ou de groupement de livraison. Conclusions Dans le cadre de la recherche d'efficacité de la commande publique, les CE alliant DD et pilier économique sont à privilégier. L'intégration de CE supplémentaires, simples et facilement documentés, permettant la limitation des coûts à la fois pour le fournisseur et l'acheteur, est possible pour valoriser l'achat durable.

Gosset, A., Polope, P. et Perrodin, Y. (2020). "Ecotoxicological risk assessment of micropollutants from treated urban wastewater effluents for watercourses at a territorial scale: Application and comparison of two approaches." Int J Hyg Environ Health **224**: 113437.  
<https://www.sciencedirect.com/science/article/abs/pii/S1438463919309332?via%3Dihub>

In most cases, urban Wastewater Treatment Plants (WWTP) only partially abate pollutants occurring in the influent. Treated effluents can thus contain a complex mixture of ecotoxic pollutants, such as heavy metals, detergents, disinfectants, plasticizers, pharmaceuticals residues or pesticides. In this context, Ecotoxicological Risk Assessment (ERA) provide essential decision-making tools to public authorities for establishing environmental policies and conducting territorial planning. The present

work aims to develop a territorial-scale ERA methodology using two complementary approaches based on a Risk Quotient (RQ) calculation: (1) the first, based on the risk linked to each individual pollutant (single substances ERA); (2) the second, considering all pollutants present, and the "cocktail effect" (mixture ERA). This research was performed at 33 urban WWTPs of in a highly urbanized part of France (Lyon area). Initial minimum, median and maximum pollutant concentrations in treated effluents were obtained from a literature review of physico-chemical analysis studies, to reconstitute "typical" effluents. The classical approach (single substances ERA) identified the riskiest substances (e.g. endocrine disruptors, as the Estrone with RQ up to 593.75), and showed the risks for each WWTP. The mixture ERA approach revealed new risks, which were not highlighted in the classical ERA approach, thus increasing the number of WWTPs identified as at risk. This study shows the importance of accounting for the cocktail effect, which is not considered in current regulatory decisions. Finally, this methodology allowed us to identify the riskiest situations (often medium sized WWTPs, releasing into small streams), that could worsen in the context of climate change.

Guibourg, S., Moalic, E., Baron, R., et al. (2019). "Emergency management of water supply pollution in a French teaching hospital." *Infect Control Hosp Epidemiol* **40**(10): 1207-1209.

<https://www.cambridge.org/core/services/aop-cambridge-core/content/view/F09EEE13EDC1272BD6C6C34EEA5DD99A/S0899823X1900223Xa.pdf/div-class-title-emergency-management-of-water-supply-pollution-in-a-french-teaching-hospital-div.pdf>

Haguenoer, J.-M. (2010). "Les résidus de médicaments présentent-ils un risque pour la santé publique ?" *Sante Publique* **22**(3): 325-342.

[BDSP. Notice produite par EHESP HEnR0xBC. Diffusion soumise à autorisation]. Partant du constat de la contamination environnementale par les résidus et déchets médicamenteux, cet article présente tout d'abord les différentes sources de contamination et les milieux concernés. Sources diffuses ou sources ponctuelles, elles peuvent entraîner une pollution des sols, des eaux (résiduaire, stations d'épuration, eaux de surfaces, eaux marines...) des sédiments et des aliments. Cependant l'évaluation des risques pour l'environnement et l'homme est complexe et les données disponibles restent incomplètes en comparaison avec les connaissances toxicologiques. L'article aborde les risques relatifs aux anticancéreux, les résidus antibiotiques et les hormones. Pour terminer, l'article fait le point sur la gestion des risques et les réglementations existantes. Il conclut sur les recommandations de l'Académie nationale de Pharmacie.

Hahran, E., Ertel, E., Perlemoine, T., et al. (2022). "Du smart Hospital au smart Territoire." *Dsih*(37): 22-27.

Haut Conseil de la Santé Publique (2022). Avis relatif à la mesure du dioxyde de carbone dans l'air intérieur des établissements recevant du public. Paris : HCSP.

<https://www.hcsp.fr/explore.cgi/avisrapportsdomaine?clefr=1154>

L'avis du HCSP relatif à la mesure du dioxyde de carbone (CO<sub>2</sub>) s'inscrit dans le contexte de l'évolution du cadre réglementaire de la surveillance obligatoire de la qualité de l'air intérieur dans certains établissements recevant du public (ERP), à des moments clés de la vie des bâtiments, selon l'action n°14 du Plan national santé-environnement 2021-2025 (PNSE4). L'élévation des concentrations de CO<sub>2</sub>, une molécule produite par la respiration humaine, correspond à un confinement de l'air des locaux qui est associé à une diminution des performances cognitives et, en présence de personnes sources, à l'augmentation de la concentration d'agents infectieux aéroportés.

Helbert, A., Ronziere, N. et Vela, G. (2011). "Nouvel hôpital de Cannes. Objectifs : bien-être et qualité." *Techniques Hospitalières*(725): 51-54.

[BDSP. Notice produite par EHESP R0x9DArG. Diffusion soumise à autorisation]. Cet article nous présente les points forts du nouvel hôpital de Cannes dont l'ouverture est prévue au printemps 2011. Celui-ci offre notamment une accessibilité optimisée, un haut niveau de confort pour le malade et de meilleures conditions de travail pour le personnel. Il intègre également des contraintes de qualité environnementale et des outils à la pointe de la technologie.

Henriques, L. et Lequillec, L. (2021). Initiation à l'achat public performant. Antony : Editions du moniteur

Cet ouvrage se présente sous la forme d'un mode d'emploi de l'achat performant et durable. Chaque participant à l'acte d'achat pourra y trouver des techniques et d'outils juridiques et pratiques simples à mettre en oeuvre pour nourrir ses réflexions et développer des stratégies d'achats efficaces. Par ailleurs, il a pour objectif de guider les acheteurs publics dans leur gestion quotidienne des projets d'achats afin d'optimiser leurs gains et de les aider à en faire un levier des politiques publiques durables. Il permet ainsi : -de définir les besoins de manière adéquate -de déterminer une stratégie d'achat durable adaptée aux besoins -de mettre en oeuvre des techniques d'achat performantes -de sélectionner une offre durable dans le cadre de l'attribution de marché -et enfin, d'évaluer l'achat durable et la fonction achats. (4<sup>ème</sup> couv.)

Jean, J., Perrodin, Y., Pivot, C., et al. (2012). "Identification and prioritization of bioaccumulable pharmaceutical substances discharged in hospital effluents." J Environ Manage **103**: 113-121.

The consumption of pharmaceuticals and their excretion in wastewater is a continuous source of pollution for aquatic ecosystems. In certain cases these compounds are found in the environment at concentrations high enough to cause disturbance in aquatic organisms. Aware of this problem hospitals are giving increasing attention to the nature of their effluents and their impact on the environment, by implementing more efficient effluent management policies. This concern is justified in view of the large volumes of toxic products consumed (detergents, disinfectants, pharmaceuticals, chemical reagents, radioactive elements, etc.). Moreover, these effluents usually do not undergo any specific treatment before being discharged into urban sewage networks. In this article, we present a method for selecting the pharmaceuticals discharged in hospital effluents that have the worst impact on the aquatic ecosystem, primarily based on their bioaccumulation potential. This study focused on the pharmaceuticals consumed at the Hospices Civils de Lyon (HCL), the second largest hospital structure in France (5200 hospital beds). Of the 960 substances consumed in HCL hospitals, a shortlist of 70 substances considered as being potentially bioaccumulable was established. The use of aggravating factors of risk has then led to the final selection of 14 priority compounds. They include 4 compounds consumed in large quantities in HCL hospitals, 6 endocrine disruptors and 4 potentially ecotoxic compounds. For all these compounds, it is now advisable to verify their bioaccumulation potential experimentally and confirm their presence in the environment. In addition, in order to monitor the risk relating to possible contamination of the food chain, it will be necessary to measure accumulated dose levels in species of different trophic levels. Lastly, chronic ecotoxicity tests will permit evaluating the danger and risk that some of these substances may represent for aquatic ecosystems.

Josephson, A., Sabotka, P., Diallo, S., et al. (2014). "Développement durable. Les pharmacies passent au vert." Gestions Hospitalières(536): 270-275

[BDSP. Notice produite par EHESP HR0xCG7F. Diffusion soumise à autorisation]. L'engagement des établissements hospitaliers dans une démarche de développement durable (DD) est aujourd'hui essentiel et s'accompagne d'une évolution de la réglementation engagée depuis plusieurs années. Dans le cadre du projet DD présenté ici, la pharmacie de l'établissement a mené trois actions appliquées plus particulièrement à l'approvisionnement des dispositifs médicaux et des solutés massifs : participation à l'organisation d'une journée DD au sein de l'établissement (axe social), intégration d'un questionnaire lors des mises en concurrence de fournisseurs (axe économique) et cadencement des commandes afin de diminuer la consommation de papier et les émissions de CO<sub>2</sub> (axe écologique). Indépendamment des bénéfices attendus pour l'environnement, ces trois actions ont eu des impacts positifs en termes de communication au sein de l'établissement, ainsi qu'auprès des fournisseurs, notamment en termes d'optimisation du processus de commande des dispositifs médicaux et des solutés.

Jouanno, C. (2009). "Développement durable et établissements de santé. Interview." Techniques Hospitalières(715): 13-14.

[BDSP. Notice produite par EHESP BR0xmlo8. Diffusion soumise à autorisation]. Chantal Jouanno, chargée de l'écologie au ministère de l'Écologie, de l'énergie, du développement durable et de l'aménagement du territoire répond à un certain nombre de questions : Quel soutien apporte le ministère aux établissements de santé qui s'engagent dans une démarche de développement durable ? Quelles sont les pistes prioritaires ?

Lacorte, S., Gómez-Canela, C. et Calas-Blanchard, C. (2021). "Pharmaceutical Residues in Senior Residences Wastewaters: High Loads, Emerging Risks." *Molecules* **26**(16).

[https://mdpi-res.com/d\\_attachment/molecules/molecules-26-05047/article\\_deploy/molecules-26-05047.pdf](https://mdpi-res.com/d_attachment/molecules/molecules-26-05047/article_deploy/molecules-26-05047.pdf)

Senior residences are health-care facilities that are socially-accepted for the assistance of elderly people. Since the elderly account for the foremost pharmaceutical-consuming age-group, senior residences become a hot-spot for pharmaceuticals discharge to the sewage grid. The objectives of the present study were to identify the bioactive pharmaceuticals in sewage waters from senior residences and to propose an on-site monitoring strategy for their control. In this study, we have studied the presence of 43 pharmaceuticals highly consumed by the elderly population in six senior residences located in Spain, France and Portugal. Wastewater was sampled directly from the water-chest in each residence during different times of the day throughout one week. Main compounds detected at the high  $\mu\text{g L}^{-1}$  level were analgesic and antipyretic drugs such as acetylsalicylic acid, paracetamol, ibuprofen; antibiotics such as amoxicillin and sulfamethoxazole; compounds for the treatment of neuropathies as gabapentin, trazodone and valsartan; pharmaceuticals for the treatment of diabetes (vildagliptin) and anticancer drugs. The daily loads discharged were estimated and their fate was evaluated. The final objective of this study is to highlight the need to implement at-source waste water treatment procedures in senior residences, which have been identified as a point source pollution of pharmaceuticals.

Lacorte, S., Luis, S., Gómez-Canela, C., et al. (2018). "Pharmaceuticals released from senior residences: occurrence and risk evaluation." *Environ Sci Pollut Res Int* **25**(7): 6095-6106.

<https://link.springer.com/content/pdf/10.1007/s11356-017-9755-1.pdf>

One of the main pursuits, yet most difficult, in monitoring studies is to identify the sources of environmental pollution. In this study, we have identified health-care facilities from south European countries as an important source of pharmaceuticals in the environment. We have estimated that compounds consumed in by the elderly and released from effluents of senior residences can reach river waters at a concentration higher than  $0.01 \mu\text{g/L}$ , which is the European Medicines Agency (EMA) threshold for risk evaluation of pharmaceuticals in surface waters. This study has been based on five health institutions in Portugal, Spain, and France, with 52 to 130 beds. We have compiled the pharmaceuticals dispensed on a daily base and calculated the consumption rates. From 54.9 to 1801 g of pharmaceuticals are consumed daily, with laxatives, analgesics, antiepileptics, antibiotics, and antidiabetic agents being the main drug families administered. According to excretion rates, dilution in the sewerage system, and elimination in wastewater treatment plants, macrogol, metformin, paracetamol, acetylcysteine, amoxicillin, and gabapentin, among others, are expected to reach river waters. Finally, we discuss the risk management actions related to the discharge of pharmaceuticals from senior residences to surface waters.

Laquaz, M., Dagot, C., Bazin, C., et al. (2018). "Ecotoxicity and antibiotic resistance of a mixture of hospital and urban sewage in a wastewater treatment plant." *Environ Sci Pollut Res Int* **25**(10): 9243-9253.

<https://link.springer.com/content/pdf/10.1007/s11356-017-9957-6.pdf>

Hospital and urban effluents are a source of diverse pollutants such as organic compounds, heavy metals, detergents, disinfectants, pharmaceuticals, and microorganisms resistant to antibiotics. Usually, these two types of effluent are mixed in the sewage network, but a pilot site in France now allows studying them separately or mixed to understand more about their characteristics and the phenomena that occur following their mixing. In this study, their ecotoxicity (*Daphnia magna* mobility, *Pseudokirchneriella subcapitata* growth, *Brachionus calyciflorus* reproduction, and SOS Chromotest) and antibiotic resistance (integron quantification) were assessed during mixing and treatment steps.

The main results of this study are (i) the ecotoxicity and antibiotic resistance potentials of hospital wastewater are higher than in urban wastewater and (ii) mixing two different effluents does not lead to global synergistic or antagonistic effects on ecotoxicity and antibiotic resistance potential. The global additivity effect observed in this case must be confirmed by other studies on hospital and urban effluents on other sites to improve knowledge relating to this source of pollution and its management.

Lavrard, F. (2012). "Diagnostic énergétique d'établissements de santé." Techniques Hospitalières(733): 30-32, fig.

[BDSP. Notice produite par EHESP R0x18oHI. Diffusion soumise à autorisation]. Les consommations d'énergie des établissements de santé sont nettement plus élevées que celles des bâtiments de logement ou tertiaires classiques, notamment à cause des conditions d'ambiance strictes attendues et des équipements biomédicaux installés, très "énergivores". D'où l'importance de mener un diagnostic énergétique sur le site hospitalier afin d'analyser la performance des différents postes (bâtiment, équipements techniques.) et établir, si possible, un programme de travaux permettant des économies d'énergie. Cet article présente la démarche et les thématiques de ce diagnostic énergétique.

Lebrun Merrant, F. (2009). "Bâtiment et développement durable. Réglementation et labels." Techniques Hospitalières(717): 54-58

[BDSP. Notice produite par EHESP C8kAR0xr. Diffusion soumise à autorisation]. Du 10 au 12 juin 2009, l'association des ingénieurs hospitaliers de France (IHF) organisait ses 49èmes journées d'études et de formation à Paris, journées qui proposaient des ateliers en adéquation avec l'actualité : nanotechnologies, développement durable, gestion des risques... Cet article synthétise les éléments abordés lors de la thématique bâtiment et développement durable : réglementation thermique et énergétique applicable aux établissements existants et neufs, existence de labels d'efficacité énergétique et de labels de haute qualité environnementale (HQE), expériences menées dans certains centres hospitaliers.

Lebrun Merrant, F. (2009). "Grenelle de l'environnement et hôpital." Techniques Hospitalières(716): 61-63.

[BDSP. Notice produite par EHESP G7R0x8As. Diffusion soumise à autorisation]. L'article fait un bref compte-rendu de la journée de formation organisée en avril 2009 sur le thème "Grenelle de l'environnement et hôpital : Quels enjeux ? Quelle mise en oeuvre ?" : présentation des Awards 2009 sur le management du développement durable et de témoignages sur des projets lancés dans différents établissements.

Les Entreprises du Médicament (2009). Responsabilité sociétale des Entreprises du Médicament 2008, Paris : LEEM

<https://www.leem.org/responsabilite-societale-des-entreprises-du-medicament>

La Responsabilité Sociétale des Entreprises (RSE) est un concept dans lequel les entreprises intègrent les préoccupations sociales, environnementales et économiques dans leurs activités et dans leurs interactions avec leurs parties prenantes, sur une base volontaire. Elle consiste de la part des entreprises, à mettre en oeuvre un développement économique plus « durable » que celui d'aujourd'hui. Depuis trois ans, les Entreprises du Médicament ont engagé un travail collectif pour s'approprier les enjeux de responsabilité sociétale sur lesquels elles sont sollicitées : développement de l'innovation, transparence des décisions, éthique et gouvernance, sécurité des produits, gestion de l'impact environnemental, impact social et engagement sociétal du secteur au service du développement humain. Pour se faire, les Entreprises du Médicament se sont appuyées sur trois piliers : la création d'un « comité RSE » au Leem rapportant au Conseil d'Administration ; un dialogue continu et ouvert avec les parties prenantes dans le cadre d'un « Comité des parties prenantes » ; le déploiement d'initiatives de progrès dans l'ensemble des champs identifiés et dans le contexte du Grenelle de l'environnement. L'ensemble des rapports RSE est accessible dans la rubrique publication de ce site. Le rapport RSE 2008 est accessible en mode feuilleter en ligne.

Lemeillet, A. (2022). La gestion des déchets dans les établissements de santé. Paris Take & Waste: 11.

Les flux de déchets principaux sont très diversement triés en établissement sanitaire. Dans un baromètre, l'entreprise Take a Waste constate en outre que les initiatives pour réduire à la source les déchets sont encore peu nombreuses. Or les coûts de gestion vont continuer d'augmenter dans les années à venir. Ce livre blanc compile les données de collecte et traitement des déchets issues deqs activités de Take & Waste auprès de leurs clients du secteur santé. Il dresse un état des lieux de la gestion des déchets avant l'intervention de Take a waste et mise en conformité réglementaire de l'établissement. Les données recueillies proviennent de 132 cliniques, 45 centres de soins de suite et de réadaptation et 217 Ehpad, toutes enseignes et régions confondues. Afin d'assurer la représentativité des données, la période de collecte a été restreinte aux trois dernières années calendaires et s'étend donc de janvier 2020 à juin 2022.

Leroux, V., Francois, L., Moureaux-Philibert, S., et al. (2008). "Décider de se mettre au développement durable... Et après ?" Gestions Hospitalières(476): 321-323.

[BDSP. Notice produite par EHESP CBsAR0xp. Diffusion soumise à autorisation]. Le concept de développement durable, après vingt ans de cheminement incertain en France, est désormais sur le devant de la scène et fait l'objet de toutes les attentions. Mais comment le conjuguer en actions dans un établissement de santé ?

Lethi, V. et Bonnevalle, P. (2010). "Hospices civils de Lyon : la plus grande cuisine hospitalière de France." Techniques Hospitalières(723): 12-16

[BDSP. Notice produite par EHESP 8R0xqmAG. Diffusion soumise à autorisation]. La réflexion engagée par les Hospices civils de Lyon (HCL) sur la restructuration de la fonction restauration depuis 2005 va se concrétiser par l'ouverture en septembre 2010 d'une nouvelle unité centrale de production alimentaire (UCPA) qui regroupera en 2012 l'activité de quatre des cinq unités actuellement existantes aux HCL. La mise en oeuvre d'innovations techniques et technologiques importantes aura un impact fort sur le management et les effectifs de la fonction, le métier des cuisiniers et la prestation destinée au patient. Cet article nous présente le fonctionnement de cette nouvelle unité centrale, les innovations technologiques du projet ainsi que la stratégie d'investissement et de financement mise en oeuvre.

Livonnet-Montcelon, E. (2010). "Projet d'établissement "vert" au centre hospitalier de Blois." Techniques Hospitalières(723): 19-21.

[BDSP. Notice produite par EHESP mR0x9E7k. Diffusion soumise à autorisation]. Cet article nous présente la démarche "développement durable" du centre hospitalier de Blois, démarche présente dans les différents volets du projet d'établissement 2010-2014, ainsi que les actions qui seront menées prochainement dans ce cadre.

Ludwig, D. et Jouvin, M.-L. (2010). "Le centre hospitalier de Jury-lès-Metz, pionnier en matière de bilan carbone." Techniques Hospitalières(721): 45-50,

[BDSP. Notice produite par EHESP pR0xlot8. Diffusion soumise à autorisation]. Afin de guider la restructuration de l'établissement qui comprend une quarantaine de bâtiments répartis sur soixante hectares et de disposer d'une analyse précise des faiblesses de l'établissement, le centre hospitalier de Jury-lès-Metz a fait le choix de réaliser un bilan carbone. Cet article nous présente la méthode adoptée pour mener ce bilan (information du personnel, items retenus, documents fournis...) ainsi que les résultats obtenus et les axes d'amélioration possibles qui ont été dégagés.

Marraud, L., Lefébure, A. et Baurès, E. (2021). "Comprendre l'impact environnemental du secteur de la santé : pour un leadership partagé en faveur d'un système de santé durable et résilient." La Presse Médicale Formation 2(6): 628-633.

<https://www.sciencedirect.com/science/article/pii/S2666479821002743>

Résumé Le réchauffement climatique—de par l'augmentation en fréquence et en intensité des extrêmes (vagues de chaleur, inondations...) météorologiques—à une influence considérable à court et à long terme sur notre environnement de vie et notre santé. Ce processus de changement global aggrave les risques sanitaires existants et modifie plus généralement l'environnement, favorisant ainsi la pollution de l'air et des eaux, l'insécurité alimentaire, la survenue de maladies vectorielles<sup>11</sup>Ainsi, le moustique tigre, vecteur de maladies tropicales comme le Chikunguya, la dengue et le Zika est désormais présent sur l'ensemble des départements français. et la dégradation de la santé mentale (Rapports du Lancet Countdown 2019 et 2020). Or le système de santé lui-même, par ses activités de production de soins, participe à ce réchauffement. L'article expose le besoin de formation des professionnels de santé sur les enjeux santé et environnement dans le but de leur permettre de participer activement à la transition écologique de la santé.

Martin, D. (2013). "Mal recycler nuit gravement à l'environnement !" *Gestions Hospitalières*(531): 588-589

[BDSP. Notice produite par EHESP 8mR0x9F9. Diffusion soumise à autorisation]. Les établissements de santé remplacent régulièrement leurs dispositifs médicaux hors service. Une filière de collecte et de recyclage financée par les producteurs de ces équipements existe depuis août 2012. Elle est orchestrée par Récyclum - éco-organisme à but non lucratif - qui propose des solutions de collecte gratuites, adaptées à tout type de besoins, conformes à la réglementation et respectueuses de l'environnement.

Masset, G., Vieux, F., Verger, E. O., et al. (2014). "Reducing energy intake and energy density for a sustainable diet: a study based on self-selected diets in French adults." *Am J Clin Nutr* **99**(6): 1460-1469.

BACKGROUND: Studies on theoretical diets are not sufficient to implement sustainable diets in practice because of unknown cultural acceptability. In contrast, self-selected diets can be considered culturally acceptable. OBJECTIVE: The objective was to identify the most sustainable diets consumed by people in everyday life. DESIGN: The diet-related greenhouse gas emissions (GHGE) for self-selected diets of 1918 adults participating in the cross-sectional French national dietary survey Individual and National Survey on Food Consumption (INCA2) were estimated. "Lower-Carbon," "Higher-Quality," and "More Sustainable" diets were defined as having GHGE lower than the overall median value, a probability of adequate nutrition intake (PANDiet) score (a measure of the overall nutritional adequacy of a diet) higher than the overall median value, and a combination of both criteria, respectively. Diet cost, as a proxy for affordability, and energy density were also assessed. RESULTS: More Sustainable diets were consumed by 23% of men and 20% of women, and their GHGE values were 19% and 17% lower than the population average (mean) value, respectively. In comparison with the average value, Lower-Carbon diets achieved a 20% GHGE reduction and lower cost, but they were not sustainable because they had a lower PANDiet score. Higher-Quality diets were not sustainable because of their above-average GHGE and cost. More Sustainable diets had an above-average PANDiet score and a below-average energy density, cost, GHGE, and energy content; the energy share of plant-based products was increased by 20% and 15% compared with the average for men and women, respectively. CONCLUSIONS: A strength of this study was that most of the dimensions for "sustainable diets" were considered, ie, not only nutritional quality and GHGE but also affordability and cultural acceptability. A reduction in diet-related GHGE by 20% while maintaining high nutritional quality seems realistic. This goal could be achieved at no extra cost by reducing energy intake and energy density and increasing the share of plant-based products.

Ministère chargé de la santé (2023). Planification écologique du système de santé : feuille de route. Paris : Ministère de la santé

<https://sante.gouv.fr/actualites/presse/communiqués-de-presse/article/planification-ecologique-du-systeme-de-sante-lancement-d-une-feuille-de-route>

Les urgences climatiques, énergétiques et écologiques imposent une accélération sans précédent des mesures collectives pour réduire drastiquement l'empreinte environnementale de nos activités. Le système de santé a donc également un rôle majeur à jouer dans la maîtrise de son impact. Il doit se

transformer pour ouvrir la voie vers un système plus sobre, plus soutenable, circulaire et moins dépendant des énergies fossiles. La transition écologique en santé est une démarche de santé durable favorisant l'intégration de mesures économiquement viables, socialement équitables et écologiquement soutenables, promotrices de santé et de bien-être. Car en effet le système de santé aujourd'hui c'est : Plus de 8 % des émissions nationales de gaz à effet de serre (près de 50 millions de tonnes équivalent CO<sub>2</sub>). L'impact de l'offre de soins représente environ 45 % de ces 50 millions de tonnes. Les médicaments et les dispositifs médicaux engendrent les 55 % restants. Un secteur qui doit faire sa part dans la nécessaire baisse des émissions de gaz à effet de serre de 5 % par an jusqu'en 2050, afin de respecter l'engagement national français de rester sous la barre des +1,5°C supplémentaires. Un rôle majeur à jouer dans la maîtrise de son impact en matière de biodiversité, d'épuisement des ressources naturelles et d'accès à l'eau douce, ou encore de dégradation et de pollutions des milieux naturels. De nombreuses initiatives locales de transformation écologique existent et témoignent de la forte attente exprimée par les acteurs du secteur de la santé. Elles ont guidé l'élaboration de la feuille de route présentée lors du COPIL. Le souhait partagé par le plus grand nombre de « trouver du sens » au travail et de collaborer autour de projets engagés, porteurs et enthousiasmants, font de la stratégie nationale de transformation écologique un outil de cohésion et d'attractivité majeur pour les personnels du secteur de la santé. Les ministres réunis lundi 22 mai en comité de pilotage au ministère de la Santé et de la Prévention se sont engagés à travailler autour des sept axes suivants : Accentuer la rénovation et la transformation énergétique du parc immobilier sanitaire et médicosocial; Accélérer la transition vers des achats et une alimentation durables ; Transformer et accompagner les pratiques vers les soins écoresponsables dès 2023 ; Accélérer la réduction des déchets et leur valorisation d'ici 2030 et optimiser le périmètre DASRI pour le limiter le plus possible dès 2024 ; Former l'ensemble des agents de la fonction publique hospitalière à la transition écologique, en commençant par les 6 500 cadres dirigeants hospitaliers d'ici fin 2024 : une formation inédite adaptée aux enjeux spécifiques de la santé et permettant une mise en action concrète, grâce à des partages d'expérience et à des visites de terrain ; Sensibiliser tous les professionnels de santé et administratifs à l'éco-conception des soins et des accompagnements médicosociaux, et soutenir des projets de recherche ; Accélérer la transition vers des transports et des schémas de mobilité à faibles et très faibles émissions d'ici 2030. Cette publication présente la feuille de route pour le système de santé.

Molieres, V. et Fraleux, D. (2008). "Quand le développement durable s'invite à l'hôpital." Gestions Hospitalières(476): 324-325.

[BDSP. Notice produite par EHESP ro98IR0x. Diffusion soumise à autorisation]. Pollueur, producteur de déchets toxiques, surconsommateur d'énergie... Quand l'hôpital tire son bilan environnemental, les indicateurs sont en rouge. Il est temps que le développement durable fasse irruption dans la sphère hospitalière.

Mourgues, F. (2021). L'hôpital agit pour la planète : guide 2021 des pratiques vertueuses en développement durable des établissements sanitaires et médico-sociaux. Montluis-sur-Loire : Comité pour le développement durable en santé (C2DS)

Depuis quelques années, les établissements de santé ont intégré un volet environnemental dans leur stratégie et ont mis en oeuvre des actions concrètes : 19% des établissements de santé ont réalisé un bilan d'émissions de gaz à effet de serre, 48% ont réalisé un diagnostic de performance énergétique et 32% un audit énergétique (données 2020). Cette 6ème édition présente une photographie partielle des réalisations dans les établissements sanitaires et médico-sociaux sur le territoire français. Sont présentés notamment des démarches responsables dans les domaines suivants : le transport et l'écomobilité, la politique énergétique, l'achat responsable et la lutte contre le gaspillage, la gestion des déchets, les soins.

Mourgues, F. (2017). " Guide pratique. Développement durable au bloc opératoire ". Montluis-sur-Loire : Comité pour le développement durable en santé (C2DS)



Engager une démarche pour réduire l'impact écologique de l'activité de soins des blocs opératoires et prendre soin des ressources humaines est noble. Ce projet est à la portée collective des professionnels de santé. Il crée du lien, de la cohésion sociale, du sens, optimise les performances et les dépenses solidaires de santé. Et si tous ensemble, nous étions acteurs de ce changement ?

Mourgues, F. et Chanabas, F. (2010). "Tic et Hôpital. Engagement, innovation, ambition et persévérance." *Gestions Hospitalières*(495): 232-235.

[BDSP. Notice produite par EHESP R0x9oCk8. Diffusion soumise à autorisation]. Le Centre hospitalier d'Alès (CHA) s'est investi depuis une dizaine d'année dans des projets de qualité environnementale forte. Cet article présente les ambitions affichées du futur hôpital "centre hospitalier Alès-Cévennes" qui ouvrira ses portes en 2010. D'une part il respectera les normes de Haute Qualité Environnementale (HQE) et de Développement durable (DD), d'autre part il aura développé des applications innovantes au service des patients et des agents hospitaliers, dont un réseau Voix/données/image (VDI) unifié. Différentes applications y sont détaillées.

Mullot, J. U., Karolak, S., Fontova, A., et al. (2010). "Modeling of hospital wastewater pollution by pharmaceuticals: first results of Mediflux study carried out in three French hospitals." *Water Sci Technol* **62**(12): 2912-2919.

<https://iwaponline.com/wst/article-abstract/62/12/2912/16700/Modeling-of-hospital-wastewater-pollution-by?redirectedFrom=fulltext>

A study has been carried out in three French hospitals in order to assess and model the pharmaceutical load in hospital wastewater and its impact in WWTP. This study, called Mediflux, consisted of three successive steps: first, an original prioritization procedure developed in our laboratory enabled us to select a list of relevant molecules from different Anatomical Therapeutic Chemical (ATC) classes containing pharmaceuticals for specific hospital use such as anesthetics or antineoplastic agents and pharmaceuticals dispensed in the community. Then, analytical quantification procedures were developed and validated according to 2002/657/EC European directive. Sampling campaigns were performed in three different hospitals, two located in the Paris area and one in a medium-sized city 150 km from Paris. Sampling was also carried out in wastewater treatment plants. At the same time, in order to model the pharmaceutical loads from hospitals, predicted concentrations were calculated as a first approach assuming it would be a single-box model, i.e. hospitals have no effect on drug loads and only human metabolism is taken into account to evaluate the fraction of drugs eliminated in hospital effluent. In the last step, the comparison of measured and calculated concentrations showed a satisfactory correlation for some pharmaceuticals, mainly those with short elimination half-lives and weak human metabolism. For others, it appeared that modeling should take into account various factors such as out patient use, pharmacokinetic data and molecule stability in wastewater.

Muret, J., Matezak, M.-P. et Houle, M. (2017). "Le bloc opératoire durable." *Le Praticien en Anesthésie Réanimation* **21**(2): 98-101.

<https://www.sciencedirect.com/science/article/pii/S1279796017300414>

Résumé Cet article rapporte l'expérience de différents établissements de soins dans leur tentative d'améliorer l'impact de l'activité hospitalière de bloc opératoire sur l'environnement. Les actions entreprises vont du tri sélectif aux économies de papier, plastique, eau et électricité en passant par la réutilisation des déchets métalliques et l'éco-conception des soins au bloc opératoire.

Nicolay, S. (2020). Sustainable development and health system: inventory and avenues for improvement applied to medical devices. Bordeaux : Université de Bordeaux

<https://dumas.ccsd.cnrs.fr/dumas-02988294>

Le développement durable est devenu ces dernières années un enjeu majeur de notre société. L'activité humaine a non seulement des effets néfastes sur l'environnement et la biodiversité, mais aussi sur la santé publique, que ce soit par la favorisation des causes infectieuses ou les émissions de

polluants atmosphériques. Le système de santé français joue paradoxalement un rôle non négligeable dans cette crise, de par la consommation importante des établissements de santé en énergie, les milliers de tonnes de déchets engendrés par l'activité de soin chaque année, et un fonctionnement global compliquant toute démarche écologique. Le domaine des dispositifs médicaux (DM) n'est pas en reste, avec une production importante de déchets, et la nécessité de stériliser l'instrumentation par un processus énergivore. Face à cette incohérence, nous avons exploré deux axes d'amélioration potentielle : - l'optimisation des DM nécessaires à une intervention chirurgicale, par la mise en évidence des produits non utilisés en pratique réelle, - la comparaison des DM usage unique (UU) et usage multiple (UM) au regard de la littérature disponible. Alors que le choix « UU ou UM » se révèle plus complexe que prévu, avec un nombre important de paramètres demandant une décision au cas par cas, l'optimisation des DM au bloc opératoire semble être une piste prometteuse dans la démarche écologique, malgré une valorisation économique difficile à mettre en évidence. D'autres pistes restent à approfondir, comme la valorisation des déchets ou le retraitement de l'usage unique.

Parvy, P., Sigwalt, C., Roig, B., et al. (2009). "Les effluents liquides dans les établissements de santé : état des lieux et perspectives de gestion (II). Dossier." *Techniques Hospitalières*(715): 44-90.

[BDSP. Notice produite par EHESP CE9GR0xJ. Diffusion soumise à autorisation]. Ce numéro présente la deuxième partie des interventions du congrès sur les effluents liquides des établissements de santé qui s'est tenu à Chambéry le 26 et 27 novembre 2008 et qui avait pour objectif de faire le point sur les produits rejetés et retrouvés dans les effluents ainsi que sur les méthodes de traitement, à la source ou en station d'épuration. Les établissements de santé utilisent une grande variété de produits (antibiotiques, solvants, métaux lourds, radioéléments) mais aussi des produits d'hygiène et d'entretien, qui se retrouvent dans les eaux usées. Ces dernières peuvent également être chargées en micro-organismes. Tous ces produits se retrouvent au niveau de la station d'épuration qui, le plus souvent, met en oeuvre des processus microbiologiques de dégradation. L'efficacité de ces procédés sur la dégradation ou la rétention de ces produits est mal connue. Ces molécules peuvent se retrouver dans l'eau et dans les boues et, de fait, dans le milieu naturel. Le devenir des produits présents dans les rejets liquides des centres de soins voire du domicile de certains patients est une question émergente qui doit être abordée de manière coordonnée par les acteurs concernés. Après une première partie publiée dans le n° 714 de mars-avril 2009 qui établissait un état des lieux, cette deuxième partie présente les interventions relatives au traitement des effluents.

Perreau, S., Pauchard, J.-C. et Hafiani, E. M. (2021). "Intégration progressive du développement durable par les systèmes de santé." *Le Praticien en Anesthésie Réanimation* **25**(4): 167-174.

<https://www.sciencedirect.com/science/article/pii/S1279796021000838>

Résumé Les systèmes de santé sont responsables de presque 5 % des émissions de gaz à effet de serre. L'application des règles de développement durable dans le système de santé s'applique dans un contexte réglementaire. Quatre plans nationaux santé-environnement se sont succédés depuis 2004. Le dernier plan comprend quatre volets : mieux comprendre l'impact de l'environnement sur la santé – informer et former les professionnels – réduire les expositions – favoriser les initiatives locales. Depuis 2010, trois manuels de certification des hôpitaux ont intégré des critères relatifs à l'engagement durable. La Fédération Hospitalière de France a également publié des propositions pour soutenir la transition écologique des établissements de santé. L'état des lieux du DD d'un établissement de santé peut être apprécié grâce à l'Indicateur développement durable en santé, à l'outil « Mon observatoire du développement durable® » et piloté grâce aux normes ISO 14001, 26000 et 50001. La norme HQE s'applique également aux hôpitaux.

Perrin, P., Andrieux, L., Baures, E., et al. (2009). "Les effluents liquides dans les établissements de santé : état des lieux et perspectives de gestion (I). Dossier." *Techniques Hospitalières*(714): 12-66.

[BDSP. Notice produite par EHESP njJGFR0x. Diffusion soumise à autorisation]. Ce numéro présente la première partie des interventions du congrès sur les effluents liquides des établissements de santé qui s'est tenu à Chambéry le 26 et 27 novembre 2008 et qui avait pour objectif de faire le point sur les produits rejetés et retrouvés dans les effluents ainsi que sur les méthodes de traitement, à la source

ou en station d'épuration. En effet, les établissements de santé utilisent une grande variété de produits (antibiotiques, solvants, métaux lourds, radioéléments) mais aussi des produits d'hygiène et d'entretien, qui se retrouvent dans les eaux usées. Ces dernières peuvent également être chargées en micro-organismes. Tous ces produits se retrouvent au niveau de la station d'épuration qui, le plus souvent, met en oeuvre des processus microbiologiques de dégradation. L'efficacité de ces procédés sur la dégradation ou la rétention de ces produits est mal connue. Ces molécules peuvent se retrouver dans l'eau et dans les boues et, de fait, dans le milieu naturel. Le devenir des produits présents dans les rejets liquides des centres de soins voire du domicile de certains patients est une question émergente qui doit être abordée de manière coordonnée par les acteurs concernés. La première partie des interventions publiée dans ce numéro établit un état des lieux de la situation : nature des produits, résultats de prélèvements, culture des individus ou des institutions concernées en matière de pollution, évaluation des risques. La deuxième partie des interventions qui porte sur le traitement des effluents sera publiée dans le numéro n° 715 de mai-juin 2009.

Poitou, Q. (2020). Accélérer la transition écologique à l'hôpital : enjeux et défis. L'exemple du GHU AP-HP. Nord. Rennes : EHESP.

[https://documentation.ehesp.fr/memoires/2020/edh/quentin\\_poitou.pdf](https://documentation.ehesp.fr/memoires/2020/edh/quentin_poitou.pdf)

L'urgence climatique est déclarée par l'Union européenne : les accords de Paris n'étant pas suffisants pour maintenir la hausse des températures mondiales en deçà de 2°C, des mesures fortes sont attendues à la prochaine « COP 26 » de Glasgow. Dans ce contexte, les hôpitaux se trouvent dans une position paradoxale : ils en subissent les conséquences fortes pour la santé humaine et sont en partie à l'origine des causes du réchauffement climatique : environ 5% des émissions mondiales de gaz à effet de serre sont émises par le secteur de la santé. Les principaux postes d'émissions sont les approvisionnements, notamment de produits de santé et de produits alimentaires, les déplacements et l'énergie. En France, de nombreuses lois et plans visant à développer une politique de développement durable ont concerné les hôpitaux ces dernières années. Pourtant, l'application de ces politiques se révèle très inégale parmi les établissements de santé français : peu ont réalisé un bilan carbone ou un diagnostic de performance énergétique, pourtant prévus par la loi. Le fait que la politique de transition écologique dépende de la volonté d'un décideur plus ou moins « branché développement durable » est de plus en plus critiqué par les professionnels de santé. La transition écologique doit devenir une priorité des instances à l'hôpital et le référent développement durable doit être placé sous la responsabilité directe de la direction générale. Ces dernières années, l'AP-HP et son GHU Nord ont mené une politique volontariste dans les domaines de l'énergie et des mobilités durables, mais ont rencontrés de nombreux freins dans la mise en oeuvre d'une politique d'achats durables et de réduction des déchets plastiques. A la suite de la mesure 14 du Ségur de la santé, le ministère des solidarités et de la santé doit lancer un grand plan pour la transition écologique à l'hôpital, avec des objectifs précis, sur le modèle du NHS britannique. Le niveau national doit aussi relocaliser la production des produits de santé au niveau européen afin de diminuer l'empreinte carbone très forte de ce secteur. L'AP-HP et le GHU Nord doivent travailler sur leurs points faibles et ainsi lancer une politique d'alimentation durable et de réduction des déchets plastique. (R.A.)

Pouillaude, H. B. "Les marchés publics dans la transition écologique des établissements de santé et médico-sociaux. L'alignement des planètes (2021)." *Finances hospitalières*(161): 23-25.

Plusieurs planètes s'alignent en cette rentrée 2021 pour ancrer encore davantage l'hôpital dans le mouvement social et politique de la transition écologique : lancement de l'Observatoire du développement durable par l'ANAP, publication par la Haute Autorité de Santé d'un nouveau référentiel de certification, qui comprend désormais un critère relatif à la contribution de l'établissement aux enjeux du développement durable... Au titre de cette transition écologique, les contrats publics - marchés publics ; concessions ; autorisations d'occupation du domaine public, notamment - jouent un rôle central. La publication en septembre 2021 du guide des marchés publics de fournitures dans les industries de réseaux par le ministère de l'Economie, des Finances et de la Relance, donne l'occasion de faire un point sur l'évolution du droit des marchés applicables aux établissements de santé : inclusion de critères environnementaux et financement des marchés responsables.

Ressaux, P., Andrès, E. et Emmanuel, A. (2021). "Peut-on encore concevoir un système de santé moderne en dehors d'une démarche de développement durable ?" Cahiers Santé Médecine Thérapeutique **30**(6): 408-411. [http://www.jle.com/fr/revues/smt/e-docs/peut\\_on\\_encore\\_concevoir\\_un\\_systeme\\_de\\_sante\\_moderne\\_en\\_dehors\\_dune\\_demarche\\_de\\_developpement\\_durable\\_321750/article.phtml](http://www.jle.com/fr/revues/smt/e-docs/peut_on_encore_concevoir_un_systeme_de_sante_moderne_en_dehors_dune_demarche_de_developpement_durable_321750/article.phtml)

« Le développement durable est un mode de développement qui répond aux besoins du présent sans compromettre la capacité des générations futures de répondre aux leurs. » Défini par le rapport Brundtland de 1987 (du nom de la présidente de la Commission mondiale sur l'environnement et le développement), le développement durable s'applique désormais dans tous les secteurs d'activité [1]. Si la première pierre a été posée dans les établissements de santé par un amendement à la loi Ségur – lequel propose [...]

Roux, A. et Roques, V. (2015). "Hôpital et environnement. De l'indifférence à la cohérence ?" Gestions Hospitalières(550): 524-527

[BDSP. Notice produite par EHESP 9F9oDR0x. Diffusion soumise à autorisation]. L'environnement est un défi pour l'hôpital. Au moment de la Conférence de Paris sur le climat, l'heure est au bilan écologique pour les secteurs sanitaires et médico-social. Forts d'environ 6000 établissements sanitaires et 30 000 médico-sociaux, ils détiennent une empreinte écologique non négligeable. Longtemps pensés séparément, les enjeux sanitaires et écologiques doivent être abordés conjointement, suivant un principe de cohérence. Il s'agit d'affirmer clairement que des structures de soins ne sauraient participer aux pollutions et, donc, à l'augmentation des risques de pathologies liées. A l'approche de la COP21, perspectives pour un hôpital respectueux de l'environnement. (introd.).

Toma, O. (2012). Guide des pratiques vertueuses en développement durable des établissements sanitaires et sociaux. Amboise : C2DS

Le tour du monde du développement durable en santé.

<https://www.c2ds.eu/guide-des-pratiques-vertueuses-2012/>

Toma, O. (2010). Guide des pratiques vertueuses en développement durable des établissements sanitaires et sociaux. Amboise : C2DS

Europe-Etats Unis : Le tour du monde du développement durable en santé.

<https://www.c2ds.eu/guide-des-pratiques-vertueuses-2010/>

Touret, J. et Maes, C. (2008). "L'hôpital et le développement durable." Gestions Hospitalières(476): 340-351.

[BDSP. Notice produite par EHESP 8CsHR0xG. Diffusion soumise à autorisation]. L'Assistance publique-Hôpitaux de Paris organise régulièrement pour ses cadres des conférences intitulées "Rencontres du management". Celle du 27 septembre 2007 portait sur l'hôpital et le développement durable, ce dernier vocable signifiant que "les besoins des générations actuelles doivent être satisfaits, sans compromettre la capacité des générations futures à répondre aux leurs".

Valadaud, R., Gauthey, J., Soyer, M., et al. (2022). "Les médecins et les pharmaciens de ville peuvent-ils contribuer à la réduction à la source des résidus médicamenteux ? Une enquête sociologique auprès de ces professionnels de santé sur le territoire du bassin d'Arcachon en France." Environnement, Risques & Santé **21**(2): 137-148.

Des travaux ont mis en évidence la contamination et l'impact des résidus médicamenteux, et plus largement des produits de soins, sur les milieux aquatiques et le milieu marin. La réduction à la source des micropolluants d'origine pharmaceutique, liés à la consommation de médicaments ou à une mauvaise gestion des médicaments non utilisés, s'avère nécessaire. Au regard de leur rôle déterminant dans la consommation de médicaments, il est important de comprendre comment les

médecins et les pharmaciens appréhendent la problématique des micropolluants liés aux médicaments et comment ils intègrent, ou pensent pouvoir intégrer, cet enjeu dans leurs pratiques de prescription et de délivrance de médicaments. Sur la base d'une enquête sociologique qualitative auprès de médecins et de pharmaciens de ville du bassin d'Arcachon, cet article montre la faible « préhension » de l'enjeu des micropolluants liés aux médicaments par ces professionnels, que ce soit en termes de représentations ou d'intégration de l'enjeu dans leurs logiques de prescription, de conseils et de délivrances de médicaments aux patients et/ou aux consommateurs. Les contraintes et les déterminants (économiques, sociologiques, organisationnels, symboliques et culturels, etc.) qui structurent les relations médecin-patient et pharmacien-patient-consommateur en France n'apparaissent pas propices à une réduction de la consommation de médicaments, qu'ils soient prescrits ou autoconsommés. En dépit de représentations et pratiques professionnelles différentes, pour tous les médecins et pharmaciens interrogés, les enjeux de santé (bénéfice-risque pour le patient ou le consommateur) demeurent toujours prioritaires sur les objectifs de préservation de la biodiversité. Cela étant, des professionnels enquêtés soulignent l'existence de marges de manœuvre pour « optimiser » la consommation de médicaments. Une relation médecin-patient moins contrainte par le temps et moins organisée autour de la prescription de médicaments, et une relation pharmacien-médecin-consommateur où les pharmaciens ont un rôle plus reconnu et actif dans la gestion des traitements médicamenteux des individus, semblent des pistes intéressantes pour réduire les micropolluants médicamenteux à la source sans compromettre l'atteinte des objectifs de santé. Dans ce cadre, notre analyse montre que l'action publique devra accompagner l'écologisation des pratiques des professionnels de santé, à commencer par les informer et les former davantage sur les risques environnementaux et potentiellement sanitaires liés à l'abondante consommation de médicaments. D'autres leviers et outils devront aider les professionnels à intégrer davantage les enjeux de préservation du vivant dans leurs logiques professionnelles.

Vincent, G. (2009). "Développement durable : valeurs et stratégies hospitalières." Techniques Hospitalières(714): 10-11.

[BDSP. Notice produite par EHESP sPROxCEp. Diffusion soumise à autorisation]. "Manager le développement durable en établissement de santé" est un nouveau programme d'actions destiné à mettre en oeuvre le Grenelle de l'environnement à l'hôpital. Parrainé par l'Agence de l'environnement et de la maîtrise de l'énergie, il est mis en place avec la Fédération hospitalière de France, la Fédération des établissements hospitaliers et d'aide à la personne et les élèves directeurs de l'Ecole des hautes études en santé publique. Ces derniers ont élaboré un baromètre de développement durable permettant d'établir une photographie de la réalité dans plus de 1600 hôpitaux.

Vogel, M. Protéger et accompagner les individus en construisant la Sécurité sociale écologique du XXI<sup>e</sup> siècle. Paris Sénat: 10p.

<http://www.senat.fr/notice-rapport/2021/r21-594-notice.html>

Le Sénat a créé une mission d'information sur le thème "Protéger et accompagner les individus en construisant la sécurité sociale écologique du XXI<sup>e</sup> siècle", à la demande du Groupe Écologiste - Solidarité et Territoires. Ce rapport présente les conclusions de la mission. Il rassemble 48 propositions.

## Lu dans la presse

- 01/02/2022** - L'OMS s'inquiète de la quantité de déchets médicaux générés pendant la pandémie de Covid-19 > [Les tonnes de déchets des activités de soins liées à la Covid-19 montrent qu'il est urgent d'améliorer les systèmes de gestion des déchets](#) - Communiqué de presse de l'OMS, 1er février 2022
- > [Analyse mondiale des déchets des activités de soins dans le contexte de la COVID-19 : état, conséquences et recommandations](#) (en anglais) - Organisation mondiale de la santé (OMS), 1er février 2022
- > [Masques, gants, kits de tests... Les déchets médicaux liés au Covid inquiètent l'OMS](#) - Libération, 1er février 2022, Libération avec AFP

**07/02/2022** - Au CH de Lannion, le bloc adopte des tenues en fibres de bois et polymère biodégradable Fini le coton. Pendant au moins un an, et peut-être plus si l'essai s'avère concluant, la trentaine de médecins et paramédicaux du bloc opératoire de l'hôpital de Lannion en Bretagne vont porter des casaques, pantalons et charlottes écoresponsables.

> [Hospimédia, 7 février 2022 \(Accès abonnés\)](#)

**24/02/2022** - À Tours, les futurs généralistes veulent construire un exercice plus vert et inclusif

> [Egora, 24 février 2022](#)

**28 /02/2022** – 6e rapport du Giec (Groupe intergouvernemental d'experts sur l'évolution du climat) Rapport 2022. 2<sup>e</sup> volet : une nouvelle alerte sur le réchauffement climatique.

> [Vie publique, 1<sup>er</sup> mars 2022](#)

> [Site des Nations Unis, 28 février 2022](#)

**02/2022** – La transition énergétique à l'heure des choix (Pierre Papon)

> [Futuribles, n° 447, 2022/02](#)

**07/03/2022** – Ecomaternité : l'ARS Île-de-France met en place un programme territorial de maternités écoresponsables initié avec l'AP-HP.

> [ARS-Ile-de-France](#)

> [Hospimédia, 11 mars 2022 \(Accès abonnés\)](#)

**03/2022** – Rapport de l'Onerc (Observatoire national sur les effets du réchauffement climatique)

[La prospective au service de l'adaptation au changement climatique. Rapport au Premier ministre et au Parlement](#)

**09/2022** – [Rapport de l'Ademe](#) (Agence de la transition écologique)

Cette étude présente quatre scénarii de transition énergétique vers la neutralité carbone pour la France d'ici 2050. Un premier scénario, intitulé "Génération frugale", vise une consommation énergétique totale de 790 TWh/an, contre 1 600 aujourd'hui, soit une consommation divisée par deux. Il s'appuie sur un ensemble composé à 97% d'énergies renouvelables, sans prolongement de réacteurs nucléaires existants. Cette hypothèse nécessiterait un investissement d'un peu plus de 1 000 Md€. À l'opposé, le quatrième scénario, ou "Pari réparateur", se veut moins axé sur la flexibilité pour satisfaire une consommation électrique similaire à aujourd'hui (840 TWh/an). Dans cette hypothèse, les sources d'énergie renouvelables seraient renforcées et le développement des centrales nucléaires serait envisagé. Ce scénario est le plus coûteux des quatre avec un besoin d'investissement de plus de 1 500 Md€. Deux scénarii intermédiaires sont également envisagés : l'un, scénario de réduction du prix de l'électricité en s'appuyant sur les énergies renouvelables ; l'autre fondé sur une électrification massive des usages et un fort recours à l'efficacité énergétique.

**04/2022** – 6<sup>e</sup> rapport du Giec. 3<sup>e</sup> volet : Diviser les émissions de gaz à effet de serre par deux d'ici à 2030, c'est possible.

Clôture de la trilogie ouverte en août 2021 – avec son rapport sur la « science du changement climatique » suivi en mars 2022 par celui sur les « impacts et adaptation » –, le Giec (Groupement intergouvernemental sur l'étude du climat) rend public ce lundi 4 avril 2022 son nouveau rapport sur l'« atténuation ». Initiée en 2018, cette somme signée par 278 scientifiques du monde entier dresse l'état des connaissances scientifiques sur les options de réduction des émissions (« l'atténuation » du titre) de gaz à effet de serre.

> [The Conversation, 4 avril 2022](#)

> [Site du Giec](#)

**02/05/2022** – Débat : « Un système de santé décarboné » (replay)

Frédéric Collet a participé, à l'occasion de la 13<sup>ème</sup> Convention on Health Analysis and Management, à un débat sur le thème de la décarbonisation du système de santé.

> [Site du Leem](#)

**03/05/2022** – Le verdissement des systèmes de santé, une question de cohérence

Québec - Le plus grand centre hospitalier du Québec (le Chum) a installé de nouvelles stations anesthésiques qui réduisent au maximum les fuites de gaz. Le centre hospitalier utilise pour cela des agents anesthésiques qui émettent moins de GES. Il existe d'autres options à l'anesthésie au gaz. Il est possible d'utiliser des produits intraveineux avec des pompes de précision qui ont un effet anesthésiant équivalent voire meilleur. Qui plus est, les patients auraient moins de nausées au réveil. Avec ces changements, le département d'anesthésie s'attend à réduire ses émissions de gaz à effet de serre de 3 500 tonnes en 2017 à 150 tonnes dès 2023. Déjà la facture s'allège : les coûts des gaz anesthésiques pour le CHUM sont passés de 532 000 dollars canadiens en 2017 à 106 000 dollars en 2022. À la suite d'un premier bilan, une série de mesures a été proposée, parmi lesquelles : s'éloigner des énergies fossiles pour le chauffage et le transport, réduire l'utilisation des objets et outils jetables et, lorsque cela s'avère possible, les remplacer par des instruments réutilisables, et développer la valorisation des matières résiduelles (réduire, recycler et composter).

> [lci.radio-canada-ges](http://lci.radio-canada-ges)

**18/05/2022** - Premiers résultats du Bilan Carbone® de l'AP-HP sur l'ensemble de ses activités

L'AP-HP a mis en place une mesure de l'empreinte carbone sur l'ensemble de ses activités et sur des parcours de patients.

> [Site de l'AP-HP](#)

**24/05/2022** – Rapport du Cese (Conseil économique, social et environnemental)

Pour une politique publique nationale de santé environnement au cœur des territoires

> [Site du Cese](#)

**31/05/2022** – L'augmentation du coût de l'énergie amène les établissements vers une gestion responsable Face à l'augmentation des prix de l'énergie mais aussi des nouvelles réglementations en matière de réduction de l'impact environnemental, les établissements de santé sont amenés à analyser leur consommation et à trouver des alternatives. Le Comité pour le développement durable en santé (C2DS) rappelle ainsi dans un communiqué les mesures déjà entreprises par certains CH et cliniques pour réduire à la fois leur facture et leur empreinte carbone. "*L'heure n'est plus à la transition mais à la transformation rapide, les marges d'amélioration [étant] importantes et à portée*", estime-t-il.

> [Hospimédia, 31 mai 2022 \(Accès abonnés\)](#)

**14/06/2022** - Les fabricants d'antibiotiques veulent s'imposer des normes environnementales

> [Envir2b, 14 juin 2022](#)

**13/07/2022** - Les établissements engagent peu d'initiatives de réduction à la source de leurs déchets

Les flux de déchets principaux sont très diversement triés en établissement. Dans un baromètre, l'entreprise Take a Waste constate en outre que les initiatives pour réduire à la source les déchets sont encore peu nombreuses. Or les coûts de gestion vont continuer d'augmenter dans les années à venir.

> [Hospimédia, 13 juillet 2022 \(Accès abonnés\)](#)

> [Site de Takewaste](#)

**07/2022** - La branche AT/MP, mise au défi de la neutralité carbone.

Première partie. Christophe Willmann. Droit social, n° 6, juin 2022, p. 546 à 555

Seconde partie. Christophe Willmann. Droit social, n° 7-8, juillet 2022, p. 653 à 660.

La France s'est fixé l'objectif d'atteindre la neutralité carbone en 2050. Dans quelle mesure la branche AT peut-elle y contribuer ? Elle peut, d'abord, infléchir sa politique de réparation des AT/MP, en privilégiant par exemple les accidents de trajet dont le trajet aurait respecté des priorités environnementales ou par une politique de prévention des AT/MP inscrite dans la transition écologique. La branche AT/MP peut, ensuite, mobiliser des leviers financiers, spécialement au titre de la tarification, pour inciter les employeurs écoresponsables (ou au contraire, les punir).

**13/09/2022** - Elsan lance "Green blocs" pour limiter l'impact environnemental de l'activité chirurgicale.

Un programme baptisé "Green blocs" est lancé par le groupe d'hospitalisation privé Elsan. Il s'agit de promouvoir dans les blocs opératoires de ses établissements "des processus et des choix d'organisation plus respectueux" de l'environnement, incluant notamment une réduction des déchets et de la consommation de certains gaz anesthésiques.

> [Hospimédia, 13 septembre 2022 \(Accès abonnés\)](#)

**29/09/2022** - La dangerosité des fumées chirurgicales mérite une nouvelle réglementation. Une journée de travail sans aspiration au bloc opératoire équivaut à fumer un paquet de cigarettes. Cette image est lourde de sens, pourtant le sujet des fumées chirurgicales n'est à ce jour pas consensuel. La mobilisation s'organise.

> [Hospimédia, 29 septembre 2022 \(Accès abonnés\)](#)

**04/11/2022** - Quand l'hôpital devient plus écolo : « C'est bénéfique aussi pour la santé »  
Pour le professeur Patrick Pessaux, président du Collectif écoresponsabilité en santé (Cérès), il y a urgence à rendre plus verts nos hôpitaux. Si cela permet de réaliser des économies, il en va du bien-être de la planète mais aussi... de la santé des patients eux-mêmes.

> [Le Parisien, 4 novembre 2022 \(Accès abonnés\)](#)

**12/11/2022** - Ces anesthésistes qui tentent de réduire leur empreinte sur le climat

> [Le Quotidien du médecin, 12 novembre 2022](#)

**16/11/2022** - Comment évoluer du bionettoyage à l'éconettoyage ?

Les alternatives à l'utilisation de produits chimiques se développent pour le nettoyage des locaux des établissements sanitaires et médico-sociaux. Certains points demandent cependant d'être vigilants pour maîtriser la prolifération des bactéries

> [Hospimédia, 16 novembre 2022 \(Accès abonnés\)](#)

**29/11/2022** - Hospimedia lance son podcast sur les actions des établissements pour réduire leur impact sur l'environnement. Pour ce quatrième épisode, Hospimedia s'est rendu au CHU de Strasbourg où s'est lancé un projet de green bloc avec une variété d'actions.

> [Hospimédia, 29 novembre 2022 \(Accès abonnés\)](#)

**27/11/2022** - La France ne sera pas une nation verte tant que son système de santé ne sera pas durable

> [Le Monde, 27 novembre 2022](#)

**12/2022** : Transition écologique : obligations des hôpitaux et ESMS publics concernant les mobilités

> [Note juridique de la Fédération Hospitalière de France \(FHF\)](#)

**11/01/2023** - Comment procéder à la rénovation énergétique de l'éclairage de ses bâtiments ?

> [Hospimédia, 11 janvier 2023 \(Accès abonnés\)](#)

**19/01/2023** – Les hôpitaux français amorcent leur transition verte

Leur mission est d'accompagner les établissements de santé et médico-sociaux "dans l'élaboration et la mise en œuvre d'une gestion planifiée de l'énergie" avec à la clé des actions qui permettront notamment de calculer et de suivre leurs consommations, d'effectuer des bilans d'émissions de gaz à effet de serre, d'améliorer l'efficacité énergétique des bâtiments et leur confort hygrothermique, de limiter les pollutions, etc.

> [Le Monde, 19 janvier 2023](#)

**20/01/2023** - "Il y a pour l'instant peu d'actions concrètes pour la transformation écologique du système de santé"

Tout comme chez les soignants, des initiatives écologiques existent chez les responsables sanitaires. La preuve avec Raphaël Yven, directeur d'hôpital et cofondateur du réseau «Le Lierre», qui fédère les professionnels de la haute administration engagés pour le climat.

> [Egora, 20 janvier 2023](#)

**20/01/2023** -10 bonnes résolutions pour un cabinet écoresponsable

> [Egora, 20 janvier 2023](#)

**20/01/2023** - Green Data for Health : Mobilisation des bases de données environnementales et de santé



Le Green Data For Health (GD4H) et le Health Data Hub (HDH) ont lancé un appel à projets commun afin d'améliorer la mobilisation des bases de données environnementales et de santé au service des projets de recherche et d'innovation.

> [Site du ministère chargé de l'écologie](#)

**8/02/2023** - La santé environnementale reste une notion (trop) rare dans la formation des futurs médecins. Face à l'urgence climatique et environnementale, des universitaires alertent sur la nécessité de former les futurs médecins à cette problématique. Un module national sur la santé environnementale vient d'être créé pour épauler les facultés. Cette notion reste encore peu abordée malgré une volonté de basculer vers un système plus préventif.

> [Hospimédia, 8 février 2023 \(Accès abonnés\)](#)

> [Ministère de l'Enseignement \(Rapport Jean Jouzel\)](#)

**12/02/2023** - Antibiotiques, antidépresseurs... Absorbons-nous des résidus de médicaments sans le savoir ?

> [The Conversation, 12 février 2023](#)

**23/02/2023** - Le système de santé émettrait 8% des émissions françaises de gaz à effet de serre. Le conseil scientifique de la Société française du cancer a organisé un webinaire le 21 février sur l'empreinte écologique des systèmes de santé. Transports, énergie, bâtiments, gestion des déchets, Dr Jane Muret dresse un état des lieux.

> [Hospimédia, 23 février 2023 \(Accès abonnés\)](#)

> [The Lancet countdown, 5 novembre 2022](#)

> [Rapport du Shift project 2021](#)

**02/02/2023** - Tri, collecte, recyclage, énergie... : le pharmacien, acteur de l'écologie

L'écoresponsabilité est entrée progressivement dans l'exercice quotidien des pharmaciens au fil des années, elle est devenue un objectif majeur depuis l'entrée en vigueur de la convention pharmaceutique du 9 mars 2022. Un texte qui fait du pharmacien un véritable « acteur de l'écologie », pour la collecte des déchets d'activité de soins à risque infectieux mais pas seulement...

> [Le Quotidien du pharmacien, 2 mars 2023](#)

> [Convention du 9 mars 2022](#)

**10/03/2023** - « La révolution verte ne fait que commencer à l'hôpital » : entretien avec le Pr Laurent Zielekiewicz, comité de pilotage « green » de l'AP-HM

> [Le Quotidien du médecin, n° 9976, 10 mars 2023, p. 14-15](#)

**21/03/2023** - Le Shift project dévoile une étude actualisée de l'empreinte carbone de la santé qui représente toujours en moyenne 8% du total national. Le périmètre d'étude est élargi et des changements sont notables selon les postes d'émissions.

> [Hospimédia, 21 mars 2023](#)

**21/03/2023** - Publication du 6e rapport de synthèse du GIEC

> [Site du ministère chargé de l'écologie](#)

> [Vie publique](#)

> [RéseauActionClimat](#)

**03/2023** – Une feuille de route sur la soutenabilité environnementale du système de santé est en préparation au ministère chargé de la santé (DGOS) avec la collaboration de la Cnam, de l'Anap... Publication prévue en mai 2023.

**28/03/2023** - Les ingénieurs hospitaliers prennent leur responsabilité quant à la sobriété énergétique. Il est de la responsabilité des ingénieurs hospitaliers de participer à la protection du climat. En attendant le décret qui fixera de manière aboutie l'objectif de réduction énergétique, le président de l'IHF invite à accumuler les actions.

> [Hospimédia, 28 mars 2023 \(Accès abonnés\)](#)

**27/03/2023** : la CNSA et l'EN3S lancent une étude sur la décarbonation de la branche autonomie avec The Shift project

> [Site de la CNSA](#)

**23/05/2023** : Le Gouvernement s'attèle au verdissement de la santé et des produits de santé Transition énergétique, produits de santé, valorisation des déchets, pratiques de soins, formation et recherche, transports durables, numérique vert... Le Gouvernement présente une feuille de route de planification écologique pour le système de santé avec sept axes assortis d'objectifs. Une attention particulière est portée aux produits de santé.

> [Site du ministère chargé de la santé](#)

> [Hospimédia, 23 mai 2023 \(Accès abonnés\)](#)

**30/05/2023** : Le changement climatique doit être pris en compte dans la construction et la rénovation des bâtiments de santé

> [Hospimédia, 30 mai 2023 \(Accès abonnés\)](#)

**06/2023** : Note du Comité 21 sur le programme d'adaptation aux changements climatiques

> [Comité 21](#)

**8/06/2023** : Climat, biodiversité et santé : décarboner les parcours

> [Pharmaceutiques](#)

**26/07/2023** : National Incentives to Promote Health Care Climate Action

> [The Commonwealth Fund](#)

**19/08/2023** : La « lente révolution verte » du médicament

> [Le Monde, 17 août 2023](#)

**21/09/2023** : Une certification haute qualité environnementale des bâtiments de santé est lancée Coconstruite depuis dix-huit mois, une nouvelle certification HQE des bâtiments des établissements de santé et médico-sociaux est proposée par Certivea. Elle concerne autant la construction et la rénovation que l'exploitation des structures.

> [Hospimédia, 21 septembre 2023 \(Accès abonnés\)](#)

**26/09/2023** : Rapports du Shift project sur la branche autonomie

• [Climat : décarbonons le secteur de l'autonomie | Rapport intermédiaire complet](#) - The shift project, 26 septembre 2023

• [Planification écologique : quel impact carbone pour la branche Autonomie ? | Rapport intermédiaire spécial évaluant l'impact carbone de l'Autonomie](#) - The shift project, 26 septembre 2023

**5/10/2023** : Le grand public demande plus de transparence sur l'empreinte carbone des médicaments (Pharmaphorum)

Selon une enquête menée par YewMaker, une organisation à but non lucratif qui plaide pour des médicaments plus durables, 84% des personnes interrogées aux États-Unis, au Royaume-Uni, en France et en Australie sont favorables à une obligation de divulgation de l'empreinte carbone des médicaments.

> [Décarbonation des systèmes de santé : faut-il en faire une priorité ?](#) - Forbes, 2 octobre 2023, Loick Menvielle

**6/10/2023** : Les initiatives d'hôpitaux se multiplient pour réduire l'empreinte des produits de santé L'Agence nationale d'appui à la performance recense les bonnes pratiques organisationnelles en matière de réduction de l'impact environnemental des produits de santé. L'usage de dispositifs réutilisables, l'arrêt de certains gaz ou l'amélioration des filières de tri se déploient dans les établissements de santé.

> [Hospimédia, 6 octobre 2023 \(Accès abonnés\)](#)

**9/10/2023** : L'équation parfaite pour financer la transition écologique n'existe pas

Les investissements des établissements de santé n'étant pas extensibles, la transition écologique fait l'objet d'arbitrage. Sans appui financier, il leur sera néanmoins difficile de répondre aux objectifs ambitieux de la planification écologique.

> [Hospimédia, 9 octobre 2023 \(Accès abonnés\)](#)

**11/10/2023** : Comprendre pour mieux agir : la Sécu s'engage pour le climat

> [Ucanss sur Youtube, vidéo, 1h37](#)

**9/11/2023** : Un premier accord dans la branche pharmaceutique confirme son engagement pour la transition écologique

> [Le secteur pharmaceutique confirme son engagement pour la transition industrielle en signant le 1er accord de branche](#) - Communiqué de presse du Leem

**15/11/2023** : L'OMS suggère la mise en place de systèmes de santé à faibles émissions de carbone

L'Organisation mondiale de la Santé (OMS) a récemment dévoilé un Cadre opérationnel destiné à guider la mise en place de systèmes de santé à faibles émissions de carbone et résilients face aux changements climatiques. Ce Cadre, présenté en prévision de la prochaine Convention-cadre des Nations Unies sur les changements climatiques (COP-28), poursuit deux objectifs : Renforcer la résilience des systèmes de santé ; Réduire les émissions de gaz à effet de serre. Le Dr Tedros Adhanom Ghebreyesus, directeur général de l'OMS, offre ainsi aux États une feuille de route pour atteindre les deux objectifs suscités.

Face à l'augmentation mondiale des températures et des phénomènes météorologiques

> [L'OMS présente un Cadre pour la mise en place de systèmes de santé à faibles émissions de carbone et résilients face aux changements climatiques](#) - Communiqué de presse de l'OMS, 9 novembre 2023

> [Cadre opérationnel pour renforcer la résilience des systèmes de santé face au changement climatique](#) - OMS, rapport, 2016

**27/11/2023** : La FHF a publié un recueil de 50 propositions pour engager la transformation écologique du système de santé. Les leviers identifiés couvrent de nombreux postes (achats, alimentation, dispositifs médicaux, déchets...). Une partie des établissements de la fédération - les établissements de santé publics - ne bénéficient pas des financements nécessaires pour atteindre les objectifs.

> [Communiqué de presse de la Fédération hospitalière de France \(FHF\), 27 novembre 2023](#)

**28/11/2023** : Marguerite Cazeneuve, directrice déléguée de l'Assurance-maladie, annonce la création d'une Mission nationale pour la Transition écologique du système de santé et la santé environnementale. Une des priorités de la nouvelle mission créée par l'Assurance maladie : La réduction de l'empreinte carbone du médicament grâce à une nouvelle méthode d'évaluation. De son côté, l'industrie pharmaceutique a déjà posé de premiers jalons et prépare un changement de paradigme associant transition écologique et responsabilité sociétale.

> [Linkedin](#)

> [Hospimédia, 28 novembre 2023 \(Accès abonnés\)](#)

> [Site d'Ameli](#)

> [COG 2023-2027 : les 6 grands objectifs](#)

**28/11/2023** : la HAS adopte la feuille de route santé environnement.

> [Site de la HAS](#)

**07/12/2023** : Le 3 décembre avait lieu à Dubaï la première "Journée de la santé" organisée dans le cadre d'une Cop, conférence de l'Organisation des nations unies (Onu) sur le climat. La veille, 123 pays avaient signé une déclaration sur le climat et la santé de la Cop 28. Ce texte reconnaît la nécessité pour les gouvernements de protéger les communautés et de préparer les systèmes de santé à affronter les conséquences sanitaires liées au climat (chaleurs extrêmes, pollution de l'air et maladies infectieuses).

> Effets du changement climatique sur la santé et action numérique verte au menu de la Cop 28 - Onu Info, 2 décembre 2023

> Over 40 million health professionals demand bold health and climate action at Cop 28 - OMS, 2 décembre 2023 (en anglais)

**15/12/2023** : Planification écologique du système de santé : 2ème réunion du comité de pilotage national  
> [Site du ministère de la Santé et de la Prévention](#)

**18/01/2024** : Le directeur général de la Cnam Thomas Fatôme annonce la mise en place d'un comité de pilotage Cnam-réseau. Ce comité abordera chaque trimestre les sujets liés à la transition écologique du système de santé.  
> [Linkedin](#)

## Pour aller plus loin

### DOSSIERS DOCUMENTAIRES

Calvez, C. (2022). Développement durable et RSE en établissement sanitaire et médicosocial Dossier documentaire.  
<https://documentation.ehesp.fr/ajax.php?module=cms&categ=document&action=render&id=645>

Marchand, S. (2022). Construire l'action publique face à l'urgence écologique : Sélection bibliographique  
<https://documentation.ehesp.fr/ajax.php?module=cms&categ=document&action=render&id=640>

Garlantezec, R. et Migeot, V. (2022). "La santé-environnement : des constats aux actions." Horizon Pluriel(38): 20.  
<https://irepsbretagne.fr/horizon-pluriel/horizon-pluriel-n38/>

Les inégalités environnementales et la santé : mieux comprendre les liens pour mieux agir.  
Lyon : Iresp Auvergne Rhône-Alpes - 2023/01  
<https://ireps-ara.org/portail/portail.asp>

Fnors

Environnement, un déterminant pour la santé Indicateurs territoriaux  
> [Site de la Fnors](#)

Vie publique

Neutralité carbone, adaptation...La politique de la France face au changement climatique – 2024/02/22  
<https://www.vie-publique.fr/eclairage/19383-snbc-ppe-pnacc-la-politique-climatique-de-la-france>

### ORGANISMES RESSOURCES

#### Organismes gouvernementaux

ANSES - Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail

ADEME - Agence de l'Environnement et de la Maîtrise de l'Énergie - Changement climatique - transition écologique, énergétique

ANAP - Agence nationale d'appui à la performance

ANSM – Agence nationale de sécurité du médicament et des produits de santé

ARS – Agence régionale de santé

CESE - Conseil économique social et environnemental

CGDD – Commissariat général du développement durable

Pôle documentation de l'Irdes – Marie-Odile Safon, Véronique Suhard

[www.irdes.fr/documentation/syntheses-et-dossiers-bibliographiques.html](http://www.irdes.fr/documentation/syntheses-et-dossiers-bibliographiques.html)

<https://www.irdes.fr/documentation/syntheses/la-soutenabilite-environnementale-des-systemes-de-sante.pdf>

[www.irdes.fr/documentation/syntheses%20la-soutenabilite-environnementale-des-systemes-de-sante.epub](http://www.irdes.fr/documentation/syntheses%20la-soutenabilite-environnementale-des-systemes-de-sante.epub)

CNIS – Conseil national de l’investissement en santé

CNTE – Conseil national de la transition écologique

DRIEAT – Direction régionale et interdépartementale de l’environnement, de l’Aménagement et des transports

HAS – Haute Autorité de santé

HCC – Haut Conseil pour le climat

IRSET- Institut de recherche en santé, environnement et travail

Ministère de la Transition écologique et de la cohésion des territoires

Ministère de la transition énergétique

ONERC – Observatoire national sur les effets du réchauffement climatique

Portail [notre-environnement.gouv.fr](http://notre-environnement.gouv.fr)

SPF - Santé publique France

#### Organismes non gouvernementaux et associations

APCC - Climat – Association des professionnels en conseil climat énergie et environnement

Cérès - Collectif écoresponsabilité en santé

Comité 21

C2DS – Comité pour le développement durable en santé

A cette adresse : <https://www.c2ds.eu/category/nouvelles/memoires-du/> : les mémoires des étudiants du diplôme universitaire *Management du DD en santé* accessible uniquement aux adhérents.

Toutes les publications de cet organisme peuvent être consultées ici : <https://www.c2ds.eu/publications/>

IHF – Association des ingénieurs hospitaliers

#### Instituts de recherche

EHESP – Ecole des hautes études en santé publique

Chaire Résilience en santé, prévention, environnement, climat et transition

INEE – Institut écologie et environnement