

## Environmental Stewardship Resource Desk

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### New Research

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#### COVID-19

- 1. Healthcare waste management assessment: Challenges for hospitals in COVID-19 pandemic times.** de Aguiar Hugo A, Lima RDS. Waste Manag Res. 2021 Apr 12:734242X211010362. doi: 10.1177/0734242X211010362. Online ahead of print.  
<https://journals.sagepub.com/doi/full/10.1177/0734242X211010362>  
With the spread of the new Coronavirus, there was an increase in the generation of contaminated waste. Thus, healthcare waste management (HCWM) became even a greater challenge in hospitals due to Coronavirus easily spread. In this context, it was necessary to create tools that could aid healthcare facilities in evaluating their HCWM. Therefore, the objective of this article was to elaborate a support tool that helps in identifying the shortcomings of hospitals' HCWM. For this purpose, the Health Service Waste Management Index was developed based on the selection of indicators in the area. The index was applied to six hospitals in the state of Minas Gerais, Brazil. Its application meet the purpose of this research, since the results in the form of an index objectively summarize the reality of the HCWM in healthcare facilities. From the six hospitals investigated, four were classified as highly efficient. However, even though most of them were well evaluated, they still have difficulties with properly training their employees, which can be even a worse problem during a pandemic, when every precaution is extremely important to reduce the spread of the disease. Therefore, beyond this article contribution related to sustainability by demanding the hospitals to check which points of HCWM should be improved, it also adds academically by developing a tool with indicators that evaluate operational, human, economic and environmental factors in an innovative way.
- 2. Pandemic meets pollution: Poor air quality increases deaths by COVID-19.** Isphording IE, Pestel N. J Environ Econ Manage. 2021 Apr 8:102448. doi: 10.1016/j.jeem.2021.102448. Online ahead of print.  
<https://www.sciencedirect.com/science/article/pii/S0095069621000310>

We study the impact of short-term exposure to ambient air pollution on the spread and severity of COVID-19 in Germany. We combine data at the county-by-day level on confirmed cases and deaths with information on local air quality and weather conditions. Following Deryugina et al. (2019), we instrument short-term variation in local concentrations of particulate matter (PM10) by region-specific daily variation in wind directions. We find significant positive effects of PM10 concentration on death numbers from four days before to ten days after the onset of symptoms. Specifically, for elderly patients (80+ years) an increase in ambient PM10 concentration by one standard deviation between two and four days after developing symptoms increases the number of deaths by 19 percent of a standard deviation. In addition, higher levels air pollution raise the number of confirmed cases of COVID-19 for all age groups. The timing of effects surrounding the onset of illness suggests that air pollution affects the severity of already-realized infections. We discuss the implications of our results for immediate policy levers to reduce the exposure and level of ambient air pollution, as well as for cost-benefit considerations of policies aiming at sustainable longer-term reductions of pollution levels.

3. **Building up an ecologically sustainable and socially desirable post-COVID-19 future.** Duflot R, Baumeister S, Burgas D, Eyvindson K, Triviño M, Blattert C, Kuparinen A, Potterf M. *Sustain Sci.* 2021 Apr 5:1-7. doi: 10.1007/s11625-021-00940-z. Online ahead of print. <https://link.springer.com/article/10.1007/s11625-021-00940-z>  
COVID-19 crisis has emphasized how poorly prepared humanity is to cope with global disasters. However, this crisis also offers a unique opportunity to move towards a more sustainable and equitable future. Here, we identify the underlying environmental, social, and economic chronic causes of the COVID-19 crisis. We argue in favour of a holistic view to initiate a socio-economic transition to improve the prospects for global sustainability and human well-being. Alternative approaches to "Business-As-Usual" for guiding the transition are already available for implementation. Yet, to ensure a successful and just transition, we need to change our priorities towards environmental integrity and well-being. This necessarily means environmental justice, a different worldview and a closer relationship with nature.
4. **Climate change risk communication: a vaccine hesitancy perspective.** Paterson P, Clarke RM. *Lancet Planet Health.* 2021 Apr;5(4):e179-e180. doi: 10.1016/S2542-5196(21)00027-9. [https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196\(21\)00027-9/fulltext](https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(21)00027-9/fulltext)  
Late last year in 2020, the UK government announced their ten point plan for a green industrial revolution.<sup>1</sup> It is excellent to see the government moving towards the UK's goal of net-zero carbon emissions by 2050, focusing on sustainable energy, protecting our natural environment, and increasing green public transport, cycling and walking. However, the success of any net-zero carbon emissions strategy is contingent on public co-operation and support. The human complexities around rapid societal change is something the government has become well acquainted with over the past year with the COVID-19 pandemic. If the government want to fulfil the largely technological, green revolution they have planned, they would do well to pay attention and take notes in the coming months as they try to encourage a fatigued and nervous public to take a COVID-19 vaccine. As experts in vaccine hesitancy, we provide three key lessons

in risk communication that are needed to successfully maintain public support for policies designed to quickly and substantially cut carbon emissions.

5. **Environmental Earth Sciences Progress Report 2020 and Outlook 2021.** Kolditz O, Teti P, Dörhöfer G, LaMoreaux J, Andriani GF, Appleyard S, Asch T, Buttafuoco G, Dietrich P, Hursthouse A, Kim D, Merkel BJ, Schwarzbauer J, Siegesmund S, Kolditz B. *Environ Earth Sci.* 2021;80(8):314. doi: 10.1007/s12665-021-09531-8. Epub 2021 Apr 9. <https://link.springer.com/article/10.1007/s12665-021-09531-8>

The present editorial 2020 continues the series of status reports in Environmental Earth Sciences (EES) in previous years 2017 and 2019 (Kolditz et al. in *Environ Earth Sci* 77: 8, 2018, Kolditz et al. in *Environ Earth Sci* 79: 11, 2020). The year 2020 coming to an end was heavily influenced by the COVID-19 pandemic affecting all areas of life including research work and, therefore, scientific publishing as well ("Introduction"). One bright spot which shows longevity of journals that produce a quality product is that Environmental Earth Sciences (EES) is celebrating its 45th anniversary of publication. To this extent EES continues the tradition to honor the most cited papers contributing to the 2020 Impact Factor (IF) ("Highly and most cited topics") and provide information on the current status of EES as well as an outlook to 2021 ("Progress report").

6. **Plasma gasification of the medical waste.** Erdogan AA, Yilmazoglu MZ. *Int J Hydrogen Energy.* 2020 Dec 31. doi: 10.1016/j.ijhydene.2020.12.069. Online ahead of print. <https://www.sciencedirect.com/science/article/pii/S0360319920346048>

In terms of infection control in hospitals, especially the Covid-19 pandemic that we are living in, it has revealed the necessity of proper disposal of medical waste. The increasing amount of medical waste with the pandemic is straining the capacity of incineration facilities or storage areas. Converting this waste to energy with gasification technologies instead of incineration is also important for sustainability. This study investigates the gasification characteristics of the medical waste in a novel updraft plasma gasifier with numerical simulations in the presence of the plasma reactions. Three different medical waste samples, chosen according to the carbon content and five different equivalence ratios (ER) ranging from 0.1 to 0.5 are considered in the simulations to compare the effects of different chemical compositions and waste feeding rates on hydrogen (H<sub>2</sub>) content and syngas production. The outlet properties of a 10 kW microwave air plasma generator are used to define the plasma inlet in the numerical model and the air flow rate is held constant for all cases. Results showed that the maximum H<sub>2</sub> production can be obtained with ER = 0.1 for all waste samples.

### Health Impacts of Climate Change

7. **Is climate change a mental health crisis?** Romeu D. *BJPsych Bull.* 2021 Apr 15:1-3. doi: 10.1192/bjb.2021.30. Online ahead of print. <https://www.cambridge.org/core/journals/bjpsych-bulletin/article/is-climate-change-a-mental-health-crisis/12D40726B54C13C1A1BC0F6E4008A60C>

The Earth's climate is in a complex state of change as a result of human activity. The interface between climate change and physical health has received significant attention, but its effects

on mental health and illness are less understood. This article provides an insight into the psychiatric sequelae of climate change, suggests strategies that psychiatrists can use to take action, and argues that it is their responsibility to do so.

- 8. Temperature and place associations with Inuit mental health in the context of climate change.** Middleton J, Cunsolo A, Pollock N, Jones-Bitton A, Wood M, Shiwak I, Flowers C, Harper SL. *Environ Res.* 2021 Apr 12:111166. doi: 10.1016/j.envres.2021.111166. Online ahead of print. BACKGROUND: Climate change has important implications for mental health globally. Yet, few studies have quantified the magnitude and direction of associations between weather and mental health-related factors, or assessed the geographical distribution of associations, particularly in areas experiencing rapid climatic change. This study examined the associations between air temperature variables and mental health-related community clinic visits across Nunatsiavut, Labrador, Canada, and the place-specific attributes of these associations. METHODS: Daily de-identified community clinic visit data were collected from the provincial electronic health recording system and linked to historical weather data (2012-2018). A multilevel, multivariable negative binomial regression model was fit to investigate associations between temperature variables and mental health-related community clinic visits across the region, adjusting for seasonality as a fixed effect and community as a random effect. A multivariable negative binomial model was then fit for each Nunatsiavut community, adjusting for seasonality. RESULTS: Mental health-related visits contributed to 2.4% of all 228,104 visit types across the study period; this proportion ranged from 0.6% to 11.3% based on community and year. Regionally, the incidence rate of mental health-related community clinic visits was greater after two weeks of warm average (i.e. above  $-5^{\circ}\text{C}$ ) temperatures compared to temperatures below  $-5^{\circ}\text{C}$  (IRR $_{-5\leq 5^{\circ}\text{C}}$  = 1.47, 95% CI = 1.21-1.78; IRR $_{6\leq 15^{\circ}\text{C}}$  = 2.24, 95% CI = 1.66-3.03; IRR $_{>15^{\circ}\text{C}}$  = 1.73, 95% CI = 1.02-2.94), and the incidence rate of mental health-related clinic visits was lower when the number of consecutive days within  $-5$  to  $5^{\circ}\text{C}$  ranges (i.e. temperatures considered to be critical to land use) increased (IRR = 0.96; 95% CI = 0.94-0.99), adjusting for seasonal and community effects. Community-specific models, however, revealed that no two communities had the same association between meteorological conditions and the incidence rate of daily mental health-related visits. DISCUSSION: Regionally, longer periods of warm temperatures may burden existing healthcare resources and shorter periods of temperatures critical to land use (i.e.  $-5$  to  $5^{\circ}\text{C}$ ) may present enjoyable or opportunistic conditions to access community and land-based resources. The heterogeneity found in temperature and mental health-related clinic visits associations across Nunatsiavut communities demonstrates that place quantitatively matters in the context of Inuit mental health and climate change. This evidence underscores the importance of place-based approaches to health policy, planning, adaptation, and research related to climate change, particularly in circumpolar regions such as Nunatsiavut where the rate of warming is one of the fastest on the planet.
- 9. The climate change-homelessness nexus.** Kidd SA, Hajat S, Bezgrebelna M, McKenzie K; Climate-Homelessness Working Group. *Lancet.* 2021 Apr 12:S0140-6736(21)00834-5. doi: 10.1016/S0140-6736(21)00834-5. Online ahead of print.

<https://www.clinicalkey.com/#!/content/journal/1-s2.0-S0140673621008345>

Climate change affects human health and wellbeing 1 with differential impacts on populations and regions. For example, climate change disproportionately affects girls and women and can amplify conflict and violence in resource-deprived environments. 2 The way climate change exacerbates economic and social disparities underscores the role of migration in response to climate pressures. 3 Movement or staying in place, whether forced or voluntary, have important immediate and downstream implications for the growing numbers of people affected. Although the mechanisms through which climate impacts human health are becoming better understood, substantial knowledge gaps remain. One such gap is the role of shelter. Housing and shelter are pivotal in considering the physical and mental health impacts of climate change for individuals without shelter or who live in temporary and unfit housing. 4

10. **Future behavior of wind wave extremes due to climate change.** Lobeto H, Menendez M, Losada IJ. *Sci Rep.* 2021 Apr 12;11(1):7869. doi: 10.1038/s41598-021-86524-4.

<https://www.nature.com/articles/s41598-021-86524-4>

Extreme waves will undergo changes in the future when exposed to different climate change scenarios. These changes are evaluated through the analysis of significant wave height (Hs) return values and are also compared with annual mean Hs projections. Hourly time series are analyzed through a seven-member ensemble of wave climate simulations and changes are estimated in Hs for return periods from 5 to 100 years by the end of the century under RCP4.5 and RCP8.5 scenarios. Despite the underlying uncertainty that characterizes extremes, we obtain robust changes in extreme Hs over more than approximately 25% of the ocean surface. The results obtained conclude that increases cover wider areas and are larger in magnitude than decreases for higher return periods. The Southern Ocean is the region where the most robust increase in extreme Hs is projected, showing local increases of over 2 m regardless the analyzed return period under RCP8.5 scenario. On the contrary, the tropical north Pacific shows the most robust decrease in extreme Hs, with local decreases of over 1.5 m. Relevant divergences are found in several ocean regions between the projected behavior of mean and extreme wave conditions. For example, an increase in Hs return values and a decrease in annual mean Hs is found in the SE Indian, NW Atlantic and NE Pacific. Therefore, an extrapolation of the expected change in mean wave conditions to extremes in regions presenting such divergences should be adopted with caution, since it may lead to misinterpretation when used for the design of marine structures or in the evaluation of coastal flooding and erosion.

11. **More floods, fires and cyclones - plan for domino effects on sustainability goals.** Reichstein M, Riede F, Frank D. *Nature.* 2021 Apr;592(7854):347-349. doi: 10.1038/d41586-021-00927-x.

<https://www.nature.com/articles/d41586-021-00927-x>

Climate change is provoking ever-more-extreme events, from storms and droughts to floods and cyclones. The risk of such hazards increases as the planet warms, and these risks interact across many environmental and social systems. A heatwave can spark forest fires, which lead to air pollution, thus damaging public health. Drought-wrecked harvests can result in food-price volatility, which can increase social unrest or migration.

**12. Is climate change exacerbating health-care workforce shortages for underserved populations?**

Pendrey CG, Quilty S, Gruen RL, Weeramanthri T, Lucas RM. *Lancet Planet Health*. 2021 Apr;5(4):e183-e184. doi: 10.1016/S2542-5196(21)00028-0.

[https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196\(21\)00028-0/fulltext](https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(21)00028-0/fulltext)

Like many countries, Australia is faced with substantial maldistribution of the health-care workforce and inequity in access to health-care services. This inequity is especially acute in rural and remote areas, where health-care professionals are continuously in short supply, and where recruitment and retention are major policy challenges.<sup>1, 2</sup> It is well established that, in these areas of Australia, increasing ambient temperatures caused by global climate change are heightening the risk of heat-related illnesses.<sup>3, 4</sup> Heat might also be affecting health and access to health-care by making work in these locations less appealing to medical practitioners, but little is known about the specific effects of heat on the health-care workforce. We aimed to assess these effects in the Northern Territory of Australia, a geographically remote and sparsely populated region spanning 1.42 million km<sup>2</sup>. First Nations people make up 30.9% of the Northern Territory population, compared with 3.3% of the population of the entire country. They have much poorer health outcomes and a life expectancy of 66.6 years for men and 69.9 years for women, compared with the average of 78.1 years for men and 82.7 years for women in the non-Indigenous population of the Northern Territory.<sup>5</sup>

**13. Evidence-Based Heatstroke Management in the Emergency Department.** Rublee C, Dresser C,

Giudice C, Lemery J, Sorensen C. *West J Emerg Med*. 2021 Feb 26;22(2):186-195. doi: 10.5811/westjem.2020.11.49007.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7972371/>

**INTRODUCTION:** Climate change is causing an increase in the frequency and intensity of extreme heat events, which disproportionately impact the health of vulnerable populations. Heatstroke, the most serious heat-related illness, is a medical emergency that causes multiorgan failure and death without intervention. Rapid recognition and aggressive early treatment are essential to reduce morbidity and mortality. The objective of this study was to evaluate current standards of care for the emergent management of heatstroke and propose an evidence-based algorithm to expedite care.

**METHODS:** We systematically searched PubMed, Embase, and key journals, and reviewed bibliographies. Original research articles, including case studies, were selected if they specifically addressed the recognition and management of heatstroke in any prehospital, emergency department (ED), or intensive care unit population. Reviewers evaluated study quality and abstracted information regarding demographics, scenario, management, and outcome.

**RESULTS:** In total, 63 articles met full inclusion criteria after full-text review and were included for analysis. Three key themes identified during the qualitative review process included recognition, rapid cooling, and supportive care. Rapid recognition and expedited external or internal cooling methods coupled with multidisciplinary management were associated with improved outcomes. Delays in care are associated with adverse outcomes. We found no current scalable ED alert process to expedite early goal-directed therapies.

**CONCLUSION:** Given the increased risk of exposure to heat waves and the time-sensitivity of the condition, EDs and healthcare systems should adopt processes for rapid recognition and

management of heatstroke. This study proposes an evidence-based prehospital and ED heat alert pathway to improve early diagnosis and resource mobilization. We also provide an evidence-based treatment pathway to facilitate efficient patient cooling. It is hoped that this protocol will improve care and help healthcare systems adapt to changing environmental conditions.

## WE ACT

14. **Will the United States make its most dramatic climate pledge yet?** Tollefson J. *Nature*. 2021 Apr 16. doi: 10.1038/d41586-021-01000-3. Online ahead of print.  
<https://www.nature.com/articles/d41586-021-01000-3>  
The United States has a new president, and is rolling out new plans for fighting climate change. Last month, President Joe Biden revealed a mammoth infrastructure proposal that would invest heavily in clean-energy technologies, electric vehicles and a modernized electric grid. Next week, he plans to use a climate summit to signal to the world that the United States is back on the climate stage — and make a heavily anticipated announcement about how much the country will curb its greenhouse-gas emissions by 2030.
15. **Beliefs and Social Norms as Precursors of Environmental Support: The Joint Influence of Collectivism and Socioeconomic Status.** Sherman DK, Updegraff JA, Handy MS, Eom K, Kim HS. *Pers Soc Psychol Bull*. 2021 Apr 15:1461672211007252. doi: 10.1177/01461672211007252. Online ahead of print.  
The present research investigates how the cultural value of collectivism interacts with socioeconomic status (SES) to influence the basis of action. Using a U.S. national sample (N = 2,538), the research examines how these sociocultural factors jointly moderate the strength of two precursors of environmental support: beliefs about climate change and perceived descriptive norms. SES and collectivism interacted with climate change beliefs such that beliefs predicted environmental support (i.e., proenvironmental behaviors and policy support) more strongly for those who were high in SES and low in collectivism than for all other groups. This interaction was explained, in part, by sense of control. For descriptive norms, SES and collectivism did not interact but rather norms predicted action most strongly for those high in collectivism and high in SES. These findings demonstrate the theoretical and applied importance of examining multiple sociocultural characteristics together to understand the factors that drive action.
16. **Individual and social-psychological factors to explain climate change efficacy: The role of mindfulness, sense of global community, and egalitarianism.** Scafuto F. *J Community Psychol*. 2021 Apr 15. doi: 10.1002/jcop.22576. Online ahead of print.  
This article focused on the study of individual and social-psychological determinants of a sense of efficacy on climate change mitigation. A correlational study investigated the predictive role of mindfulness, egalitarianism, risk concern, knowledge, and psychological sense of global community (PSGC). An online survey was administered to US College students (N = 277). The main predictors of climate change response efficacy (CCRE) were PSGC and egalitarianism,

followed by risk concern and climate knowledge. Among the facets of mindfulness, observing, and describing were the only ones associated with CCRE. The results found that mindfulness observing predicted response efficacy both directly and through the mediation of risk concern and sense of global community. Conversely, egalitarianism was not a significant mediator. Community psychologists should promote a sense of belonging to all humanity, and a more egalitarian view of the world, beyond risk concern, to increase climate efficacy. Training the skill of mindfulness observing could be a way to produce a sense of global community and affect climate change efficacy.

17. **A roadmap for bio-medical waste management research.** Shwetmala K, Arkalgud R, Anilkumar M. *Int J Health Plann Manage.* 2021 Apr 14. doi: 10.1002/hpm.3170. Online ahead of print.

<https://onlinelibrary.wiley.com/doi/10.1002/hpm.3170>

Bio-Medical waste is solid or liquid waste generated from healthcare activities. Bio-Medical waste management (BMWM) is necessary to protect local community health and environment, to reduce its financial loss and to preserve its social and aesthetic values. BMWM encompasses the waste generation, segregation, collection, transportation, processing and disposal. The BMWM system is complex and challenging. The research on BMWM must address the complexity for the solutions to be effective. We present an ontology of BMWM to visualize the complexity of the system and analyse it systematically. The research corpus of all the 184 articles from Scopus on BMWM is mapped onto the ontology. Ontological and theme maps are generated to highlight the emphases and gaps in the research. The results show the roadmap of BMWM research with the dominant emphasis on its functional elements and outcomes. There is little emphasis on the composition of the waste, the stakeholders and the policy instruments that guide and regulate the system. Correcting the biases in the present research corpus will help develop effective research and practice. This review results can be used to develop a roadmap for research to improve the BMWM system.

18. **Environmental sustainability and the carbon emissions of pharmaceuticals.** Richie C. *J Med Ethics.* 2021 Apr 14:medethics-2020-106842. doi: 10.1136/medethics-2020-106842. Online ahead of print.

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.

19. **Integrating planetary health into healthcare: A document analysis.** Kalogirou MR, Dahlke S, Davidson S, Yamamoto S. *Health Policy*. 2021 Apr 5:S0168-8510(21)00089-0. doi: 10.1016/j.healthpol.2021.04.002. Online ahead of print. <https://www.clinicalkey.com/#!/content/journal/1-s2.0-S0168851021000890>  
BACKGROUND: Anthropogenic climate change poses a major health risk to humankind. The healthcare sector both contributes to climate change and is vulnerable to its impacts. Healthcare's greenhouse gas emissions are primarily derived from its supply chain: the production, transport, and disposal of goods.  
METHODS: Document analysis was used to investigate the workplace policies of one large, Western Canadian healthcare organization. Policies that indicated how employees should engage with resources were reviewed through the lens of environmentally responsible practice and planetary health. Content and thematic analysis were applied.  
RESULTS: Four themes were identified: procurement of resources, resource utilization, resource conservation, and waste management.  
CONCLUSION: There was little evidence of environmental or climate impact consideration within the organization's policies.  
IMPLICATIONS: Healthcare organizations could benefit from integrating a planetary health perspective into their policies to deliver healthcare that considers the health and safety of both humans and the climate.
20. **Ethics, morality, and the psychology of climate justice.** Pearson AR, Tsai CG, Clayton S. *Curr Opin Psychol*. 2021 Mar 6;42:36-42. doi: 10.1016/j.copsy.2021.03.001. Online ahead of print. Climate change is increasingly understood as a social justice issue by academics, policymakers, and the public; however, the nature of these perceptions and their implications for cooperation and decision-making have only recently begun to receive empirical attention. We review emerging empirical work that suggests that morality and justice perceptions can serve as both a bridge and a barrier to cooperation around climate change and highlight two critical areas for future development, identifying psychological processes that promote and impede climate vulnerability and that enhance equity in the design and implementation of climate solutions. We argue that conceptualizing climate justice as a multidimensional process addressing both social and structural barriers can stimulate new psychological research and help align disparate approaches within the social sciences.
21. **Biodegradable Materials for Sustainable Health Monitoring Devices.** Hosseini ES, Dervin S, Ganguly P, Dahiya R. *ACS Appl Bio Mater*. 2021 Jan 18;4(1):163-194. doi: 10.1021/acsabm.0c01139. Epub 2020 Dec 23. <https://pubs.acs.org/doi/10.1021/acsabm.0c01139>  
The recent advent of biodegradable materials has offered huge opportunity to transform healthcare technologies by enabling sensors that degrade naturally after use. The implantable electronic systems made from such materials eliminate the need for extraction or reoperation, minimize chronic inflammatory responses, and hence offer attractive propositions for future biomedical technology. The eco-friendly sensor systems developed from degradable materials could also help mitigate some of the major environmental issues by reducing the volume of electronic or medical waste produced and, in turn, the carbon footprint. With this background,

herein we present a comprehensive overview of the structural and functional biodegradable materials that have been used for various biodegradable or bioresorbable electronic devices. The discussion focuses on the dissolution rates and degradation mechanisms of materials such as natural and synthetic polymers, organic or inorganic semiconductors, and hydrolyzable metals. The recent trend and examples of biodegradable or bioresorbable materials-based sensors for body monitoring, diagnostic, and medical therapeutic applications are also presented. Lastly, key technological challenges are discussed for clinical application of biodegradable sensors, particularly for implantable devices with wireless data and power transfer. Promising perspectives for the advancement of future generation of biodegradable sensor systems are also presented.

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