

## Environmental Stewardship Resource Desk

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### New Research

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#### COVID-19

1. **A Call for One Health in Medical Education: How the COVID-19 Pandemic Underscores the Need to Integrate Human, Animal, and Environmental Health.** Dykstra MP, Baitchman EJ. Acad Med. 2021 Mar 23. doi: 10.1097/ACM.0000000000004072. Online ahead of print.

[https://journals.lww.com/academicmedicine/Abstract/9000/A\\_Call\\_for\\_One\\_Health\\_in\\_Medical\\_Education\\_How.96747.aspx](https://journals.lww.com/academicmedicine/Abstract/9000/A_Call_for_One_Health_in_Medical_Education_How.96747.aspx)

During the early stages of the COVID-19 pandemic in 2020, the first author, then a fourth-year student at Harvard Medical school, was enrolled in a One Health clinical experience at Zoo New England where he was introduced to a transdisciplinary approach to integrate human, animal, and ecosystem health. Seeing the vast impact of the pandemic and knowing its roots as a zoonotic disease, he realized this approach was critical to his medical education and for preparation against future novel infectious diseases. Zoonotic diseases have been emerging into human populations with increasing frequency, leading to public health emergencies such as Ebola, Avian Influenza, and SARS. The SARS-CoV-2 narrative, starting in bats then mutating through an intermediate host into humans, is another striking example of the interconnectedness between human, animal, and ecosystem health that underlies these infections. Preventing future pandemics will require a transdisciplinary One Health approach, and physicians should be prepared to participate in these discussions while advocating for One Health initiatives for the benefit of their current and future patients. Integration of One Health education into medical school curricula will also prepare future physicians for other complex and urgently important health issues such as climate change, antimicrobial resistance, and the impact of biodiversity loss. As the consequences of the COVID-19 pandemic persist, education in One Health must become a priority; it is essential to break down the conventional disciplinary silos of human medicine, veterinary medicine, environmental health, public health, and the social sciences, so that future health crises can be prevented and mitigated collaboratively.

2. **Emerging infectious encephalitides.** Venkatesan A. *Curr Opin Neurol.* 2021 Mar 23. doi: 10.1097/WCO.0000000000000936. Online ahead of print.  
<https://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=ovft&AN=00019052-900000000-98825&PDF=y>

**PURPOSE OF REVIEW:** The COVID-19 pandemic has cast increased attention on emerging infections. Clinicians and public health experts should be aware of emerging infectious causes of encephalitis, mechanisms by which they are transmitted, and clinical manifestations of disease.

**RECENT FINDINGS:** A number of arthropod-borne viral infections -- transmitted chiefly by mosquitoes and ticks -- have emerged in recent years to cause outbreaks of encephalitis. Examples include Powassan virus in North America, Chikungunya virus in Central and South America, and tick-borne encephalitis virus in Europe. Many of these viruses exhibit complex life cycles and can infect multiple host animals in addition to humans. Factors thought to influence emergence of these diseases, including changes in climate and land use, are also believed to underlie the emergence of the rickettsial bacterium *Orientia tsutsugamushi*, now recognized as a major causative agent of acute encephalitis syndrome in South Asia. In addition, the COVID-19 pandemic has highlighted the role of bats as carriers of viruses. Recent studies have begun to uncover mechanisms by which the immune systems of bats are poised to allow for viral tolerance. Several bat-borne infections, including Nipah virus and Ebola virus, have resulted in recent outbreaks of encephalitis.

**SUMMARY:** Infectious causes of encephalitis continue to emerge worldwide, in part because of climate change and human impacts on the environment. Expansion of surveillance measures will be critical in rapid diagnosis and limiting of outbreaks in the future.

3. **A sustainable medical waste collection and transportation model for pandemics.** Babae E, Tirkolaee E, Aydın NS. *Waste Manag Res.* 2021 Mar 24:734242X211000437. doi: 10.1177/0734242X211000437. Online ahead of print.

We are currently experiencing a critical period for the prevention and control of the COVID-19 pandemic. COVID-19 related waste is a threat to global public environmental health. Medical waste management during this pandemic is one of the major issues facing public service organizations such as municipalities, which is of great importance in terms of logistics, environment and social aspects. The discussion of logistics operations is related to the collection, transportation and disposal of waste, which imposes high expenses. Many methods have been applied to develop and improve waste management policies in the literature. Apart from these studies, very few researchers have improved vehicle operations in waste management considering environmental aspects and the possibility of outsourcing. In this paper, by examining the gaps in the field, we try to explain and formulate the sustainable medical waste management problem for pandemics. Finally, by designing several practical examples with different scales, we solve the problem using CPLEX solver, compare different conditions and discuss the practical implications using the sensitivity analysis of demand parameter.

4. **Cuckoo optimization algorithm in reverse logistics: A network design for COVID-19 waste management.** Shadkam E. Waste Manag Res. 2021 Mar 24:734242X211003947. doi: 10.1177/0734242X211003947. Online ahead of print.

<https://journals.sagepub.com/doi/full/10.1177/0734242X211003947>

Today, reverse logistics (RL) is one of the main activities of supply chain management that covers all physical activities associated with return products (such as collection, recovery, recycling and destruction). In this regard, the designing and proper implementation of RL, in addition to increasing the level of customer satisfaction, reduces inventory and transportation costs. In this paper, in order to minimize the costs associated with fixed costs, material flow costs, and the costs of building potential centres, a complex integer linear programming model for an integrated direct logistics and RL network design is presented. Due to the outbreak of the ongoing global coronavirus pandemic (COVID-19) at the beginning of 2020 and the consequent increase in medical waste, the need for an inverse logistics system to manage waste is strongly felt. Also, due to the worldwide vaccination in the near future, this waste will increase even more and careful management must be done in this regard. For this purpose, the proposed RL model in the field of COVID-19 waste management and especially vaccine waste has been designed. The network consists of three parts - factory, consumers' and recycling centres - each of which has different sub-parts. Finally, the proposed model is solved using the cuckoo optimization algorithm, which is one of the newest and most powerful meta-heuristic algorithms, and the computational results are presented along with its sensitivity analysis.

5. **Effect of COVID-19 pandemic on medical waste management: a case study.** Kalantary RR, Jamshidi A, Mofrad MMG, Jafari AJ, Heidari N, Fallahizadeh S, Hesami Arani M, Torkashvand J. J Environ Health Sci Eng. 2021 Mar 18:1-6. doi: 10.1007/s40201-021-00650-9. Online ahead of print.

<https://link.springer.com/article/10.1007/s40201-021-00650-9>

Covid-19 Pandemic leads to medical services for the society all over the world. The Covid-19 pandemic influence the waste management and specially medical waste management. In this study, the effect of the Covid-19 outbreak on medical waste was evaluated via assessing the solid waste generation, composition, and management status in five hospitals in Iran. The results indicated that the epidemic Covid-19 leads to increased waste generation on average 102.2 % in both private and public hospitals. In addition, the ratio of infectious waste in the studied hospitals increased by an average of 9 % in medical waste composition and 121 % compared with before COVID-19 pandemic. Changes in plans and management measurement such as increasing the frequency of waste collection per week leads to lower the risk of infection transmission from medical waste in the studied hospitals. The results obtained from the present research clearly show the changes in medical waste generation and waste composition within pandemic Covid-19. In addition, established new ward, Covid-19 ward with high-infected waste led to new challenges which should be managed properly by change in routine activities.

6. **Challenges and actions to the environmental management of Bio-Medical Waste during COVID-19 pandemic in India.** Goswami M, Goswami PJ, Nautiyal S, Prakash S. Heliyon. 2021 Mar;7(3):e06313. doi: 10.1016/j.heliyon.2021.e06313. Epub 2021 Feb 19.

<https://www.sciencedirect.com/science/article/pii/S2405844021004187>

The outbreak of COVID-19 has engendered a global health crisis along with diverse impacts on economy, society and environment. Efforts to combat this pandemic have also significantly shot-up the quantity of Bio-medical Waste (BMW) generation. Safe disposal of large quantity of BMW has been gradually posing a major challenge. BMW management is mostly implemented at municipal level following regulatory guidelines defined by respective states and the Union. This article is a narrative of the status of BMW generation, management and regulation in India in the context of COVID-19 crisis. The article is based on comparative analysis of data on BMW generation and management from authentic sources, a systematic literature review and review of news reports. In the current pandemic situation where media has been playing a significant role in highlighting all the concerns related to COVID-19 spread and management. Assessing the ground situation regarding effectiveness of prevailing BMW management facilities, requirement and suggestions can provide insights to the subject with policy implications for India and countries as well. The discussion has been built on different dimensions of BMW management during the pandemic including existing infrastructures, capacity utilisation, policy guidelines, operational practices and waste-handlers aspects. The results on state-wise analysis of reported BMW quantity and active COVID-19 patients also reveal some non-linear relationship between the two variables. Delhi, the National Capital is situated at a better position in terms of BMW management as compared to other studied states. The findings are expected to provide valuable insights to the policy makers and other relevant authorities to evaluate adequateness as well as efficiency quotients of entire BMW management landscape. Some of the critical observations of this article are also expected to offer impetus for enhancing national disaster preparedness in future.

7. **Valorisation of medical waste through pyrolysis for a cleaner environment: Progress and challenges.** Su G, Ong HC, Ibrahim S, Fattah IMR, Mofijur M, Chong CT. *Environ Pollut.* 2021 Mar 11;279:116934. doi: 10.1016/j.envpol.2021.116934. Online ahead of print.

The COVID-19 pandemic has exerted great shocks and challenges to the environment, society and economy. Simultaneously, an intractable issue appeared: a considerable number of hazardous medical wastes have been generated from the hospitals, clinics, and other health care facilities, constituting a serious threat to public health and environmental sustainability without proper management. Traditional disposal methods like incineration, landfill and autoclaving are unable to reduce environmental burden due to the issues such as toxic gas release, large land occupation, and unsustainability. While the application of clean and safe pyrolysis technology on the medical wastes treatment to produce high-grade bioproducts has the potential to alleviate the situation. Besides, medical wastes are excellent and ideal raw materials, which possess high hydrogen, carbon content and heating value. Consequently, pyrolysis of medical wastes can deal with wastes and generate valuable products like bio-oil and biochar. Consequently, this paper presents a critical and comprehensive review of the pyrolysis of medical wastes. It demonstrates the feasibility of pyrolysis, which mainly includes pyrolysis characteristics, product properties, related problems, the prospects and future challenges of pyrolysis of medical wastes.

## Health Impacts of Climate Change

8. **Climate-related migration and population health: social science-oriented dynamic simulation model.** Reuveny R. BMC Public Health. 2021 Mar 26;21(1):598. doi: 10.1186/s12889-020-10120-w.

<https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-020-10120-w>

**BACKGROUND:** Social science models find the ecological impacts of climate change (EICC) contribute to internal migration in developing countries and, less so, international migration. Projections expect massive climate-related migration in this century. Nascent research calls to study health, migration, population, and armed conflict potential together, accounting for EICC and other factors. System science offers a way: develop a dynamic simulation model (DSM). We aim to validate the feasibility and usefulness of a pilot DSM intended to serve as a proof-of-concept and a basis for identifying model extensions to make it less simplified and more realistic.

**METHODS:** Studies have separately examined essential parts. Our DSM integrates their results and computes composites of health problems (HP), health care (HC), non-EICC environmental health problems (EP), and environmental health services (ES) by origin site and by immigrants and natives in a destination site, and conflict risk and intensity per area. The exogenous variables include composites of EICC, sociopolitical, economic, and other factors. We simulate the model for synthetic input values and conduct sensitivity analyses.

**RESULTS:** The simulation results refer to generic origin and destination sites anywhere on Earth. The effects' sizes are likely inaccurate from a real-world view, as our input values are synthetic. Their signs and dynamics are plausible, internally consistent, and, like the sizes, respond logically in sensitivity analyses. Climate migration may harm public health in a host area even with perfect HC/ES qualities and full access; and no HP spillovers across groups, conflict, EICC, and EP. Deviations from these conditions may worsen everyone's health. We consider adaptation options.

**CONCLUSIONS:** This work shows we can start developing DSMs to understand climate migration and public health by examining each case with its own inputs. Validation of our pilot model suggests we can use it as intended. We lay a path to making it more realistic for policy analysis.

9. **Multidimensional analysis of global climate change: a review.** Bandh SA, Shafi S, Peerzada M, Rehman T, Bashir S, Wani SA, Dar R. Environ Sci Pollut Res Int. 2021 Mar 24. doi: 10.1007/s11356-021-13139-7. Online ahead of print.

Even though climate change involves much more than warming, it is the name given to a set of physical phenomena. It is a long-term change in weather patterns that characterises different regions of the world. The warming effect in the earth's atmosphere has dramatically increased through the influence of some heat-trapping gases emitted by various human activities, especially fossil fuel burning. The more the input of such gases, the more will be the warming effect in the coming times. Global climate change is already visible in various parts of the larger ecosystems like forests, fisheries, biodiversity, and agriculture; however, it is now also influencing the supply of freshwater, human health, and well-being. This paper reviews climate change drivers, its global scenario, major global events, and assessing climate change impacts. The most daunting problem of economic and ecological risks, along with the threats to humanity, is also

discussed. The paper further reviews the species' vulnerability to climate change and the heat waves and human migration vis-à-vis climate change. Climate change politics and coverage of climate change episodes in mass media is the special focus of this review that concludes with a few mitigation measures.

10. **Unequal effects of climate change and pre-existing inequalities on the mental health of global populations.** Zhang S, Braithwaite I, Bhavsar V, Das-Munshi J. *BJPsych Bull.* 2021 Mar 24;1-5. doi: 10.1192/bjb.2021.26. Online ahead of print.

<https://www.cambridge.org/core/journals/bjpsych-bulletin/article/unequal-effects-of-climate-change-and-preexisting-inequalities-on-the-mental-health-of-global-populations/992E02986D06769C34B74488FD0184B9>

Climate change is already having unequal effects on the mental health of individuals and communities and will increasingly compound pre-existing mental health inequalities globally. Psychiatrists have a vital part to play in improving both awareness and scientific understanding of structural mechanisms that perpetuate these inequalities, and in responding to global calls for action to promote climate justice and resilience, which are central foundations for good mental and physical health.

11. **Politics of disease control in Africa and the critical role of global health diplomacy: A systematic review.** Chattu VK, Knight WA, Adisesh A, Yaya S, Reddy KS, Di Ruggiero E, Aginam O, Aslanyan G, Clarke M, Massoud MR, Jha A. *Health Promot Perspect.* 2021 Feb 7;11(1):20-31. doi: 10.34172/hpp.2021.04. eCollection 2021.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7967135/>

Background: Africa is facing the triple burden of communicable diseases, non-communicable diseases (NCDs), and nutritional disorders. Multilateral institutions, bilateral arrangements, and philanthropies have historically privileged economic development over health concerns. That focus has resulted in weak health systems and inadequate preparedness when there are outbreaks of diseases. This review aims to understand the politics of disease control in Africa and global health diplomacy's (GHD's) critical role. Methods: A literature review was done in Medline/PubMed, Web of Science, Scopus, Embase, and Google scholar search engines. Keywords included MeSH and common terms related to the topics: "Politics," "disease control," "epidemics/ endemics," and "global health diplomacy" in the "African" context. The resources also included reports of World Health Organization, United Nations and resolutions of the World Health Assembly (WHA). Results: African countries continue to struggle in their attempts to build health systems for disease control that are robust enough to tackle the frequent epidemics that plague the continent. The politics of disease control requires the crafting of cooperative partnerships to accommodate the divergent interests of multiple actors. Recent outbreaks of COVID-19 and Ebola had a significant impact on African economies. It is extremely important to prioritize health in the African development agendas. The African Union (AU) should leverage the momentum of the rise of GHD to (i) navigate the politics of global health governance in an interconnected world(ii) develop robust preparedness and disease response strategies to tackle emerging and reemerging disease epidemics in the region (iii) address the linkages between health and broader human security issues driven by climate change-induced food, water, and other insecurities (iv) mobilize resources and capacities to train health officials

in the craft of diplomacy. Conclusion: The AU, Regional Economic Communities (RECs), and African Centres for Disease Control should harmonize their plans and strategies and align them towards a common goal that integrates health in African development agendas. The AU must innovatively harness the practice and tools of GHD towards developing the necessary partnerships with relevant actors in the global health arena to achieve the health targets of the Sustainable Development Goals.

- 12. Compounding Effects of Social Vulnerability and Recurring Natural Disasters on Mental and Physical Health.** Hahn MB, Van Wyck R, Lessard L, Fried R. *Disaster Med Public Health Prep.* 2021 Mar 24;1-9. doi: 10.1017/dmp.2020.476. Online ahead of print.  
OBJECTIVE: This study evaluated the relationships between the occurrence of recent and recurring natural disasters on the incidence of acute and chronic health outcomes at the census tract level in 500 cities across the United States between 2001 and 2015.  
METHODS: Using the Centers for Disease Control and Prevention (CDC) 500 cities data set, the CDC Social Vulnerability Index, and the US Small Business Administration (SBA) Disaster Loan Database, we modeled the incidence of self-reported, poor mental and physical health, or a clinical diagnosis of high blood pressure or asthma in census tracts (N = 27 204 tracts in 500 cities) that had experienced recent or recurring natural disasters while controlling for social and environmental risk factors.  
RESULTS: Communities that experienced a natural disaster in the previous 5 years compared to those that had not had a higher incidence of poor mental health (RR: 1.02, 95% CI: 1.01-1.02), poor physical health (RR: 1.03, 95% CI: 1.02-1.04), high blood pressure (RR: 1.04, 95% CI: 1.02-1.05), and asthma (RR: 1.01, 95% CI: 1.01-1.02). The incidence of these poor health outcomes increased 1-2% with each additional year that a community experienced a disaster.  
CONCLUSIONS: Prevention and preparedness plans that work to build resilience in communities before disasters should focus on closing the gap in environmental and social determinants that have been linked with disproportionate health burdens and slow recovery post-disaster.
- 13. Geospatial indicators of exposure, sensitivity, and adaptive capacity to assess neighbourhood variation in vulnerability to climate change-related health hazards.** Yu J, Castellani K, Forsyinski K, Gustafson P, Lu J, Peterson E, Tran M, Yao A, Zhao J, Brauer M. *Environ Health.* 2021 Mar 22;20(1):31. doi: 10.1186/s12940-021-00708-z.  
<https://ehjournal.biomedcentral.com/articles/10.1186/s12940-021-00708-z>  
BACKGROUND: Although the frequency and magnitude of climate change-related health hazards (CCRHHs) are likely to increase, the population vulnerabilities and corresponding health impacts are dependent on a community's exposures, pre-existing sensitivities, and adaptive capacities in response to a hazard's impact. To evaluate spatial variability in relative vulnerability, we: 1) identified climate change-related risk factors at the dissemination area level; 2) created actionable health vulnerability index scores to map community risks to extreme heat, flooding, wildfire smoke, and ground-level ozone; and 3) spatially evaluated vulnerability patterns and priority areas of action to address inequity.  
METHODS: A systematic literature review was conducted to identify the determinants of health hazards among populations impacted by CCRHHs. Identified determinants were then grouped into categories of exposure, sensitivity, and adaptive capacity and aligned with available data.

Data were aggregated to 4188 Census dissemination areas within two health authorities in British Columbia, Canada. A two-step principal component analysis (PCA) was then used to select and weight variables for each relative vulnerability score. In addition to an overall vulnerability score, exposure, adaptive capacity, and sensitivity sub-scores were computed for each hazard. Scores were then categorised into quintiles and mapped.

**RESULTS:** Two hundred eighty-one epidemiological papers met the study criteria and were used to identify 36 determinant indicators that were operationalized across all hazards. For each hazard, 3 to 5 principal components explaining 72 to 94% of the total variance were retained. Sensitivity was weighted much higher for extreme heat, wildfire smoke and ground-level ozone, and adaptive capacity was highly weighted for flooding vulnerability. There was overall varied contribution of adaptive capacity (16-49%) across all hazards. Distinct spatial patterns were observed - for example, although patterns varied by hazard, vulnerability was generally higher in more deprived and more outlying neighbourhoods of the study region.

**CONCLUSIONS:** The creation of hazard and category-specific vulnerability indices (exposure, adaptive capacity and sensitivity sub-scores) supports evidence-based approaches to prioritize public health responses to climate-related hazards and to reduce inequity by assessing relative differences in vulnerability along with absolute impacts. Future studies can build upon this methodology to further understand the spatial variation in vulnerability and to identify and prioritise actionable areas for adaptation.

14. **Mouse Lung Structure and Function after Long-Term Exposure to an Atmospheric Carbon Dioxide Level Predicted by Climate Change Modeling.** Larcombe AN, Papini MG, Chivers EK, Berry LJ, Lucas RM, Wyrwoll CS. *Environ Health Perspect.* 2021 Jan;129(1):17001. doi: 10.1289/EHP7305. Epub 2021 Jan 13.

<https://ehp.niehs.nih.gov/doi/10.1289/EHP7305>

**BACKGROUND:** Climate change models predict that atmospheric carbon dioxide [CO<sub>2</sub>] levels will be between 700 and 900 ppm within the next 80 y. Despite this, the direct physiological effects of exposure to slightly elevated atmospheric CO<sub>2</sub> (as compared with ~ 410 ppm experienced today), especially when exposures extend from preconception to adulthood, have not been thoroughly studied.

**OBJECTIVES:** In this study we aimed to assess the respiratory structure and function effects of long-term exposure to 890 ppm CO<sub>2</sub> from preconception to adulthood using a mouse model.

**METHODS:** We exposed mice to CO<sub>2</sub> (~ 890 ppm) from prepregnancy, through the in utero and early life periods, until 3 months of age, at which point we assessed respiratory function using the forced oscillation technique, and lung structure.

**RESULTS:** CO<sub>2</sub> exposure resulted in a range of respiratory impairments, particularly in female mice, including higher tissue elastance, longer chord length, and lower lung compliance.

Importantly, we also assessed the lung function of the dams that gave birth to our experimental subjects. Even though these mice had been exposed to the same level of increased CO<sub>2</sub> for a similar amount of time (~ 8 wk), we measured no impairments in lung function. This suggests that the early life period, when lungs are undergoing rapid growth and development, is particularly sensitive to CO<sub>2</sub>.

DISCUSSION: To the best of our knowledge, this study, for the first time, shows that long-term exposure to environmentally relevant levels of CO<sub>2</sub> can impact respiratory function in the mouse. <https://doi.org/10.1289/EHP7305>.

15. **The costs and benefits of environmental sustainability.** Ekins P, Zenghelis D. *Sustain Sci*. 2021 Mar 16:1-17. doi: 10.1007/s11625-021-00910-5. Online ahead of print.

<https://link.springer.com/article/10.1007/s11625-021-00910-5>

The natural science in GEO-6 makes clear that a range and variety of unwelcome outcomes for humanity, with potentially very significant impacts for human health, become increasingly likely if societies maintain their current development paths. This paper assesses what is known about the likely economic implications of either current trends or the transformation to a low-carbon and resource-efficient economy in the years to 2050 for which GEO-6 calls. A key conclusion is that no conventional cost-benefit analysis for either scenario is possible. This is because the final cost of meeting various decarbonisation and resource-management pathways depends on decisions made today in changing behaviour and generating innovation. The inadequacies of conventional modelling approaches generally lead to understating the risks from unmitigated climate change and overstating the costs of a low-carbon transition, by missing out the cumulative gains from path-dependent innovation. This leads to a flawed conclusion as to how to respond to the climate emergency, namely that significant reductions in emissions are prohibitively expensive and, therefore, to be avoided until new, cost-effective technologies are developed. We argue that this is inconsistent with the evidence and counterproductive in serving to delay decarbonisation efforts, thereby increasing its costs. Understanding the processes which drive innovation, change social norms and avoid locking in to carbon- and resource-intensive technologies, infrastructure and behaviours, will help decision makers as they ponder how to respond to the increasingly stark warnings of natural scientists about the deteriorating condition of the natural environment.

## WE ACT

16. **Failing Efforts to Mitigate Climate Change are a Futile Band-Aid that will not Stop Other Elephants Filling the Room.** Weinstein P, Daszak P. *Ecohealth*. 2021 Mar 27:1-3. doi: 10.1007/s10393-020-01512-w. Online ahead of print.

<https://link.springer.com/article/10.1007/s10393-020-01512-w>

Much was made of the Paris Accord, an international agreement to reduce greenhouse gas emissions in an attempt to arrest global climate change, both before it spiralled out of control, and before the adverse effects on planetary and human health would be felt in earnest. Unfortunately, 20 years later, progress has been dismal—most industrial countries are still producing emissions well above the agreed targets, and many developing countries understandably are not in a position to lead on this in the absence of clear support from richer nations. As a result, we are now in a situation where interest and intervention has shifted from attempting to reduce emissions, to investing time, energy, and resources into mitigating the adverse effects of global warming instead.

17. **From Reductionism to Reintegration: Solving society's most pressing problems requires building bridges between data types across the life sciences.** Thessen AE, Bogdan P, Patterson DJ, Casey TM, Hinojo-Hinojo C, de Lange O, Haendel MA. *PLoS Biol.* 2021 Mar 26;19(3):e3001129. doi: 10.1371/journal.pbio.3001129. eCollection 2021 Mar.

<https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.3001129>

Decades of reductionist approaches in biology have achieved spectacular progress, but the proliferation of subdisciplines, each with its own technical and social practices regarding data, impedes the growth of the multidisciplinary and interdisciplinary approaches now needed to address pressing societal challenges. Data integration is key to a reintegrated biology able to address global issues such as climate change, biodiversity loss, and sustainable ecosystem management. We identify major challenges to data integration and present a vision for a "Data as a Service"-oriented architecture to promote reuse of data for discovery. The proposed architecture includes standards development, new tools and services, and strategies for career-development and sustainability.

18. **Multiple probabilistic traveling salesman problem in the coordination of drug transportation- In the context of sustainability goals and Industry 4.0.** Twaróg S, Szwarc K, Wronka-Pośpiech M, Dobrowolska M, Urbanek A. *PLoS One.* 2021 Mar 25;16(3):e0249077. doi: 10.1371/journal.pone.0249077. eCollection 2021.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0249077>

Improving the effectiveness of route planning, especially in road transport deliveries is a challenge we need to face in the context of advancing climate change and the sustainable development goals. The main aim of the paper is to demonstrate the above average and utilitarian significance of the multiple probabilistic traveling salesman problem (MPTSP) in the coordination and modeling of sustainable product transportation, which is a novelty at the theoretical, conceptual, methodological and empirical level. We propose a new, hybrid algorithm of solving MPTSP instances (it connects harmony search, k-means and 2-opt), which can be successfully used in economic practice for coordination and modeling of Industry 4.0. The effectiveness of proposed approach is tested using a case study of drugs distribution services and datasets obtained from the transportation enterprise located in Poland. The study focuses on the issue of planning routes, with particular emphasis on the changing demand of customers. It should be stressed that this work may be of interest to researchers but also to management practitioners. The value added of this research lies in the innovative modeling the coordination of sustainable drug transportation as an instance of MPTSP and proposing an effective method to solve it. The main research results confirm that proposed method contributes to overall sustainability of studied supply chain.

19. **Observations of greenhouse gases as climate indicators.** Bruhwiler L, Basu S, Butler JH, Chatterjee A, Dlugokencky E, Kenney MA, McComiskey A, Montzka SA, Stanitski D. *Clim Change.* 2021;165(1):12. doi: 10.1007/s10584-021-03001-7. Epub 2021 Mar 8.

<https://link.springer.com/article/10.1007/s10584-021-03001-7>

Humans have significantly altered the energy balance of the Earth's climate system mainly not only by extracting and burning fossil fuels but also by altering the biosphere and using halocarbons. The 3rd US National Climate Assessment pointed to a need for a system of

indicators of climate and global change based on long-term data that could be used to support assessments and this led to the development of the National Climate Indicators System (NCIS). Here we identify a representative set of key atmospheric indicators of changes in atmospheric radiative forcing due to greenhouse gases (GHGs), and we evaluate atmospheric composition measurements, including non-CO<sub>2</sub> GHGs for use as climate change indicators in support of the US National Climate Assessment. GHG abundances and their changes over time can provide valuable information on the success of climate mitigation policies, as well as insights into possible carbon-climate feedback processes that may ultimately affect the success of those policies. To ensure that reliable information for assessing GHG emission changes can be provided on policy-relevant scales, expanded observational efforts are needed. Furthermore, the ability to detect trends resulting from changing emissions requires a commitment to supporting long-term observations. Long-term measurements of greenhouse gases, aerosols, and clouds and related climate indicators used with a dimming/brightening index could provide a foundation for quantifying forcing and its attribution and reducing error in existing indicators that do not account for complicated cloud processes.

20. **Nurses Achieving the Sustainable Development Goals: The United Nations and Sigma.** Sensor CS, Branden PS, Clary-Muronda V, Hawkins JE, Fitzgerald D, Shimek AM, Al-Itani D, Madigan EA, Rosa WE. *Am J Nurs.* 2021 Apr 1;121(4):65-68. doi: 10.1097/01.NAJ.0000742544.07615.db. [https://journals.lww.com/ajnonline/Fulltext/2021/04000/Nurses\\_Achieving\\_the\\_Sustainable\\_Development.35.aspx](https://journals.lww.com/ajnonline/Fulltext/2021/04000/Nurses_Achieving_the_Sustainable_Development.35.aspx)

This article is one in a series in which contributing authors discuss how the United Nations (UN) Sustainable Development Goals (SDGs) are linked to everyday clinical issues; national public health emergencies; and other nursing issues, such as leadership, shared governance, and advocacy. The 2030 Agenda for Sustainable Development, a 15-year plan of action to achieve the goals, was unanimously adopted by all UN member states in September 2015 and took effect on January 1, 2016. The Agenda consists of 17 SDGs addressing social, economic, and environmental determinants of health and 169 associated targets focused on five themes: people, planet, peace, prosperity, and partnership. The SDGs build on the work of the UN Millennium Development Goals, which were in effect from 2000 to 2015. The current article highlights SDGs 5 (gender equality), 8 (decent work and economic growth), and 17 (partnerships for the goals), along with the advocacy of these goals by Sigma Theta Tau International Honor Society of Nursing in the UN system.

21. **Guidelines for developing a systematic literature review for studies related to climate change adaptation.** Shaffril HAM, Samah AA, Samsuddin SF. *Environ Sci Pollut Res Int.* 2021 Mar 21. doi: 10.1007/s11356-021-13178-0. Online ahead of print. <https://link.springer.com/article/10.1007/s11356-021-13178-0>

This study proposes a set of GuFSyADD guidelines on steps for developing suggestions that enhance of its rigor in systematic literature review (SLR) for studies related to climate change adaptation. The prescribed guidelines are based on the following six steps, (1) guided by review of protocol/publication standard/established guidelines/related published articles, (2) formulation of review questions, (3) systematic searching strategies, (4) appraisal of quality, (5) data extraction and analysis, and (6) data demonstration. Essentially, this set of proposed

guidelines enables researchers to develop an SLR pertaining to climate change adaptation in an organised, transparent, and replicable manner.

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