

Open Research Online

The Open University's repository of research publications and other research outputs

The work of waste during COVID-19: logics of public, environmental, and occupational health

Journal Item

How to cite:

Garnett, Emma; Balayannis, Angeliki; Hinchliffe, Steve; Davies, Thom; Gladding, Toni and Nicholson, Phillip (2022). The work of waste during COVID-19: logics of public, environmental, and occupational health. *Critical Public Health* (Early access).

For guidance on citations see [FAQs](#).

© 2022 The Authors



<https://creativecommons.org/licenses/by/4.0/>

Version: Version of Record

Link(s) to article on publisher's website:

<http://dx.doi.org/doi:10.1080/09581596.2022.2048632>

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's [data policy](#) on reuse of materials please consult the policies page.

oro.open.ac.uk



The work of waste during COVID-19: logics of public, environmental, and occupational health

Emma Garnett, Angeliki Balayannis, Steve Hinchliffe, Thom Davies, Toni Gladding & Phillip Nicholson

To cite this article: Emma Garnett, Angeliki Balayannis, Steve Hinchliffe, Thom Davies, Toni Gladding & Phillip Nicholson (2022): The work of waste during COVID-19: logics of public, environmental, and occupational health, *Critical Public Health*, DOI: [10.1080/09581596.2022.2048632](https://doi.org/10.1080/09581596.2022.2048632)

To link to this article: <https://doi.org/10.1080/09581596.2022.2048632>



© 2022 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



Published online: 14 Mar 2022.



Submit your article to this journal [↗](#)









View related articles [↗](#)



View Crossmark data [↗](#)

The work of waste during COVID-19: logics of public, environmental, and occupational health

Emma Garnett ^a, Angeliki Balayannis ^b, Steve Hinchliffe ^b, Thom Davies ^c,
Toni Gladding ^d and Phillip Nicholson ^b

^aPopulation Health Sciences, King's College London, London, UK; ^bDepartment of Geography, University of Exeter, Exeter, UK; ^cDepartment of Geography, University of Nottingham, Nottingham, UK; ^dSchool of Engineering and Innovation, The Open University, Milton Keynes, UK

ABSTRACT

Waste has become a pivotal public health and environmental problem during the COVID-19 pandemic. In this interdisciplinary review, we move beyond the 'coronalitter' and 'coronawaste' discourses, which have come to dominate public imaginaries of waste, to consider less-visible dimensions of waste infrastructures and systems. We demonstrate how waste is coming to matter in new ways that offer opportunities for reconfiguring health research. By examining the literature addressing the impacts of COVID-19 on the geographies of waste, we shed light on how waste is being problematised and researched through logics of public, environmental, and occupational health. We argue that these logics structure understandings and practice, whilst drawing attention to the overlaps and limits that allow links across disciplinary silos and problem domains to be forged. Developing a multi-logics approach, the paper outlines a research agenda for approaching waste as a critical public health problem at a time of intersecting health crises.

ARTICLE HISTORY

Received 5 July 2021
Accepted 25 February 2022

KEYWORDS

Waste; occupational health; environmental health; logics of health

Introduction

Waste has become a pivotal public health and environmental problem during the COVID-19 pandemic. Although concerns about waste and pollution long precede this pandemic, in this interdisciplinary review we demonstrate how waste is coming to matter in new ways that offer opportunities for reconfiguring health research. 'Coronalitter' has come to dominate public imaginaries of waste at this time – with the disposable mask becoming a 'poster object' (Marres, 2012) for thinking through environmental problems entangled with the COVID-19 response. The environmental concerns around personal protective equipment (PPE) have productively revealed the tensions between various and sometimes competing logics of health (see, De Wilde et al., 2020). But it is also important to note that the discards of COVID-19 are more than just wayward disposable masks – litter after all constitutes a small fraction of total wastes produced (Pollans, 2021). There are less-visible dimensions of waste infrastructures that are obscured in concerns over PPE lingering on footpaths and finding its way into distant environments. The processes of collecting, transporting, sorting, storing, disposing, burying, recycling, and incinerating waste materials – and the people who perform this pivotal labour – have been side-lined in pandemic waste politics. Attending to the practices and processes of waste management can generate situated understandings of waste and its implications for health, in ways that avoid 'purity politics' which too readily individualise and responsabilise systemic environmental problems (see, Shotwell, 2016).

CONTACT Angeliki Balayannis  A.A.Balayannis@exeter.ac.uk

This paper presents a novel broad-reaching interdisciplinary review of the literature addressing the effects of COVID-19 on the problems of waste and its management. This scholarship has grown rapidly since the early stages of the pandemic and continues to proliferate – spanning biomedicine, the social sciences, environmental sciences, and fields beyond. The aim of our review is to interrogate this research and consider how it provides lessons for approaching the problems of waste. Approaching waste as a *critical public health* problem can, we argue, unsettle the sequestration of waste from broader health consideration, and at the same time confront economies and cultures of disposability. By paying close attention to waste work – both as an infrastructural practice and an analytical problem that enables new forms of understanding – we articulate the different ways health is examined across disciplinary fields of research and expertise. Thinking with Mol (2008), we learned through our review that waste is problematised through different ‘logics’ of health, specifically public health, environmental health, and occupational health. By identifying and comparing the different logics, we demonstrate how waste is a problem that embodies some of the key challenges of achieving health across a variety of domains at a time of intersecting planetary health crises.

After outlining our methods and analytical framework, we discuss the logics of health that emerged from the analysis of the literature. We draw out the different ways these logics problematise wastes and attend to their assumptions about health. To avoid viewing different forms of health as simply in tension, we work with these logics to flesh out their intersections and capacities for more complex and critical research. Based on this analysis, in the fourth section we draw upon long-standing ethnographic literature on waste labour to flesh out a critical public health agenda for waste. We argue that approaching waste as a systemic and infrastructural problem can also help address the overlapping conjunctural crises of public and planetary health – ‘coproductions of inequities, vulnerabilities, and marginalizations’ (Sultana, 2021, p. 2). Our review is intended to be of wide interest, but we had two audiences in mind when undertaking the analysis: critical public health scholars addressing environmental issues, and researchers in the environmental sciences concerned with the impacts of COVID-19 on waste.

Review methodology

To undertake this review, we mapped the various intersections of ‘waste’ and ‘COVID-19’ using broad search terms to enable conversations across diverse fields and disciplines. As the literature was rapidly expanding (and continues to do so), this required multiple review methods: a series of systematic searches through PubMed and Taylor & Francis, and more informally, to make up for temporal lags and algorithmic shortcomings in databases, papers were also located through social media, workshops, and conferences. Database searches were repeated three times in the review process: the first preliminary search was undertaken in October 2020 and the final search was performed on the 26 April 2021. The search terms were COVID-19 or coronavirus AND waste management. We tested other search terms to avoid oversights, including SARS-CoV-2 AND waste management, however the same results emerged from the process. After reading and reviewing abstracts, and checking reference lists, we identified 123 relevant papers via the systematic searches: 22 through Taylor & Francis, 101 through PubMed. Papers were included in the review if they evaluated, compared, used, or described COVID-19 and waste, and/or the waste sector or waste management practices.

Four key publication types emerged through our searches: (1) The majority of the publications were papers drawing out lessons and recommendations based on quantitative data (e.g. Ilyas et al., 2020), anecdotal evidence (e.g. Dente & Hashimoto, 2020), or national and local government responses (e.g. Das et al. 2021). These papers tended to be comparisons of different countries and regions – a reflection of how waste is routinely examined (and governed). (2) Letters to editors in high-impact medical and scientific journals, including *The British Medical Journal* and *Science*, were the second key form of publication (e.g. You et al. 2020b). (3) Commentaries, rather than empirical

research, emerged from the social sciences and humanities. The preponderance of social science commentary may be indicative of a slower time frame for publication of results from qualitative research. 4) And finally, by drawing on grey literature and policy documents, case studies of waste systems generated analyses of preparedness and response (e.g. Ragazzi et al., 2020).

Rather than review the state of knowledge on waste during COVID-19, we critically consider how *health* is constituted in the practices of research and writing. Our analysis draws out and delineates the different versions of health that are entangled with waste through Mol's (2008) Logics of Health framework. In her ethnographic research of care practices for people with diabetes, Mol develops an alternative logic of care to the logic of individual choice that is often assumed to underpin Western medicine. Unlike 'discourse', the concept of logic refers to the rationality of particular practices, from which a style, rationale, and coherence can be discerned. Although waste is not usually imagined as a health practice (see discussion for exceptions), we found that during COVID-19 the questions of how to manage changing geographies of waste revealed there are different health logics at play.

The logics of waste

Environmental health: sustainability and experimentation

The so-called 'natural experiments' that unfolded early in the pandemic, when governments halted industries and transport systems to reveal cleaner air and bluer skies, highlighted the complex relations between COVID-19 and the climate crisis. Sarkodie and Owusu (2021) describe this environmental-health-economic nexus as 'a trilemma' to indicate the trade-offs between economic restrictions and reductions in pollution and thereby improvements in health. As we noted in the introduction, this push and pull of different logics in relation to waste (in the above example between ecological health and the 'health' of the economy) is powerfully encapsulated in the proliferation of disposable facemasks and single-use plastics. These are intended to offer protection against infections whilst also inevitably polluting environments (Bamber & Christmas, 2020; Tabish et al., 2020). These tensions highlight how COVID-19 is embedded in a broader set of intersecting health crises (Nzeadibe & Ejike-Alieji, 2020) in which problems are emergent, and as one challenge unfolds a new one is likely to arise (cf. Mol 2008).

In contexts where waste infrastructures were already overstretched, environmental derogations were enacted to address increasing volumes of waste and depleted workforces. In the UK, for instance, the Environment Agency allowed the temporary storage of wastes and incineration ash in sites not granted a permit (You et al. 2020b). Some of the changes in waste streams are described by Tabish et al. (2020, p. 8) who explain how: 'lockdown initiatives have resulted in a rise in the quantity of packaging used to distribute food and produce to residences'. The increased use of single-use plastics was a concern right across the literature (e.g. Anderson et al., 2021; Fadare & Okoffo, 2020; J.J. Klemeš et al., 2020; Vanapalli et al., 2021), however the authors largely emphasise the role of consumers, thereby running the risk of responsabilising the problems of waste and wasting. Drawing links with reductions (albeit temporary and uneven) in air pollution, S.A. Sarkodie and Owusu (2021) argue that any environmental benefits have been offset by the significant increases in medical and municipal waste streams. Ouhine et al. (2020) also challenge the argument that the pandemic has led to 'environmental restoration' by highlighting increases in unrecyclable wastes and the increased and widespread use of hazardous chemicals in disinfectants. Measures to protect workers implemented by the waste sector have also affected waste supply chains and slowed down recycling processes, particularly in higher-income countries (Vaverková et al., 2020). Overall, the literature argues pandemic restrictions have intensified many environmental problems that preceded the pandemic.

Alongside these challenges, however, the pandemic has also been framed as a catalyst for environmental change, in which more 'sustainable' waste management approaches can be developed (Cesaro & Pirozzi, 2020; J.J. Klemeš et al., 2020; Kulkarni & Anantharama, 2020; Sharma et al.

2020). It is argued that the pandemic has made environmental issues more visible in ways that waste sector professionals consider opportune for wider structural change (Resource London, 2020). What this change might look like includes a variety of approaches, including: improvements to databases, and more accurate waste flow monitoring and modelling (Mihai, 2020); improved PPE and compliance by employees and 'state of the art' management systems (Rahman et al., 2020); and the localisation of supply chains to build resilience during economic and social turbulence (Sharma et al. 2020). In a different set of environmental science papers, empirical data, largely from surveys and waste tonnage monitoring, have been analysed to delineate 'lessons' from countries or cities (Das et al., 2021), including Morocco (Peng et al., 2020), Bangladesh (Rada et al., 2020), Iran (Zand & Heir, 2020), Italy (Ragazzi et al., 2020), and Wuhan, China (Yu et al., 2020). Drawing on a broad range of data-sets or 'unconventional data' (Dente & Hashimoto, 2020), and assembling data and analyses through apparently novel approaches, these papers suggest an experimental approach to environmental health where the long-term promissory impacts of the pandemic are broached with scepticism.

Public health: surveillance and transmission

A key concern in the public health literature we reviewed is the surface transmission risks posed by waste materials. Early case studies of waste management practices set in 'high-risk' settings, including hospitals (Lima et al., 2020; Peng et al., 2020) and universities (Rada et al., 2020), traced the effects of the rapid re-classifications of waste during the pandemic outbreak. For instance, the disposal implications of classifying all medical waste as biohazardous waste (Tabish et al., 2020) and the uncertainty of domestic waste as sources of onward infection (M. P. G. Mol & Caldas, 2020) meant local governments had to reorganise the labour of waste collection and create new public guidelines for sorting domestic waste. Municipal waste management, and in particular the processes of solid waste collection became a central public health concern (Mihai, 2020).

As a result, papers discussed local interventions and approaches for future public health preparedness plans. These included technologies that might limit transmission (Ilyas et al., 2020); disinfectants and waste quarantine (Kayshap et al. 2020; Di Maria et al., 2020), particularly given the initial uncertainties associated with transmission routes (see, Mondelli et al., 2021); and new procedures for processing waste that break routes of exposure (Hoseinzadeh et al., 2020; Di Maria et al., 2020; Tabish et al., 2020). Improvements in existing mechanisms of waste collection and disposal were also discussed (Tabish et al., 2020), in addition to improving access and availability of PPE (Nzediegwu & Chang, 2020) and updating occupational health protocols (Hoseinzadeh et al., 2020). This focus on presumed fomite transmission in communities via environmental media shaped the kinds of interventions proposed. It has also led to investments in waste water epidemiology that focus on how waste streams can be used as indicators of community carriage of infections (Harries et al., 2020; Lodder & de Roda Husman, 2020; Mallapaty, 2020; Nourinejad et al. 2021; Paleologos et al., 2020; Tiwari et al., 2021; Tran et al., 2021) and as diagnostics for potentially discerning community transition in the future (Manoj, 2020; Mihai, 2020; Naughton, 2020; Nghiem et al., 2020; Paleologos et al., 2020).

Beyond surveillance and transmission, there was limited discussion on the public health implications of pressures on waste management. As one study about the effectiveness of solid waste management in different countries during and after the pandemic pointed out, there is an absence of research on the social and environmental impacts of COVID-19 on the waste sector compared with studies detailing changes to consumer practices and waste generation (Liang et al., 2021). We found two papers that did discuss the consequences of public health interventions on day-to-day experiences of urban environments, including the challenges of implementing waste management policy in lower-income settings (Islam et al. 2020) and the public health implications of COVID-19 on living conditions (Murray et al., 2020). In terms of the latter, a study in Chicago examined how social distancing measures to protect public health led

to increased rat activity in residential areas because of restaurant closures (and therefore a reduction in garbage), which the authors associate with negative impacts on people's health and wellbeing (Murray et al., 2020). Although poor waste management is a risk for spreading COVID-19, the accumulation of waste was largely reported as a 'management issue' – of maintaining flows and meeting contractual service-level obligations (see, Gregson & Forman, 2021 on the centrality of contracts in waste geographies). The problem of waste seems to be conceived in economic and service terms rather than in connection to the pressures on waste management and the dangers they pose to public health.

Occupational health: labour and risk management

The emerging logics of public health and environmental health intersect to generate important insights on waste during the pandemic. However, they are not yet adequate for fully understanding and addressing the challenges to the waste sector caused by, or rendered visible by, the pandemic. As Dey (2020) argues, because waste impacts all dimensions of societies it is necessary to find ways to articulate waste as a collective problem (rather than a problem for consumers, for instance). With the need for social distancing measures, more sickness among 'frontline' waste workers, and changes to the organisation of waste collection due to increases in domestic waste, the everyday practices of waste work have become more difficult to carry out. Compared to the papers underpinned by logics of environmental health and public health, the review has only thrown up a handful of papers substantially and critically discussing the pressures on waste workers and emerging occupational hazards during COVID-19 (Nzeadibe & Ejike-Alieji, 2020; Salve & Jungari, 2020). These have tended to be case studies of the pressures faced by waste managers and local authorities, who feared that labour shortages due to social distancing and furloughing would lead to service disruptions (Souter et al., 2020). For waste managers occupational health is a central concern in the pandemic response, largely because workers are both at risk and pose risks for transmission (e.g. ADEPT, 2020; Resource London, 2020; UNEP, 2020). Yet there is a paucity of research published on occupational health. This is echoed by Storr et al. (2021) who call for renewed interest in cleaners and sanitation workers as 'key workers' within any pandemic response (also see McClure et al. 2020).

Similar to other public services like health care, the protection of *occupational* health is essential for the continuity of services that ensure *public* health. The 'essential' work of waste collection during the pandemic has started to draw attention to occupational health concerns in this sector (e.g. Torkashvand et al. 2021). These are particularly concerning in contexts where infrastructures and supply chains were already under strain. For instance, in the UK (where the authors are located), the marketisation and privatisation of the waste sector along with ongoing cuts to local government funding through austerity policies, has eroded this critical service to the barest essentials. Notable engagements include research of interventions to protect workers from transmission risk, such as the implementation of protocols to cut possible 'pathways of exposure' in day-to-day practices (Nghiem et al., 2020; Shammi et al., 2021). Other research showed that exposure risks have largely been reported in sites where workers handle waste in close proximity to each other (Hoseinzadeh et al., 2020; Zand & Heir, 2020). Nonetheless, occupational health-related concerns in these examples centre on workers' bodies as sites of exposure rather than wider occupational health risk issues, such as exhaustion from longer shifts and greater absenteeism during COVID-19, which added pressures to waste work. Indeed, the logic of occupational health broadly overlooked more systemic questions around labour justice, sustainable waste management, and health equity. This brings us then to questions of how to hold these different logics together – what might a multi-logic approach to waste look like, or require?

Discussion

Re-constituting logics

The review has focused on three health logics of waste that are distinct, but by no means separate. Our task is to now flesh out these logics, attend to their intersections, and then open-up the discussion to consider what they enable in terms of developing a critical public health agenda for waste. In other words, to consider how waste can be approached as a health issue (and why doing so matters). We suggest that these logics are becoming entangled, with COVID-19 encouraging a mixing of issues; hitherto siloed disciplines are taking on public health *and* environmental health concerns, and researching public health matters that are increasingly dependent on the state of occupational health. This set of circumstances requires a multi-logic approach that is capable of accounting for the different relations of health that complex problems like waste evoke.

First, the logic of environmental health approaches COVID-19 as an opportunity to study the harmful ecological effects of waste management. Like government lockdowns that led to reductions in air pollution and (momentarily) exposed the impacts of industrial processes underpinning modern life, the proliferation of disposable PPE has also rendered economies and cultures of disposal visible. This is seen most explicitly in ‘coronalitter’ discourses. However, the new sights of disposal during COVID-19 have also reified waste, treating waste materials and the individuals discarding them as ‘bad actors’. Such environmental health approaches individualise responsibility and overlook the relations of power that shape waste-full systems. The coronalitter discourse is also underpinned by the assumption that there is a ‘right place’ for waste – an assumption predicated on the disposability of certain (often racialised and classed) bodies and lands (cf., Liboiron, 2021). At the same time, our review indicates how calls for more ‘sustainable’ waste management are also considering the intersections of climate change, resource use, health inequalities and the impacts of waste management.

Rather than addressing the systems that environmental health gestures towards, the logic of public health is narrowly focused on COVID-19 transmission and surveillance. Waste becomes a site for detecting and knowing the virus, and research is often directed to serve top-down public health interventions. The reviewed research on surveillance does not engage with the pivotal social science scholarship that has shed light on the ethical and practical implications of biomedical-centric surveillance approaches (e.g. Lohse & Canali, 2021) and tends to ignore how political systems shape policy responses (e.g. Lees et al. 2021). This evasion goes some way in explaining why the intersections of waste and public health often focus on discarded PPE. Responsibility to protect health continues to be framed as an individual problem because social and material contexts are not being paid attention to. As our review highlights this can result in the overarching concern of waste classification and quarantine locating blame for environmental harm on the individual and consumer practices of disposal (see, Roberts et al., 2021 for a discussion on litter). This narrow framing of the problem closes down possibilities for more nuanced and complex conversations about waste.

The political, social, and economic dimensions of waste labour were rarely a concern in the reviewed papers. Although the practices of waste work invited attention to workers’ bodies in terms of occupational health risk, the inequalities that shape this work were erased. Public health during COVID-19 is contingent on workers who are exhausted and often insecurely employed. Widespread industrial action led by waste workers during the pandemic – taking place across India, South Africa, the United States, and the UK, at the time of writing – have drawn attention to the pivotal role of this work. The widespread industrial action captures how health injustices are interlinked across scales and sites (Sultana, 2021). Indeed the ‘health’ of cities always relies on – or comes at the cost of – the health of those working with waste (see, Nagle, 2014; Reno, 2016). Yet in our review there was no discussion about the social implications of waste workers serving as a pressure-point, nor what might be learned for future preparedness. We argue that these practices must be apprehended and improved on in their own terms (cf. Mol 2008: 73), not only because occupational health is a political concern but also due to the capacity of occupational health to traverse different logics.

A more broadly defined approach to occupational health, which moves beyond risk management to account for the politics of waste labour, is a generative entry point for building what we call a ‘multi-logic’ approach. Holding public health, environmental health, and occupational health logics together enables critical conversations about the causes and impacts of the increasing toxicity and tonnage of waste. So, how might critical public health scholars move forward in this field? Although occupational health and labour have been side-lined, there is much to be learned from the ethnographic work on waste labour published over the past decade (e.g. Fredericks, 2018; Nagle, 2014; Reno, 2016). This scholarship has highlighted how waste work is central to the health of cities, for instance. Foregrounding labour reveals how waste management ‘sutures’ bodies and infrastructure together (Fredericks, 2018) in ways that make it vulnerable to collapse in a pandemic – despite it providing a core public service (cf. Dey 2020).

Learning from the longstanding social science literature on waste labour, we outline a research agenda for approaching waste as a critical public health problem: (1) first, understanding waste as an infrastructural issue. This means rejecting the ‘myth’ that waste is fundamentally a consumer problem (cf., Liboiron & Lepawsky, 2022) – a myth that is implicit in much of the environmental health literature. (2) Second, understanding waste management as care labour, for instance, re-values risky, marginalised, and ‘dirty’ work (see, Gregson et al., 2016). This pivotal relationship between occupational health risks and public health protection has yet to be critically considered for matters of waste (although see, Reno, 2016). However, during COVID-19, the politics of occupational health has rendered this relationship visible. By exploring the interrelations between different logics of health matters of waste can be attended to and cared for through a multi-logics approach. (3) Third, understanding waste as a planetary health problem (Hincliffe et al., 2021). This involves attending to intersecting injustices (Sultana 2021), as exemplified in the discourses surrounding striking waste workers and so-called climate revival. Waste as a planetary health problem can create new ways of holding public, environmental, and occupational health logics together. By outlining how different logics of health shape how waste is problematised, we propose this agenda as an invitation to examine the changing constitution of health within and beyond these logics.

Conclusions

This interdisciplinary review demonstrates how waste has come to matter in distinct ways during the COVID-19 pandemic, providing opportunities to re-think waste as a problem. We analysed the different research engagements with COVID-19 that surfaced in the waste literature, drawing out logics of environmental health, public health, and occupational health. In doing so, we highlighted how waste has the capacity to re-assemble actors and ideas around health at a time of intersecting health crises and inequalities. By delineating different logics of health, we identified productive overlaps and reshufflings that also offer analytical purchase on the ways in which the problem of waste might be articulated, or joined together. Our review illustrates why it is not possible to separate cultural or disciplinary understandings of waste from the practices and processes of management – the point is not to swap one logic with another but rather to help articulate their coexistence (A. Mol & Hardon, 2020). We therefore offer a reminder that waste is not merely discarded material to be managed away, rather, waste should be understood as fundamentally *constituting* the social (see, Moore, 2012) – or, in this context, constituting health. At a time when waste has been made to matter like never before, it is vital for critical public health scholars to re-centre waste in their research and discussions about health. By drawing out, and reading across, different logics of waste emerging during COVID-19, we argue waste offers an important and generative starting point for doing critical public health research.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data access statement

As this paper is a review it did not generate any new data.

Funding

This project is funded by ESRC as part of UK Research and Innovation's rapid response to COVID-19. Grant number: ES/V005200/1.

ORCID

Emma Garnett  <http://orcid.org/0000-0001-9318-8548>
 Angeliki Balayannis  <http://orcid.org/0000-0002-4504-4029>
 Steve Hinchliffe  <http://orcid.org/0000-0002-0698-8924>
 Thom Davies  <http://orcid.org/0000-0001-8392-8151>
 Toni Gladding  <http://orcid.org/0000-0002-2011-5046>
 Phillip Nicholson  <http://orcid.org/0000-0003-4131-165X>

References

- ADEPT. (2020) *COVID-19 Waste Survey Results*, Retrieved 17th November 2020, from <https://www.adeptnet.org.uk/groups/waste-group>
- Anderson, A., Chandralingam, R., & PraveenKumar, T. R. (2021). Impact of COVID-19 pandemic on plastic surge and environmental effects. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, 1–7. <https://doi.org/10.1080/15567036.2021.1900456>
- Bamber, J. H., & Christmas, T. (2020). COVID-19: Each discarded face mask is a potential biohazard. *BMJ (Clinical Research Ed.)*, 369, m2012. <https://doi.org/10.1136/bmj.m2012>
- Cesaro, A., & Pirozzi, F. (2020). About the effects of Covid-19 on solid waste management. *TeMA - Journal of Land Use, Mobility and Environment*, 59–66. <https://doi.org/10.6092/1970-9870/6904>
- Das, A. K., Islam, M. N., Billah, M. M., & Sarker, A. (2021). COVID-19 and municipal solid waste (MSW) management: A review. *Environmental Science and Pollution Research International*, 28(23), 28993–29008. <https://doi.org/10.1007/s11356-021-13914-6>
- de Wilde, M., Koopman, W., & Mol, A. (2020). Clean in Times of COVID-19: On hygiene and pollution. *Somatosphere*. <http://somatosphere.net/2020/clean-in-times-of-covid-19.html/>
- Dente, S. M. R., & Hashimoto, S. (2020). COVID-19: A pandemic with positive and negative outcomes on resource and waste flows and stocks. *Resources, Conservation, and Recycling*, 161, 104979. <https://doi.org/10.1016/j.resconrec.2020.104979>
- Dey, T. (2020). COVID-19 as method: Managing the ubiquity of waste and waste-collectors in India. *Journal of Legal Anthropology*, 4(1), 76–91. <https://doi.org/10.3167/jla.2020.040106>
- Di Maria, F., Beccaloni, E., Bonadonna, L., Cini, C., Confalonieri, E., La Rosa, G., Milana, M. R., Testai, E., & Scaini, F. (2020). Minimization of spreading of SARS-CoV-2 via household waste produced by subjects affected by COVID-19 or in quarantine. *The Science of the Total Environment*, 743, 140803. <https://doi.org/10.1016/j.scitotenv.2020.140803>
- Fadare, O. O., & Okoffo, E. D. (2020). Covid-19 face masks: A potential source of microplastic fibers in the environment. *The Science of the Total Environment*, 737, 140279. <https://doi.org/10.1016/j.scitotenv.2020.140279>
- Fredericks, R. (2018). *Garbage citizenship: Vital infrastructures of labor in Dakar, Senegal*. Duke University Press.
- Gregson, N., Crang, M., Botticello, J., Calestani, M., & Krzywoszynska, A. (2016). Doing the 'dirty work' of the green economy: Resource recovery and migrant labour in the EU. *European Urban and Regional Studies*, 23(4), 541–555. <https://doi.org/10.1177/0969776414554489>
- Gregson, N., & Forman, P. J. (2021). England's municipal waste regime: Challenges and prospects. *The Geographical Journal*, 187(3), 214–226. <https://doi.org/10.1111/geoj.12386>
- Harries, A. D., Dar Berger, S., Satyanarayana, S., Thekkur, P., & Kumar, A. M. V. (2020). Testing wastewater to detect severe acute respiratory syndrome coronavirus 2 in communities. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 114(10), 782–783. <https://doi.org/10.1093/trstmh/traa066>

- Hinchliffe, S., Manderson, L., & Moore, M. (2021). Planetary healthy publics after COVID-19. *The Lancet Planetary Health*, 5(4), e230–e236. [https://doi.org/10.1016/S2542-5196\(21\)00050-4](https://doi.org/10.1016/S2542-5196(21)00050-4)
- Hoseinzadeh, E., Javan, S., Farzadkia, M., Mohammadi, F., Hossini, H., & Taghavi, M. (2020). An updated min-review on environmental route of the SARS-CoV-2 transmission. *Ecotoxicology and Environmental Safety*, 202, 111015. <https://doi.org/10.1016/j.ecoenv.2020.111015>
- Ilyas, S., Rajiv, R. S., & Hyunjung, K. (2020). Disinfection technology and strategies for COVID-19 hospital and bio-medical waste management. *The Science of the Total Environment*, 749(August), 141652. <https://doi.org/10.1016/j.scitotenv.2020.141652>
- Islam, S. M. D., Safiq, M. B., Bodrus-Doza, Md., & Mamun, M.A. (2020). Perception and Attitudes Toward PPE Related Waste Disposal amid COVID-19 in Bangladesh: An Exploration Study. *Frontiers in Public Health*, 8, 592345.
- Kayshap, S., Ramaprasad, A., & Bidare Sastry, N. (2020). Waste quarantine to reduce COVID-19 infection spread. *The international journal of health planning and management*, 35(5), 1277–1278.
- Klemeš, J. J., Fan, Y. V., Tan, R. R., & Jiang, P. (2020). Minimising the present and future plastic waste, energy and environmental footprints related to COVID-19. *Renewable and Sustainable Energy Reviews*, 127(July), 109883. <https://doi.org/10.1016/j.rser.2020.109883>
- Kulkarni, B. N., & Anantharama, V. (2020). Repercussions of COVID-19 pandemic on municipal solid waste management: Challenges and opportunities. *The Science of the Total Environment*, 743, 140693. <https://doi.org/10.1016/j.scitotenv.2020.140693>
- Lees, S., Sariola, S., Schmidt-Sane, M., Enria, L., Tan, K. A., Aedo, A., Grietens, K. P., Kaawa-Mafigiri, D., On behalf of the COVID-19 Clinical Research Coalition Social Science Working Group. (2021). Key social science priorities for long-term COVID-19 response. *BMJ Global Health*, 6, e006741.
- Liang, Y., Song, Q., Wu, N., Li, J., Zhong, Y., & Zeng, W. (2021). Repercussions of COVID-19 pandemic on solid waste generation and management strategies. *Frontiers of Environmental Science & Engineering*, 15(6), 115. <https://doi.org/10.1007/s11783-021-1407-5>
- Liboiron, M. (2021). *Pollution is Colonialism*. Duke University Press.
- Liboiron, M., & Lepawsky, J. (2022). *Discard studies: Wasting, systems, and power*. MIT Press.
- Lima, L., de Brito, R. R., Labiak Junior, S., & Casagrande Junior, E. F. (2020). Health services waste management during COVID-19. *Revista Tecnologia E Sociedade*, 16(43), 60–69. <https://doi.org/10.3895/rt.s.v16n43.12367>
- Lodder, W., & de Roda Husman, A. M. (2020). SARS-CoV-2 in wastewater: Potential health risk, but also data source. *The Lancet. Gastroenterology & Hepatology*, 5(6), 533–534. [https://doi.org/10.1016/S2468-1253\(20\)30087-X](https://doi.org/10.1016/S2468-1253(20)30087-X)
- Lohse, S., & Canali, S. (2021). Follow *the* science? On the marginal role of the social sciences in the COVID-19 pandemic. *European Journal for Philosophy of Science*, 11(4), 99. <https://doi.org/10.1007/s13194-021-00416-6>
- Mallapaty, S. (2020). How sewage could reveal true scale of coronavirus outbreak. *Nature*, 580(7802), 176–177. <https://doi.org/10.1038/d41586-020-00973-x>
- Manoj, K. (2020). Wastewater monitoring and public health surveillance of SARS-CoV-2. *Indian Journal of Public Health*, 64(Supplement), S247–S248. https://doi.org/10.4103/ijph.IJPH_490_20
- Marres, N. (2012). *Material participation: Technology, the environment and everyday publics*. Palgrave Macmillan.
- McClure, E. S., Vasudevan, P., Bailey, Z., Patel, S., & Robinson, W. R. (2020). Racial capitalism within public health—how occupational settings drive COVID-19 disparities. *American Journal of Epidemiology*, 189(11), 1244–1253. <https://doi.org/10.1093/aje/kwaa126>
- Mihai, F.-C. (2020). Assessment of COVID-19 waste flows during the emergency state in Romania and related public health and environmental concerns. *International Journal of Environmental Research and Public Health*, 17(15), 5439. <https://doi.org/10.3390/ijerph17155439>
- Mol, A. (2008). *The logic of Care: Health and the Problem of Patient Choice*. Routledge
- Mol, M. P. G., & Caldas, S. (2020). Can the human coronavirus epidemic also spread through solid waste? *Waste Management & Research: The Journal of the International Solid Wastes and Public Cleansing Association, ISWA*, 38(5), 485–486. <https://doi.org/10.1177/0734242X20918312>
- Mol, A., & Hardon, A. (2020). What COVID-19 may teach us about interdisciplinarity. *BMJ Global Health*, 5(12), e004375. <http://dx.doi.org/10.1136/bmjgh-2020-004375>
- Mondelli, M. U., Colaneri, M., Seminari, E. M., Baldanti, F., & Bruno, R. (2021). Low risk of SARS-CoV-2 transmission by fomites in real-life conditions. *The Lancet Infectious Diseases*, 21(5), e112. [https://doi.org/10.1016/S1473-3099\(20\)30678-2](https://doi.org/10.1016/S1473-3099(20)30678-2)
- Moore, S. A. (2012). Garbage matters: Concepts in new geographies of waste. *Progress in Human Geography*, 36(6), 780–799. <https://doi.org/10.1177/0309132512437077>
- Murray, M. H., Byers, K. A., Buckley, J., Magle, S. B., Maffei, D., Waite, P., & German, D. (2020). “I don’t feel safe sitting in my own yard”: Chicago resident experiences with urban rats during a COVID-19 stay-at-home order. *MedRxiv*, 2020.11.25.20238741. <https://doi.org/10.1101/2020.11.25.20238741>
- Nagle, R. (2014). *Picking up: On the streets and behind the trucks with the sanitation workers of New York City*. Farrar Straus Giroux.

- Naughton, C. C. (2020). Will the COVID-19 pandemic change waste generation and composition?: The need for more real-time waste management data and systems thinking. *Resources, Conservation, and Recycling*, 162, 105050. <https://doi.org/10.1016/j.resconrec.2020.105050>
- Nghiem, L. D., Morgan, B., Donner, E., & Short, M. D. (2020). The COVID-19 pandemic: Considerations for the waste and wastewater services sector. *Case Studies in Chemical and Environmental Engineering*, 1(May), 100006. <https://doi.org/10.1016/j.cscee.2020.100006>
- Nourinejad, M., Berman, O., & Larson, C. (2021). Placing sensors in sewer networks: A system to pinpoint new cases of coronavirus. *PLoS One*, 16(4), e0248893.
- Nzeadibe, T. C., & Ejike-Alieji, A. U. P. (2020). Solid waste management during Covid-19 pandemic: Policy gaps and prospects for inclusive waste governance in Nigeria. *Local Environment*, 25(7), 527–535. <https://doi.org/10.1080/13549839.2020.1782357>
- Nzediegwu, C., & Chang, S. X. (2020). Improper solid waste management increases potential for COVID-19 spread in developing countries. *Resources, Conservation, and Recycling*, 161, 104947. <https://doi.org/10.1016/j.resconrec.2020.104947>
- Ouhssine, O., Ouigmane, A., Layati, E., Aba, B., Isaifan, R., & Berkani, M. (2020). Impact of COVID-19 on the qualitative and quantitative aspect of household solid waste. *Global Journal of Environmental Science and Management*, 6, 41–52. (Special Issue (Covid-19)). <https://doi.org/10.22034/GJESM.2019.06.SI.05>
- Paleologos, E. K., O'Kelly, B. C., Tang, C.-S., Cornell, K., Rodríguez-Chueca, J., Abuel-Naga, H., Koda, E., Farid, A., Vaverková, M. D., Kostarelou, K., Goli, V. S. N. S., Guerra-Rodríguez, S., Leong, E.-C., Jayanthi, P., Shashank, B. S., Sharma, S., Shreedhar, S., Mohammad, A., Jha, B., & Singh, D. N. (2020). Post Covid-19 water and waste water management to protect public health and geoenvironment. *Environmental Geotechnics*, 1–15. <https://doi.org/10.1680/jenge.20.00067>
- Peng, J., Wu, X., Wang, R., Li, C., Zhang, Q., & Wei, D. (2020). Medical waste management practice during the 2019–2020 novel coronavirus pandemic: Experience in a general hospital. *American Journal of Infection Control*, 48(8), 918–921. <https://doi.org/10.1016/j.ajic.2020.05.035>
- Pollans, L. B. (2021). *Resisting garbage: The politics of waste management in American cities*. University of Texas Press.
- Rada, E. C., Romenovna Magaril, E., Schiavon, M., Karaeva, A., Chashchin, M., & Torretta, V. (2020). MSW management in universities: Sharing best practices. *Sustainability*, 12(12), 5084. <https://doi.org/10.3390/su12125084>
- Ragazzi, M., Rada, E. C., & Schiavon, M. (2020). Municipal solid waste management during the SARS-COV-2 outbreak and lockdown ease: Lessons from Italy. *The Science of the Total Environment*, 745, 141159. <https://doi.org/10.1016/j.scitotenv.2020.141159>
- Rahman, M. M., Bodrud-Doza, M., Griffiths, M. D., & Mamun, M. A. (2020, August). Biomedical waste amid COVID-19: perspectives from Bangladesh. *The Lancet Global Health*, 8(10), e1262. [https://doi.org/10.1016/S2214-109X\(20\)30349-1](https://doi.org/10.1016/S2214-109X(20)30349-1)
- Reno, J. O. (2016). *Waste away: Working and living with a North American landfill*. University of California Press.
- Resource London. (2020). *COVID-19 commercial waste adaptation phase two: Assessment of the future impact of COVID-19 on commercial waste in London*, Retrieved 17th November 2020, from <https://resourcelondon.org/wp-content/uploads/2020/10/Phase-two-Assessment-of-the-future-impact-of-COVID-19-on-commercial-waste-in-London.pdf>
- Roberts, K. P., Phang, S. C., Williams, J. B., Hutchinson, D. J., Kolstoe, S. E., de Bie, J., Williams, I. D., & Stringfellow, A. M. (2021). Increased protective equipment litter as a result of COVID-19 measures. *Nature Sustainability*. <https://doi.org/10.1038/s41893-021-00824-1>
- Salve, P. S., & Jungari, S. (2020). Sanitation workers at the frontline: Work and vulnerability in response to COVID-19. *Local Environment*, 25(8), 627–630. <https://doi.org/10.1080/13549839.2020.1792430>
- Sarkodie, S. A., & Owusu, P. A. (2021). Global assessment of environment, health and economic impact of the novel coronavirus (COVID-19). *Environment, Development and Sustainability*, 23(4), 5005–5015. <https://doi.org/10.1007/s10668-020-00801-2>
- Sarkodie, S. A., & Owusu, P. A. (2021). Global effect of city-to-city air pollution, health conditions, climatic & socio-economic factors on COVID-19 pandemic. *The Science of the Total Environment*, 778, 146394. <https://doi.org/10.1016/j.scitotenv.2021.146394>
- Shammi, M., Behal, A., & Tareq, S. M. (2021). The escalating biomedical waste management to control the environmental transmission of COVID-19 pandemic: A perspective from two South Asian countries. *Environmental Science & Technology*, 55(7), 4087–4093. <https://doi.org/10.1021/acs.est.0c05117>
- Sharma, M., Luthra, S., Joshi, S., & Kumar, A. (2020b). Developing a framework for enhancing survivability of sustainable supply chains during and post-COVID-19 pandemic. *International Journal of Logistics Research and Applications*, 1–21. <https://doi.org/10.1080/13675567.2020.1810213>
- Sharma, H. B., Vanapalli, K. R., Cheela, V. R. S., Ranjan, V. P., Jaglan, A. K., Dubey, B., Goel, S., & Bhattacharya, J. (2020a). Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic. *Resources Conservation and Recycling*, 162, 105052. <https://doi.org/10.1016/j.resconrec.2020.105052>
- Shotwell, A. (2016). *Against purity: Living ethically in compromised times*. University of Minnesota Press.
- Souter, N., Balayannis, A., Jennings, P., Martin, H., Hardman, C., & Benfield, T. (2020). *UK waste sector COVID-19 response and resilience report*. The Chartered Institution of Wastes Management. <https://www.circularonline.co.uk/wp-content/uploads/2020/12/UK-Waste-Sector-COVID-19-Response-and-Resilience-Report.pdf>

- Storr, J., Kilpatrick, C., & Lee, K. (2021). Time for a renewed focus on the role of cleaners in achieving safe health care in low- and middle-income countries. *Antimicrobial Resistance and Infection Control*, 10(1), 59. <https://doi.org/10.1186/s13756-021-00922-x>
- Sultana, F. (2021). Political ecology II: Conjunctures, crises, and critical publics. *Progress in Human Geography*, 45(6), 1721–1730. <https://doi.org/10.1177/03091325211028665>
- Tabish, M., Khatoon, A., Alkahtani, S., Alkahtane, A., Alghamdi, J., Ahmed, S. A., Mir, S. S., Albasher, G., Almeer, R., Al-Sultan, N. K., Aljarba, N. H., Al-Qahtani, W. S., Al-Zharani, M., Nayak, A. K., & Hasnain, M. S. (2020). Approaches for prevention and environmental management of novel COVID-19. *Environmental Science and Pollution Research International*, 28(30), 40311–40321. <https://doi.org/10.1007/s11356-020-10640-3>
- Tiwari, S. B., Gahlot, P., Tyagi, V. K., Zhang, L., Zhou, Y., Kazmi, A. A., & Kumar, M. (2021). Surveillance of wastewater for early epidemic prediction (SWEEP): Environmental and health security perspectives in the post COVID-19 anthropocene. *Environmental Research*, 195, 110831. <https://doi.org/10.1016/j.envres.2021.110831>
- Torkashvand, J., Jonidi Jafari, A., Godini, K., Kazemi, Z., Kazemi, Z., & Farzadkia, M. (2021). Municipal solid waste management during COVID-19 pandemic: a comparison between the current activities and guidelines. *Journal of Environmental Health Science & Engineering*, 19(1), 1–7.
- Tran, H. N., Le, G. T., Nguyen, D. T., Juang, R.-S., Rinklebe, J., Bhatnagar, A., Lima, E. C., Iqbal, H. M. N., Sarmah, A. K., & Chao, H.-P. (2021). SARS-CoV-2 coronavirus in water and wastewater: A critical review about presence and concern. *Environmental Research*, 193, 110265. <https://doi.org/10.1016/j.envres.2020.110265>
- UNEP. (2020). *Waste management during the COVID-19 pandemic from response to recovery*. United Nations Environment Programme. <https://wedocs.unep.org/bitstream/handle/20.500.11822/33416/WMC-19.pdf?sequence=1&isAllowed=y>
- Vanapalli, K. R., Sharma, H. B., Ranjan, V. P., Samal, B., Bhattacharya, J., Dubey, B. K., & Goel, S. (2021). Challenges and strategies for effective plastic waste management during and post COVID-19 pandemic. *The Science of the Total Environment*, 750, 141514. <https://doi.org/10.1016/j.scitotenv.2020.141514>
- Vaverková, M. D., Paleologos, E. K., Dominijanni, A., Koda, E., Tang, C.-S., Małgorzata, W., Li, Q., Guarena, N., Mohamed, A.-M. O., Vieira, C. S., Manassero, M., O’Kelly, B. C., Xie, Q., Bo, M. W., Adamcová, D., Podlasek, A., Anand, U. M., Mohammad, A., Goli, V. S. N. S., & Singh, D. N. (2020). Municipal solid waste management under COVID-19: challenges and recommendations. *Environmental Geotechnics*, 1–15. <https://doi.org/10.1680/jenge.20.00082>
- You, S., Sonne, C., & Ok, Y. S. (2020a). COVID-19: Resource recovery from plastic waste against plastic pollution. *Cogent Environmental Science*, 6(1), 1801220. <https://doi.org/10.1080/23311843.2020.1801220>
- You, S., Sonne, C., & Ok, Y. S. (2020b). COVID-19’s unsustainable waste management. *Science*, 368(6498), 1438. <https://doi.org/10.1126/science.abc7778>
- Yu, H., Sun, X., Solvang, W. D., & Zhao, X. (2020). Reverse logistics network design for effective management of medical waste in epidemic outbreaks: Insights from the coronavirus disease 2019 (COVID-19) outbreak in Wuhan (China). *International Journal of Environmental Research and Public Health*, 17(5), 1770. <https://doi.org/10.3390/ijerph17051770>
- Zand, A. D., & Heir, A. V. (2020). Emerging challenges in urban waste management in Tehran, Iran during the COVID-19 pandemic. *Resources, Conservation, and Recycling*, 162, 105051. <https://doi.org/10.1016/j.resconrec.2020.105051>