BMJ Global Health

Prepared for the polycrisis? The need for complexity science and systems thinking to address global and national evidence gaps

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To cite: Kwamie A, Causevic S, Tomson G, *et al*. Prepared for the polycrisis? The need for complexity science and systems thinking to address global and national evidence gaps. *BMJ Glob Health* 2024;**9**:e014887. doi:10.1136/bmjgh-2023-014887

Handling editor Helen J Surana

► Additional supplemental material is published online only. To view, please visit the journal online (https://doi.org/10.1136/bmjgh-2023-014887).

Received 21 December 2023
Accepted 28 August 2024

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ABSTRACT

The Sustainable Development Goals are far off track. The convergence of global threats such as climate change, conflict and the lasting effects of the COVID-19 pandemic—among others—call for better data and research evidence that can account for the complex interactions between these threats. In the time of polycrisis, global and national-level data and research evidence must address complexity. Viewed through the lens of 'systemic risk', there is a need for data and research evidence that is sufficiently representative of the multiple interdependencies of global threats. Instead, current global published literature seems to be dominated by correlational, descriptive studies that are unable to account for complex interactions. The literature is geographically limited and rarely from countries facing severe polycrisis threats. As a result, country guidance fails to treat these threats interdependently. Applied systems thinking can offer more diverse research methods that are able to generate complex evidence. This is achievable through more participatory processes that will assist stakeholders in defining system boundaries and behaviours. Additionally, applied systems thinking can draw on known methods for hypothesising, modelling, visualising and testing complex system properties over time. Application is much needed for generating evidence at the global level and within national-level policy processes and structures.

SUMMARY BOX

⇒ There have been many assertions that the convergence of climate change, conflict and COVID-19, among other global threats, is hindering progress towards the Sustainable Development Goals.
⇒ While the need for timely and accurate data has been recognised, it seems that neither data nor research evidence generated at global and national levels are sufficiently able to account for the complexity required in an era of polycrisis.
⇒ Applied systems thinking can enhance the polycrisis evidence base and better guide complex policy action, especially in countries facing the most severe polycrisis threats.
⇒ It can do this by enabling better theorising of complex interactions, supporting more participatory solution-building and offering methods to hypothesise, visualise, model and test solutions over time.

INTRODUCTION: THE NEED FOR COMPLEX EVIDENCE TO ADDRESS THE POLYCRISIS

The 2024 Sustainable Development Goals (SDGs) report notes that only 17% of the targets are on track.[1] The COVID-19 pandemic tested the resilience of social, political, economic, environmental and health systems spanning household, community, national, regional and global levels.[2] The frequency of emerging infectious disease threats like COVID-19 is expected to increase.[3] Furthermore, such threats occur in contexts of worsening climate change and new and protracted global conflicts—and low-income countries bear the brunt of these mutually reinforcing effects. Terms like polycrisis—multiple overlapping and interdependent crises—are now commonly used to describe the coexistence of simultaneous and interlinked global threats.[4] Polycrisis underscores widespread perceptions that global complexity is increasing. The complexity of the polycrisis is not just the multiplicity, simultaneity or even gravity of the threats—it is their systemic and cascaded nature that depletes multilevel coping capacities and demands transformed and systemic global responses.

The 2024 SDG Report further notes that data are vital for measuring progress towards and identifying challenges and solutions related to the attainment of the SDGs. Beyond the persistent challenges of data availability and

Box 1 Systems, systems thinking and complex systems properties

- ⇒ System: An assembly of components that interact in some organised way over time to serve an overall function.
- ⇒ Systems thinking: A problem-solving approach that recognises and prioritises understanding of linkages, relationships, interactions and interdependencies among the components of a system (structures and agents) that give rise to the system's observed behaviour.
- ⇒ Complex system: A system consisting of multiple components connected in multiple ways that demonstrate complex properties either behaviourally or structurally.
- ⇒ Complex system properties:
  - ⇒ Emergence: System property that was not initially present that comes into existence spontaneously through other systemic interactions.
  - ⇒ Self-organisation: Within-system aggregation that takes place in the absence of any external stimuli/direction.
  - ⇒ Feedback: Cyclical effects from interactions that reinforce (ie, positive) or dampen (ie, negative) the interactions' effects. These causal interrelationships can be visualised diagrammatically as causal loop diagrams.
  - ⇒ Path dependence: History-dependent patterns that are deterministic to a future system state.
  - ⇒ Non-linearity: Interactions that occur out of (expected) sequence.
  - ⇒ Holism: The collective (macro) systemic behaviours that amount to more than the discrete, individual microinteractions.
  - ⇒ Tipping point: The point at which multiple, often continuous, microchanges result in system-wide change.
  - ⇒ Time delay: A break in (expected) time between the onset and effect of an interaction.

timeliness,[1] the question must be addressed of whether or not the evidence that is being generated is representative of the systemic nature of interacting phenomena. In response, recent literature on the polycrisis has called for greater focus on the development of new leadership competencies,[5] on social protection[6] and on social epidemiology for more evidence to act on the social determinants of health.[7]

In this paper, we contend that the polycrisis demands greater use of complexity science and systems thinking. Interdependency of the global threats must be viewed through the lens of systemic risk: risk embedded in wider contexts of systems' processes, global in nature, highly interconnected with complex, non-linear, causal structures.[8] Yet, it is not clear that complexity science—the study of complex system properties (see box 1)—is being sufficiently harnessed to inform new solutions. Likewise, applied systems thinking—the loose set of methodologies used to define, diagnose and make sense of system properties—has been underused and under-theorised in global public health.[9]

This paper seeks to add to a small but growing literature that applies systems thinking to global threats like climate change, conflict and COVID-19 (3Cs),[10–15] (as a proxy for future pandemics/epidemics), and SDG interactions more generally.[16 17] In particular, we seek to go beyond simplistic, linear interactions, towards considering complex system properties.

Global systems in health, economics, environment, society and politics and their overarching governance are failing the polycrisis test. To strengthen these systems in order to prepare for and respond to existing and emerging global threats, complexity needs to be engaged in a scientific way. We aim to demonstrate that there are insufficient types of evidence—at global and national levels—to enable the study and improved understanding of complexity across these systems, which in turn could support the formulation of adequate policy responses. We also consider how this evidence gap might be closed so that research evidence informs policy interventions that can have a meaningful impact in a time of polycrisis. Our findings are informed by a review of the available evidence and an examination of country policy documents.

WHAT KIND OF EVIDENCE EXISTS AT GLOBAL LEVEL?

Since the 2022 SDG Report,[18] the convergence of the effects of the COVID-19 pandemic, accelerated climate change and increasing conflict (the 3Cs) has been understood but not well accounted for in terms of research evidence. The global published evidence on 3Cs primarily reflects interactions between only two 'Cs'. Most study types used to investigate 3C interactions are correlational studies,[19 20] systematic reviews[21–23] or commentaries and perspective papers.[24–29] Where the literature does reflect interactions between all three 'Cs', these articles are primarily from countries in the Eastern Mediterranean region.[30–32] They focus on COVID-19 responses and broader lessons for climate adaptation from Afghanistan,[33] Yemen[34] and Palestine.[35] In conflict-affected countries, COVID-19 interactions have largely exacerbated livelihood threats, internal displacement and food security.[33]

Government effectiveness, state capacity, economic disparities, levels of trust and other political determinants have shaped pandemic responses.[30] More broadly, governance interactions that considered a lack of trust in science and political systems, and misinformation linked to climate change have been documented in studies related to COVID-19.[36–38] Skewed towards descriptive, correlational studies that by their very design, can only yield results that depict bidirectional interactions, this literature ignores myriad other interactions that need elucidating. Moreover, there is a geographical imbalance in published studies, with fewer papers focused on Africa, Asia and Latin America, regions that face acute polycrisis threats hindering their SDG progress. In short, global published literature on the 3Cs is methodologically, topically and geographically limited.

Box 2 Burkina Faso, a country caught in the polycrisis

Burkina Faso is a Sahelian country in West Africa. It has an agricultural and livestock-based economy and ranks 184th of 191 countries on the Human Development Index.[46] Worsening security contexts affect already- fragile subsistence livelihoods. While the nation experiences cycles of drought and flooding, farmer-pastoralist tensions over shrinking natural resources and an ongoing jihadist insurgency have led to high levels of internal displacement. Since 2015, attacks on public institutions such as schools, health facilities and churches by armed groups have resulted in more than 4000 deaths.[47] 1.76 million internally displaced persons within the country, and 25 300 refugees, strain already scarce and contested natural resources and social cohesion and food security.[48 49] Since October 2022, 196 health facilities have been closed or are non-functional and 410 others have been operating at minimum capacity, depriving 2 million people of access to care.[50] Though Burkina Faso had low COVID-19 prevalence, there are significant challenges of recurrent climate-linked 'endemo-epidemics' (meningitis, acute respiratory illness, cholera and malaria), and in recent times, outbreaks of avian influenza.

WHAT KIND OF EVIDENCE EXISTS IN LOW-INCOME COUNTRIES?

Many low-income countries face acute polycrisis threats that are hindering their SDG achievement. An example is Burkina Faso, a country affected by conflict while also facing stark climate change realities and fragile preparedness and response readiness that threaten the health of its population (see box 2).

Burkina Faso was the first country in the world to adopt its National Climate Change Adaptation Action Plan (NAP) in 2015, and a number of policy documents exist to guide national action on climate, conflict and endemo-epidemics—and more recently, COVID-19 . Similar to the global published literature, much of the available country-level guidance on the 3Cs is limited. For example, the National Multi-risk Plan for Disaster Preparedness and Response[39] and the NAP[40] both mention climate change, conflict and endemo-epidemics.

However, where the 'Cs' are mentioned, they are only listed, often with the responsible lead sectors highlighted, but without indication of how these 'Cs' might be interacting. Of note, energy, environment and water sectors appear to dominate; health and security are broadly absent. Prioritisation of health as part of climate adaptation lags behind, as evidenced by low NAP allocations to health (<5% of NAP resources), compared with agriculture (34%) and energy sectors (29%).[40]

The situation in Burkina Faso illustrates the common challenge in countries: that policy frameworks account for but do not operationalise 3C interactions. At the national level, Burkina Faso policy documents recognise the numerous challenges to polycrisis preparation and response. However, these documents do not sufficiently analyse how these interactions might be occurring. Gaps in data accessibility and underinvestment in institutionalisation, monitoring, evaluation and participatory planning, have been cited as barriers to policy implementation.[41–43]

THE WAY FORWARD: MORE USE OF COMPLEXITY THEORY AND SYSTEMS THINKING TO STRENGTHEN DATA AND RESEARCH EVIDENCE

The current evidence base—both globally and nationally—is inadequate. It is not able to generate an understanding of the complexity of the polycrisis that can enable sound policy advice. Global published literature is largely correlational and descriptive—which inherently negates the possibilities of elucidating longer-term and more complex interactions. The literature is also geographically limited, with few studies emanating from Africa, Latin America and the Caribbean, and the Western Pacific, global regions at the forefront of the polycrisis. Moreover, in a low-income country like Burkina Faso, where progress towards the SDGs is hampered by serious repercussions from the polycrisis, national-level policy documents do not provide adequate guidance for complex action.

Systems thinking can partially fill these gaps in the evidence base. Applied systems thinking, grounded in complexity science, can offer more diverse research methods that can advance our ability to analyse polycrisis threats. First, applied systems thinking enables better hypothesising of the complex system properties that might be at play among global threats. This is achieved through expanding stakeholders' perceptions of system boundaries and behaviours as they adapt to changes over time. Second, applied systems thinking can deploy known methods and tools to define, model, visualise and test complex system properties in real time. Properties such as feedback and path dependence, time delays, emergence, self-organisation, and tipping points can be studied through systems dynamic modelling and the use of process maps and causal loop diagrams. Similarly, participatory processes such as soft systems methodology, and critical systems heuristics can help stakeholders to jointly make sense of the system and offer a structured way of responding to system problems.

In terms of systemic risk, 3Cs can be considered risk multipliers: their modulating effects can be studied over time, with a view towards hypothesising their emergent and self-organising properties. This is particularly important given that correlational, descriptive studies largely overlook the dimension of time as a complex property. With much of the global published literature representing cross-sectional, short-term findings, the hidden temporality of time delays may only be revealed through longitudinal studies that can better measure systemic change of causal pathways that are often indirect.

What are the implications for improving research evidence to better respond to the polycrisis? There is evidently an urgent need for more diverse research methods that can deepen explanatory power. This will

require investments in longitudinal, embedded and transdisciplinary research. Systems thinking can draw on participatory approaches that have the potential to render solutions more equitable and accurate as they convene the actors who make up the system. Furthermore, a systemic risk perspective encourages research that accounts for tensions within systems, between 'slow' interactions that are near-imperceptible and irreversible (like climate change), and 'acute' interactions that introduce system shock (like conflict or pandemics and epidemics).

Multidimensional and longitudinal datasets that contain indicators from across global threats are a start. Examples of Health and Demographic Surveillance Systems datasets expanding beyond births, deaths and in/out migration, to include climate indicators—as is currently the case in Burkina Faso[44]—are important for developing comprehensive country-level early-warning systems. As more light is shone on other emerging global threats, including conflict, these indicators should be included. Another solution may be a 'polycrisis data repository' that can strengthen multisectoral and multidisciplinary research and policy efforts. Such a repository could further support governance structures and policy interventions that are adaptive and able to govern the complexity while being guided by equity considerations for data gathering and sharing. This is much needed at both global and local levels.

Critics of systems thinking may say it is too abstract, too difficult, too costly, has too many tools and approaches to knowledgeably choose from and is unproven in attaining more effective or efficient processes.[45] In response, we contend that the power of applied systems thinking lies in its ability to increase equity of collective engagement as stakeholders begin to share understandings of the whole system—not just their discrete sections of it. This can dissolve the separation between system actors and lead to more accurate definitions of the system's problems—and thus its feasible solutions. Systems thinking offers a rigorous way to penetrate complexity. For policy-makers and practitioners seeking to improve health, complexity is not the endpoint, but the beginning of investigation and intervention. To this end, more documented examples of the applicability of systems thinking in practice and its manner of supporting change are much needed.

CONCLUSION

Applied systems thinking based on complexity science can enhance nuanced understanding of the impacts of interlinked crises and their cascading risks. There is a lack of good research evidence—both global and national—that can usefully inform policy in the era of polycrisis. The current evidence base demonstrates some interactions between 3Cs. There are more global threats beyond these three. To better understand their complexity and interdependence, there needs to be greater use of complexity science and applied systems thinking, facilitated by strengthening and joining data systems. This speaks to the urgent need for more diverse research methods. Failing to fill this evidence gap will continue to hamper an effective response to interlinked crises and will further imperil the possibility of achieving the SDGs. On the eve of the High-level Political Forum on SDGs 2024, this is a timely reminder.

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Acknowledgements The authors thank Aristide Ouédraogo, Pascal Zabré and Issouf Traoré for statistical support, and Amanda Karapici for comments in reviewing early drafts of this manuscript. Ole Petter Ottersen is Visiting Fellow at Charité University Medicine Berlin, supported by the Charité Foundation.

Contributors GT and AK conceived of the study. AK, SC and GT designed the study. SC and AK conducted the literature search. AK, SC and AS conducted the data collection and analysis. AK, SC, AS, GT, RS and OPO interpreted the data. AK, SC, KR, OPO, RS, GT and AS drafted, critically revised and approved the final version of the manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Disclaimer The author is a staff member of the World Health Organization. The author alone is responsible for the views expressed in this publication and they do not necessarily represent the views, decisions or policies of the World Health Organization.

Competing interests None declared.

Patient and public involvement statement Patients/public were not involved in the research, design or conduct of this analysis paper.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article.

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REFERENCES

1 United Nations. The sustainable development goals report 2024. United Nations New York; 2024.
2 Wernli D, Clausin M, Antulov-Fantulin N, *et al*. Building a multisystemic understanding of societal resilience to the COVID-19 pandemic. *BMJ Glob Health* 2021;6:e006794.
3 Rockström J, Norström AV, Matthews N, *et al*. Shaping a resilient future in response to COVID-19. *Nat Sustain* 2023;6:897–907.
4 World Economic Forum. The global risks report 2023. 2023.
5 Wong BLH, Nordström A, Piot P, *et al*. From polycrisis to metacrisis: harnessing windows of opportunity for renewed political leadership in global health diplomacy. *BMJ Glob Health* 2024;9:e015340.

6 Landin Basterra E, Naidoo M, Calvacanti D, *et al*. Social protection in global crises: a gap between evidence and action. *BMJ Glob Health* 2023;8:e013980.
7 Rasella D, Macicame I, Naheed A, *et al*. The need for global social epidemiology in the polycrisis era. *BMJ Glob Health* 2024;9:e015320.
8 Li H-M, Wang X-C, Zhao X-F, *et al*. Understanding systemic risk induced by climate change. *Adv Clim Change Res* 2021;12:384–94.
9 Kwamie A, Ha S, Ghaffar A. Applied systems thinking: unlocking theory, evidence and practice for health policy and systems research. *Health Policy Plan* 2021;36:1715–7.
10 Gallo G. Conflict Theory, Complexity and Systems Approach. *Syst Res* 2013;30:156–75.
11 Cawthorn DM, Kennaugh A, Ferreira SM. The future of sustainability in the context of COVID-19. *Ambio* 2021;50:812–21.
12 Talukder B, vanLoon GW, Hipel KW. Planetary health & COVID-19: A multi-perspective investigation. *One Health* 2022;15:100416.
13 Sahin O, Salim H, Suprun E, *et al*. Developing a Preliminary Causal Loop Diagram for Understanding the Wicked Complexity of the COVID-19 Pandemic. *Syst* 2020;8:20.
14 Hendriks SL, Montgomery H, Benton T, *et al*. Global environmental climate change, covid-19, and conflict threaten food security and nutrition. *BMJ* 2022;378:e071534.
15 Heffernan C. Climate change and multiple emerging infectious diseases. *Vet J* 2018;234:43–7.
16 Pradhan P, Costa L, Rybski D, *et al*. A Systematic Study of Sustainable Development Goal (SDG) Interactions. *Earths Future* 2017;5:1169–79.
17 Nilsson M, Chisholm E, Griggs D, *et al*. Mapping interactions between the sustainable development goals: lessons learned and ways forward. *Sustain Sci* 2018;13:1489–503.
18 United Nations. The sustainable development goals report, 2022. United Nations New York; 2022.
19 Abraham J, Turville C, Dowling K, *et al*. Does Climate Play Any Role in COVID-19 Spreading?-An Australian Perspective. *Int J Environ Res Public Health* 2021;18:17:9086.
20 Wells JS, Scheibein F. Global pandemics, conflict and networks - the dynamics of international instability, infodemics and health care in the 21st century. *J Res Nurs* 2022;27:291–300.
21 Bowles DC, Butler CD, Morisetti N. Climate change, conflict and health. *J R Soc Med* 2015;108:390–5.
22 Katoto PDMC, Brand AS, Bakan B, *et al*. Acute and chronic exposure to air pollution in relation with incidence, prevalence, severity and mortality of COVID-19: a rapid systematic review. *Environ Health* 2021;20:41.
23 Silva ACT, Branco PTBS, Sousa SIV. Impact of COVID-19 Pandemic on Air Quality: A Systematic Review. *Int J Environ Res Public Health* 2022;19:1950.
24 Agrawala S, Amann M, Binimelis de Raga G, *et al*. Call for comments: climate and clean air responses to covid-19. *Int J Public Health* 2020;65:525–8.
25 Manirambona E, Uwizeyimana T, Uwiringiyimana E, *et al*. Impact of the COVID-19 pandemic on the food rations of refugees in Rwanda. *Int J Equity Health* 2021;20:107.
26 Ang I. Beyond the crisis: transitioning to a better world? *Cult Stud* 2021;35:598–615.
27 Ching J, Kajino M. Rethinking Air Quality and Climate Change after COVID-19. *Int J Environ Res Public Health* 2020;17:5167.
28 Grobusch LC, Grobusch MP. A hot topic at the environment-health nexus: investigating the impact of climate change on infectious diseases. *Int J Infect Dis* 2022;116:7–9.
29 Kuzemko C, Bradshaw M, Bridge G, *et al*. Covid-19 and the politics of sustainable energy transitions. *Energy Res Soc Sci* 2020;68:101685.
30 Bizri NA, Alam W, Mobayed T, *et al*. COVID-19 in conflict region: the arab levant response. *BMC Public Health* 2021;21:1590.
31 Negev M, Dahdal Y, Khreis H, *et al*. Regional lessons from the COVID-19 outbreak in the Middle East: From infectious diseases to climate change adaptation. *Sci Total Environ* 2021;768:144434.
32 Osman M, Cummings KJ, El Omari K, *et al*. Catch-22: War, Refugees, COVID-19, and the Scourge of Antimicrobial Resistance. *Front Med (Lausanne)* 2022;9:921921.
33 Ahmadi A, Gandour G, Ghaffari H, *et al*. Food security and COVID-19 in Afghanistan: a two-sided battlefront. *Trop Med Health* 2021;49:77.
34 Alsabri M, Alhadheri A, Alsakkaf LM, *et al*. Conflict and COVID-19 in Yemen: beyond the humanitarian crisis. *Global Health* 2021;17:83.
35 Mahamid F, Veronese G, Bdier D. Gender-based violence experiences among Palestinian women during the COVID-19 pandemic: mental health professionals' perceptions and concerns. *Confl Health* 2022;16:13.
36 Al-Rawi A, Blackwell B, Kane O, *et al*. COVID-19 in the Time of Climate Change: Memetic Discourses on Social Media. *Env Comm* 2022;16:864–82.
37 Ahmad E. Multilevel responses to risks, shocks and pandemics: lessons from the evolving Chinese governance model. *J Chin Gov* 2022;7:291–319.
38 Assefa Y, Woldeyohannes S, Cullerton K, *et al*. Attributes of national governance for an effective response to public health emergencies: Lessons from the response to the COVID-19 pandemic. *J Glob Health* 2022;12:05021.
39 Gouvernement du Burkina Faso. Plan National Multirisque de Preparation et de Reponse aux Catastrophes, Periode 2013-2014. Ouagadougou ouvernement du Burkina Faso; 2013.
40 Ministere de L'Enironnement et des Ressources Halieutiques. *Plan National D'Adaptation Aux Changements Climatiques (PNA) Du Burkina Faso*. Ouagadougou: Ministere de L'Enironnement et des Ressources Halieutiques, 2015.
41 Theokritoff E, D'haen S. Etat des lieux de l'integration du changement climatique dans les politiques nationales d'adaptation et de developpement au Burkina Faso. Berlin Climate Analytics gGmbH; 2019.
42 Basson F, Zougmoré F, Somda J, *et al*. Analyse Du Plan National d'Adaptation Aux Changements Climatiques (PNA) Du Burkina Faso Et De Sa Capacité A Atteindre Ses Objectifs. *ESJ* 2020;16.
43 Basson F, Zougmoré F, Somda J, *et al*. Analyse Du Plan National d'Adaptation Aux Changements Climatiques (PNA) Du Burkina Faso Et De Sa Capacité A Atteindre Ses Objectifs. *ESJ* 2020;16:27.
44 Barteit S, Sié A, Zabré P, *et al*. Widening the lens of population-based health research to climate change impacts and adaptation: the climate change and health evaluation and response system (CHEERS). *Front Public Health* 2023;11:1153559.
45 Haynes A, Garvey K, Davidson S, *et al*. What Can Policy-Makers Get Out of Systems Thinking? Policy Partners' Experiences of a Systems-Focused Research Collaboration in Preventive Health. *Int J Health Policy Manag* 2020;9:65–76.
46 UNDP. Human development report 2021-22. UNDP (United Nations Development Programme); 2022.
47 Uppsala conflict data programme. 2023. Available: www.ucdp.uu.se
48 Sorgho R, Jungmann M, Souares A, *et al*. Climate Change, Health Risks, and Vulnerabilities in Burkina Faso: A Qualitative Study on the Perceptions of National Policymakers. *Int J Environ Res Public Health* 2021;18:4972.
49 Ozer P, Dembele A, Yameogo SS, *et al*. The impact of COVID-19 on the living and survival conditions of internally displaced persons in Burkina Faso. *World Dev Perspect* 2022;25:100393.
50 Sante C. Bulletin No.35 du Cluster Sante: Decembre 2022. Burkina Faso Centre des Operations de Reponse aux Urgences Sanitaire (CORUS); 2022.