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RESEARCH PAPER

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Empowering health systems research to engage with technical, organizational, social and economic forces: Lessons from the 2014 Ebola epidemic

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Abstract

This paper draws lessons from the Ebola Virus Disease epidemic to suggest how health systems research can be strengthened to assist better with preparedness for and mitigation of future public health emergencies. The epidemic killed more than 11 000 people in West Africa between February 2014 and January 2016. The causes of the epidemic and the response to the outbreak harbour many lessons concerning how health systems were overwhelmed and need to be re-designed in order to cope with future public health emergencies and limit their escalation. From these lessons, it is possible to identify the most significant systemic issues that must be addressed to ensure health systems can exhibit greater resilience in the face of similar events in the future. The paper goes on to consider the current capacity of health systems research (HSR) to assist with the management of these issues and to suggest that critical systems thinking and practice could empower health systems researchers and practitioners in a manner that would give them much greater potency. The research has additional importance now that Covid-19 has demonstrated that pandemics are not 'black swan' events.

KEYWORDS

complexity, critical systems thinking, Ebola, epidemics, health systems research

1 | INTRODUCTION

The Ebola Virus Disease (EVD) is a zoonosis (an infectious disease that has jumped from animals to humans) that falls into the category of poverty related, often neglected diseases. An EVD epidemic occurred in three post-conflict West African countries that according to the Human Development Index, which ranks countries according to level of income, education, life expectancy and quality of life, positioned Guinea at 179, Liberia at 175 and Sierra Leone at 183 out of 187 countries in the world (UNDP, 2014). Among the poorest in the world, these countries were going through different processes of reconstruction following civil unrest that damaged their social fabrics, economies and health infrastructures, especially in rural areas. The EVD epidemic in West Africa killed more than 11 000 people between February 2014 and January 2016. The causes of the epidemic and the response to the outbreak harbour many lessons concerning how health systems need to be designed and improved in order to prevent future epidemics of this type or, at least, limit their escalation. From these lessons, it is possible to identify the most significant systemic issues, consider the current capacity of health systems research (HSR) to contribute to their management and suggest how critical systems thinking

(CST) could empower HSR to better assist in coping with similar situations.

2 | STRUCTURE OF THE ARGUMENT

The paper assesses the causes, spread and impact of the epidemic. It examines the reaction from community to global level and identifies major systemic issues that could be better addressed to improve both preparedness and response. The information and data are drawn from the experiences of one of the authors (Luis Sambo) who, as the World Health Organization (WHO) Regional Director for Africa, coordinated the local response in 2014; from published WHO sources; and from scientific papers related to the EVD epidemic and systems thinking. The paper highlights *first*, the main features of the epidemic, including its social and economic impact, and identifies major systemic issues such as: its inherent complexity, the lack of effective technologies to fight the disease, the epidemiological surveillance and contact tracing challenges, the weakness of health system infrastructures, the myriad of diverse stakeholders, community resistance and the impact of inequality. *Secondly*, the paper unfolds a critical review of the current state of HSR, underscoring how it has responded to complexity challenges and revealing how it contributes and where it falls short both in theory and in practice. *Thirdly*, it explores the broader systems theory literature, using a critical systems thinking lens to unveil what it has to offer. It underlines the need for a holistic analysis of complex problem situations and the use of a multi-perspectival and multimethodological approach that guides the informed use of different system approaches in combination, as required by the context, to improve practice and outcomes when coping with public health emergencies.

3 | THE EPIDEMIC

3.1 | Background

The index case ('patient zero') occurred on the 26 December 2013 in an 18-month-old boy who was seen playing in his backyard near a hollow tree heavily infested with bats, prior to onset of symptoms, in a village called Meliandou, with 31 households, located in the forest region of the Gueckédou District in south-eastern Guinea. This district, where 85% of the population is Muslim, shares borders with the district of Lofa in Liberia and the district of Kailahun in Sierra Leone. On 10 March 2014, public health services in Gueckédou alerted the central level of the Ministry of Health of Guinea about clusters of an uncommon disease characterized by 'fever, severe diarrhoea, vomiting and high fatality rate'. Three days later, the Ministry of Health reported to WHO and a joint team of experts was deployed to the field to undertake an epidemiological investigation. This took place from 14–20 March. On the 21st of March, following laboratory confirmation, WHO officially reported on a rapidly evolving outbreak of EVD, with 49 cases including 29 deaths in the forested areas of south-eastern Guinea in the Mano-River region. The deadly virus spread fast within Guinea and across adjacent borders up to the capitals of the three countries, causing wide-spread community transmission in crowded metropolitan areas (AFRO, 2014; Bell et al., 2016).

The Ebola virus is thought to be introduced into humans when a person has direct contact with the blood, body fluids or organs of infected animals (such as fruit bats, chimpanzees or gorillas) or prepares meat from infected animals. Then, the infection in human communities is sustained through human-to-human transmission through direct contact through blood or body fluids (such as urine, saliva, sweat, faeces, vomit, breast milk and semen), often from symptomatic persons to caregivers in households and health care facilities where Infection Prevention Control (IPC) practice is inadequate or Protective Personal Equipment (PPE) is unavailable. Because infected corpses have high viral loads, funeral and burial ceremonies and rituals of washing and touching bodies of deceased patients, which are traditional practices in West Africa, became a source of additional and multiple chains of virus transmission. On 8 August 2014, 5 months after the declaration of the epidemic, the number of cases reached 1848, including 1013 deaths in the three affected countries reflecting a 55% case fatality rate. In this context, and based on the recommendations of its International Health Regulations-Emergency Committee, the Director General of WHO declared the EVD outbreak in West Africa a 'Public Health Emergency of International Concern' (AFRO, 2014). One month later, Ebola was spreading at an exponential rate, with the number of cases doubling approximately every 3 weeks. In September, Ban Ki-moon, Secretary-General of the UN, declared that the epidemic was not just a public health crisis 'but has become multidimensional, with significant political, social, economic, humanitarian, logistical and security dimensions'. At an emergency meeting, the UN Security Council adopted Resolution 2177 (2014) declaring the outbreak of Ebola Hemorrhagic Fever in West Africa a threat to international peace and security. Burci (2014) argues that the major factor in this was the unique

political and economic vulnerability of the three countries that had emerged only recently, and with difficulty, from vicious civil wars and risked seeing their development and political gains reversed by Ebola. Pondering on the UN's willingness to come up with a new vision of *international security*, which included infectious diseases as threats, the author alludes to Robert Ullman's definition of *threats to security* as 'events that acutely degrade the quality of life of a population or that threaten significantly to narrow the range of policy choices available to a government or to private entities within a state'. He finally argues that the Security Council Resolution was actually based on the risk of international spread of the Ebola epidemic.

3.2 | Social impact

In Guinea, the geographic area of epidemic onset is one of very intense movements of people and goods across and within borders. Gueckédou had been severely affected by the civil wars in Liberia and Sierra Leone, particularly during the heavy fighting of 2000 and 2001, which led to rural migration and the scattering of families throughout neighbouring countries. Prior to the onset of the outbreak, a flourishing sub-regional market had been re-established on a weekly basis with the participation of people coming from Sierra Leone, Liberia, Cote d'Ivoire, Mali, Senegal and Nigeria. However, the epidemic put an end to this and imposed a renewed strain on social life in the region. Burial practices were a complicating factor. For example, burial location in Gueckédou could change according to families, village of origin and social status of the dead person. Individuals could be buried at the house, in the backyard, in the outskirts of the village or at the cemetery (Epelboin, 2014). Attempts to alleviate the spread of the pandemic had social consequences. For example, forest inhabitants are game meat eaters, and this includes bats. The interdiction against eating game meat during the epidemic was seen as discrimination against local people by the political and administrative officials of non-forest areas.

A study conducted by Niang (2014) in Sierra Leone, in the Districts of Kailahun and Kenema, indicates the scale of social disruption. One villager stated:

> ... it came to a time when 5 to 6 people would die each day in the village. We dug graves until we got tired. One day, we put 6 corpses in one grave because we were tired.

Another informant said:

> ... Difo (a pseudonym) has several wives and 18 children. 5 of his wives and 10 of his children have all died from Ebola. Seku (a pseudonym) lives alone with 3 children less than 7 years old. Their mother died, as well as his sister and his brother.

Another informant complained that:

> ... the village looks like a ghost village. The mosque of this predominant Muslim community is deserted during prayer hours.

Particular social and cultural practices impacted the development of the epidemic and who suffered most. Physical contact with the body of a sick person was seen as a way of sharing pain, which in turn reduces the suffering of the sick person. It also represented joy and happiness, which are considered as important influences in the recovery of sick people. Niang (2014) notes the recorded deaths of many traditional healers, infected while touching and taking care of sick persons. In Njala village, the study reflected that the number of deaths from Ebola were 48% women, 26% men and 26% children. Niang comments that:

> ... when a woman dies, it is a woman who takes care of washing and putting clothes to the dead body; men do the same for men. But, in addition, women are responsible for washing the clothes worn by the deceased at the moment of his or her death.

He concludes, first, that social interactions, practices, attitudes and behaviours can increase vulnerability to Ebola virus infections both in rural and urban areas; second, individual infections resulting from several factors such as stress, family pressures, working conditions and low socio-economic status, can drive new dynamics in the spread of the infection; thirdly, that women appear the most vulnerable because of their social and family role.

In a study conducted in Liberia (Fallah et al., 2017), on the outcomes of bolstering community cooperation in Ebola resurgence protocols, the authors reveal that community resistance arising from fear, stigma and lingering trauma posed challenges for surveillance. The community of Margibi County, the study site, refused to cooperate with a field blood draw of 51 high-risk contacts

of a deceased person with a positive Ebola test, arguing that he died of malaria. However, after discussion and negotiations among community leaders, key stakeholders and the affected families, agreement was reached on drawing blood samples from high-risk contacts and their subsequent admission to Ebola treatment units in the event of positive diagnosis. Such an approach improved community participation and accelerated early detection of cases and their isolation, which is fundamental to curtail the transmission and improve the prognosis.

Other changes in social behaviour, such as curtailing the usual greetings among people (kissing, hugging, hand shaking etc.) and the cancellation of mass gatherings (sports, religious and political meetings), contributed to further disrupt social life. Furthermore, misconceptions about the origin and transmission of the Ebola infection led to the hiding of sick persons and corpses in communities and sometimes a refusal to cooperate, including violence against health and community staff.

3.3 | Economic impact

The economic impact, in terms of reduction of mining operations, disruption of agricultural cycles, restriction of domestic and cross border trade, reduction in air travel and tourism and decline in investments due to panic and investors pulling out, inevitably led to a reduction in Gross Domestic Product (GDP), which negatively affected development agendas. The epidemic reduced GDP growth, in the three most affected countries, by 0.8% on average between 2015 and 2017. In West Africa, most of population live below the poverty line of US$1.25 per day, and the per capita income fell by US$18.00 per year during the course of the epidemic. A study (UNDG, 2015) on the socio-economic impact emphasized that the epidemic heightened the incidence of poverty in the three countries. Poverty affected 52.9% of the population in Sierra Leone (in 2011), 55.2% in Guinea (in 2012) and 83.8% in Liberia (in 2011). The study demonstrated that for Guinea, in 2014, the poverty rate increased by around 2.65%, whereas Liberia and Sierra Leone registered increases of 13.76% and 5.46% respectively during the Ebola period. In terms of GDP, per capita income and poverty, this result supported the need to prioritize proactive recovery measures (UNDG, 2015). The United Nations Economic and Social Council considered that the Ebola epidemic could drain $3–4 billion from the Sub-Saharan African Economy, reverse peace-building gains and erode economic growth in the hardest-hit nations (ECOSOC/6653, 5 December 2014). According to the World Bank (2014) study on the economic impact of the Ebola Epidemic

> In the worst-case scenario West Africa's gross domestic product (GDP) could suffer a $32 billion loss by 2015. Foreign investors are withdrawing in droves from worst-hit countries. ArcelorMittal, the world's leading steelmaker, recently moved its expatriate staff out of Liberia. London Mining, a British company, also removed staff from Sierra Leone. Without iron ore, Sierra Leone's growth output, which was 20% in 2013, will fall to 5.5%, according to the International Monetary Fund (IMF), stressing how critical the iron ore sector is to the country's economy. Fearing for staff safety, a number of international non-governmental organizations in Liberia have also closed their operations.

Before the period of the EVD epidemic, each of Guinea, Liberia and Sierra Leone had been under IMF lending programmes that prioritized economic objectives over social and health investments (Kentikelenis et al., 2015). This may have contributed to lack of investment in health infrastructure that could have helped to improve preparedness to cope with infectious disease outbreaks. The EVD epidemic calls into question the effectiveness of some global and national development institutions that may need to revisit their policies to make them more consistent with their espoused human development ambitions.

3.4 | The complexity of the EVD epidemic: Systemic issues

The Ebola epidemic constituted a multidimensional public health ‘mess’ made up of interacting issues of a biophysical, technical, political, socio-cultural and economic nature. It began in an extremely poor rural setting in which people co-existed with the wild environment, facilitating contact between human beings and animals. The likelihood of a zoonosis disease outbreak was exacerbated by the actions of multinational timber and mining operations, which were laying waste to the forests and driving animals from their natural habitats. It has further been suggested that climate change was driving farmers further into the remaining forests in search of cultivatable land (Ali et al., 2016). The three countries primarily involved were recovering from political turbulence and civil war. They are amongst the world's poorest. The boundaries between the countries were porous. There had been an unprecedented migration of people to urban centres where disease could spread rapidly because of the close interactions between

people and the unhygienic conditions. These inter-related factors triggered and sustained the epidemic for more than 2 years. The impact was felt from community to global level. Although it is impossible to untangle the causal chains linking all these factors, we can identify certain 'systemic issues', which were of huge significance in driving the spread of the epidemic and preventing an effective response. For the purpose of this analysis, they can be grouped as technical, organizational, socio-cultural and inequality issues.

Much of the basic *technical* capacity to fight the disease and prevent its spread was lacking. There was no specific vaccine available to combat the disease, although human trials of potential vaccines and therapies were underway led by different research institutions in the Global North (Ali et al., 2016). In the absence of specific medicines, clinical treatment could only be supportive, based on rehydration, electrolyte management, antibiotics and antivirals for secondary infections and medications to control pain, fever and gastro-intestinal disorders (Semalulu et al., 2014). Mounting an effective response to infectious diseases requires appropriate laboratory facilities and strong surveillance and monitoring processes. These were not in place. Biosafety level 3 and level 4 laboratories, which are required for isolation of Ebola virus and real-time reverse transcription Polymerase Chain Reaction (RT-PCR) tests, were unavailable in the affected countries. In this context, specimens had to be collected from suspected and high-risk contacts and further transported to reference laboratories, under very special conditions, outside these countries. This was time consuming and limited the quality of patient management as well as the accuracy of the overall surveillance system (because in the absence of laboratory confirmation the epidemiological surveillance reports were based on suspected cases). The epidemic highlighted the necessity to maintain a network of organized laboratories with quality and capacity; to innovate on new and quicker means of diagnosis; to develop new mechanisms of transport of materials and specimens between countries and research institutions; and to deploy laboratory experts in specific areas (Sealy et al., 2016). Accurate and timely reporting of cases is critical for evidence-based crisis management, public information, advocacy, resource mobilization and allocation. In fact, there was limited capacity for investigation, reporting and contact tracing. Different case-definition and underreporting presented particular challenges. In some instances, the true number of cases might have been anywhere from 17%–250% higher than the reported number (McNamara et al., 2016). Contact tracing was hindered by shortages of staff and the intense movement of people across the country and the region. Limited access to information and communications technology, in the three countries, constrained the use of cell phones and internet for disease surveillance. Finally, the national logistics systems were not designed to meet the requirements of epidemic response. Weak transport infrastructures compromised the service delivery of the core resources at the right time, in the right place, in the right condition and in the right quantity.

In terms of *organizational* issues, there was a lack of preparedness in the health infrastructures of the affected countries and significant problems with the way the response to the epidemic was handled. The outbreak hit three countries with limited health system capacity and few trained personnel, especially in rural areas. It was the first time that West Africa had to deal with an extensive Ebola virus epidemic. Following the civil wars, the national health systems were going through reform processes and still grappling with problems of organization, leadership, communications, control and capacity strengthening, especially at the district/county/local levels. In this context, they could not meet the core competencies required by WHO International Health Regulations in order to cope with public health emergencies. Hospitals were barely functioning, with only intermittent access to electricity, and lacked basic infection-control essentials. The high number of Ebola patients overwhelmed the health care facilities that were available, calling for an increased number of hospital beds and compromising the access of non-Ebola patients to health care. It is estimated that the epidemic reduced by 50% the access to health care services, exacerbating Malaria, HIV/AIDS and Tuberculosis mortality rates by additional death counts of 6269 in Guinea, 1535 in Liberia and 2819 in Sierra Leone (Parpia et al., 2016).

Another organizational issue, of significance in the outbreak, was the lack of coordination between health and veterinary services. Being a zoonosis, catching an Ebola outbreak early requires close collaboration between health and veterinary services in a 'one health approach' intended to improve surveillance, assess and identify risk factors for people and animals, and investigate the geographic spread of the disease. There were no such integrated arrangements.

The response to the epidemic was hindered by poor co-ordination between global, regional, national and local efforts. International agencies tended to adopt a 'top-down' approach, which prevented them partnering effectively with local health services. The WHO, suffering from budget cuts following the 2008 global financial crisis, was accused of being too bureaucratic and of a failure to establish good communications between its central and regional arms. Inter-country co-operation was difficult to achieve and had an impact on issues such as the

closure of borders, cross-border joint activities, the transport of health staff and logistic support, and sanitary control at the borders. Careful diplomacy was necessary because national governments were unwilling to give up sovereignty and control over communities and resources.

The absence of a specific vaccine and treatments, and the lack of organizational capacity, meant that controlling the spread of the virus depended on significant behavioural change—individually and socially. *Socio-cultural* issues were therefore of paramount importance. Unfortunately, there was mistrust of international and national agencies among local people. There was a suspicion of health workers, and they were subject to abuse and violence. In one Guinean village, eight health workers were attacked and killed. The attackers either denied the presence of Ebola or blamed health workers for spreading it. It was, after all, a British naval vessel that brought Spanish flu to Sierra Leone in 1918 (Ali et al., 2016). In addition, there were various traditional and religious beliefs that compromised the quality and scope of the response. They promoted denial and misconception, leading to the hiding of infected people and corpses. We mentioned earlier the unsafe mourning rituals and burial practices.

To overcome issues of this sort requires considerable political and cultural sensitivity, an awareness of the perceptions and values of local people, and an approach that seeks community engagement and participation. Community participation is, in fact, recommended by WHO and UNICEF as one of the founding principles of primary health care because it makes people more receptive to health interventions; it stimulates pooling of individual and collective resources for health improvements; it opens opportunities for health literacy and healthier behavioural changes; and boots the community capacity to challenge existing social arrangements that may contribute to their deprivation (Cueto, 2004). However, 30 years after the Alma Ata Declaration on primary health care, Rifkin (2009) identified three reasons why integrating community participation into health programmes is so difficult: first, because of the dominance of the biomedical paradigm in health planning, community assistance is seen simply as an intervention rather than a process; secondly, the frequent lack of an in-depth analysis of community perceptions; and thirdly, the propensity of using a framework of analysis that limits the scope of investigation. Unfortunately, in the Ebola case, many of the interventions eschewed a holistic, community participation approach. They were dominated by positivistic, biomedical thinking that failed to consider the values and beliefs of the population and discouraged participation, dialogue and inclusivity in decision-making.

Despite all this, local people, subject to fear, panic, insecurity and disruption of their social, cultural and economic life, did respond thoughtfully and collectively and took initiatives that boosted the efforts to reverse the tide of the epidemic and offer hope for the creation of more resilient societies in the aftermath.

Issues of *inequality* pervade the course taken by the epidemic and the capacity to respond to it. *The Washington Post* (Mui, 2014) quotes Jim Kim, World Bank President, as saying:

> The battle against the virus is a fight on many fronts—human lives and health foremost among them .... But it is also a fight against inequality .... Thousands of people in these countries are dying because, in the lottery of birth, they were born in the wrong place .... This pandemic shows the deadly cost of unequal access to basic services and the consequences of our failure to fix this problem.

Large haemorrhagic virus outbreaks almost always occur in regions and countries where the economy has been devastated by failed development, and events such as civil war, and public health systems have been left in a totally inadequate state. The knowledge and ability to contain the disease existed in wealthier countries. But, in countries such as Liberia, Sierra Leone and Guinea, there was no capacity to invest in public infrastructure, access to health care, and trained medical staff. As the same Washington Post article states:

> When the first case of the Ebola virus entered the United States this month in Dallas, the medical team that treated the infected patient was quarantined and even the ambulance in which he was transported was decontaminated. When the virus entered Sierra Leone, an entire hospital was forced to shut down.

There was a huge shortage of experienced health manpower in critical care, epidemiology, logistics and other relevant disciplines in the affected countries. Liberia, with a population over four million, and Sierra Leone, with over five million people, had 51 and 136 doctors, respectively, at the beginning of the outbreak (Ali et al., 2016). To address this gap, WHO and other global health partners embarked on international recruitment of health workers. The human resource issue was made worse by the number of health workers who, themselves, were contracting the disease. The total number of infected health workers eventually rose to 1049 (3.7% of the total), with 535 deaths (4.7% of the total). This fact may have discouraged other health professionals from

volunteering to participate in the response efforts. Because of health care workers mortality, the epidemic led to an increase of maternal mortality of 38% in Guinea, 74% in Sierra Leone and 111% in Liberia; and a rise of child mortality from 7% to 28% across the three countries (Evans et al., 2015).

The particular vulnerability of women to the effects of Ebola has been noted. The gendered impacts included 'greater fatality rates for pregnant women, higher risks for caregivers who are often women, and dangers from sexual violence due to Ebola-related economic collapse' (Ali et al., 2016). Women accounted for roughly 60%–75% of the deaths in the 2014 epidemic. An IDS Practice Paper in Brief (2015) sees this 'pathology of inequality' as requiring attention to 'existing hierarchies and the contextually specific institutional fabric into which men and women's lives are woven'.

We are now in a position to use these lessons, from the 2014 Ebola outbreak, to assess the current state of health systems research and to suggest how it might be empowered by critical systems thinking and practice. On this basis, it can hopefully be strengthened and be in a better position to contribute to mitigating future public health emergencies.

4 | THE CURRENT CAPACITY OF HEALTH SYSTEMS RESEARCH (HSR) TO MANAGE SUCH ISSUES

The last 25 years have seen a significant growth in interest in applying systems thinking and complexity theory in health research. A paper by Jackson and Sambo (2020) traces this development in HSR in terms of host institutions, reports and books, journal articles and conferences. The interest here, however, is in identifying the strengths and weaknesses of HSR in understanding and meeting the challenges posed by emergencies such as the 2014 Ebola epidemic.

The thing that HSR is most proud of is its commitment to systems thinking. According to the 'Alliance for Health Policy and Systems Research' (Alliance)

> Throughout all our work, we prioritize and promote systems thinking, which recognizes that the whole of the system is more than its constituent parts. (Alliance for HPSR, 2019)

Considering this further, however, we find that HSR has a limited appreciation of systems thinking and that this hinders its theoretical awareness and its capacity to improve practice. Three issues stand out—first, a lack of clarity about what type of 'system' a health system is; second, a failure to embrace the full range of systems theories and methodologies; and third, a failure to consider how they might be used in combination to tackle the multi-dimensional character of public health emergencies, as exemplified in the Ebola epidemic. These are considered in turn.

First, the problems start because of a lack of clarity among health system researchers about what kind of 'system' they are dealing with. van Olmen et al. (2012) summarize this weakness:

> Despite this mounting attention [to systems thinking] and the many published health systems frameworks and theories, there is a persisting lack of consensus on how health systems can be conceptualised and effectively strengthened (p. 775).

Among those who do think they know, most argue that health systems are 'complex adaptive systems'. Chughtai and Blanchet (2017) identify three of the five co-authorship groups in the systems and public health arena as taking their lead from complexity theory. The most sustained attempt to apply complexity theory to public health can be found in the four volumes associated with Sturmburg - *Handbook of systems and complexity in health* (Sturmberg & Martin, 2013 eds), *The value of systems and complexity sciences for healthcare* (Sturmberg, 2016, ed.), *Putting systems and complexity sciences into pra*ctice (Sturmberg, 2018b, ed.), and *Health system redesign* (Sturmberg, 2018a). The *Handbook* introduces the seven characteristics of complex adaptive systems, derived from the work of Cilliers, upon which the work builds. These are non-linearity, open to the environment, self-organization, emergence, pattern of interaction, adaptation and evolution, and co-evolution.

This commitment to the notion of complex adaptive systems is, however, not particularly helpful. Cilliers, in his own contribution to Sturmburg and Martin's influential *Handbook of systems and complexity in health* (Sturmberg & Martin, 2013, eds), argues that 'there is not a clear-cut paradigm for complexity theory at this stage'. He is right. The key characteristics of complex adaptive systems mean vastly different things to different authors. There are as many types of complexity theory as there are social theorists. Jackson (2019) notes Cilliers' 'poststructuralist' perspective; Wheatley's 'functionalist' account; Stacey's 'interpretivist' version; Walby's 'sociology of radical change' model; and Byrne and Callaghan's 'critical realist' reading. To these we can add Preiser and Woermann's (2018) 'critical-emancipatory' interpretation. To put it bluntly, complexity theory remains too theoretically incoherent when applied to social systems to

act as a guide to HSR. As well as leaving HSR theoretically bereft, the commitment to complexity theory leaves it short in terms of methodologies to guide practice. Relying on a few simple metaphors drawn from the natural sciences ('strange attractors', 'self-organisation', 'edge of chaos' etc.) cannot yield the kind of precise guidance that practitioners crave. Agent-based modelling is too reductionist of human behaviour and social reality to cope with the 'complex causality' found in the health domain. Adam (2014) sums it up in stating that there remains a 'dearth of practical guidance' on how systems thinking can be applied in health systems research and practice. But this takes us onto our second line of criticism of HSR.

Secondly, there are many different systems approaches and methodologies, but HSR does not take advantage of most of them. Peters (2014) details the 'large body of theories, methods, and tools associated with systems thinking' and reflects on the 'new opportunities' they provide in HSR. Adam (2014) is convinced, on the basis of Peters' work, that HSR applications 'by no means capture the entire range of relevant [systems thinking] tools and approaches that can be applied'. Carey et al. (2015) note Lich et al.'s contention that

> ... despite a growing appreciation for 'multiple levels' and systems of influence, public health is yet to take full advantage of the analytical approaches—or toolbox—provided by systems science. (quoted in Carey et al., 2015: 9)

Their own review of 117 papers combining systems and complexity concepts with public health, published between 1990 and February 2015, reaches similar conclusions:

> Our analysis suggests that soft systems modelling techniques are likely to be the most useful addition to public health, and align well with current debate around knowledge transfer and policy. However, the full range of systems methodologies is yet to be engaged with by public health researchers. (Carey et al., 2015: 1–2)

Overwhelmingly, HSR favours the systems dynamics (SD) approach and largely ignores other systems methodologies. This privileging of SD started as a response to the perceived failings of the WHO's 'six building blocks' model (WHO, 2007). This primitive model was 'organismic' in character, assuming that if the six identified subsystems of a health system all function properly then the overall goals of the system will be achieved. *Systems thinking for health systems strengthening*, published by the Alliance and WHO (de Savigny & Taghreed, 2009), takes this work forward. It does so by introducing key concepts from SD. The authors declare that, 'We must know the system in order to strengthen it ...'. In their view, the six building blocks can act as a starting point, but it also necessary to consider the relationships and interactions between the sub-systems and the actors involved in them. This is because any attempt to intervene in one sub-system can reverberate around the others and produce counter-intuitive, system-wide effects. For example, providing incentives for performance in the 'financing' sub-system might lead to distortions in the operation of the 'health workforce' sub-system as healthcare professionals follow the incentives. The result will be sub-optimization overall. In their editorial to the special issue of *Health Policy and Planning*, Taghreed and de Savigny (2012) reinforce the bias towards SD. They call for a 'paradigm shift' from 'linear reductionist approaches' to 'dynamic and holistic approaches', and although other systems approaches get a brief mention, it is again the SD worldview that predominates. An examination of the methodologies employed in studies reported in *Health Policy and Planning* (published since 1986) highlights the SD approach, with next to nothing from other systems traditions of work. The 'methodological handbook' edited by de Savigny et al. (2017) may seem to provide an exception to SD partiality. Accounts of 11 methodologies and methods are provided, written by authors with expertise in applying the particular approaches. These are primarily drawn from SD and complexity theory but, refreshingly, also include 'critical systems heuristics' and 'soft systems methodology'. However, de Savigny et al. (2017) conclude by arguing that:

> The common theme of all of these systems thinking methods is that systems behaviour is governed by common principles that can be identified and better understood, and in so doing, system outcomes can be better documented and predicted, thus facilitating the development of interventions for amplification of good outcomes and the damping of bad outcomes (loc 5948).

This statement applies to SD but not to the many other threads of systems thinking.

Viewing health systems issues, and seeking to address them only through the SD lens, means that other possible ways of seeing the 'system' and intervening in it are ignored. For example, reflecting on whether the cybernetic laws that ensure viability and resilience have been

respected in health system design; viewing the issues as being about multiple stakeholders with different perspectives that must be reconciled; or considering that the 'system' might be governed by powerful, coercive forces that impact what can be done and need to be addressed so that radical possibilities for change can be entertained. Even the most sophisticated systems thinkers in HSR seem blind to the implications of the evidence, that they themselves present, showing that systems thinking is far more than just SD.

In the case of the Ebola epidemic, there would have been something to be gained by using SD to try to unearth and respond to the various feedback and feedforward loops, and lags, driving system behaviour. However, as already noted, it would hardly have been possible to identify and quantify all the relevant factors and grasp the causal chains linking them together. And such an effort would have been misguided if it detracted from the use of other systems approaches and methodologies to help address the other key 'systemic issues'—technical, organizational, socio-cultural and inequality—which we identified in the earlier analysis. Systems engineering and systems process methodologies could have assisted with the technical issues identified. Beer's (1981) organizational cybernetic model of any 'viable system' is highly relevant to matters of health system organization, resilience and adaptation. Soft systems approaches, such as Checkland's (1981) 'soft systems methodology', were developed to help manage the range of socio-cultural factors that health systems researchers themselves recognize as crucial to successful interventions. These include dealing with the multiple purposes exhibited by different stakeholders, 'aligning policies, priorities and perspectives', 'managing and coordinating partnerships', 'implementing and fostering ownership' (de Savigny & Taghreed, 2009, eds); 'shared vision', 'ongoing iterative learning', 'transformational leadership' (Swanson et al., 2012); 'values and principles' (van Olmen et al., 2012); and 'ensuring collaboration between different stakeholders with multiple perspectives and addressing issues of leadership' (Chemonics International, 2019). With regard to inequality, Ulrich's (1983) 'critical systems heuristics' is a systems methodology that can help ensure that the potentially disadvantaged are recognized and their voices are heard.

Thirdly, we noted that HSR does not consider how different systems approaches might be used in combination to tackle the multi-dimensional character of public health events as exemplified in the Ebola epidemic. The challenge, recognized by Bennett et al. (2018), is to retain coherence in a field of diverse perspectives, where different disciplinary orientations and knowledge paradigms co-exist. This, of course, becomes even more essential if HSR is to embrace the variety of systems approaches available. A coherent approach to preparing for and responding to health emergencies, using the range of systems methodologies in informed combinations, could not but yield significant benefits. In the final chapter of their 'methodological handbook', de Savigny et al. (2017) seek to classify the different 'tools' according to the contributions they can make to the sequence of steps in the research process. However, the discussion is superficial and ignores the decades of work that has gone into developing multi-methodological practice in the 'critical systems thinking' tradition of work.

5 | HOW CRITICAL SYSTEMS THINKING (CST) CAN EMPOWER HSR TO BETTER MANAGE SUCH ISSUES

CST is one of the latest developments in the transdiscipline of systems thinking. There is a prima facie case for its relevance to HSR because it respects and seeks to build upon previous systems approaches to management, understand their strengths and weaknesses, and consider how they can be used in combination to bring about overall improvement. We will now look at how it can help overcome the three weaknesses of HSR, identified above, and so empower it to deal with public health emergencies such as the Ebola pandemic.

First, CST takes a radically different approach to HSR in the way it responds to the complexity encountered in the health systems domain. Primarily, HSR designates health systems as 'complex adaptive systems', and then looks to SD to provide knowledge of their inner workings and supply insights into how they can best be managed. CST by contrast regards 'messes', like those found in public health, as 'unknowable'. They give rise to what Rittel and Webber (1981) call 'wicked problems', which are intractable for decision-makers:

> The planner who works with open systems is caught up in the ambiguity of their causal webs. Moreover, his would-be solutions are confounded by a still further set of dilemmas posed by the growing pluralism of the contemporary publics, whose valuation of his proposals are judged against an array of different and contradicting scales (p. 99).

We can understand the difference between the HSR and CST approaches using Morin's (2008) distinction between 'restricted complexity' and 'general complexity'. Those who act as though they are confronting restricted

complexity seek to refine particular computational modelling techniques through which, they believe, they can explain complex systems. This is true of those in SD who build computer simulation models of real-world system behaviour and seek to validate them scientifically.

Morin accepts that the 'restricted complexity' viewpoint, dominating HSR, encourages advances in formalization, modelling, and interdisciplinary working but regards it as remaining 'within the epistemology of classical science', searching for hidden laws behind the appearances. It represents a simple mode of understanding in which one believes one possesses the truth. In Morin's view, the kind of 'hyper-complexity' we witness in, for example, the health systems domain, requires the more complex knowing implied in the concept of 'general complexity'. General complexity resists universal truth. All attempts to model it are partial and, therefore, the fundamental problem of general complexity 'is epistemological, cognitive, paradigmatic'; concerned with the ways we seek to understand and manage complexity.

It is an achievement of CST, in my view, that it has embraced and developed Morin's concept of general complexity. It regards it as impossible for any systems approach to provide the kind of prior understanding of complex adaptive systems that would allow intervention on the basis of explanation, prediction and control. The nature of complex adaptive systems is 'unknowable' in this sense. In each case, an informed exploration of the problem situation needs to be undertaken. Putting this into practice, CSP argues that a rich appreciation of complex problem situations can be achieved by making use of the lenses provided by some proven 'systemic perspectives'. Systemic perspectives are structured, interlinked sets of ideas, making up cohesive wholes. This ensures that they can be kept distinct from one another, they can provide deep interrogations of a problem situation, and they can produce learning. Each must be well-tested, and together, they should constitute a comprehensive set. Jackson (2020a) has derived such a set of 'systemic perspectives' from Pepper's 'world hypotheses' (Pepper, 1942), and from the sociological paradigms and metaphors that have been found useful in organization theory and systems thinking. They are summaries of what Pepper refers to as 'successes of cognition' and the 'creative discoveries of generations'; and what Lakoff and Johnson (1980) identify as 'experiential gestalts' that have enabled us to have coherent encounters with reality and provided for successful functioning in our physical and cultural worlds. Five systemic perspectives have demonstrated a capacity to provide significant insight into complex problem situations and appear to cover the ground:

- Machine—is there an agreed goal, are the necessary parts well connected together to achieve the goal, and are the necessary components to hand or easily obtainable? The machine is judged on whether it demonstrates efficacy (is well organized to achieve its purpose) and efficiency (does so with minimum use of resources).
- Organism—is the system viable, are the sub-systems functioning well, with their own autonomy but still serving the whole, and is the whole adaptive to the environment, resilient in the face of shocks, and capable of learning? The organism is judged on whether its semi-autonomous parts are well coordinated and controlled, and whether the system is 'anti-fragile' (Taleb, 2013) in the face of its turbulent environment.
- Cultural/political—is there agreement that the system is doing the right things (effectiveness), has this been subject to challenge (not emerged from groupthink), and are there processes for dealing with conflict? This systemic perspective is not used as an exemplar. Rather, it alerts practitioners to look out for a variety of cultural and political factors that may require attention in the problem situation.
- Societal/environmental—have the interests of all stakeholders (including those of the marginalized and future generations) been considered, and have sustainability and environmental issues received sufficient attention? This systemic perspective is used to identify neglected stakeholders, discrimination, and inequality, and to argue that interventions should consider the situation of the disadvantaged and the consequences for the environment.
- Interrelationships—can we identify chains of mutual causality in the problem situation and leverage points for bringing about change? The issues identified by the other systemic perspectives will, of course, be interrelated. Although general complexity forestalls mathematical modelling of these interrelationships, it may occasionally be possible to identify important linkages which offer leverage points for achieving improvement and/or suggest unintended consequences that might follow from proposed actions.

These different systemic perspectives can provide breadth and depth to the exploration of the problem situation. Each reveals new matters worthy of attention and may provide a different explanation as to why the issues of concern have arisen. They will often provide conflicting information and explanations, and this is particularly helpful in gaining a full appreciation of the complexity involved and in supporting informed decision making.

Secondly, we noted that HSR does not embrace the full range of systems approaches. Once a complex problem situation has been interrogated in the way described, it becomes clear that a range of different systems methodologies will be required to address the multidimensional set of issues displayed. CST can empower HSR by providing it with a 'second-order' understanding of the systems methodologies available and their different strengths and weaknesses. This allows an appropriate choice of methodologies to be made according to the requirements of the complex problem situation. This type of second-order critique has been a feature of CST from its beginnings (Jackson, 2020b). Called 'critical awareness' in CST, it corresponds to Morin's call to focus attention on the fundamental problem of general complexity, which is 'epistemological, cognitive, paradigmatic'. Such second-order analysis finds strong support in the work of Luhmann. In his opinion, social theory must give up its quest for ontological certainty and become the study of how first-order observers observe. Such second-order observation represents a shift from ontology to epistemology. Instead of trying to uphold claims about the nature of social reality, sociologists should concentrate on how different social theories construct societal issues and problems from the 'distinctions' they employ. Using second-order observation, we are able to understand how the first-order theory we are studying observes, and what it sees and does not see:

> Second-order observation is observation of an observer with a view to that which he cannot see … we become interested in the distinctions with which the observed observer works, and in how he divides up the world, and in what he considers important (or not) in which situations (Luhmann, 2013: 112).

In the book *Critical systems thinking and the management of complexity* (Jackson, 2019), Jackson undertakes a second-order critique of 10 different systems approaches. These 10 are chosen because they are philosophically sound, thoroughly researched and have a good track record of application. They are then divided into broad classes on the basis of a second-order critique setting out the distinctions that they employ in looking at 'complexity'—in other words, what aspects of complexity they give priority to in examining and seeking to improve problem situations. If we follow this logic and divide them into five classes, we can easily see how they correspond to the 'systemic issues' identified during our account of the Ebola epidemic:

- Systems approaches for 'technical complexity' (e.g. systems engineering and lean systems)—concentrating on how to efficiently organize components and sub-systems and expedite processes to reach pre-defined purposes.
- Systems approaches for 'organizational (including environmental) complexity' (e.g. the viable system model)—concentrating on making systems adaptive, resilient, and anti-fragile so they can survive and thrive over time in the face of internal interactions and environmental turbulence that cannot be predicted in advance.
- Systems approaches for 'socio-cultural complexity' (e.g. soft systems methodology)—concentrating on exploring different perspectives and worldviews and ensuring that enough agreement is obtained among stakeholders to enable them to come together to undertake beneficial action.
- Systems approaches for 'coercive complexity' (e.g. critical systems heuristics)—concentrating on achieving fairness by ensuring that those potentially disadvantaged by power have a say in decisions and, if necessary, by working directly on their behalf.
- Systems approaches for 'structural complexity' (e.g. system dynamics)—concentrating on identifying the significant variables and interactions that influence system behaviour and modelling the interactions on the basis of positive and negative feedback loops and lags.

The critical awareness element of CST, therefore, can help HSR to appreciate the particular theoretical distinctions made by the different systems approaches. Further, it suggests that all the various methodologies have something to offer and that it is a mistake for HSR to be restrictive in the choices it makes. This is obvious when we consider the range of 'systemic issues' that came to the fore when we considered the preparedness for and response to the Ebola outbreak.

Once the value of the range of systems methodologies is understood, the need to address the *third* failing of HSR becomes apparent. It is essential to consider how they can be used in appropriate combinations according to the requirements of the problem situation. This is necessary if we are to have any prospect of managing the multi-dimensional, hyper-complexity found in the health domain, as exemplified in the Ebola epidemic. Of course, we then encounter another matter that has seemed problematic in HSR—retaining coherence in a field of diverse perspectives where different knowledge paradigms co-exist. We have ruled out trying to resolve this by discovering 'the truth' about the nature of problem situations. The 'critical systems practice' (CSP)

multi-methodology, which puts CST into action, proceeds differently. It seeks to view problem situations using the different systems approaches and to learn its way to what works in practice (Jackson, 2019, 2020a, 2020b). It begins, in the manner outlined, with an **explore** stage—viewing a problem situation through a variety of 'systemic perspectives'. The aim is to reveal the range of issues that need addressing. It then proceeds to a **produce** phase. Critical awareness provides knowledge about the strengths and weaknesses of the different systems approaches. Depending upon the type of issues surfaced during the 'explore' stage, an intervention strategy is produced. A particular systems methodology, or often more than one methodology, will be chosen to start the intervention. **Intervention** can then proceed according to the guidelines of the chosen methodology or methodologies. There is a need for flexibility because as the problem-situation develops, and renewed iterations through the 'explore' stage demonstrate different issues are becoming dominant, appropriate changes in methodology can be enacted. A **check** stage evaluates the success of the changes made and seeks to derive learning about how to improve the whole CSP process. The complexity of most health-related problem situations ideally requires us to use all the systems approaches in combination. CSP provides a pragmatic response to this requirement to work with different knowledge paradigms and their linked systems methodologies.

It is impossible to know how exactly such an approach would have helped in relation to the Ebola epidemic. However, the authors would like to think that a prima facie case for its value has been made. Three further 'thought experiments' have been carried out by Sambo (2009) to suggest how actual, large-scale health interventions, in which he was involved, would have been better managed if they had adopted CSP. Jackson (2020c) has conducted a similar thought experiment, using critical systems thinking, to evaluate the UK's preparedness for and response to the Covid-19 pandemic.

6 | CONCLUSION

A review was carried out of the multiple factors involved in the development, spread, impact and response to the 2014 Ebola epidemic in West Africa. From this, various 'systemic issues'—technical, organizational, socio-cultural and inequality based—were identified. The interaction of these factors created a major public health 'mess' exhibiting all the characteristics of 'hyper-complexity'. The capacity of HSR, as currently conceived, to help practitioners think about and act in such cases of hyper-complexity was then examined. It was found wanting, largely because of its commitment to the worldview of 'restricted complexity'. CST, based on the idea of 'general complexity', has for some decades been studying the strengths and weaknesses of the full range of available systems approaches and how they can be used in informed combinations to bring about improvement in hyper-complex contexts. It was argued that CST is capable of empowering HSR so that it becomes more effective in recognizing and responding to the various interacting technical, organizational, social, economic and environmental matters that underlie major public health events such as epidemics and pandemics.

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