



# A call to prioritise prevention: Action is needed to reduce the risk of zoonotic disease emergence

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## Summary

Anthropogenic changes to the environment are facilitating the spread of animal pathogens into human populations. A global focus on detecting and containing emerging infectious diseases has deflected from the need for upstream prevention measures to reduce the risk of pathogen emergence. The drivers of infectious disease emergence have predominantly been considered as environmental and conservation issues and not as risks to human health. There is an opportunity for the UK to take a leadership position on this complex issue. This will require the establishment and maintenance of effective governance and policy mandates. Novel ways of policymaking are needed urgently to achieve three key aims: coordination and collaboration across sectors and government departments, the inclusion of diverse expertise, and the prioritisation of measures directed at prevention.

**The Lancet Regional Health - Europe**  
**2022;23: 100506**  
 Published online xxx  
<https://doi.org/10.1016/j.lanepe.2022.100506>

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**Keywords:** Public health; Pandemic prevention; Emerging infectious diseases; Zoonotic disease; One Health

## Introduction

It is widely stated that the majority (60%) of emerging infectious diseases of people and all known human pandemics in the past century (including influenza, HIV, MERS and SARS-CoV-2) have been caused by the zoonotic spill-over and spread of animal pathogens, principally from wildlife reservoirs.<sup>1</sup> The transmission of pathogens between species is a natural ecological process that has been occurring since before the start of human records (measles, cholera and the black death are early examples).<sup>2</sup> Most animal pathogens are not well adapted to humans; they emerge sporadically through cross-species transmission ('spillover') events, which may lead to localized outbreaks in human populations but the majority fail to adapt to a new host and ongoing transmission is not established.<sup>3</sup> However, evidence suggests that the rate of zoonotic infectious disease emergence from wildlife has been increasing over recent decades,<sup>4</sup> and there is substantial evidence linking this increase to anthropogenic changes to the environment that alter human-animal interfaces, such as contact rates, between people, domesticated species and wildlife.<sup>5,6</sup>

Driven by global consumption patterns, human activities such as international trade, urban expansion and infrastructure development, natural resource

extraction, and large-scale conversion of land to agriculture are altering the environment, encroaching on wildlife habitat and changing human-wildlife interfaces. Stressors to wildlife caused by habitat degradation and loss, and the live wild animal trade, cause nutritional and physiological stress in animals, potentiating immunosuppression and the shedding of pathogens, and increasing susceptibility to novel infectious agents. Deforestation alters population structures, species complements and, hence, inter-species interactions, facilitating pathogen transmission between animals, while human contact with wildlife through hunting and trade facilitates zoonotic transmission. It has been demonstrated that the wild animal species more able to live in human-modified habitats tend to have a higher rate of carriage of zoonotic pathogens than the species that decline or disappear.<sup>7</sup> Protective effects that may be afforded by a high level of biodiversity, such as the pathogen dilution effect, are therefore lost and we are increasing both the levels and proportion of the remaining pathogens that are zoonotic.<sup>8</sup> Furthermore, as the remaining wild animals are better adapted for living in human-disturbed and peri-domestic habitats, the frequency of human-wildlife contact and the chances of pathogen spillover increase.

By far the biggest driver of habitat destruction is agriculture. According to the United Nations Environment Programme, agriculture contributes to 70% of biodiversity loss. Yet, while 83% of farmland is dedicated to the production of meat and dairy, these animal products provide just 18% of calories and 37% of protein and, in

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doing so, they produce 60% of the greenhouse gas emissions produced by agriculture.<sup>9</sup> Government policymakers face significant challenges in aligning the private interests of the agri-food sector with delivering environmental benefits, and existing policymaking structures remain susceptible to lobbying and other influences. It was recently estimated that an average of \$540bn a year is provided in support globally to agricultural producers through price incentives and fiscal subsidies, of which 87% is considered harmful to the environment and human health.<sup>10</sup>

Animal consumption-based food systems facilitate the zoonotic transmission of pathogens, not only from livestock but also directly and indirectly from wildlife. The encroachment of livestock and poultry production into natural and semi-natural habitats, and the intensification of animal farming provide unintended opportunities and routes for pathogens to spread from wild animals to domestic animals, with subsequent spread to people either directly or following pathogen mutation within farmed animals.<sup>11</sup> Livestock and poultry have played a key role in cross-species transmission of zoonotic pathogens in the past. For example, domestic pigs have been identified as intermediate and amplifying hosts for multiple viruses with pandemic potential, including influenza, and Japanese encephalitis and Nipah viruses,<sup>12</sup> while multiple influenza strains (including H5N1) have originated from farmed poultry.<sup>13</sup> Government mandates directed at reducing population meat consumption, therefore, would be an effective way to reduce both direct zoonotic threats and the drivers of disease emergence while also helping to mitigate climate change, biodiversity loss, and other threats to public health such as unsustainable fresh water extraction, AMR and the health effects of processed meat-based diets.

Climate change is in turn affecting the incidence of zoonotic disease emergence, with changing climatic conditions altering interactions between animal hosts, vectors, and pathogens, and driving the evolution of pathogens. All of these factors can, individually or combined, influence the likelihood of the emergence of a zoonotic disease in human populations.<sup>14</sup> There is thus a complex interplay between global human activities, emergence of novel pathogens, climate change, biodiversity loss, and public health issues that needs to be recognised if opportunities to have impacts across all these pressing and interrelated issues are to be realised.

The global risk of pathogen emergence can be stratified by geographical location, with the highest risk in forested tropical regions where the rate of land-use changes are currently greatest and where wildlife biodiversity is high.<sup>15</sup> However, novel zoonoses can emerge anywhere and, as exemplified by COVID-19, globalisation means that no country is immune to the threats posed by the emergence of a novel pathogen.

The prevailing international strategy for tackling pandemics has been to emphasise national and

international public health capacity to rapidly detect local disease outbreaks and prevent them from becoming international emergencies.<sup>16</sup> The World Health Organisation (WHO) provides a legal framework that defines countries' obligations for preventing the transnational spread of infectious diseases under the International Health Regulations (IHR). However, the IHR do not address the drivers of disease emergence or provide guidance to member states for upstream prevention measures, focusing instead on strengthening capacity to respond to emerging pathogens once circulating in the human population. Whilst capacity for early detection and containment of novel pathogens is essential, COVID-19 has demonstrated our limited ability to stop the global spread of a disease. A recent WHO manifesto articulated a need for countries to go further upstream than early detection and control of disease outbreaks; with a need to lessen our impact on the environment to reduce the risk 'at source'.<sup>17</sup>

Thus, given the unprecedented threats posed by climate change, ecological destruction and the consequent risks of novel pathogen emergence, transformational changes in our thinking and approaches to prevention are needed. Radical orienting of policy towards prioritising the prevention of future crises is essential. However, this is unlikely to be achieved within the existing governance structures across human, animal and environment sectors that have led us to the current global position. Substantial reform of these structures is core to such transformational change.

## The UK role in pandemic prevention

The United Kingdom (UK) has an opportunity to take a leading role on driving this agenda for change. The UK was the first nation to publish a cross government strategy recognising infectious disease as a threat to national and international economic security and to global health, and it has played a notable role in developing capacity and governance for responding to infectious disease worldwide.<sup>18</sup> The UK is also prominent in many relevant scientific fields, such as pathogen discovery, wildlife disease and how ecological and socioeconomic factors interact to drive infectious disease emergence. In the UK, there is a strong citizen voice for government action to address environmental issues; the outcomes of the UK Climate Assembly demonstrated citizens' understanding of, and support for, wide-spread reform and policy change in the name of protecting the environment and health.<sup>19</sup>

High level commitments have been made by the UK government for a green recovery, to "build back better" from the COVID-19 crisis and to prevent future pandemics. However, there appear to be critical gaps in governance that are likely to prevent these commitments being fulfilled. To galvanise the current opportunities to progress the zoonotic spill-over prevention agenda, it is

imperative to understand how the systems that govern policymaking and practice need to be strengthened. Here we identify important elements of our current government systems that need to be transformed in order to support the prioritisation of prevention: accountability, capacity, robust systems of scrutiny and planning, cross-departmental working, and transparency. Many of these challenges are not unique to the UK context, emphasising the relevance of the following discussion to policymakers in other settings.

### Accountability and capacity to act

Government action is led by policy, but currently there is no single government department or office that can produce, or be accountable for policies to reduce the risk of future pandemics. The UK Department of Health and Social Care and the Foreign, Commonwealth and Development Office work together on mitigating disease threats with the potential to cross national boundaries, but these departments do not have the regulatory authority or technical expertise to address the drivers of zoonotic pathogen spill-over and disease emergence. Multi-stakeholder solutions are required to reduce and mitigate health risks posed by the unsustainable consumption of commodities and those arising from the capture, trade, farming and consumption of wild animals and their products. These issues span industries and sectors across multiple government departments, including health, trade, border control, agriculture, and the environment. Cross-cutting policies spanning multiple government departments will require joint consultation and participation processes, shared objectives and outcome targets, and dedicated resources including budgets for delivery. Effective governance, likely involving government department restructuring will be required to enable this.

### Scrutiny of environmental policy is needed

Although several government departments are responsible for delivering international programmes against environmental objectives (including agricultural practices, climate change and conservation), there is no single overarching strategy for the achievement of the UK government's global environmental and health goals. An independent review estimated that £1.2 billion of UK aid funding was allocated to protecting forests and biodiversity overseas between 2015 and 2020, but the report identified a piecemeal approach that reduced the impact that might have resulted from a clearer strategic focus.<sup>20</sup> Without lines of accountability between government departments there is a risk of policy conflict, gaps and duplication. A strategic approach to prioritising resources is essential.

Whilst public health has assumed higher visibility in government for some environmental issues, such as air

pollution and climate change, it has remained noticeably absent from others, including the wildlife trade, agricultural development, and land use policies. There is a need for impact assessments for all major infrastructure projects (including biodiversity and climate change mitigation efforts) to determine risks to human, animal and ecosystem health, and to ascertain appropriate mitigations, whilst balancing the trade-offs of environmental and developmental decisions.<sup>21</sup> The call to integrate land use into public health policy is not new,<sup>22</sup> and unless mandated in regulatory frameworks it will likely continue to be overlooked. Scrutiny of existing policies using a prevention-focused lens is required to identify if any undermine realising objectives elsewhere in the system; beneficial change requires transforming both existing policies and the policymaking processes that govern them.

A statutory process for considering the impact of the government's global environmental policies or programmes on human health is currently lacking. Many development projects require environmental impact assessments, but assessment of the risk of infectious disease emergence is rarely considered. There is a lack of empirical data on how large-scale conservation and human development programmes that alter landscapes or human-animal interfaces, such as habitat restoration and the promotion of alternative livelihoods, affect the transmission of zoonotic pathogens, however modelling suggests they have potential to either promote or reduce spillover risk. Given the uncertainty, a precautionary approach is likely to be warranted in this context, and funding for research is urgently needed to better assess the impacts of such interventions on pathogen transmission.

### Systems of knowledge production and sharing must be strengthened

Managed by the UK Department for Environment, Food and Rural Affairs, the UK aims to invest over £66 million between 2014 and 2024 on projects addressing the illegal wildlife trade,<sup>23</sup> with a primary objective of protecting endangered species. Whilst the origin of COVID-19 is still unknown, the pandemic has shone a light on the zoonotic risk that exists in the trade and consumption of wild animals. The Convention on International Trade of Endangered Species of Flora and Fauna (CITES), the international agreement that regulates trade in endangered species does so based on species' conservation status alone. There is an urgent need for global action to address the risk that the wildlife trade, both legal and illegal, poses to human health. Reform of national and international wildlife trade policies and regulations are urgently required to identify and mitigate zoonotic risks in the international wildlife trade, for example through legal mandates to inspect

shipments and test for high-risk pathogen groups in internationally traded species, and to promote international cooperation and information exchange. Improved mechanisms of enforcement are needed, but these must be carefully considered because reactive policies could have severe unintended consequences. Poorly considered restrictions on wildlife hunting, consumption and trade have the potential to disproportionately harm millions of people in developing countries who rely on sustainable hunting for income and nutrition.<sup>24,25</sup> Across jurisdictions, the legal trade in wildlife differs substantially in biosecurity, animal welfare and hygiene standards, and therefore in public health risks. Policymakers need insight into how to identify, and target, actions towards high-risk areas of trade and this requires input from a breadth of stakeholders including human and animal epidemiologists, behavioural scientists, law enforcement, ecologists and others. Differences in socio-political, economic, ecological and cultural contexts must be considered and multi-lateral cooperation is essential to identifying equitable and effective solutions. Enabling the voices and unique expertise of local communities to inform content and implementation of dynamic and responsive policy systems that bring about sustained and effective change requires redesign of current systems, including the valuing and use of different forms of evidence and knowledge that have historically been overlooked. As the UK participates in discussions with international stakeholders on future action, it is unclear if and how this essential expertise is being acquired and utilised.

The UK has a long history of ‘departmentalism’, with departments operating within narrow mandated areas and taking into consideration the views of industry groups and scientific bodies who are often working within the same political and disciplinary silos. Some forms of ‘knowledge’ or ‘evidence’ tend to be prioritised over others, and funding and career structures do not inherently reward cross-discipline working or a tendency to stimulate innovation or critique of current paradigms. There is a pressing need for a robust, science-policy interface that spans the breadth of disciplines required to address the drivers of emerging infectious diseases. Funding for transdisciplinary research and innovation is essential. Forums for cross sector engagement and regulation, free from conflicts of interest, must be established to find innovative solutions to challenges that extend beyond the boundaries of a single department, organisation or community.

The term ‘One Health’ is being used increasingly within governments as an approach for collaborative working when considering threats to public health arising from animals. One Health is an umbrella concept incorporating human, animal (domestic & wild), plant (cultivated and uncultivated) and ecosystem health that is critical to future human health and wellbeing.<sup>26</sup> However, as an integrated approach it currently lacks

governance and operational objectives within governments - gaps that undermine acting at this critical time. Inclusion of the phrase within policy without establishing an operational meaning and effective governance for implementation and evaluation (such as identification of adequate resources, reporting and structures of accountability) risks failure to achieve objectives. Some progress has been made towards integrating human and animal health policies over the past decade, however the overwhelming focus has been on zoonoses from domestic animals, possibly as a legacy of recent crises (examples include the emergence of Bovine Spongiform Encephalopathy and the 2009 swine flu pandemic). Little attention has been paid to the risks and impacts of zoonotic diseases at wildlife –human or wildlife–livestock interfaces, or to the wider health impacts of anthropogenic environmental change.<sup>27</sup>

## Transparency

There is a wide range of policy levers available to governments to influence national and overseas agricultural and land use practices, yet these are rarely implemented in full due to perceived inherent tensions between the pursuit of economic growth and advocating for action to prevent future pandemics. The economic and societal costs of the COVID-19 pandemic, however, clearly indicate that this dichotomised line of thinking obscures the complex and nuanced interplay between economies, health and the environment. Within the UK, England has developed environmental regulations post-Brexit through the Environment Act 2021<sup>28</sup> which introduces financial penalties for large companies that import products or commodities that contribute to deforestation deemed illegal in the country of origin. However, a significant amount of deforestation is undertaken legally yet is still highly damaging to the environment and increases zoonotic disease spillover risk. Critically, the Act doesn’t include the needs for banks or other financial institutions to exercise due diligence with regard to their investments, despite the role they play in providing the finance that enables deforestation.<sup>29</sup> By focusing only on illegal activity, the Act does not address the international drivers of deforestation or acknowledge the complexities of commodity supply chains. Advocating for deforestation prohibitions is problematic given the immediate economic benefits of agricultural expansion, and biodiverse developing countries are likely to be disproportionately affected by efforts to reduce land use changes. Partnerships with producer countries will need to be encouraged to achieve sustainable transformation of supply chains and extend this to other areas of land use change in addition to deforestation.

It is estimated that primary prevention costs less than 1/20th the value of lives lost each year to emerging viral zoonoses.<sup>30</sup> The orders of magnitude in the differences in the estimated costs of practical actions to

reduce the risk of zoonotic emergence through better management of wildlife trade and substantial reduction of deforestation (as well as the potential co-benefits of such actions), and the costs of actions to control epidemics and pandemics should provide strong economic incentives for transformative change.

### Never waste a crisis

In 2021, under UK leadership, the G7 declared a commitment to take steps towards preventing a global pandemic from ever happening again.<sup>31</sup> While the G7 Carbis Bay Health Declaration<sup>32</sup> recognised upstream drivers of zoonotic disease emergence, the declaration outlined plans for vaccines and diagnostics, global surveillance networks and genomic sequencing capacity, but not plans for operationalising and financing prevention-oriented activities. Yet prevention protects the most deprived and vulnerable, whereas, detection and response measures tend to protect those in more privileged positions who are least likely to be harmed by future disease emergence crises.

Drivers of zoonotic disease emergence often are also drivers of biodiversity loss and of climate change. An editorial published in over 200 leading health journals called for governments to properly address the climate, biodiversity and public health crises and concluded: “The greatest threat to global public health is the continued failure of world leaders to keep the global temperature rise below 1.5°C and to restore nature”.<sup>33</sup> It is cause for optimism that prevention-oriented policies and actions that mitigate one global crisis can synergise in helping to mitigate others.

Public health professionals have an important and powerful voice in advocating for evidence-based and equitable solutions that will reduce pandemic risk whilst ensuring the most vulnerable are protected. Until now, increased surveillance for, and response to, zoonotic disease emergence has been widely advocated, but prevention is more just and equitable and avoids irreversible harms and burdens on already overwhelmed public services. The public health community has been central to responding to the current pandemic and must carry this forward into recovery, further developing transdisciplinary working and increasing policy engagement to identify and rectify weaknesses in national and global systems that fail to minimise the risk of future pandemic disease emergence. Public health professionals can demonstrate the crucial need for broad understandings of the drivers and impacts of crises like the COVID-19 pandemic, and the ways which narrow views on specific endpoints undermine prevention.<sup>34</sup> In addition to putting our own governance house in order, current inter-governmental negotiations to develop a global pandemic instrument<sup>35</sup> need to prioritise *prevention* of zoonotic spill-over rather than the current trends of prioritising surveillance and response.

### Contributors

SS led on drafting and conceptualising the paper and is the guarantor of the article. SS and MvS completed a first draft. All authors participated in reviewing, drafting and final approval of the manuscript.

### Declaration of interests

AAC is a member of the WHO/FAO/OIE/UNEP One Health High Level Expert Panel <https://www.who.int/groups/one-health-high-level-expert-panel>, a member of the Centre for European Policy Studies Expert Working Group on alternative configurations for the institutional design of the European Health Emergency Preparedness and Response Authority, and a member of the Eklipse Expert Working Group on Biodiversity and Pandemics <https://eklipse.eu/request-biodiversity-pandemics/>.

SS has previously worked for the Department for the Environment, Food and Rural Affairs.

### Acknowledgements

We thank Anthony R. Fooks for his valuable comments on earlier drafts of this manuscript.

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