Foresight approaches for future health shocks: integration into policy making and accompanying research priorities

Christina Pagel and colleagues argue that foresight approaches are key to preparedness for emergencies such as covid-19 and that these must be integrated within policy making at all levels

Effective structured decision making for policy making relies on comprehensive analysis and strategic foresight that enables policy makers to prevent, mitigate, and respond to potential emergencies. Foresight approaches aim to explore and anticipate future situations. Foresight approaches to inform emergency prevention and response have been used in many different contexts from adaptation to extreme heat or rainfall to terrorism, foreign policy, and pandemics.[1-8]

KEY MESSAGES

- An articulated set of fundamental values and clearly defined objectives should underlie policy selection, particularly in emergency situations
- Embedding systems thinking in the policy making process helps to support optimal decision making when faced with complex problems and inevitable trade-offs
- Developing long term resilience can help to avoid crises and prepare for emergencies but requires continuous investment
- Decision makers must be involved from the beginning to improve the probability that insights are both useful and translated into policy
- Practising situational awareness means anticipating and being prepared to respond to context specific challenges associated with potential emergencies
- A broad range of stakeholders and expertise should be included to ensure that foresight approaches capture the key drivers of potential adverse outcomes
- An overarching open research question is how to accommodate emergency preparedness within the reality of politics as well as policy

Foresight approaches include many methods, one of which is scenario planning, which offers a structured method for anticipating and preparing for future uncertainties.[9] Scenario planning involves exploring a range of plausible futures, each with distinct challenges and opportunities.[10] It can involve narrative exercises,[11] real life exercises with personnel on the ground (for example, for antiterrorism[3]), computer simulations (for example, of crowd movement or population behaviour in a pandemic[4 7]), or probabilistic mathematical models of possible futures (for example, epidemics or climate change[8 12]).

However, foresight approaches and scenario planning support emergency prevention and response only if their insights are both useful and acted upon.[10] For instance, the UK government held a national flooding exercise in 2004 (Exercise Triton[13]), yet the summer of 2007 saw devastating flooding across much of England. A government commissioned report by Sir Michael Pitt to review the UK flood strategy in 2008 highlighted serious gaps in the exercise that meant its insights were not sufficiently useful: lack of inclusion of regional and local organisations, lack of inclusion of the voluntary sector, and deficiencies in planning.[14] In the aftermath of the 2007 floods, in 2012 the government reported having implemented 83 of the 92 wide reaching Pitt recommendations.[15]

Exercise Cygnus for UK pandemic planning was undertaken in 2016. This time its insights were useful, and the exercise highlighted many of the problems that were realised with the arrival of covid-19: shortages of critical care capacity, healthcare workforce, and personal protective equipment. However, the insights were not acted upon, and Exercise Cygnus did not prevent these problems arising in 2020.[16] The exercise failed to influence policy sufficiently to ensure that the necessary remedial actions were undertaken.

Arguably, then, the biggest challenge for foresight approaches lies not in any deficiency of the methods used but in their translation into resilient policy making. In this paper, we highlight six essential principles for integrating insights from foresight approaches into policy making, each with future research priorities, and presented in order of importance. Figure 1 offers a conceptual map of how these principles fit together. We specifically focus on planning undertaken on behalf of national government before an emergency arises. A consistent theme is that although the literature is clear that these six principles are crucial, much less evidence exists for how to ensure that they are implemented and followed.

Principle 1—Articulating fundamental values and defining clear objectives

Any process choosing between policy options requires the objectives of policy to be clear.[17] Particularly in an emergency situation, objectives will relate to core values. For instance, core values inform policy choices such as the duration and severity of lockdowns or vaccine prioritisation.[18] Different values could lead to radically different policies (for instance, the amount of weight given to equity perspectives would change vaccine rollout policy[18]).

In normal times, the values—and consequent objectives—of government policy may be understood through the usual system of parliamentary and political scrutiny. However, in times of emergency, the fundamental values of a country that would underlie any policy objectives may not have been articulated. Public deliberation is needed before the emergency. Whether the emergency is flooding, climate change, terrorism, infectious disease, or something else, the policy options involve complex questions, uncertainty, and difficult trade-offs

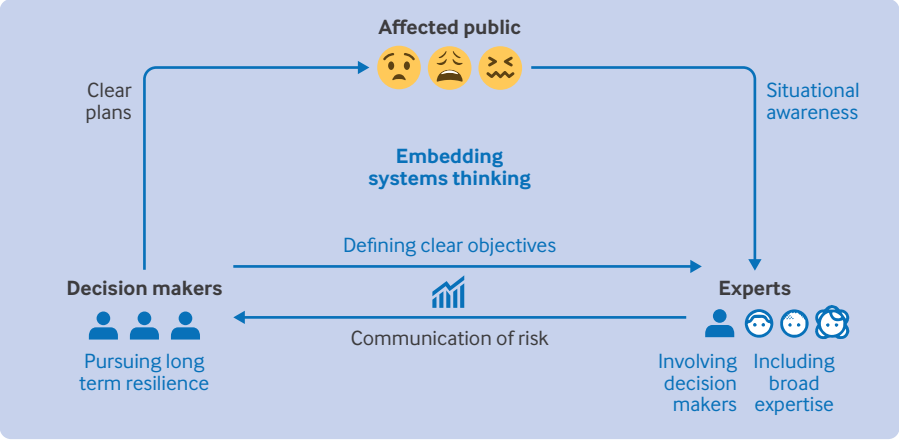

Fig 1 | Diagram depicting the relation between decision makers, experts, and the public, incorporating the six essential principles (shown in blue). Clear plans flow from an articulation of fundamental values and defining clear objectives (principle 1). Communication of risk, involving decision makers from the start (principle 4), and including broad expertise (principle 6) are all key parts of pursuing long term resilience (principle 3). Situational awareness (principle 5) must flow from people on the ground (including the public, where possible). Systems thinking (principle 2) should underlie everything

(for example, collective action versus individual freedoms, current versus future resource allocation) and often require population buy-in, both for legitimacy and for successful implementation.[19]

Ideally, values would be codified—for example, as a statement of national values that has been debated in parliament and has been pre-scrutinised as part of a democratic process before an emergency hits. Methods exist to elicit community values and priorities, under the umbrella of deliberative public engagement, such as citizens' assemblies, citizens' panels, and citizens' juries.[19 20] These have been used in several countries including Ireland (constitutional questions), France (climate change priorities), Finland (freedom of expression), and the UK (funding for adult social care, future of Scotland, climate change).[20]

The citizens' assembly of Scotland produced a 10 point vision for Scotland and recommendations for the government.[21] A similar exercise to articulate the UK's values for setting objectives in a future emergency would be valuable. In the case of the covid-19 pandemic, clearly articulated values would have provided increased transparency, greater accountability, and agreed measures against which to judge and guide government policy, in both its aims and in its implementation, meaning that more valuable time during the emergency phase could have been spent on implementation rather than debate.

Given the many diverse views within the nation, consensus may not be possible. But in this case, the attempt to achieve consensus—whatever the method—serves as "an open discourse that enables interaction and communication ... and leads to mutual understanding"[22] and, hopefully, greater legitimacy in whatever decisions are ultimately made.[23] Again, whatever the method, decision makers must be transparent as to which values underlie their policy and how they were chosen.

Once the values underlying policies have been articulated, these can be translated into objectives and policy options, and the different options can then be assessed using a range of methods. Values can be explicitly incorporated into cost-benefit analyses by using methods such as "social welfare functions," which aim to quantify overall benefit for a society.[18] Techniques such as multicriteria decision analysis, preference ranking, or causal inference can help to prioritise preferences in the face of difficult trade-offs, on the basis of articulated values and objectives.[24-27] This would also make the process of parliamentary scrutiny of emergency measures easier, more efficient, and more legitimate.[28]

Future research efforts need to consider how to choose a set of values when consensus is not achieved, while retaining legitimacy[29]; how to translate values into specific policy objectives[30]; how best to incorporate the articulated values into decision methods for choosing between policy options; what frameworks work best to capture intended and unintended consequences of major policy initiatives; and how broad to go when considering costs and benefits (for example, whether to include the potential economic benefit of future new technology production and adoption in climate change adaptation). This is particularly important when costs and benefits are uncertain.[31]

Principle 2—Embedding systems thinking

The decisions made leading up to and during an emergency can have unintended knock-on effects. A decision to make one process more efficient may lead to exposure to increased risk in another area. For instance, the US hospital budgeting model to minimise costs resulted in low stockpiles of personal protective equipment and contributed to a severe shortage once the covid-19 pandemic began.[31] Other examples are the complex interdependency of services needed to keep care homes functioning in a severe flood and urban planning to reduce heat risk.[1 2] The complexity of decision making means that if components of a system are viewed or optimised in isolation, this may lead to suboptimal decisions for the system as a whole.

In the UK, some progress has been made to encourage civil servants to adopt systems thinking (for example, helping civil servants to identify when a project requires systems thinking, actively training civil servants in systems thinking, providing a systems thinking tool kit and case studies).[32] But political decision makers need to be part of this process if evidence based "joined-up" policy options are to be adopted. Although measures have been taken to embed systems thinking within the civil service, without cabinet level support these measures are prone to failure in times of emergency. Leadership is needed and ministers need to be trained to develop competencies in what may to them be a new way of making decisions. Meanwhile, systems thinking also needs to be embedded within local response structures, to reduce fragmentation of response and increase resilience.[17]

Future research should consider how better to communicate the importance of, and then to facilitate training in and practice of, systems thinking with policy makers at local and national levels and how to be resilient to changes in personnel, whether through organisational churn, elections, or the unavailability of key

decision makers personally affected by the emergency.[33] Research needs to be done on how better to map and understand complex interdependencies across different systems, to identify all the relevant stakeholders, and as part of the practice of implementing systems thinking for emergency preparedness. Although an understanding of systems thinking exists within the UK Civil Service, more work needs to be done to include political decision makers in these processes.[34]

Principle 3—Pursuing long term resilience

The UK's strategic approach to resilience is the UK Government Resilience Framework (resilience in this context meaning the frameworks, systems, and capabilities that prevent risks manifesting or crises happening and prepare for and manage emergencies as they occur).[35] Resilience has been described as the "governance of complexity"[36] and is crucial for mitigating the effects of emergencies.[37] However, resilience is expensive in the short term. It involves incurring opportunity costs by investing now in preparation for future events. Some policy makers may shortsightedly view these investments as unnecessary or characterise them as inefficiencies and consequently seek to cut these investments as part of a "cost saving" programme. Ultimately, however, if and when the future events occur and we have not developed resilience, these "cost savings" can turn out to be extremely expensive. If organisational knowledge is not retained, a new cohort of managers may not be aware of decisions made in the past to ensure resilience and so may view a complex system as a simple system that can be optimised for an illusion of efficiency.

For instance, Mehring and colleagues highlighted that institutional responses to flooding are focused on "in the moment" thinking and called for building long term resilience, including sufficient allocation of funding.[38] A National Audit Office report in November 2020 highlighted the shortage of centrally held personal protective equipment at the start of the pandemic and the contribution to this shortage of changes to the NHS Supply Chain Model in 2018 to "prioritise financial savings."[39]

The cycles generated from resilience (instigated in the aftermath of a failure) to cost saving and austerity (in the run-up to a failure) are costly in the long term.[40] The need for resilience must be maintained as an explicit policy objective, even when political or organisational pressures seek to minimise short term costs. For instance, Sayers and colleagues report on using analyses of social vulnerability to flooding to make a long term economic case for investment in flood risk prevention or reduction in areas with most vulnerability.[41]

Biases, such as availability bias and stability bias, can skew the planning process towards familiar or overly optimistic scenarios.[42] Known features of policy making, such as siloed working and short term focus, can hinder the integration of comprehensive, long term resilient strategies.[43]

Two urgent research priorities are how to reduce bias in long term decision making and how to include the distal costs of short term cost saving measures and the distal benefits associated with short term investment, where that distance is across both time and sector.

Principle 4—Involving decision makers from the start

Foresight approaches have the best chance of making a positive impact if decision makers are involved from the very beginning.[17] Doing so ensures that scenarios can be aligned to policy (or policy aligned to realistic scenarios). If foresight approaches are being used to explore the impact of different policy options, then the options considered need to be feasible and relevant to policy makers. That said, effective foresight approaches can also change what is considered feasible for policy—but only if policy makers are involved early and have fully bought into the process.[22 44] For instance, explicitly placing foresight approaches within an existing policy agenda on managing conflict between groups has had success in South Korea.[45]

Scenarios must be designed to offer actionable insights for decision makers to maximise the chance of influencing policy.[46] Involving decision makers from the outset means that the outputs of scenario modelling and the way they are communicated can be co-developed.[11] If the results of foresight approaches can be presented in formats and language familiar to decision makers, that will aid uptake. A dedicated team to convert academic, detailed, and lengthy outputs into policy friendly length, presentation, and format, co-developed with decision makers from the outset, could be important in improving the successful implementation of scenario planning and other foresight approaches.

For elected decision makers in particular, political considerations around policy options are an added pressure. Perceived worry about electoral backlash can prevent effective policy choices, even if they are well evidenced and cost effective. The interaction of political and societal systems needs further study.

Research into the most effective ways to translate between foresight experts and decision makers across local, national, and different sectoral contexts is therefore crucial. Development of frameworks to support early involvement and types of foresight approaches most suited to integration of decision makers would be useful.[11 22] Such frameworks would provide a structured guide on how to identify key decision makers, how to then involve them, and which foresight approaches are best suited to the emergency in question.

Principle 5—Situational awareness

Situational awareness involves anticipating and being prepared to respond to challenges associated with any given emergency.[47] A deep understanding of the current context and resources is needed to enable both preventive and response planning—and an understanding of how communities will react to different emergencies.

For instance, preparedness might take the form of "war gaming" exercises (meaning simulation of a crisis situation in a "safe-to-fail" environment to better prepare key actors to respond to a real crisis).[48 49] Recent examples include pandemic preparedness exercises in the UK,[16 50 51] as well as system maps of local healthcare, social care, and transport options for flood resilience.[2] Part of situational awareness should include what Curtis and colleagues call "enhanced risk identification."[2] This not only identifies communities at most risk from specified disasters but also seeks to understand what (modifiable and non-modifiable) factors contribute to that risk.[2] This information could be captured in existing protocols such as risk registers.

The final stage in creating resilient and effective preparedness plans is to enable rapid identification of when an emergency has begun. Although the occurrence of a fire or a flood may be obvious, an emerging pandemic or a wide scale cyber attack may not immediately be treated as an emergency. Slow recognition of an emergency delays action and makes effective responses more difficult. This is especially true if the optimal response (prevention of escalation) can be implemented only in the very early stages

(for example, when an infectious disease is spreading).

A key challenge to overcome is normalcy bias, which results from a combination of our unfamiliarity with extreme events and the tendency to believe that things will continue to function in the future in the same way as they have in the past. Normalcy bias causes people to minimise, question, or disregard warnings of imminent threats because they are so far beyond the realm of our experience as to make them unbelievable.[52] This is compounded in decision makers by a reluctance to take expensive action that might be unnecessary.

Research priorities related to situational awareness include how to incorporate new understanding of the causes of enhanced risk in emergency preparedness policies[53]; how best to plan for a range of community responses following an emergency[54]; and supporting the rapid identification of new emergencies[55] (for instance, exploring the implementation and impact of methods such as adaptive surveillance and horizon scanning within foresight approaches[2 56]).

Principle 6—Including broad expertise and stakeholders

To ensure that foresight approaches capture the key drivers of potential adverse outcomes, a wide range of expertise should be involved from the beginning.[10 11 46] Expertise should represent all relevant policy areas, bringing together the relevant decision makers and subject matter experts—a form of a strategic foresight approach.[22] Ham, for instance, suggests collective governance bringing together a "team of teams."[37] For quantitative modelling, external experts are key in informing the model assumptions and structure (for example, social sciences can inform patterns of household and non-household contacts and help with the communication of model outputs,[57] or the detailed knowledge of health and social care networks can support modelling of the impact of flooding on crucial services[58]). The wider the range of expertise involved, the less likely that a vital component is overlooked. Perez-Soba and Maas advise that teams should regularly ask themselves, "What would cause surprises or abrupt changes?" and then develop scenarios to explore those surprises.[9]

If possible, stakeholders should include representatives from the communities themselves, as is increasingly the case in flood adaptation planning.[38 46] If equity considerations are an explicit part of the articulated values and objectives (see principle 1), then any planned policy responses must include insights from experts from within disadvantaged communities.[59] The Institute of Development Studies proposes five priority action areas in emergency planning to mitigate disproportionate impacts on such communities.[59]

Priority areas for future research include better methods for effective mechanisms for engagement of a diverse range of stakeholders and expertise within policy making processes[60 61]; understanding and quantifying the impact a wider range of expertise and stakeholders have on chosen policies; and how better to integrate scientific expertise or local or domain specific expertise with the politics of policy making,[62] particularly as a preconception may exist within the political domain that such expertise may be biased.[63 64]

Reality of politics and policy

Finally, one overarching, unresolved problem remains: how to accommodate emergency preparedness within the reality of politics as well as policy. How do we support resilient, long term (often over decades) policy making within short term electoral cycles and concerns? How do we support choosing optimal policies, in line with articulated values and objectives, if they conflict with the current political situation?

Perhaps, then, the final future research strand needs to be how to move from an aim of optimal policy making to one that is pragmatic and "good enough"—that is, resilient to the vagaries of politics and high turnover of decision makers at all levels.

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Competing interests: We have read and understood *The BMJ* policy on declaration of interests and have the following interests to declare: none.

Provenance and peer review: Commissioned; externally peer reviewed.

This article is part of a collection proposed by the Health Foundation. The Health Foundation provided funding for the collection, including open access fees. *The BMJ* commissioned, peer reviewed, edited, and made the decision to publish this article. Richard Hurley was the lead editor for *The BMJ*.

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1 Kingsborough A, Jenkins K, Hall JW. Development and appraisal of long-term adaptation pathways for managing heat-risk in London. *Clim Risk Manage* 2017;16:73-92. doi:10.1016/j.crm.2017.01.001
2 Curtis S, Fair A, Wistow J, Val DV, Oven K. Impact of extreme weather events and climate change for health and social care systems. *Environ Health* 2017;16(Suppl 1):128. doi:10.1186/s12940-017-0324-3
3 Krasmann S, Hentschel C. 'Situational awareness': Rethinking security in times of urban terrorism. *Secur Dialogue* 2019;50:181-97. doi:10.1177/0967010618819598
4 Ma L, Chen B, Qiu S, et al. Agent-based modeling of emergency evacuation in a railway station square under sarin terrorist attack. *Int J Model Simul Sci Comput* 2017;8:1750022. doi:10.1142/S1793962317500222
5 Liu J, Jia Y, Mao T, et al. Modeling and simulation analysis of crowd evacuation behavior under terrorist attack. *Physica A* 2022;604:127891. doi:10.1016/j.physa.2022.127891
6 Brozus L. While we were planning: Unexpected developments in international politics. Foresight contributions 2018. SWP Research Paper 2018. https://www.econstor.eu/handle/10419/253192.
7 Aylett-Bullock J, Cuesta-Lazaro C, Quera-Bofarull A, et al. June: open-source individual-based epidemiology simulation. *R Soc Open Sci* 2021;8:210506. doi:10.1098/rsos.210506
8 Keeling MJ, Guyver-Fletcher G, Dyson L, Tildesley MJ, Hill EM, Medley GF. Precautionary breaks: Planned, limited duration circuit breaks to control the prevalence of SARS-CoV2 and the burden of COVID-19 disease. *Epidemics* 2021;37:100526. doi:10.1016/j.epidem.2021.100526
9 Pérez-Soba M, Maas R. Scenarios: tools for coping with complexity and future uncertainty? In: Jordan AJ, Turnpenny JR, eds. *The tools of policy formulation.* Edward Elgar, 2015: 52-75. doi:10.4337/9781783477043.00014
10 Georgiou P, Pantos S. A critical analysis on the use of scenario planning as a policy making tool for

resilience. 2022. https://sentiojournal.uk/wp-content/uploads/2022/11/Georgiou-and-Pantos-Issue-4.pdf
11 Cordova-Pozo K, Rouwette EAJA. Types of scenario planning and their effectiveness: A review of reviews. *Futures* 2023;149:103153. doi:10.1016/j.futures.2023.103153
12 Gasparrini A, Guo Y, Sera F, et al. Projections of temperature-related excess mortality under climate change scenarios. *Lancet Planet Health* 2017;1:e360-7. doi:10.1016/S2542-5196(17)30156-0
13 Environment Agency. Working together for a better flood response. 2005. https://assets.publishing.service.gov.uk/media/5a7bf9b6ed915d4147621fed/geho0305birq-e-e.pdf
14 Pitt M. Pitt Review of UK Flood Strategy. 2008. https://www.jesip.org.uk/wp-content/uploads/2022/03/Pitt-Review-UK-Floods.pdf
15 Department for Environment, Food & Rural Affairs. The Government's Response to Sir Michael Pitt's Review of the summer 2007 Floods; Final Progress Report. 2012. https://www.gov.uk/government/publications/government-s-response-to-sir-michael-pitts-review-of-the-summer-2007-floods-final-progress-report
16 Keays R. Emergency Planning and Disaster Management. In: Singh S, Pelosi P, Morris AC, eds. *Oxford Textbook of Respiratory Critical Care.* Oxford University Press, 2023.
17 Pherson RH. Leveraging the future with foresight analysis. *The International Journal of Intelligence, Security, and Public Affairs* 2018;20:102-31. doi:10.1080/23800992.2018.1484237
18 Antioch KM. The economics of the COVID-19 pandemic: economic evaluation of government mitigation and suppression policies, health system innovations, and models of care. *Z Gesundh Wiss* 2023;1-16. doi:10.1007/s10389-023-01919-z
19 Involve. Deliberative public engagement. https://www.involve.org.uk/resources/knowledge-base/what/deliberative-public-engagement
20 Institute for Government. Citizens' assemblies. 2024. https://www.instituteforgovernment.org.uk/explainer/citizens-assemblies
21 National Records of Scotland. Citizens' Assembly of Scotland. 2022. https://webarchive.nrscotland.gov.uk/20211201193424/https://www.citizensassembly.scot/
22 Habegger B. Strategic foresight in public policy: Reviewing the experiences of the UK, Singapore, and the Netherlands. *Futures* 2010;42:49-58. doi:10.1016/j.futures.2009.08.002
23 Roper J, Hurst B. Public relations, futures planning and political talk for addressing wicked problems. *Public Relat Rev* 2019;45:101828. doi:10.1016/j.pubrev.2019.101828
24 Stewart TJ, French S, Rios J. Integrating multicriteria decision analysis and scenario planning—Review and extension. *Omega* 2013;41:679-88. doi:10.1016/j.omega.2012.09.003
25 Cadham CJ, Prosser LA. Eliciting Trade-Offs Between Equity and Efficiency: A Methodological Scoping Review. *Value Health* 2023;26:943-52. doi:10.1016/j.jval.2023.02.006
26 Marsh K, Dolan P, Kempster J, Lugon M. Prioritizing investments in public health: a multi-criteria decision analysis. *J Public Health (Oxf)* 2013;35:460-6. doi:10.1093/pubmed/fds099
27 Kühne F, Schomaker M, Stojkov I, et al. Causal evidence in health decision making: methodological approaches of causal inference and health decision science. *Ger Med Sci* 2022;20:Doc12.
28 Nagy GJ, Gutiérrez O. Scenario Planning Toward Climate Adaptation: The Uruguayan Coast. In: Leal Filho W, Esteves de Freitas L, eds. *Climate Change Adaptation in Latin America: Managing Vulnerability, Fostering Resilience.* Springer International Publishing, 2018: 457-76. doi:10.1007/978-3-319-56946-8_28
29 Gupta S. What To Do If You Can't Achieve Consensus in a Conflict? 2020. https://sumit4all.medium.com/what-to-do-if-you-cant-achieve-consensus-in-a-conflict-38e854d61b04
30 Scharfbillig M. Understanding values for policymaking: the challenges. 2022. https://knowledge4policy.ec.europa.eu/blog/understanding-values-policymaking-challenges_en
31 Cohen J, Rodgers YVM. Contributing factors to personal protective equipment shortages during the COVID-19 pandemic. *Prev Med* 2020;141:106263. doi:10.1016/j.ypmed.2020.106263
32 Government Office for Science. Introduction to systems thinking for civil servants. 2023. https://www.gov.uk/government/publications/systems-thinking-for-civil-servants/introduction
33 Seville E. *Resilient organizations: how to survive, thrive and create opportunities through crisis and change.* Kogan Page Publishers, 2016.
34 Dentoni D, Cucchi C, Roglic M, et al. Systems thinking, mapping and change in food and agriculture. *Bio-Based Appl Econ* 2022;11:277-301. doi:10.36253/bae-13930
35 Cabinet Office. The UK Government Resilience Framework. 2023. https://www.gov.uk/government/publications/the-uk-government-resilience-framework
36 Chandler D. *Resilience: the governance of complexity.* 1st ed. Routledge, 2014. doi:10.4324/9781315773810
37 Ham C. *Leadership and governance of the response to COVID-19 in the United Kingdom. Research Handbook on Leadership in Healthcare.* Edward Elgar Publishing, 2023: 457-92. doi:10.4337/9781800886254.00034
38 Mehring P, Geoghegan H, Cloke HL, et al. Going home for tea and medals: How members of the flood risk management authorities in England construct flooding and flood risk management. *J Flood Risk Manag* 2022;15:e12768. doi:10.1111/jfr3.12768
39 The National Audit Office. The supply of personal protective equipment (PPE) during the COVID-19 pandemic. 2020. https://www.nao.org.uk/reports/supplying-the-nhs-and-adult-social-care-sector-with-personal-protective-equipment-ppe/
40 Stuckler D, Reeves A, Loopstra R, Karanikolos M, McKee M. Austerity and health: the impact in the UK and Europe. *Eur J Public Health* 2017;27(suppl_4):18-21. doi:10.1093/eurpub/ckx167
41 Sayers P, Penning-Rowsell EC, Horritt M. Flood vulnerability, risk, and social disadvantage: current and future patterns in the UK. *Reg Environ Change* 2018;18:339-52. doi:10.1007/s10113-017-1252-z
42 Erdmann D, Sichel B, Yeung L. Overcoming obstacles to effective scenario planning. 2015. https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/overcoming-obstacles-to-effective-scenario-planning
43 Patel R. Common policy problems and what researchers can do about them. Impact of Social Sciences, 2020. https://blogs.lse.ac.uk/impactofsocialsciences/2020/10/29/common-policy-challenges-and-what-researchers-can-do-about-them/
44 Van Dasselaar T, Giddings J, Stewart S. Applications of foresight for defence and security: the future of crime. In: Masys AJ, ed. *Safety and security science and technology: perspectives from practice.* Springer International Publishing, 2023: 75-101. doi:10.1007/978-3-031-21530-8_5
45 Heo K, Seo Y. Applying foresight to policy agenda-setting: A successful case in South Korea. *Futures* 2021;127:102701. doi:10.1016/j.futures.2021.102701
46 Pasquier U, Few R, Goulden MC, et al. "We can't do it on our own!"—Integrating stakeholder and scientific knowledge of future flood risk to inform climate change adaptation planning in a coastal region. *Environ Sci Policy* 2020;103:50-7. doi:10.1016/j.envsci.2019.10.016
47 Endsley MR. Toward a theory of situation awareness in dynamic systems. *Human Factors*1995;37:32-64. https://journals.sagepub.com/doi/10.1518/001872095779049543
48 Angafor GN, Yevseyeva I, He Y. Game-based learning: A review of tabletop exercises for cybersecurity incident response training. *Secur Priv* 2020;3:e126. doi:10.1002/spy2.126
49 Toups Dugas PO, Hamilton WA, Alharthi SA. Playing at planning: game design patterns from disaster response practice. *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play.* Association for Computing Machinery, 2016:362-75.
50 Dyer C. Pandemic preparedness: UK government kept coronavirus modelling secret. *BMJ* 2021;373:n1501. doi:10.1136/bmj.n1501
51 Department of Health and Social Care. Annex A: about Exercise Cygnus. 2020. https://www.gov.uk/government/publications/uk-pandemic-preparedness/annex-a-about-exercise-cygnus
52 Drabek TE. *Human system responses to disaster: an inventory of sociological findings.* Springer, 2012.
53 Health and Safety Executive. Planning for incidents and emergencies. https://www.hse.gov.uk/event-safety/incidents-and-emergencies.htm
54 Ready Scotland. Guide to emergency planning for community groups. 2020. https://ready.scot/get-involved/community-groups/guide-emergency-planning-community-groups
55 World Health Organization. Rapidly detecting and responding to health emergencies. https://www.who.int/activities/rapidly-detecting-and-responding-to-health-emergencies
56 Padbury P. An overview of the horizons foresight method: using the "inner game" of foresight to build system-based scenarios. *World Futures Rev* 2020;12:249-58. doi:10.1177/1946756719896007
57 Kretzschmar ME, Ashby B, Fearon E, et al. Challenges for modelling interventions for future pandemics. *Epidemics* 2022;38:100546. doi:10.1016/j.epidem.2022.100546
58 Coles D, Yu D, Wilby RL, et al. Beyond 'flood hotspots': Modelling emergency service accessibility during flooding in York, UK. *J Hydrol (Amst)* 2017;546:419-36. doi:10.1016/j.jhydrol.2016.12.013
59 Institute of Development Studies. Pandemic preparedness for the real world: why we must invest in equitable, ethical and effective approaches to help prepare for the next pandemic. *Published Online First* 2023;8. doi:10.19088/CC.2023.002
60 Stosich EL, Bae S. Engaging diverse stakeholders to strengthen policy. *Phi Delta Kappan* 2018;99:8-12. doi:10.1177/0031721718775670
61 Martin S. *Engaging with citizens and other stakeholders. Government public relations.* Routledge, 2008.
62 Williamson J. EBP+: Integrating science into policy evaluation using evidential pluralism. 2024. https://knowledge4policy.ec.europa.eu/blog/ebp-integrating-science-policy-evaluation-using-evidential-pluralism_en
63 Ingold K, Gschwend M. Science in policy-making: neutral experts or strategic policy-makers?*West Eur Polit* 2014;37:993-1018. doi:10.1080/01402382.2014.920983
64 Lee N. Do policy makers listen to experts? evidence from a national survey of local and state policy makers. *Am Polit Sci Rev* 2022;116:677-88. doi:10.1017/S0003055421000800

Cite this as: *BMJ* 2024;387:e078647
http://dx.doi.org/10.1136/bmj-2023-078647