



THE FUTURE OF SCIENCE ADVICE

A Nature survey finds that most specialists are unhappy with systems of science advice to governments. What needs to change? **By Helen Pearson**

Killer viruses. Artificial intelligence. Extreme weather. Microplastics. Mental health. These are just a few of the pressing issues on which governments need science to inform their policies. But the systems that connect scientists with politicians are not working well, according to a *Nature* survey of around 400 science-policy specialists around the world. Eighty per cent said their country's science-advice system was either poor or patchy, and 70% said that governments are not routinely using such advice.

"Every country is asking how we can do science and scientific advice," says Jeremy Farrar, chief scientist at the World Health Organization in Geneva, Switzerland. Five years after the COVID-19 pandemic exposed the importance of strong links between scientists and policymakers, the challenges to providing advice have grown. Spiralling mis- and disinformation risks obscuring science advice, while anti-science sentiment is eroding trust in experts and evidence – a phenomenon that scientists worry will worsen under the second US presidency of Donald Trump, who has repeatedly ignored or distorted evidence from research.

Nature's survey – which took place before the US election in November – together with more than 20 interviews, revealed where some of the biggest obstacles to providing science advice lie. Eighty per cent of respondents thought policymakers lack sufficient understanding of science – but 73% said that researchers don't understand how policy works. "It's a constant tension between the scientifically illiterate and the politically clueless," says Paul Dufour, a policy specialist at the University of Ottawa in Canada.

But it's a time of reinvention and evolution in science advice, too. Finland is one

country experimenting with different models for providing advice. Many groups, including the US National Academy of Sciences in Washington DC, are trying to speed up the supply of advice to match the rapid pace at which policymakers work, or to incorporate conflicting views. Last year, the United Nations secretary-general, António Guterres, launched a Scientific Advisory Board.

Many people in the field say that science-advice systems need further change. Tackling issues such as intergenerational disadvantage, youth mental health, immigration



I DON'T THINK ANY COUNTRY HAS GOT IT RIGHT."

and responses to climate change require different ways of operating, says Peter Gluckman, former chief science adviser to the New Zealand prime minister and now at the University of Auckland in New Zealand. "Science advice is not designed for that at the moment."

The first science adviser

Whenever there was a scientific crisis at London's 10 Downing Street in the mid-1960s, someone would bellow down the hall for Solly Zuckerman, the United Kingdom's first government chief scientific adviser (GCSA). Zuckerman, a physician, had guided the government on military planning during the Second World War and was appointed as GCSA by prime minister Harold Wilson in 1964.

Legend has it that Zuckerman would arrive, say his piece and smoothly exit – and that, mysteriously, once the controversy was over, there would be no sign he'd been involved. Aside from the lack of transparency, "that kind of summarizes how science advice should work", says Mark Ferguson, who was chief science adviser to the government of Ireland from 2012 to 2022 and has since retired.

Zuckerman's legacy is the chief science advisers (CSAs) that many Commonwealth and other countries have today. In the United Kingdom, the GCSA heads the Government Office for Science, which advises the prime minister and Cabinet Office, while government departments have their own CSAs alongside various councils, committees and more. The system is sometimes referred to as "the Rolls Royce of science advice", says Kathryn Oliver, who studies the use of evidence in policy at the London School of Hygiene & Tropical Medicine. It is also so complex that it took one report 93 pages to explain (see go.nature.com/4fj5tq4).

In other countries, national academies of scholars have a more central role. The National Academies of Sciences, Engineering, and Medicine in Washington DC are a key pillar of US science advice, along with the White House Office of Science and Technology Policy and its director, who advises the president. There are also myriad other ways that research informs branches of the US government.

"There's no 'one size fits all'," in science advice, says Chagun Basha, chief policy adviser in the Office of the Principal Scientific Adviser to the Government of India, who is based in Bengaluru. Each country has evolved its own system, shaped by history, culture and crises it has faced. Japan has the Council for Science, Technology and Innovation, among other means of providing advice. China has the Chinese Academy of Sciences. Chile has ad hoc committees. And at least half of countries do not have science-advice systems with a chief adviser and staff, although they might have other ways to bring evidence into policy, says Soledad Quiroz, who studies knowledge management at the Central University of Chile in Santiago.

But science-advice systems do have one thing in common: many people think they're not up to the job: 78% of respondents to *Nature's* survey said that science advisers lack influence in government and 68% felt that governments lack the relevant research to answer policy questions (see 'Science advice: survey results'). "I don't think any country has got it right, and I don't know what right would look like," says Oliver.

What's more, Oliver says, the definition of science advice is unclear. To some, it is confined to the formal mechanisms – such as academies and science advisers – by which a government accesses scientific evidence to inform policies and decisions. Others use it loosely to refer to any way in which research informs policy, including think tanks and bureaucrats googling

SCIENCE ADVICE: SURVEY RESULTS

Almost 400 respondents, most of whom are on the e-mail list of the International Network for Governmental Science Advice (INGSA), answered a *Nature* survey about the quality of science advice to governments. Just under half of those who chose to disclose their country were from high-income nations.

For more about the survey and results, see go.nature.com/3gtysud

for facts. “Taxi drivers are good at giving science advice,” says Rémi Quirion, chief scientist of Quebec in Canada, drily.

The pandemic effect

Nature’s survey on science advice was sent to about 6,000 people around the globe, most of them on the e-mail list of the International Network for Governmental Science Advice (INGSA), which is based in New Zealand. Roughly half of respondents worked in research, and half in government or an advisory group. (Respondents could work both in research and in government or advisory roles.) They were asked about the quality of routine science advice to governments and about advice during a crisis such as the COVID-19 pandemic.

In interviews, experts said that the pandemic was a key turning point in global science advice because it stress-tested systems and revealed their strengths and weaknesses. In the survey, views on the outcome were mixed. Nearly 60% of participants said that science advice was successfully factored into pandemic policymaking in their country (see ‘Response to COVID-19’). But one-quarter of this group also said that failures in science advice were a major contributor to COVID-19 excess deaths, which amounted to more than 21 million in 2021–22, according to one estimate (see go.nature.com/3gxfvo9).

In September 2020, as the death toll rose, science-policy researcher Roger Pielke at

the University of Colorado, Boulder, started a project called Evaluation of Science Advice in a Pandemic Emergency. More than 100 researchers helped to produce case studies of government science-advisory mechanisms in places from Sweden to Hong Kong.

The number-one lesson, Pielke says, was that “no one really got it right”. Number two was that the United States looked particularly bad. That science was not informing top US politicians was glaringly obvious when then-president Donald Trump made press-conference statements that science did not support – for example, stating that the anti-malaria drug hydroxychloroquine could treat COVID-19. Immunologist Anthony Fauci, a US science adviser and member of the White House coronavirus task force, raced to correct him.

To Pielke, COVID-19 exposed the United States’ lack of a high-level expert advisory mechanism to inform the government’s response – one equivalent to the United Kingdom’s Scientific Advisory Group for Emergencies (SAGE), for instance. “Given that the United States is kind of the world’s colossus of scientific research, it’s a shocking oversight,” he says.

“No one knew who was in charge” of science advice in public health, says Marcia McNutt, president of the US National Academy of Sciences. The academy was releasing advice, but various health and science agencies were interpreting it disparately, she says. The

biggest win post-pandemic, she says, would be to work out who should take the lead next time.

Globally, the fast-moving pandemic highlighted that many science advice systems are simply too slow in a crisis. The US National Research Council, which conducts studies for the National Academies, had seen a gradual drop in requests for its signature reports because policymakers couldn’t wait the 18 months they typically took to produce. During the pandemic, the council fast-tracked some reports in just a few weeks. The academy announced plans in its 2024 strategy to build a standing capacity to work at this pace.

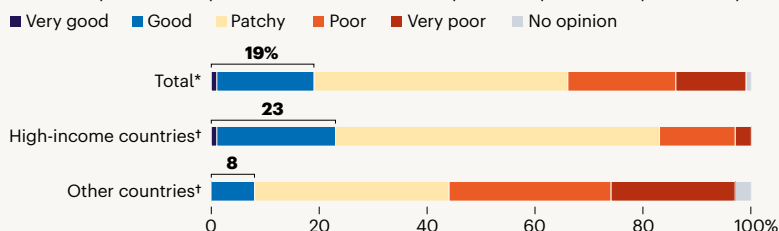
‘Shadow’ science advice

The pandemic fuelled a phenomenon that Pielke calls shadow science advice: when scientists band together and offer counsel outside established channels. During the crisis, shadow advice “became problematic in a lot of places”, Pielke says, “because you had scientists organizing to challenge governments or official science advisory mechanisms”.

One of the most prominent examples was the United Kingdom’s Independent SAGE. Former GCSA David King and other scientists started the group in mid-2020 in response to concerns about a lack of transparency from the government’s SAGE, which did not initially publish its membership or meeting details. Some scientists also criticized SAGE

POOR OPINIONS

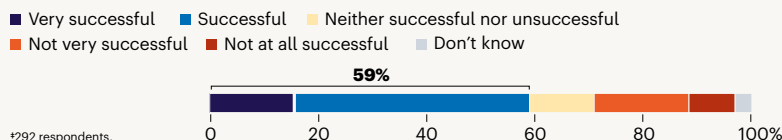
Q: What is your overall opinion of the science-advice system and practices in your country?



*389 overall respondents. †249 gave their countries (113 high-income, 136 other, by World Bank income group).

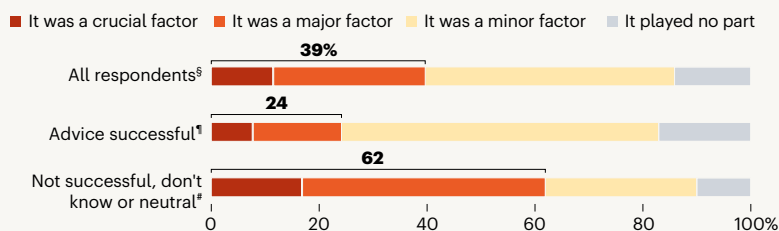
RESPONSE TO COVID-19

Q: In your country, how successful do you think science advice was in ensuring that science was factored into policymaking in the pandemic response?*



*292 respondents.

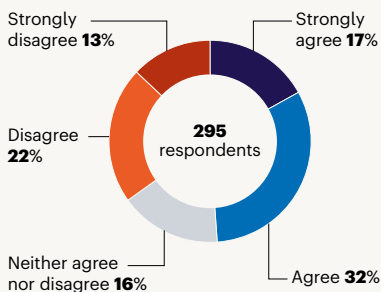
Q: How much, in your view, did failures in the science-advice system contribute to excess deaths from COVID-19 in your country?



§290 respondents. ¶170 respondents who selected ‘very successful’ or ‘successful’ and #120 respondents who answered ‘not successful’, ‘don’t know’ or were neutral when asked about science advice in the pandemic response.

ADVISE OR DECIDE?

Q: One view of science advice is that “advisers advise but ministers decide”. What is your view of this statement?



ADAPTING TO AI

Q: How do you think science advisers should adapt their work to accommodate artificial intelligence (AI) over the next two years?*

They should provide science advice on the potential benefits and harms of AI

75%

They should use AI to help provide evidence syntheses or summaries for policymakers

59

They should focus on combatting AI-generated misinformation

41

They shouldn't use AI

6

**296 respondents who could choose more than one answer.

BARRIERS TO EFFECTIVE SCIENCE ADVICE

Respondents were asked how strongly they agreed or disagreed with statements about obstacles to successful science advice, and about obstacles to evidence-informed policymaking**. Here is a selection of replies (for the full data, see go.nature.com/3gtysud).

Policy makers and politicians lack sufficient understanding of science and scientific methods

80%

Researchers lack incentives to engage in policymaking and science advice**

81

Science advisers lack influence in government

78

Researchers lack understanding of policy processes and decision-making**

73

Science advice is not a routine part of government decision-making

70

Misinformation and disinformation obscure science advice to decision makers

71

Government lacks rigorous relevant research or research syntheses to answer policy questions

68

Science advice fails to incorporate a diversity of people or viewpoints

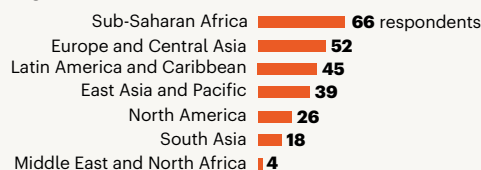
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Base of respondents: for statements on obstacles to successful science advice in their country, variously 322–331 respondents opted to answer. For statements on obstacles to evidence-informed policymaking (denoted with **) in their country, 300–302 respondents answered.

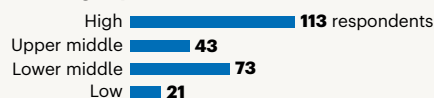
LOCATIONS OF SURVEY RESPONDENTS

Respondents to *Nature's* survey came from around the world.**

Region



Income group (World Bank)



**393 total respondents (including partial responses, which were analysed). 250 respondents chose to disclose their country, from which these regional and income-group analyses are shown. 143 people did not disclose their country.

for lacking expertise in certain disciplines and for not pointing out when government policies were inconsistent with scientific evidence.

Independent SAGE broadcast its public briefings for more than three years. Clinical virologist Deenan Pillay at University College London, who was chair of Independent SAGE from September 2020 to October 2022, says it had a complementary role to SAGE by interfacing with the public. It also put forward policy options informed by science, such as how to safely reopen schools. He says it wasn't adversarial, in that its recommendations were broadly in line with SAGE's published reports.

But Pielke argues that by challenging government advice, Independent SAGE often “delegitimized SAGE, and in the process, science advice itself”, he says. “Even members of Parliament got confused about SAGE versus Independent SAGE.”

In the Philippines, less controversially, a pop-up shadow team of experts called OCTA Research became a leading source of science advice during the pandemic. The group was successful because it had a wide range of expertise, including physicians, economists and a media specialist, says Benjamin Vallejo Jr, an environmental scientist and OCTA member at the University of the Philippines Diliman, Quezon City. It also communicated to politicians “in a way that wouldn't threaten their public credibility”, he says.

In future, Pillay and Pielke agree, science advice needs a mechanism to incorporate a wider diversity of expertise. “If the shadow voices become significant enough or have enough influence, you invite them into the room,” Pielke says. More than 60% of survey respondents said that science advice fails to incorporate a diversity of people or viewpoints.

One way of representing scientists' differing views to policymakers is to offer an array of policy options, and set out what the research says about each one. McNutt says the US National Academy of Sciences is moving towards offering policy options in reports, rather than trying to achieve consensus from its author committee, which has sometimes proved difficult. “We actually do a report that says, if you decide to do this, this is what the science says and here are the pluses and minuses,” she says.

Advisory tensions

When UK prime minister Margaret Thatcher stated in 1989 that “advisers advise and ministers decide”, she might not have imagined that she'd be stirring debate in science-advice circles 35 years on. In *Nature's* survey, roughly half of respondents agreed with the idea that the quote encapsulates: that scientists provide research findings but do not express an opinion on policy decisions, leaving policymakers to weigh up research alongside cost, politics and other factors in making a choice. But more

than one-third of respondents disagreed (see ‘Advise or decide?’)

One problem arises when science advisers are kept too distant from policymakers, says Susan Michie, a behavioural researcher at University College London. During the pandemic, Michie was a member of SPI-B, an expert group that advised the government's SAGE on behavioural science. She became frustrated that the group could respond only to policymakers' questions and did not receive feedback on the usefulness of their advice. “Of course policymakers decide,” she says, but that doesn't mean scientists should advise in a “policy vacuum”. It's much better, Michie says, for scientists and policymakers to develop an ongoing relationship in which they can ask questions.

Political scientist Jaakko Kuosmanen has tried new ways to bring scientists and policymakers together as part of the Science Advice Initiative of Finland, a project that started in 2019 at the Finnish Academy of Science and Letters in Helsinki, to develop a system for the country. Kuosmanen, its chief coordinator, decided to tackle the problem scientifically: conduct experimental pilots of different methods and study them along the way.

One method that Kuosmanen has tested is rapid-response knowledge syntheses. In April this year, when a 12-year-old boy shot and killed one child and injured two others at a school in Finland, some politicians suggested

Feature

installing metal detectors in schools to prevent future shootings, Kuosmanen says. But rather than jump to solutions, he thought that expert knowledge could help. The perpetrator said that he'd been a victim of bullying and, within a week of the shooting, Kuosmanen's team had synthesized published research and expert opinions on the links between school bullying and violence. The team also suggested a range of possible actions, such as supporting marginalized children (see go.nature.com/3gsv2rz; in Finnish). Since then, the government "keeps coming back and requesting more" syntheses, he says.

One of the most promising approaches Kuosmanen and the team has trialled is 'red teaming' for policymaking. This involves scientists working confidentially with policymakers to scrutinize early drafts of policies from a scientific perspective. This scrutiny "in a kind of confidential, trustful setting, is something that hadn't been done before", he says, and the group is now working out how to scale it up.

The European Commission chose another way to address the 'advise versus decide' tension when, in 2016, it established the Scientific Advice Mechanism (SAM), which splits the advisory process in two. When a commissioner requests advice, relevant experts across Europe first gather the relevant research. They then hand their evidence dossier to a group of seven chief scientific advisers, who summarize it and make policy recommendations personally to politicians.

"There's a deliberate firewall," between evidence synthesis and policy recommendations, says Toby Wardman, head of communications for one part of SAM, based in Brussels. This ensures that "scientists working in the field aren't the ones who are shaping the policy on the areas they're working on".

Institutions needed

In some parts of the world, the finer details of science advice mechanisms are less concerning than the struggle to have one at all. In the survey, respondents in low- and middle-income countries were much more likely to say that science advice is not a routine part of government decision making, and that their advice system was poor, than were respondents in high-income ones. In some parts of Asia, for instance, "there's a lack of awareness of the key role that scientists can play to government leaders", says Zakri Abdul Hamid, a former science adviser to the prime minister of Malaysia and now at UCSI University in Kuala Lumpur. In China, however, political leaders "attach great importance to science advice", says Duan Yibing, a science-policy researcher at the Chinese Academy of Sciences in Beijing.

In African countries, there is often a lack of appetite from policymakers for science and a greater dependence on personal relationships

compared with in the global north, says Mobolaji Oladoyin Odubango, a physician who leads science advice as chief executive at the Nigerian Academy of Science in Lagos. "It's just a case of, I call my friend who I trust to ask him what to do." But that is now changing with the growth of African academies of science, Odubango says – from 9 in 2001 to around 30 in 2023. His biggest wish for science advice in Africa is to see academies become financially sustainable.



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The impermanence of science advisory mechanisms is one of the biggest problems, say specialists. Too often, a trusted relationship or other advice route established under one government vanishes under the next. In Latin America, "political systems are too unstable," says Quiróz. She and others want to see science advice in their countries embedded in institutions.

Another problem for those working to establish or improve a science-advice system is that lessons about what works best are difficult to extract – in part because existing systems are not routinely evaluated. But impact is also difficult to measure, Gluckman points out, when behind-the-scenes advice commonly leads to a policy idea being quietly abandoned. That said, "I think there needs to be a more honest reflection on what works and what doesn't work in what context," he says.

The future of science advice

How does science advice need to change over the next ten years? When survey respondents were asked this, more training and education for researchers was top of the list. The growth of science advice in governments has created a need for professional 'knowledge brokers', specialists say. "People believe that with a PhD you can provide science advice and that is not true," says Alma Cristal Hernández Mondragón, who studies science and policy at the Center for Research and Advanced Studies of the National Polytechnic Institute in Mexico City. "You require training and additional skills."

Some are encouraged by the appetite among younger scientists for this type of work. Shobita Parthasarathy teaches graduate students about science policy at the University of Michigan in Ann Arbor. New technologies such as artificial intelligence (AI) are "really

energizing people" to consider the directions of science and technology and "what role might they have in changing them", she says.

AI is one of the biggest issues that future science advisers will have to grapple with. Asked about AI, 41% of survey respondents said that science advisers should focus on combating AI-generated misinformation; 59% said they should use AI to help synthesize evidence; and – unsurprisingly – 75% thought they should provide science advice on AI's potential benefits and harms (respondents could choose multiple answers; see 'Adapting to AI'). AI is one of the first topics for the UN Scientific Advisory Board, which is made up of chief scientists at UN agencies – such as Farrar – and seven external scientists.

Another pressing issue is the growth of misinformation (false information that is spread unwittingly) and disinformation (falsehoods spread with the intention to deceive). Quirion, who is president of INGSA, says that being in science advice now is "sometimes a bit frightening" because fake news and disinformation risk drowning out science advice. "Even if scientists make a recommendation to government, someone can just say 'I don't believe it,'" he says. And the US election result raises fresh concerns. During Trump's first term, points out Quirion, it took nearly two years to appoint a White House science adviser. "Things are not looking good at this time with [the] early slate of appointments," he says.

Gluckman and others say one of the biggest challenges now lies in solving long-term problems that involve many government departments and need robust natural and social sciences. But Farrar argues that this starts with building up solid, trusted science-advice systems able to address day-to-day problems – effectively, continuing to push the boulder up the hill. "I don't think you set up science advice just to deal with wicked problems," he says. "I think you do it because it's critical to how your transport and education systems work tomorrow."

Even with a robust science-advice system, the most important element is a prime minister or president willing to pay it heed, says Zakri. "These are the guys who make the policies, the strategies," he says. "If they don't understand the connection to evidence-based advice, then it will have limited impact."

And there is another thing, Gluckman says, that tomorrow's science advice is likely to share with the past: people like Solly Zuckerman. "I still think a CSA is the key to science advice," he says. "You need well-trained people who can be honest, and say 'Prime minister, that's the stupidest thing I've ever heard.'"

Helen Pearson is a senior editor at *Nature*.

Additional data analysis by **Jeffrey Perkel**.

See Supplementary information for full data (go.nature.com/3gtysud).