



Evidence synthesis for policy

A STATEMENT OF PRINCIPLES

THE
ROYAL
SOCIETY

 The Academy of
Medical Sciences

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Introduction

Evidence synthesis supports well-founded policymaking and public debate. The common question ‘What is the evidence for that?’ could be usefully rephrased as ‘Has sufficient synthesis of the evidence been done in relation to that?’. While typically asked in the former way, it is really the latter that is of interest.

Across disciplines and policy areas there are already good examples of evidence synthesis to inform policy and practice. These include the *Oxford Martin Restatements*¹ (see case study 1) which review the natural science evidence on policy issues from bovine tuberculosis to ionizing radiation; *Conservation Evidence*² which provides synthesised evidence relating to conservation interventions; Parliamentary Office for Science and Technology *POSTnotes*³ which succinctly summarise evidence to inform Parliamentary debate; and *Evidence Aid*⁴ which promotes the use of evidence in the humanitarian sector. *Cochrane*⁵ also provides synthesised evidence to inform specific healthcare decisions, and the *Campbell Collaboration*⁶ provides a similar service for decision-making in education, social welfare, crime and justice, and international development. For the past two decades the UK Government has been using evidence synthesis to inform policy development and implementation across departments and sectors⁷.

Despite this good practice, there are significant challenges associated with moving to a world in which high-quality synthesised evidence is routinely available across all areas of policy and science. Because evidence synthesis for policy sits at the interface of public life and academia, meeting these challenges will require collaboration between researchers, policymakers, practitioners, funders and publishers. Sustained and effective communication and brokerage between these communities will be essential.

This document from the Royal Society and Academy of Medical Sciences outlines the case for evidence synthesis. It then proposes a set of principles that defines the fundamental features of good synthesis. Finally, it proposes changes to the research and policy landscapes that would create a more effective ‘marketplace’ for synthesis: one in which policymakers and commentators reach out to where accessible and timely evidence is available, and one in which researchers are engaged in synthesising evidence because they know it will make a difference.

This document reflects discussions at two meetings organised by the Royal Society and Academy of Medical Sciences in 2017, and draws on expertise from a range of disciplines including medicine, natural sciences, social sciences and international development.

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1. Oxford Martin School. Policy Restatements. See <https://www.oxfordmartin.ox.ac.uk/policy/restatements> (accessed 3 March 2018).
 2. Conservation Evidence. See <https://www.conservationevidence.com> (accessed 3 March 2018).
 3. UK Parliament. POSTnotes. See <http://www.parliament.uk/postnotes> (accessed 3 March 2018).
 4. Evidence Aid. See <http://www.evidenceaid.org> (accessed 3 March 2018).
 5. Cochrane UK. See <http://uk.cochrane.org/> (accessed 3 March 2018).
 6. Campbell Collaboration. See <https://www.campbellcollaboration.org> (accessed 3 March 2018).
 7. UK Government. Guidance: The Magenta Book. See <https://www.gov.uk/government/publications/the-magenta-book> (accessed 3 March 2018).

CASE STUDY 1

Oxford Martin Restatements

*Oxford Martin Restatements*⁸ review the natural science evidence base in areas of current policy concern and controversy. Policymakers are consulted throughout the evidence synthesis process, from selecting the topic, to defining the question, to reviewing the final report. Evidence to inform a restatement is taken from a thorough review of the full breadth of published peer reviewed literature followed by wide consultation with stakeholders (including academia, industry, non-governmental organisations and government).

Restatements are written so that they are accessible to an informed but non-specialist audience. The exact synthesis methods used and a quality grading of the evidence are clearly presented as part of the restatement. The final restatement is published in a peer reviewed, open access academic journal, and several have been published in the Royal Society's journals⁹.



Above (top)
Oxford Martin Restatement
on neonicotinoids and
insect pollinators.

Above (bottom)
Restatement published
in *Proceedings of the
Royal Society B*.

8. *Op. cit.* note 1.

9. See McLean AR, *et al.* 2017 A restatement of the natural science evidence base concerning the health effects of low-level ionizing radiation. *Proc. R. Soc. B* **284**; Godfray HCJ, *et al.* 2015 A restatement of recent advances in the natural science evidence base concerning neonicotinoid insecticides and insect pollinators. *Proc. R. Soc. B* **282**; Godfray HCJ *et al.* 2013 A restatement of the natural science evidence base relevant to the control of bovine tuberculosis in Great Britain. *Proc. R. Soc. B* **280**; and Dadson SJ *et al.* 2017 A restatement of the natural science evidence concerning catchment-based 'natural' flood management in the UK. *Proc. R. Soc. A* **473**.

CASE STUDY 2

Scientific Advisory Group for Emergencies (SAGE)



The UK government's Scientific Advisory Group for Emergencies (SAGE)¹⁰ provides scientific and technical advice to inform government decision making during emergencies. Depending on the situation, many different types of evidence and expertise may need to be rapidly synthesised. This requires good networks and relationships between government bodies and external stakeholders.

A combination of factors made the 2013 Ebola outbreak in East Africa very difficult to control. Ebola has a high mortality rate and, in this instance, spread quickly due to poverty, limited healthcare facilities, local burial customs, and a distrust of the government and healthcare officials.

A rapid synthesis exercise – including consultation with infectious disease experts, anthropologists, behavioural scientists and historians – informed the government's response in both the UK and Africa¹¹.

Rapid synthesis of scientific and other evidence was also required in 2011 when a magnitude 9 earthquake hit the east coast of Japan, leading to a power failure at the Fukushima nuclear plant. SAGE was convened, bringing together experts from within government (the Office for Nuclear Regulation, Health Protection Agency and Department of Health) and outside (the National Nuclear Laboratory, industry and academia). The evidence from the group was used to inform the advice issued to British nationals in Japan¹².

10. UK Government. Scientific Advisory Group for Emergencies (SAGE). See <https://www.gov.uk/government/groups/scientific-advisory-group-for-emergencies-sage> (accessed 3 March 2018).
11. UK Government. How the UK government is responding to Ebola. See <https://www.gov.uk/government/topical-events/ebola-virus-government-response/about> (accessed 3 March 2018).
12. UK Government. Government response to Japan earthquake. See <https://www.gov.uk/government/news/government-response-to-japan-earthquake> (accessed 3 March 2018) – “*Even in a worst case scenario, SAGE's advice is that the risks to human health beyond the exclusion zone set by the Japanese authorities could be managed by precautionary measures, in particular staying indoors to avoid exposure. We continue to update our Travel Advice to advise and inform British nationals in Japan as the situation evolves.*”

What do we mean by evidence synthesis for policy?

Policymakers often need timely access to a reliable summary of the current best evidence, to inform both near-term policy decisions and longer-term enduring challenges such as climate change. ‘Evidence synthesis’¹³ refers to the process of bringing together information and knowledge from a range of sources and disciplines to inform debates and decisions on specific issues. While many synthesis techniques are designed to minimise bias¹⁴, the spectrum of techniques ranges from a full systematic review¹⁵ to the rapid drawing together of evidence to inform an emergency situation (see case study 2). The former, which can take many months to complete, is the most established and comprehensive way to capture all the relevant evidence on a topic, and can be used to build up a high-quality synthesised evidence base on policy topics that are predictable, enduring and recurrent. The latter can be used more tactically when the timescale is short and a policy question urgently needs addressing. Other techniques include meta-analyses¹⁶ and evidence gap maps¹⁷.

Depending on the focus and purpose of the synthesis, evidence from a variety of sources may be relevant, including published and unpublished academic literature, research conducted outside academia, policy evaluation studies from different countries and contexts, and expert and public opinion. If the aim is to demonstrate causality (for example, the effects of a particular drug on a disease) only high-quality quantitative academic research may be relevant. If the aim is to inform more complex societal debates, public opinion, qualitative evidence and anecdotal evidence may be important.

Whatever the aim, it must be recognised that the quality of research varies. The robustness of methodologies, analyses and research protocols should be taken into account in order to avoid unreliable evidence contributing to and undermining evidence synthesis.

‘Evidence synthesis’ refers to the process of bringing together information and knowledge from a range of sources and disciplines to inform debates and decisions on specific issues.

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13. The term ‘evidence synthesis’ has different meanings within different disciplines and publics (for example, ‘synthesised evidence’ is capable of being interpreted or misinterpreted to mean the opposite of what is meant here). However, during the academics’ discussions it was the term that proved most acceptable to the widest range of academic and policy audiences, so we have used it here.
 14. Throughout this document we refer to bias as ‘any process that tends to produce results or conclusions that differ systematically from the truth’, following Daly LE, Bourke GJ. 2000 *Interpretation and Uses of Medical Statistics*. 5th ed. Oxford: Blackwell Science Ltd.
 15. EPPI Centre: What is a systematic review? See <https://eppi.ioe.ac.uk/cms/Default.aspx?tabid=67> (accessed 3 March 2018).
 16. Meta-analysis is when the statistical data from a group of studies are pooled and re-analysed as one large data set. This enables conclusions to be drawn when each individual data set is too small to provide reliable evidence. See EPPI Centre. Glossary. <https://eppi.ioe.ac.uk/cms/Default.aspx?tabid=334> (accessed 3 March 2018).
 17. 3ie (International Initiative for Impact Evaluation). Evidence Gap Maps. See <http://www.3ieimpact.org/en/evaluation/evidence-gap-maps> (accessed 3 March 2018).

Policy questions are rarely answered by a single study, or even by a single discipline.

How does evidence synthesis benefit policy?

Synthesis techniques draw together a large amount of information and turn it into accessible, usable knowledge that benefits society. If made freely available through open access publication, that knowledge becomes a global public good, furthering insight and promoting evidence-informed policy and debate across national borders.

Every year there are over two million new academic publications¹⁸. However, primary research can be difficult to navigate, even for academics, and it is generally inaccessible to those outside academia. Moreover, policy questions are rarely answered by a single study, or even by a single discipline. Decision-making and public debate are best served if policymakers have access to all the relevant evidence relating to a particular issue. This involves an important step – evidence synthesis – between research being conducted and decisions being taken. Indeed, an accurate, concise and unbiased synthesis of the evidence is arguably one of the most valuable contributions the academic community can offer policymakers¹⁹.

Policy options can be viewed through multiple lenses. For example, different stakeholders may hold different personal and political values, the policy objectives themselves may be contested, and there may be questions about the extent to which an ‘ideal’ solution can actually be delivered on the ground^{20,21,22}. In such complex and contested situations, evidence synthesis can help ensure that debate and decisions are informed by the current best evidence.

While this document focuses on evidence synthesis for policy, synthesis is valuable in many different spheres of public life. Recognising this, the Royal Society has begun publishing judicial ‘primers’²³ to assist the judiciary in their understanding of scientific topics and to ensure the best scientific evidence is available to the courts. The Academy of Medical Sciences has recommended further development and use of ‘NHS Choices’^{24,25} as a source of synthesised evidence for patients making individual decisions around medical treatments.

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18. See Jinha, AE. 2010 Article 50 Million: An estimate of the number of scholarly articles in existence. *Learned Publishing* **23**, 258-263, and around 2m new articles per year are published on Scopus. See Scopus: Access and use Support Center https://service.elsevier.com/app/answers/detail/a_id/11274/kw/articles/c/10547/supporthub/scopus/ (accessed 3 March 2018).
 19. Whitty CJM. 2015 What makes an academic paper useful for health policy? *BMC Medicine* **13**:301.
 20. For an accessible discussion piece on the role of opinions in decision-making see Sutherland WJ, Burgman M. 2015 Policy Advice: Use experts wisely. *Nature* **526**, 317-318.
 21. The UK government regularly conducts feasibility studies to inform policymaking – for an example see Truck Platooning: UK road trial feasibility study, <https://www.gov.uk/government/publications/truck-platooning-uk-road-trial-feasibility-study> (accessed 3 March 2018).
 22. Innovation: managing risk, not avoiding it. Government Chief Scientific Adviser’s annual report 2014. See <https://www.gov.uk/government/publications/innovation-managing-risk-not-avoiding-it> (accessed 3 March 2018).
 23. The Royal Society: Science and the law. See <https://royalsociety.org/about-us/programmes/science-and-law> (accessed 3 March 2018).
 24. The Academy of Medical Sciences. 2017 Enhancing the use of scientific evidence to judge the potential benefits and harms of medicines. See <https://acmedsci.ac.uk/file-download/44970096> (accessed 3 March 2018).
 25. NHS choices. See <https://www.nhs.uk/pages/home.aspx> (accessed 3 March 2018).

What are the current challenges?

Despite examples of good practice and successful working relationships between evidence synthesis providers, brokers and policymakers, there remain significant challenges with both the supply of, and demand for, evidence synthesis²⁶.

Although 'supply' and 'demand' are useful organising concepts, the reality is more of a spectrum than a dichotomy. Supply-side and demand-side challenges can reinforce one another, and the means of overcoming them (outlined in chapter 3) generally require collaboration and co-production rather than action solely by synthesis providers or synthesis users.

Supply

Some academic disciplines lack a culture of evidence synthesis, which can mean that synthesis is either not done at all or done in ways that introduce bias.

Even where a culture of evidence synthesis exists, synthesis relies on the availability of high-quality primary research relevant to the policy question. Gaps in the primary research and poor-quality evidence both severely limit the utility of the resulting synthesised evidence. In addition, the UK Research Excellence Framework (REF)²⁷ and research funding system primarily value and reward original research, which can deter researchers from undertaking seemingly low-prestige synthesis even where good primary research exists.

Another challenge is that synthesised evidence is often full of technical jargon and presented in a style that is inaccessible to policymakers. Evidence will never be the only factor being considered by policymakers and synthesised evidence will be quickly discarded if it is deemed irrelevant or inaccessible. Compounding this is the fact that some synthesis articles are currently hidden behind journal pay walls or are lost among the myriad of other publications. Such limited accessibility can mean that even if policymakers are motivated to seek out and use synthesised evidence this is not always a straightforward task.

Even when synthesised evidence is freely available and written in plain language, it may not be available within policy-relevant timeframes. While rapid synthesis carries a higher risk of bias, in public policy it may be that an 80% complete synthesis provided before a decision is made is considerably more valuable than a more comprehensive version that arrives the day after, provided the limitations imposed by doing it quickly are made clear²⁸. In the long run, habitually synthesising evidence to provide answers to enduring questions could reduce the need for more rapid approaches which carry a greater risk of bias.

Even when synthesised evidence is freely available and written in plain language, it may not be available within policy-relevant timeframes.

26. For further discussion of these challenges see *op. cit.* note 19.

27. REF (Research Excellence Framework) 2021. See <http://www.ref.ac.uk/> (accessed 3 March 2018).

28. *Op. cit.* note 19.

CASE STUDY 3

Defra *Evidence Statements*

Defra's²⁹ *Evidence Statements* are neutral, succinct summaries of evidence on a defined topic of policy relevance. The statements are produced over a period of three months in collaboration with the policy customer. The topics covered are guided by Defra's research priorities, as outlined in the departmental Areas of Research Interest³⁰.

Policy officials work in a fast-paced and resource-limited environment. Pre-prepared, neutral *Evidence Statements* are an efficient way to keep officials and ministers informed of the state of the current evidence.

By producing these statements in-house, the department's existing data and scientific evidence can be considered alongside those from external sources.

A consistent method for producing and updating the *Evidence Statements* over time ensures rigour, accessibility and confidence in the findings. Each statement is completed according to a pre-defined methodology, adapted from the systematic review methods used in healthcare. The statements demonstrate how a government department can build an in-house repository of synthesised evidence relevant to its policy needs.

29. Department of Environment, Food and Rural Affairs <https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs> (accessed 11 May, 2018).

30. UK Government. Defra group areas of research interest. See <https://www.gov.uk/government/publications/defra-group-areas-of-research-interest> (accessed 3 March 2018).

Demand

Policymakers can be unwilling or unable to take account of existing evidence for a variety of reasons.

In some government departments and public sector bodies, particularly where the profile of evidence synthesis is low, policymakers may not be aware of the breadth of available evidence on a topic, or of the most up-to-date techniques for combining and critically appraising this evidence.

Time pressures, competing policy priorities, limited internal skills and external networks can also contribute to synthesis being overlooked. In addition, lack of communication and understanding between government departments and the research community can create an unintended disconnect between the questions policymakers are dealing with and the availability of research that has the potential to provide insight.

Why now?

In recent months the Royal Society and Academy of Medical Sciences have become aware of increasing, and increasingly high-profile, calls for evidence synthesis to inform policy. At a joint Royal Society and Defra conference in March 2017³¹ (see case study 3) Mark Walport, the then Government Chief Scientific Adviser (GCSA), described how policymakers often need succinct summaries of the entire evidence base on a topic, and that the main challenge for researchers and brokerage organisations³² is making these summaries available in a useful timeframe. Acting GCSA, Chris Whitty, reinforced this message at the academies' first evidence synthesis meeting in July 2017.

In September 2016, the Academy of Medical Sciences published a report on *Improving the health of the public by 2040*, which discussed the role of evidence synthesis in improving public health interventions³³. This issue was discussed further in a report on how we can best use scientific evidence, published in June 2017, which focused on synthesis to support decision-making in medicine but included recommendations with implications across the sciences³⁴.

31. The Royal Society and the Department for the Environment, Food & Rural Affairs. 2017 Science for Defra: excellence in the application of evidence. See <https://royalsociety.org/~media/policy/Publications/2017/science-for-defra-conference-report.pdf> (accessed 3 March 2018).

32. By 'brokerage organisations' we mean organisations and initiatives that connect policymakers with researchers.

33. The Academy of Medical Sciences. 2016 Improving the health of the public by 2040. See <https://acmedsci.ac.uk/download?f=file&i=37428> (accessed 3 March 2018).

34. The Academy of Medical Sciences: How can we all best use scientific evidence? See <http://acmedsci.ac.uk/policy/how-can-we-all-best-use-evidence> (accessed 3 March 2018).

More information is available digitally than before, and more of it is open access. This creates both risks and opportunities.

The Areas of Research Interest (ARIs)³⁵ now published by several government departments summarise departmental research needs, highlighting the topics on which synthesised evidence would be most welcome. The ARIs provide a useful resource for academics and others, and a useful starting point for greater collaboration between government departments and external researchers.

The establishment of UK Research and Innovation (UKRI)³⁶ also provides a potential opportunity to put in place mechanisms to support evidence synthesis as an important complement to primary research. Similarly, discussions on the shape of future Research Excellence Frameworks (REFs)³⁷ should explore how best to recognise and incentivise excellence in both subject specific and interdisciplinary evidence synthesis.

Another prompt is that more information is available digitally than before, and more of it is open access. This creates both risks and opportunities.

Digital technologies and social media platforms can mean that false information circulates and gains traction rapidly, and that unusual or exceptional cases receive unwarranted attention. There is a risk that public debate and policy decisions are based on concerns from the electorate inspired by misrepresented or overhyped information. The consequences of this have been reported in numerous medical debates, including prescription criteria

for statins, and associations between the Measles, Mumps and Rubella (MMR) vaccine and autism^{38,39}. In this context, it is increasingly important that policy and debate are informed by the current best evidence and that, where possible, this evidence is available to all.

Digital information and technologies also bring the opportunity to increase researchers' ability to synthesise evidence. Machine learning and automation could potentially improve the speed, breadth and rigour of evidence synthesis. For example, by carefully automating aspects of the synthesis process such as the identification of relevant articles, it could be possible to achieve a more thorough synthesis within shorter policy-relevant timeframes.

Finally, some forms of synthesis may become increasingly valuable to the conduct of research itself. With more researchers and more articles published than before, the challenge of enabling new research to build on what has already been carried out is increasingly acute. In any discipline, establishing what is already known (through rigorous synthesis) before undertaking new research should be a fundamental aspect of the research cycle. There is a continuing need for funders to base their funding decisions, and researchers their proposals, on proven evidence gaps; for research to be conducted and reported in a way which accumulates bodies of evidence; and for editors to recognise the importance of synthesising evidence alongside the importance of seeking novelty.

35. UK Government. Collection: Areas of Research Interest. See <https://www.gov.uk/government/collections/areas-of-research-interest> (accessed 3 March 2018).

36. UK Research and Innovation. See <https://www.ukri.org/> (accessed 3 March 2018).

37. *Op. cit.* note 27.

38. *Op. cit.* note 24.

39. The Academy of Medical Sciences. 2017 Enhancing the use of scientific evidence to judge the potential benefits and harms of medicines, online annex A: Detailed case studies. See <https://acmedsci.ac.uk/file-download/35613341> (accessed 3 March 2018).

Principles for good evidence synthesis for policy

Here we present a set of principles, grouped into four categories, for good evidence synthesis for policy (Figure 1). In developing these principles we have focused on the fundamental features that should apply to any evidence synthesis regardless of the timeframe, topic or methods used – from systematic reviews to rapid syntheses, across disciplines and policy areas. As such, many of the principles will be familiar to those already involved in synthesis.

The principles aim to make it easy for those new to synthesis – whether policymakers or researchers – to identify, use, conduct or commission good synthesis. If the principles are followed, policymakers should have a clear understanding of how synthesised evidence has been generated and reviewed, and should appreciate the complexities, areas of contention and limitations.

For their part, researchers less familiar with synthesis should be able to rapidly design processes that will add the greatest value to public debate. Only then can policymakers effectively integrate the evidence with the other factors on which they base their decisions.

The principles do not detail how to conduct a systematic review or any other type of synthesis. For this, we recommend consulting evidence synthesis experts to build knowledge and capacity.

The principles aim to make it easy for those new to synthesis – whether policymakers or researchers – to identify, use, conduct or commission good synthesis.

FIGURE 1

Principles for good evidence synthesis for policy.



ONE

Inclusive



Evidence synthesis that involves policymakers throughout – from the design of the research question to the interpretation of findings – is most likely to yield significant policy insights. Keeping the process inclusive makes it more likely that it will identify the full range of relevant evidence types, sources and expertise. Teams of contributors should have a mix of skills in synthesis and could include some or all of the following: policymakers, practitioners, subject experts, statisticians, experts in databases and search terms, objective writers (usually non-subject experts), and independent reviewers. In practice, policymakers may be less involved during parts of the process if the aim is to scan the horizon for future priorities or to synthesise evidence on a topic that is yet to attract major policy interest.

TWO

Rigorous



Researchers should be as comprehensive as possible in identifying all the relevant sources and types of evidence on the topic within the timeframe and with the available resources, before critically appraising the quality of the evidence and analysing it rigorously. Those carrying out the synthesis should acknowledge potential sources of bias and aim to minimise their influence. Many of the principles outlined here help to minimise bias, or to disclose and explain any potential biases that exist. Given the challenges of combining different forms of evidence, independent expert scrutiny is always essential, although its scale and nature will need to be proportionate.

THREE

Transparent



Synthesised evidence that is transparent is likely to be more credible, replicable and useful. A clearly described study design should include the search terms used, the databases and other evidence sources considered and when they were accessed, and the criteria that determine which studies are and are not included and why. Such measures make the synthesised evidence more useful in its own right and as a basis for undertaking further synthesis. In addition, explicitly acknowledging complexities, areas of strong consensus and contention – particularly where there are fundamental disagreements within the project team – is essential for a policymaker attempting to interpret the findings, and is important for ensuring well-founded public debate more broadly.

FOUR

Accessible



For synthesised evidence to be both useful and used it must be accessible. To be useful to the policymaker, either the main report or, if necessary, a short summary should be written in plain language by a writer who is experienced in presenting information clearly, concisely and as objectively as possible. To ensure the synthesised evidence is used, it must – of course – be made available in time to contribute to the decision-making process. In all but the most confidential situations, the full text and search terms should be published in an open access repository to allow the synthesised evidence to be extended, reproduced or updated in light of new evidence.

Ensuring synthesised evidence is available and informs policy

A shift towards a research system that supports policy-relevant synthesis will require support from several different sectors.

The principles indicate what good evidence synthesis looks like. However, to ensure that good synthesis is more widely carried out and used to inform policy and practice, the research funding, evaluation, publication and policy landscapes will need to evolve. In the final section of this document we present three proposals to academics, policymakers, funders, publishers and others:

- A. Create the incentives, rewards and research culture that support evidence synthesis in academia and beyond;
- B. Make evidence and synthesised evidence more widely available; and
- C. Build a culture of co-producing and using synthesised evidence among researchers, policymakers and government departments.

These proposals assume that some combination of government, the research community and brokerage organisations⁴⁰ is responsible for synthesising evidence for policy, as is currently the case.

Proposals for the research and policy landscapes

A. Create the incentives, rewards and research culture that support evidence synthesis in academia and beyond

Current reward structures in academia do not incentivise the synthesis of existing research. Instead they focus on original research. While academics do routinely undertake and publish integrative literature reviews as part of their academic work, these can be highly selective to the needs of the research and are generally not written with a policy audience in mind.

To address this challenge contributions to evidence synthesis need to be more strongly valued in academic research, funding and publishing. Synthesis also needs to be enabled by infrastructures that can rapidly broker the relevant interdisciplinary expertise. A shift towards a research system that supports policy-relevant synthesis will therefore require support from several different sectors.

40. *Op. cit.* note 32.

Funders could base selected funding calls on identified evidence gaps within both the primary and synthesised evidence bases. They could also provide some dedicated funding for synthesis: either funds to synthesise interdisciplinary evidence to answer policy questions, or funds to develop new, cost-effective synthesis techniques. Funders could also emphasise more strongly the role of evidence synthesis as a potential 'pathway to impact'⁴¹. For researchers to be able to fully demonstrate policy impact, government departments and the wider public sector need consistently to cite the academic references that have informed a policy decision.

In turn, publishers could champion non-standard article types alongside high-quality primary research, recognising evidence synthesis articles as high-quality research in their own right. Working together, publishers could develop agreed criteria⁴² to assess the quality of these submissions, and could train reviewers and editors to do the same. Publishers could also encourage the replication of previously published studies in order to help establish consensus^{43,44} and accumulate bodies of evidence required for synthesis.

There is a skill to generating reliable and useful synthesised evidence, and these talents should be fostered and rewarded. Universities could consider employing information specialists (currently often employed in university libraries) who are expert in searching databases, along with experts in synthesis techniques, who together can draw on academic expertise from across campus and make best use of the primary evidence. These individuals could be specifically funded through research grants or follow-on grants designed to consistently enable new information to be synthesised in the context of other relevant evidence. Universities could also consider housing global synthesis groups with a wide range of relevant skills and expertise, such as the EPPI-Centre⁴⁵ hosted by University College London (UCL) and 3ie⁴⁶ hosted at the London School of Hygiene and Tropical Medicine.

There is a skill to generating reliable and useful synthesised evidence, and these talents should be fostered and rewarded.

41. Research Councils UK: Pathways to Impact. See <http://www.rcuk.ac.uk/innovation/impacts> (accessed 3 March 2018).

42. There are already some such criteria, e.g. GRADE (Grading of Recommendations Assessment, Development and Evaluation), see <http://www.gradeworkinggroup.org> (accessed 3 March 2018), and CERQual (Confidence in the Evidence from Reviews of Qualitative Research), see <http://www.cerqual.org> (accessed 3 March 2018).

43. The Accountable Replication Policy to be introduced into *Royal Society Open Science* this year is a commitment by the journal to publish replications of previously published studies.

44. The Academy of Medical Sciences. 2015 Reproducibility and reliability of biomedical research: improving research practice. See <https://acmedsci.ac.uk/file-download/38189-56531416e2949.pdf> (accessed 3 March 2018).

45. UCL Institute of Education: Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre). See <http://www.ucl.ac.uk/ioe/departments-centres/centres/evidence-for-policy-and-coordinating-centre> (accessed 3 March 2018).

46. 3ie (International Initiative for Impact Evaluation). See <http://www.3ieimpact.org/> (accessed 3 March 2018).

By creating an incentive structure that rewards policy-relevant evidence synthesis, the research community and wider society could get better value from the primary research it produces.

In developing and evolving the Research Excellence Framework (REF)⁴⁷ process, a specific consideration could be how best to recognise excellence in evidence synthesis. The Royal Society has called for an institutional approach, where a portfolio of outputs from the institution would be submitted⁴⁸. The portfolio, along with examples of research impact, should provide evidence of the quality of the research environment and the breadth of activities it supports. This could include evidence synthesis and collaborative work with policymakers as well as other activities including, for example, public engagement and commercialisation. The Academy of Medical Sciences has called for environment assessments to include activities undertaken to improve the robustness and reliability of research. This may include work to ensure adherence to ethical codes of research practice, data-sharing policies, and recognition and reward for efforts to enhance reproducibility⁴⁹. As an exemplar of how knowledge can be captured and turned into a form accessible to non-experts, synthesis could also be recognised in the future Knowledge Exchange Framework⁵⁰.

By creating an incentive structure that rewards policy-relevant evidence synthesis, the research community and wider society could get better value from the primary research it produces, as well as a high-quality research endeavour in its own right. University bodies (such as the Cambridge Centre for Science and Policy⁵¹ and numerous university policy institutes and initiatives), non-governmental organisations and the policy divisions of learned societies⁵² can help create an enabling environment for researchers to contribute to synthesis. They can broker conversations and longer-lasting relationships between researchers and policymakers (see case study 4), making it easier for researchers to appreciate policy demand and easier for policymakers to seek out the evidence they need.

47. *Op. cit.* note 27.

48. The Royal Society. Consultation response: Reforms to the second Research Excellence Framework. See <https://royalsociety.org/media/policy/Publications/2017/17-03-2017-royal-society-REF-position-paper.pdf> (accessed 3 March 2018).

49. *Op. cit.* note 24.

50. Higher Education Funding Council for England. Knowledge Exchange Framework (KEF). See <http://www.hefce.ac.uk/ke/kef/> (accessed 3 March 2018).

51. CSaP (Centre for Science and Policy). See <http://www.csap.cam.ac.uk/> (accessed 3 March 2018).

52. See the Royal Society, Topics and Policy <https://royalsociety.org/topics-policy/> (accessed 3 March 2018), and the Academy of Medical Sciences, Policy <https://acmedsci.ac.uk/policy> (accessed 3 March 2018).

CASE STUDY 4

Effective knowledge brokerage

Organisations and initiatives that connect policymakers with researchers and other experts are an important part of the evidence synthesis infrastructure. By brokering knowledge and relationships they can help ensure that rigorous, relevant synthesised evidence is produced and used. There are many good examples of effective brokerage and many different approaches. The Cambridge Centre for Science and Policy⁵³, for instance, aims to build networks and lasting relationships between academics and policymakers through workshops and fellowship programmes.

The Royal Society⁵⁴, Academy of Medical Sciences⁵⁵, and other academies and learned societies act as brokers by engaging their Fellows or members with the evidence needs of policymakers. The Royal Society's *Science for Public Life* programme aims to strengthen networks between scientists and policymakers across public institutions and use advice and evidence from the Society's Fellowship to inform decisions affecting public life. As part of its five year strategy, the Academy of Medical Sciences aims to provide decision-makers in government and elsewhere with timely and relevant evidence and advice by convening Fellows, experts and other stakeholders through working group studies, symposia and workshops⁵⁶.

B. Make evidence and synthesised evidence more widely available

The preparation of a reliable piece of synthesised evidence requires access to all the relevant evidence. In turn, where the intended audience is policymakers or evidence brokers, they need easy access to the published synthesis.

Accessing the full evidence base can be difficult. Some literature lacks visibility and value by virtue of not being published in a searchable online repository. Much of this literature – sometimes referred to as grey literature – can be extremely valuable when undertaking synthesis to inform policy questions. Synthesis experts and information specialists have become increasingly skilled in finding and using such evidence, and individuals such as these should be viewed as an integral part of the research infrastructure.

A shift in publishing business models could encourage more and better evidence synthesis. Open access models remove barriers and paywalls to published research, and open data allow others to verify and build on this research. Many journals, including the Royal Society's journals, have made it compulsory to publish the data, code and research materials alongside the research article itself. Journals should also permit text and data mining on their content⁵⁷. Encouraging authors to submit early versions of articles in pre-print repositories can also help accelerate the communication of research.

53. *Op. cit.* note 51.

54. The Royal Society. See <https://royalsociety.org/> (accessed 3 March 2018).

55. The Academy of Medical Sciences. See <https://acmedsci.ac.uk/> (accessed 3 March 2018).

56. The Academy of Medical Sciences. Strategic challenges 2017-2021. See <https://acmedsci.ac.uk/about/strategy-2017-21/strategic-challenges-2017-21> (accessed 3 March 2018).

57. The Royal Society. Preprints and media embargoes. See <https://royalsociety.org/journals/ethics-policies/media-embargo> (accessed 3 March 2018).

By making synthesised evidence available globally, knowledge can be shared and built upon and countries with less capacity to undertake synthesis can benefit significantly.

Academic incentives have led to journal policies that produce a publication bias; whereby null or negative findings are less likely to be written up and published⁵⁸. This means that such findings are not available for inclusion in evidence syntheses, resulting in inaccurate and limited representations of some topic areas. There needs to be widespread recognition among publishers, funders and universities of the value of publishing the results of robustly designed studies, whether they have positive or negative results⁵⁹.

*Royal Society Open Science*⁶⁰ now accepts 'registered reports'⁶¹, a type of article where the proposed methods and analysis are pre-registered and peer reviewed prior to the research being conducted. This allows high-quality protocols to be accepted for publication, regardless of the final results.

Conflicts of interest can also be an important source of bias, or perceived bias, in evidence generation and synthesis. If those involved in synthesis are perceived to have conflicting interests, this can significantly undermine the value and use of the synthesis to inform policy development. This problem can be addressed by wider use of 'intelligent openness', whereby possible conflicts are disclosed in a manner that is accessible, assessable and usable

by the intended audience whilst respecting legitimate privacy concerns⁶². To promote this, the Academy of Medical Sciences recommends incorporating the need for intelligent openness in the REF environment statements within the next REF process⁶³.

Evidence synthesis provides widespread societal value by translating large amounts of information into accessible knowledge about what is currently known and unknown. For some issues policymakers' evidence needs may be specific to the time and context in which decisions have to be made. However, many issues are common to decision-makers around the world, and syntheses that draw on evidence from different countries and contexts can have global value.

By making synthesised evidence available globally, knowledge can be shared and built upon and countries with less capacity to undertake synthesis can benefit significantly – particularly if the process is collaborative and the evidence can be tested for local relevance and applicability. Repositories such as the Cochrane Library⁶⁴, the Campbell Collaboration Library⁶⁵ (see case study 5) and 3ie⁶⁶ are good examples of turning synthesised evidence into a global public good.

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58. Fanelli D. 2012 Negative results are disappearing from most disciplines and countries. *Scientometrics* **90**, 891-904.
59. The Royal Society. Research Culture. See <https://royalsociety.org/topics-policy/projects/research-culture/> (accessed 3 March 2018).
60. Royal Society Open Science. See <http://rsos.royalsocietypublishing.org/> (accessed 3 March 2018).
61. Power A. 2016 Registered Reports: what are they and why are they important? *The Royal Society Publishing Blog*. 23 November 2016. See <https://blogs.royalsociety.org/publishing/registered-reports-what-are-they-and-why-are-they-important/> (accessed 1 February 2018).
62. The Royal Society. 2012 Science as an open enterprise: open data for open science. See <https://royalsociety.org~/media/policy/projects/sape/2012-06-20-saoc.pdf> (accessed 3 March 2018).
63. *Op. cit.* note 24.
64. The Cochrane Library. See <http://www.cochranelibrary.com/> (accessed 3 March 2018).
65. The Campbell Collaboration Online Library. See <https://www.campbellcollaboration.org/library.html> (accessed 3 March 2018).
66. 3ie (International Initiative for Impact Evaluation). Find Evidence. See <http://www.3ieimpact.org/en/evidence> (accessed 3 March 2018).

CASE STUDY 5

The Campbell Collaboration and Cochrane Libraries

The Campbell Collaboration⁶⁷ promotes positive social and economic change through the production and use of systematic reviews and other evidence syntheses for policy and practice in education, social welfare, crime and justice, and international development. Cochrane⁶⁸ provides a similar service for evidence-based medicine, promoting synthesised evidence to inform specific healthcare decisions.

The Campbell and Cochrane Libraries^{69, 70} publish collections of systematic reviews in open access repositories. These repositories help to foster global collaboration and knowledge exchange as well as being a resource for researchers and policymakers worldwide.

Across both organisations, co-ordinating groups manage the systematic review process; agreeing the title, appraising the proposed methodology and reviewing the final report. All reviews are expected to undergo consultation with external stakeholders, including policymakers, prior to an exact question being defined. The published articles follow a standard format, where methods are transparent, promoting rigour, confidence and ease of use.

The Campbell Collaboration also supports ‘evidence portals’⁷¹ developed by other organisations. Evidence portals are easy-to-navigate repositories, designed to meet the specific knowledge needs of the target audience. A good example is the Education Endowment Foundation’s *Teaching and Learning Toolkit*⁷² which presents both the implementation cost and strength of evidence for a range of education interventions.



Above
Example of a Campbell Collaboration systematic review.

67. *Op. cit.* note 6.

68. *Op. cit.* note 5.

69. *Op. cit.* note 65.

70. *Op. cit.* note 64.

71. Campbell Collaboration. Evidence Portals. See <https://www.campbellcollaboration.org/better-evidence/evidence-portals.html> (accessed 3 March 2018).

72. Education Endowment Foundation. Teaching and Learning Toolkit. See <https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit/> (accessed 3 March 2018).

C. Build a culture of co-producing and using synthesised evidence among researchers, policymakers and government departments

As described in the principles, policymakers and researchers should work collaboratively to co-design synthesis questions that resonate with policy objectives. For synthesis to truly be relevant to policy, policymakers and researchers should work together to define a focused, answerable question and then continue to collaborate throughout the process. Involving researchers early and continually in the process of policy development helps policymakers and researchers to better understand each other's requirements, constraints and cultures^{73,74}. Synthesis could be built into policy development in much the same way as is frequently done with impact assessments, distributional analyses and economic appraisals.

The Areas of Research Interest (ARIs)⁷⁵ recently published by several government departments provide a mechanism for departments to consistently set out their research needs. These are a welcome innovation, enabling the wider research community to identify opportunities to support decision-makers as they try to deal with complex challenges. It is important that these ARIs (or equivalent documents) are kept up to date and communicated effectively to researchers. Organisations and initiatives that broker relationships between researchers and policymakers can help facilitate this.

Synthesised evidence ideally needs to be available as, or before, a policy problem becomes highly visible, rather than once the problem is fully realised and views on it already entrenched. In some cases, policy questions are predictably consistent over long periods of time, but may have periods of higher or lower public profile. In other cases, policymakers, researchers and brokers may choose to carry out long-term horizon scanning in order to anticipate future evidence needs and build up a synthesised evidence base that can be deployed when required. Evidence gap maps can also inform the scope and timescale of future evidence synthesis; highlighting where there are true gaps in the evidence base, reducing unnecessary duplication and strategically identifying future research and funding priorities.

73. Lavis JN, Robertson D, Woodside JM, McLeod CB, Abelson J, the Knowledge Transfer Study Group. 2003 How can research organizations more effectively transfer research knowledge to decision makers? *The Milbank Quarterly* **81**, 221-248.

74. Lomas, J. 2000 Connecting Research and Policy. *Canadian Journal of Policy Research*, Spring, 140-144.

75. *Op. cit.* note 35.

The UK Civil Service houses one of the most extensive government analytical services in the world and should continue to build on its strength by developing in-house capacity for evidence synthesis. There may be lessons to learn from Denmark, Norway and Sweden where publicly funded research agencies employ staff purely to conduct systematic reviews⁷⁶. These agencies consult government departments to determine their evidence needs, and their findings are used to inform policy and funding decisions. Models such as these could be of value in the UK, building on the existing network of What Works Centres⁷⁷, with exemplars like the Education Endowment Foundation⁷⁸.

Basic evidence synthesis skills should be an essential part of civil service training. This would spread the skills across departments, including those without an existing culture of synthesis. Policy professionals should be confident of when and how to use synthesised evidence, and their training could include aspects such as how to recognise good synthesis, where to source and how to commission good synthesis, and how to critically appraise the work.

The academies were delighted to see the UK Government Science and Engineering Profession⁷⁹ commit to continue to support the development of “an ‘Evidence Synthesis’ tool, which will help scientists and engineers to communicate and tailor their research findings more effectively to policy makers”⁸⁰, and stand ready to help develop this.

Policymakers and researchers should work collaboratively to co-design synthesis questions that resonate with policy objectives.

76. White H. 2016 Doing evidence-informed policy the Nordic way. *The Campbell Collaboration blog*. See http://archive.campbellcollaboration.org/news_/Doing_evidence-informed_policy_the_Nordic_way.php (accessed 3 March 2018).

77. UK Government. Guidance: What Works Network. See <https://www.gov.uk/guidance/what-works-network> (accessed 3 March 2018).

78. Education Endowment Foundation. See <https://educationendowmentfoundation.org.uk/> (accessed 3 March 2018).

79. UK Government Science & Engineering. See <https://www.gov.uk/government/organisations/civil-service-government-science-engineering> (accessed 3 March 2018).

80. UK Government. Corporate report. Government science and engineering profession strategy: one year on. See <https://www.gov.uk/government/publications/government-science-and-engineering-profession-strategy-one-year-on> (accessed 3 March 2018).

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Note that neither workshop attendees nor the review group were asked to endorse the document or its findings.



The Royal Society is a self-governing Fellowship of many of the world's most distinguished scientists drawn from all areas of science, engineering, and medicine. The Society's fundamental purpose, as it has been since its foundation in 1660, is to recognise, promote, and support excellence in science and to encourage the development and use of science for the benefit of humanity.

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