

Summary

Overcoming the challenges of accumulating technical knowledge

- Scientific knowledge alone will not generate vaccines. Technological knowledge is accumulated by theoretically informed but largely empirical testing.
- This testing can be improved with the development of instruments, skills and capabilities that help identify, manipulate and replicate conditions. This will allow developers to iterate back and forth

between conditions that are best for learning, and conditions that are relevant for technological use.

- This suggests the need to engage as fully co-ordinated partners the countries where the vaccine in question is most likely to be used. This will allow the innovation process to draw on local experiences, and conditions to feed into vaccine design, testing and delivery.

More reading

Knowledge Accumulation and the Development of Poliomyelitis Vaccines, STEPS Working Paper 20 by Ohid Yaqub (2009). ISBN: 978 1 85864 766 5

Epidemics for all? Governing Health in a Global Age, STEPS Working Paper 9 by Sarah Dry (2008). ISBN: 978 1 85864 543 3

Haemorrhagic Fevers in Africa: Narratives, Politics and Pathways of Disease and Response, STEPS Working Paper 14 by Melissa Leach (2008). ISBN: 979 185 64 558 1

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Credits

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About the STEPS Centre

The STEPS Centre (Social, Technological and Environmental Pathways to Sustainability) is an interdisciplinary global research and policy engagement hub uniting development studies with science and technology studies. We aim to develop a new approach to understanding, action and communication on sustainability and development in an era of unprecedented dynamic change. The STEPS Centre is based at the Institute of Development Studies and SPRU Science and Technology Policy Research at the University of Sussex with a network of partners in Asia, Africa and Latin America and is funded by the Economic and Social Research Council. Find out more: www.steps-centre.org

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Test, test and test again: Accumulating knowledge for vaccine development

From STEPS Working Paper 20:
Knowledge accumulation and the
development of poliomyelitis vaccines

STEPS briefing 20

Some vaccines are developed at lightning speed. Other, potentially useful, vaccines do not see the light of day. Understanding why this happens may help identify new policies aimed at a more sustainable vaccine development process. This briefing looks at the accumulation of technological knowledge in vaccine innovation and offers an alternative focus for policy attention.

Vaccines have been critical to the elimination of disease at global and local levels. But they are difficult to develop, and they need to keep up with ever-evolving disease ecology and fast-changing social contexts. A system is needed that can not only develop vaccines for an array of diseases, but can do so again and again. Vaccine innovation tends to be seen as a one-off event induced by market forces or forced by scientific understanding. However, vaccine innovation should be seen as a process, embedded in social systems, of accumulating knowledge.



Vaccination drive / Sean Warren / iStockphoto

Vaccine innovation: A failure of markets or a paucity of science?

A vaccine for SARS (Severe Acute Respiratory Syndrome) was developed and tested within two years of the virus appearing in humans. In contrast, it took a hundred years to develop a vaccine for meningitis. Why?

Explanations for this wide variation in vaccine innovation timelines have focused on downstream issues, post-production or late in the development process: economists have emphasised that the vaccine sector exhibits concentrated purchasing power, hostile legal environments, and long, costly development times. Sociologists, on the other hand, have highlighted anti-vaccination movements, delivery and access issues, and socio-political selection of vaccine products.

These explanations for wide variation in vaccine innovation are only part of the story. A more complete picture can only be built up if the technical details that permeate vaccine development towards the beginning of the production process are also examined. For example, economic notions of market failure and sociological notions of neglected diseases do not address the question of why HIV vaccine innovation is difficult. It has been nearly 30 years since HIV was discovered and, in 2007 alone, \$1bn was invested in HIV vaccine R&D. Yet two thirds of leading HIV scientists do not think we will have a vaccine within the next ten years.

“Innovations do not necessarily come about by making market incentives more lucrative or by funding more science”



Polio virus capsid / theasis / iStockphoto

“Technologists must be able to generate knowledge that is reliable, robust and shared, in order for it to accumulate and yield innovations”

Understanding why some vaccines are developed slowly is important because current narratives seeking to answer this question guide vaccine innovation policy. Advanced market commitments, intellectual property incentives, public-private partnerships and networking incentives all rest on the assumption that the disparity between vaccine need and supply represents a market failure.

Some scientists, on the other hand, suggest the biology of viruses can pose unusual scientific challenges which need to be surmounted with more scientific research. Such advocacy rests on assumptions that science leads to innovation largely on its own, and that any public policy that strengthens science will inevitably support vaccine innovation too.

Yet whilst innovation has generally become more related to science, the idea that scientists can turn their discoveries into products, in a simple and linear way, runs against a well-established body of research on the relationship between science and technology by historians of science, historians of technology, sociologists, scientists, engineers, patent examiners and bibliometric analysts.

Studies into the science-technology relationship show that innovations do not necessarily come about by making market incentives more lucrative or by funding more science. So, to generate new vaccines, what other policy levers are available?

Technological knowledge

An alternative analytical approach would be to trace the unpredictable twists and turns that characterise the evolution of knowledge, the historical circumstances in which certain research paths were taken and others abandoned, and the local social context into which vaccines were introduced.

The Working Paper underlying this briefing applies this approach to the story of poliomyelitis vaccine development (see Case 1).

A recurrent theme emerges from the kind of analysis advocated in the Paper: technologists must be able to generate knowledge that is reliable, robust and shared, in order for it to accumulate and yield innovations. Moreover, there is an identifiable system underlying this process: technologists skilfully test ideas with instruments under varying conditions, according to widely accepted standards, and with the active participation of co-ordinating institutions. This triad of elements (testing conditions, skills and instruments, and policy institutions) allows us to frame historical experiences in vaccine innovation as a learning process centred on the accumulation of technological knowledge. Understanding how technological knowledge is accumulated can help identify fertile areas for vaccine innovation policy (see box overleaf).

Case 1: Developing polio vaccines

In 1947, with the support of the US President, specific policies were put in place that helped the accumulation of technological knowledge for poliomyelitis vaccine development. Within a decade, two polio vaccines were developed. New techniques such as tissue culturing were developed; strategic research was contracted out to undertake virus typing; and the supply of monkeys was strengthened and stabilised. These well-funded policies allowed researchers to test, test and test again in a series of structured stages from the laboratory to the field. Institutions, such as the National Foundation for Infantile Paralysis, played a co-ordinating role to ensure that the knowledge emerging from such repeated tests did not remain fragmented between different research groups.