Deploy Vaccines to Fight Superbugs

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Antimicrobials alone won’t be able to mitigate the threat. The supply of naturally occurring antibiotics seems thin. And efforts to engineer new ones have floundered.

We think that vaccines could be a key way to stem the crisis. To launch a global strategic effort to prioritize their development, scientists, policymakers and key stakeholders need to see antibiotics and vaccines as complementary tools. Here we focus on antibiotic-resistant bacteria, for which the need for solutions is most urgent.

**INFECTION RISK**
Unchecked, AMR could substantially limit our ability to conduct routine surgery.

**Vaccines can have an effect on antimicrobial resistance by reducing the number of ill people and avoiding unnecessary antibiotic prescriptions.**

**Deploy vaccines to fight superbugs**

Immunizations combined with antibiotics could be our best shot at combating drug-resistant microbes, argue Rino Rappuoli, David E. Bloom and Steve Black.
VACCINES IN THE LEAD
Since the 1980s, 22 vaccines have been deployed in the clinic, but no truly new class of antibiotics has been discovered or engineered.

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Some, such as the pneumococcal vaccine, do so directly by reducing the carriage and transmission of antibiotic-resistant bacteria. Others do so indirectly. The influenza vaccine, for instance, cuts the incidence of fever, and so minimizes the number of antibiotic doses that are needlessly prescribed and taken.

We call for a global strategic effort to develop a portfolio of vaccines that target AMR. Launching this will require policymakers and stakeholders to make advances on three fronts.

**Economics.** If current methods were used to calculate the economic value of vaccines, many of those targeting resistant bacteria would not be deemed cost-effective because the effects on AMR are not factored in. To persuade governments and drug companies to invest in vaccines, health economists must model the incremental cost of AMR and count the avoidance of that cost as a benefit of vaccine development and use.

**Awareness.** Recent discussions with the UK Wellcome Trust, the Bill & Melinda Gates Foundation and the US National Institutes of Health suggest that all these organizations recognize vaccines as important tools in the fight against AMR. Yet the reports and mission statements of manufacturers and of policymakers, such as the World Health Organization (WHO) and the United Nations General Assembly (UNGA), indicate that most key players see AMR as a problem that needs to be addressed primarily through stewardship and the development of new antibiotics.

To change mindsets, epidemiologists need to mine the data and demonstrate the impact existing vaccines already have on AMR (see ‘Resistance curbed’). They also need work with economists to model the health and economic benefits of greater investment in vaccines. This evidence must be communicated to policymakers and the
The growth of the anti-vaccine community in recent years is a signal that those of us who recognize the health benefits of vaccines need to do better at communicating them.) Meetings between scientists and stakeholders from both the vaccine and the antimicrobial communities should be promoted and funded to enable discussion of an integrated strategy to target AMR.

**Prioritization and trial design.** Policy-makers, funders and manufacturers must agree on what resistant strains to prioritize for vaccine development, depending on the threat they pose and the feasibility of vaccine development. The WHO and other key stakeholders, such as the US Centers for Disease Control and Prevention, that already make recommendations about which strains to prioritize in the hunt for antibiotics, could take the lead.

Likewise, manufacturers of vaccines must begin discussions with regulators to establish which clinical-trial designs would demonstrate the effectiveness of vaccines targeting AMR. Also, the effects of vaccines on AMR should be included in the information leaflets that accompany them, to facilitate recommendations by agencies such as the UK Joint Committee on Vaccination and Immunisation and the US Advisory Committee on Immunization Practices.

No single strategy will suffice when it comes to overcoming the challenges posed by drug-resistant pathogens. The use of antibiotics and vaccines must be accompanied by improved diagnostics to allow caregivers to make better use of the drugs we already have. Enhanced stewardship programmes need to be developed, such as those involving improvements to sanitation, to prevent the spread of infections. And better global surveillance of drug resistance is also required to preserve the effectiveness of our current antibiotic armament. Lawmakers need to bring in more effective regulation to lessen the inappropriate use of drugs (for instance as growth promoters for livestock, or as a result of people buying cheap drugs on the black market in emerging economies). Also, shortcomings in health systems worldwide (primarily, a lack of care givers who are sufficiently informed about when vaccinations or antibiotics are the best course of treatment) could hamper vaccination strategies, even when effective vaccines are available.

These weaknesses must be shored up, for instance by overseas training programmes. One example is the master’s in vaccinology at the University of Siena in Italy, which trains visiting physicians from low-income countries in vaccine development and implementation, enabling them to apply this knowledge when they return to their home countries.

Over the past few years, key institutional stakeholders — notably the WHO, the UNGA, the World Bank, the G20 group of countries, the European Union and the UK and US governments — have called for researchers to develop new antibiotics to expand our arsenal in the war against superbugs. We appeal to these organizations to call now for a multi-layered strategy that prioritizes the development of vaccines to target resistant strains.

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