Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

particularly against highly invasive strains. The optimum number of doses needed to ensure herd immunity is unknown, but might be only one plus a booster or even just one dose at the optimum time without a following booster.

As the findings of Savulescu and colleagues show, use of PCVs can substantially decrease the incidence of invasive pneumococcal disease despite serotype diversity remaining high.[5] Thus, expanded use of available PCVs should be a priority. India, China, and Indonesia have only tiny private markets for PCVs despite having the three largest birth cohorts worldwide. India also has the greatest number of children dying from pneumonia per year.[14] PCV13 is being introduced in some high-burden Indian states in 2017 with the support of funding from the vaccine alliance Gavi. It is hoped further government funding will be made available for supplies from local or international manufacturers within the next few years. Despite only two manufacturers having licensed PCVs so far, more than a dozen are developing PCV products, of which at least some are likely to enter the market over the next decade. Increased supply is likely to drive down costs and promote high and sustainable coverage.

For more on **GAVI** see http://www.gavi.org

The success of PCV10 and PCV13 is evident. Penetration into country-based immunisation programmes in the largest countries in Asia will further enhance the effects and affordability of PCVs worldwide.

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1 Moore MR, Link-Gelles R, Schaffner W, et al. Effect of use of 13-valent pneumococcal conjugate vaccine in children on invasive pneumococcal disease in children and adults in the USA: analysis of multisite, population-based surveillance. *Lancet Infect Dis* 2015; **15:** 301–09.
2 Von Gottberg A, de Gouveia L, Tempia S, et al. Effects of vaccination on invasive pneumococcal disease in South Africa. *N Engl J Med* 2014; **371:** 1889–99.
3 Griffin MR, Zhu Y, Moore MR, Whitney CG, Grijalva CG. US hospitalizations for pneumonia after a decade of pneumococcal vaccination. *N Engl J Med* 2013; **369:** 155–63.
4 Ben-Shimol S, Givon-Lavi N, Leibovitz E, Raiz S, Greenberg D, Dagan R. Near-elimination of otitis media caused by 13-valent pneumococcal conjugate vaccine (PCV) serotypes in southern Israel shortly after sequential introduction of 7-valent/13-valent PCV. *Clin Infect Dis* 2014; **59:** 1724–32.
5 Savulescu C, Krizova P, Lepoutre A, et al. Impact of higher valency pneumococcal conjugate vaccines on invasive pneumococcal disease in children: results of SpIDnet—an observational multicentre study. *Lancet Respir Med* 2017; published online March 27. http://dx.doi.org/10.1016/ S2213-2600(17)30110-8.
6 Waight PA, Andrews NJ, Ladhani SN, Sheppard CL, Slack MP, Miller E. Effect of the 13-valent pneumococcal conjugate vaccine on invasive pneumococcal disease in England and Wales 4 years after its introduction: an observational cohort study. *Lancet Infect Dis* 2015; **15:** 535–43.
7 Pilishvili T, Lexau C, Farley MM, et al. Sustained reductions in invasive pneumococcal disease in the era of conjugate vaccine. *J Infect Dis.* 2010; **201:** 32–41.
8 Johnson HL, Deloria-Knoll M, Levine OS, et al. Systematic evaluation of serotypes causing invasive pneumococcal disease among children under five: the pneumococcal global serotype project. *PLoS Med* 2010; **7:** e1000348.
9 Loughlin AM, Hsu K, Silverio AL, Marchant CD, Pelton SI. Direct and indirect effects of PCV13 on nasopharyngeal carriage of PCV13 unique pneumococcal serotypes in Massachusetts' children *Pediatr Infect Dis J* 2014; **33:** 504–10.
10 Grant LR, Hammitt LL, O'Brien SE, et al. Impact of the 13-valent pneumococcal conjugate vaccine on pneumococcal carriage among American Indians. *Pediatr Infect Dis J* 2016; **35:** 907–14.
11 Picazo J, Ruiz-Contreras J, Casado-Flores J, et al. Effect of the different 13-valent pneumococcal conjugate vaccination uptakes on the invasive pneumococcal disease in children: analysis of a hospital-based and population-based surveillance study in Madrid, Spain, 2007–2015. *PLoS One* 2017; **12:** e0172222.
12 Jayasinghe J, Menzies R, Chiu C, et al. Long-term impact of a "3 + 0" schedule for 7- and 13-valent pneumococcal conjugate vaccines on invasive pneumococcal disease in Australia, 2002–2014. *Clin Infect Dis* 2017; **64:** 175–83.
13 Kwambana-Adams BA, Asiedu-Bekoe F, Sarkodie B, et al. An outbreak of pneumococcal meningitis among older children (≥5 years) and adults after the implementation of an infant vaccination programme with the 13-valent pneumococcal conjugate vaccine in Ghana. *BMC Infect Dis* 2016; **16:** 575.
14 Liu L, Oza S, Hogan D, et al. Global, regional, and national causes of under-5 mortality in 2000–15: an updated systematic analysis with implications for the Sustainable Development Goals. *Lancet* 2016; **388:** 3027–35.

Enhancing preparedness for tackling new epidemic threats


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New and re-emerging infectious diseases cause much human suffering worldwide.[1] Many of these diseases are zoonoses[2] with epidemic potential. All sub-Saharan African regions are highly biodiverse with large rural populations that are highly dependent on livestock agriculture. Movement of pathogens between animals and people increases as the domestic populations expand, creating novel ecotones and ecosystemic perturbation. With increasing food security demands, intensification of livestock and agriculture is required and further evolution and spill over of novel zoonoses to humans is inevitable. The emergence this century of previously unknown zoonotic respiratory tract infectious diseases with epidemic potential,[3] such as Avian influenza, Severe Acute Respiratory Syndrome (SARS), and Middle East Respiratory Syndrome (MERS), highlights an urgent need to change the current global status quo.[4] The 2015 west African Ebola virus epidemic[5] illustrated that once an infectious disease

takes hold locally, the originating region and rest of the world is put at equal risk due to ease of international travel, global food systems, livestock trade, and inadequate capacities to identify and respond to outbreaks.

Several lessons were learnt from the Ebola virus outbreak that could help guide development of more effective and appropriate response capacities. Much of the spread and devastating impact of Ebola virus in west Africa was rooted in the emerging environmental, socioeconomic, and socio-anthropological changes taking place in west Africa. The highly medicalised approach and ineffectiveness of the local and regional surveillance mechanisms delayed appropriate socioecological management of the epidemic.[6,7] Absent were effective active disease surveillance, early diagnosis using rapid diagnostic tests, rapid communication of data for health systems, and engagement and awareness of communities,[6-8] to implement intervention measures to control spread. Behavioural factors also contributed to rapid outbreak spread. Improved understanding of eco-epidemiological, socio-cultural, anthropological, and political determinants that drive the emergence and spread of disease is crucial to preventing epidemics. Furthermore, the lack of local capacity and preparedness in affected west African countries to conduct comprehensive, multidisciplinary and well-coordinated research was also evident during the Ebola virus epidemic. Foreign aid workers and research groups aroused local anxieties among communities[8] due to ignorance of, or insensitivity to, cultural norms. Research studies to assess and determine optimal management protocols and trial new treatments and vaccines were slow to start,[9] and were dominated by foreign groups, with scant involvement of African scientists or local policy makers. Newer treatments in development and those with compassionate-use regulations were available but their use and evaluation to inform optimal evidence-based management, were slowed down by the absence of rapid ethical review processes for research in emergency situations.

A more collaborative, inclusive, and strategic ONE HEALTH partnership between the human, environmental, and animal health sectors[10] is now essential to address recurrent and emergent zoonotic threats effectively and to improve national capabilities on disease preparedness, surveillance, and response for preventing another major epidemic in Africa. This partnership will also enable issues around the growing global threat of antimicrobial resistance to be tackled. Although antibiotic resistant bacteria have spread globally due to increased travel and population movement, the scale of the problem of antimicrobial resistance in Africa remains largely undefined. The WHO recommendations on antimicrobial resistance[11] points out the lack of surveillance data and highlights the need for coordination between human and animal surveillance systems.

Based on a comprehensive inter-epidemic work programme, a ONE HEALTH partnership for emerging diseases and preparedness needs to develop and strengthen suitable sites and regional networks to enable resolution of administrative, regulatory, disciplinary, ethical, and cultural barriers; harmonise clinical case definitions and management guidelines; pre-approve adaptable protocols; and introduce mechanisms to rapidly exchange high quality data and samples. Such a partnership would ensure the readiness to immediately perform coordinated basic science research, to define the source of outbreak and transmission dynamics, and to conduct large-scale multisite clinical studies. It will enable establishment of regional high quality laboratories incorporating rapid diagnostics for multiple pathogens, and proactive surveillance systems providing latest real-time information.[12] Replication of the mobile laboratory model in all African regions will also enable to take forward the important agenda of establishing effective rapid response teams for outbreaks with support of national governments and public health services.

New opportunities to take this ONE HEALTH concept forward comes from several promising developments. The newly established Africa Centers for Disease Control and Prevention (Africa CDC), through five regional centres will perform disease surveillance, investigation, and tracking of infection trends to help African Member States detect and respond to public health emergencies.[13] Four research and capacity development networks of excellence exist across central, west, east, and southern Africa[14] with extensive experience of work on tuberculosis, HIV, malaria, and viral haemorrhagic fevers. With a critical mass of political support and resources of public health, veterinary, wildlife health, and clinical laboratories will ensure the timeliness and quality of surveillance, research, and response to zoonoses and the fractious issues of antimicrobial resistance in Africa. Benefits will not only accrue to public health but also food security and biodiversity conservation. Existing links with ongoing initiatives on emerging infections such as USAID Emerging Pandemic Threats Program,[15] WHO-Global Outbreak Alert and Response

For more on **GLOPID-R** see http://www.glopid-r.org

For the **PANDORA-ID-NET consortium** see http://www.unza-uclms.org/pandora-id-net

See Online for appendix

Network (GOARN),[16] Global Research Collaboration for Infectious Disease Preparedness (GLOPID-R), World Organisation for Animal Health, and other stakeholders could ensure implementation of findings into optimal health guidelines, standards, and policy recommendations.

Importantly, the future of public health services in Africa will depend on empowering a whole generation of young African health-care workers, scientists, and technical staff to take leadership of emerging and re-emerging infections through high quality training and mentorship. The time is now for Africa to take bold steps (appendix) to develop its own capabilities and capacities to rapidly identify and respond quickly and effectively to potential outbreaks. The challenge is for African scientists, public health personnel, and national governments to take leadership of developing a new vision through a ONE HEALTH strategy for the emerging and re-emerging infectious diseases and antimicrobial resistance portfolio across the continent.

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1 Mathis M, Briand S, Prentice T. Emerging and re-emerging infectious threats in the 21st century. *Wkly Epidemiol Rec* 2015; **90:** 238–44.
2 World Health Organization. Zoonoses. http://www.who.int/zoonoses/diseases/en/ (accessed May 22, 2016).
3 World Health Organization. WHO publishes list of top emerging diseases likely to cause major epidemics. http://www.who.int/medicines/ebola-treatment/WHO-list-of-top-emerging-diseases/en/ (accessed April 15, 2017).
4 McCloskey B, Dar O, Zumla A, Heymann DL. Emerging infectious diseases and pandemic potential: status quo and reducing risk of global spread. *Lancet Infect Dis* 2014; **14:** 1001–10.
5 World Health Organization. Ebola virus disease outbreak. http://www.who.int/csr/disease/ebola/en/ (accessed May 23, 2016).
6 Jacobsen KH, Aguirre AA, Bailey CL, et al. Lessons from the Ebola outbreak: action items for emerging infectious disease preparedness and response. *Ecohealth* 2016; **13:** 200–12.
7 Walker NF, Whitty CJ. Tackling emerging infections: clinical and public health lessons from the West African Ebola virus disease outbreak, 2014–2015. *Clin Med* 2015; **15:** 565.
8 Thiam S, Delamou A, Camara S, et al. Challenges in controlling the Ebola outbreak in two prefectures in Guinea: why did communities continue to resist? *Pan Afr Med J* 2015; 22.
9 Ippolito G, Lanini S, Brouqui P, et al. Ebola: missed opportunities for Europe-Africa research. *Lancet Infect Dis* 2015; **15:** 1254–55.
10 Zumla A, Dar O, Kock R, et al. Taking forward a 'One Health' approach for turning the tide against the Middle East respiratory syndrome coronavirus and other zoonotic pathogens with epidemic potential. *Int J Infect Dis* 2016; **47:** 5–9.
11 WHO Antimicrobial resistance. http://www.who.int/antimicrobial-resistance/en/ (accessed April 18, 2017).
12 Zumla A, Goodfellow I, Kasolo F, et al. Zika virus outbreak and the case for building effective and sustainable rapid diagnostics laboratory capacity globally. *Int J Infect Dis* 2016; **45:** 92–94.
13 Nkengasong JN, Maiyegun O, Moeti M. Establishing the Africa Centres for Disease Control and Prevention: responding to Africa's health threats. *Lancet Glob Health* 2017; **5:** e246–47.
14 EDCTP networks of excellence. http://www.edctp.org/networks-excellence/ (accessed April 15, 2017).
15 USAID Emerging Pandemic Threats Program. https://www.usaid.gov/news-information/fact-sheets/emerging-pandemic-threats-program (accessed April 18, 2017).
16 Global Outbreak Alert and Response Network. http://www.who.int/ihr/alert_and_response/outbreak-network/en/ (accessed April 8, 2017).

Deteriorating respiratory health in Nepal: a call for action

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Urban areas of Nepal have been grappling with increasing levels of air pollution in the past 5 years. The extension of road networks throughout the city and installation of water distribution pipes for the long-awaited Melamchi drinking water project in most parts of Kathmandu valley have worsened air pollution levels in the capital city. The authorities have been criticised for not taking measures to contain the dust generated from these projects.[1–3] The latest report about environment performance index (EPI) by Yale University[4] ranked Nepal 177 of 180 countries in terms of air quality. The effects of air pollution on human health are immense. Additionally, people with existing morbidities like cardiovascular diseases and chronic obstructive pulmonary disease (COPD) face increased risk of exacerbations. A report published by WHO in 2016,[5] revealed that outdoor air pollution causes more than 9000 deaths every year in Nepal, mostly due to ischaemic heart disease, stroke, and COPD.

Increasing levels of air pollution could detract from Nepal's recent gains in health. The average life expectancy