

For the 2007 special issue on malaria in pregnancy see *Lancet Infect Dis* 2007; 7:79-174

For more on the past neglect of vivax malaria see *Articles* *Lancet Infect Dis* 2009; 9: 555-56

the growth in the understanding of vivax malaria in pregnancy; a form of malaria that was considered neglected less than 10 years ago.

Malaria remains one of the most preventable causes of adverse birth outcomes. But the Series emphasises a new risk to the success of recent years. Prevention of malaria in pregnancy involves prophylactic treatment with sulfadoxine-pyrimethamine, but resistance to this drug combination has decreased its efficacy and therefore increased the urgent need to hunt for new alternatives. There are also concerns at a more programmatic level as coverage with this combination and the use of insecticide treated nets continues to lag

behind targets. Fortunately, as stressed in the Series, the key barriers to uptake are well documented, and many are open to intervention.

This new Series puts the spotlight back on malaria in pregnancy where much can still be achieved with what is currently understood. However, renewed dialogue and collaboration between researchers, policy makers, and funders could reap enormous benefits if the roadmap as laid out is followed.

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## Pigs, pathogens, and public health

On Nov 8, 2017, Presidents Donald Trump and Xi Jinping announced a US\$8 billion trade agreement, part of which will further increase US pork and animal feed exports to China. Given this expansion of global pork trade, now seems an appropriate time to consider emerging pathogen threats that accompany modern pork production, particularly in China. China has been implicated as the site of origin of the 1957 and

1968 influenza pandemics<sup>1</sup> and is thought to be an epicentre for future novel influenza virus emergence.<sup>2</sup> With increasingly dense populations of pigs, poultry, and people, and often weak farm and animal market biosecurity,<sup>3</sup> it is little wonder that novel influenza A viruses, resulting in increased morbidity and mortality among both livestock and human populations, have emerged in China. China is also recognised as the site of emergent novel pig-only pathogens, such as the strains of porcine reproductive and respiratory syndrome virus (2006)<sup>4</sup> and porcine epidemic diarrhoea virus (2014),<sup>5</sup> which have resulted in hundreds of millions of dollars of agricultural losses in China and the USA.

China's 2017 population of 1.41 billion is growing at an annual rate of about 0.45%, translating to an annual increase of more than 6 million additional citizens.<sup>6</sup> Even with moderate growth, China's pork production and consumption—now over half of the world's—will be enormous. Pork is so important to China that in 2007 it established a national pork reserve.<sup>7</sup> While China's Ministry of Agriculture currently seeks to transform domestic pork production by constructing large US-style industrial animal facilities, it has increasingly turned to cheap, nutritious, and safe imported pork. Indeed, a Chinese holding company is now the largest US pork producer but the center of US pork production remains in the state of Iowa, which now has more than 14 000 animal feeding operations (AFOs). With growth of these operations almost unchecked, new Iowa AFO permits are projected to exceed 500 this year, while two



Greg Gay, China, November, 2016

**Figure: Mixing of poultry and pigs in Chinese pig farms**

In Chinese pig farms it is not uncommon to see other species of animals (poultry, passerine birds, dogs, or rodents) freely mixing with pigs. These other animals can introduce new strains of influenza A virus to the pigs, increasing the variety of influenza A viruses circulating in farms. Continual introduction of new piglets in large farms maintains virus replication and supports the mixing of viral genes, which could generate novel progeny viruses. These progeny viruses could cause epidemics in pigs or human beings.

huge pork processing facilities are under construction to meet demand driven by China's imports, with trade being facilitated by Iowa's former five-term governor, Terry Branstad, now US Ambassador to China.

Studies in the USA and China have documented the effect of industrial swine production and animal transport on the number of novel swine influenza A viruses in swine herds. Most recently, these novel or variant, swine-reservoired influenza A viruses have been increasingly infecting swine workers, most likely their family members and individuals without previous pig exposures attending agricultural fairs.<sup>8</sup> Studies have also documented introduction of human-reservoired influenza A viruses into pig herds, increasing the variety of novel viruses found in pigs from which yet more novel viruses could arise. Also, we have found that living in close proximity to US swine farms could increase the risk of an influenza-like illness possibly from influenza viruses that are amplified in pigs.<sup>9</sup>

An intensive study of swine and swine workers has documented strong evidence of influenza A virus mixing, likely reassorting, and cross-species infections on Chinese farms.<sup>10</sup> This study also documented sparse use of personal protective gear among workers, poor biosecurity (frequent mixing of animal species, figure), and essentially no monitoring for novel virus emergence. Far from adequate in the USA, there is now an opportunity—indeed, an imperative need—for bilateral adoption of biosafety and biosecurity best practices. At a minimum, new and comprehensive screening strategies for novel pathogen generation

in swine AFOs must be established, particularly for influenza A viruses. Such screening strategies are needed to strengthen and increase pork production biosecurity and, most importantly, lessen the risk of catastrophic animal epizootics and human pandemics.

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We declare no competing interests.

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## Impact of enhanced viral haemorrhagic fever surveillance on outbreak detection and response in Uganda



The recent outbreak of Marburg virus disease in Kween District, eastern Uganda, reported in *The Lancet Infectious Diseases*,<sup>1</sup> marks the 13th independent viral haemorrhagic fever outbreak identified and confirmed via laboratory test by the Uganda Virus Research Institute (UVRI)'s viral haemorrhagic fever surveillance and laboratory programme since 2010. This Marburg virus disease outbreak was followed closely by three independent confirmations of human Rift Valley fever virus infection in three districts in central

Uganda, and now brings the total viral haemorrhagic fever outbreak detections to 16. This exceptional number of early detections and subsequent outbreak responses has led to a significant decrease in the overall intensity ( $p=0.001$ ) and duration ( $p<0.0001$ ) of viral haemorrhagic fever outbreaks in Uganda, and serves as a role model for detecting and responding to public health threats of international concern.

Uganda's national viral haemorrhagic fever surveillance and laboratory programme was initiated