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Meeting Report

When Nature turns cook: An epidemiological feast: Report of the John Snow Society Pumphandle Lecture 2009, delivered by Dr David Heymann

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Introduction

The 17th annual Pumphandle Lecture was held appropriately on 8th September 2009: in 1854 on this day, the pump handle was removed from the Broad Street pump and an enduring symbol of public health intervention was born. Public health needs such anniversaries and the hero of the 1854 cholera outbreak, Dr John Snow, might also have appreciated that the main lecture theatre at the London School of Hygiene and Tropical Medicine has been named after him. There was a full house in the lecture theatre to hear Dr David Heymann reflect on his epidemiological experience over three decades, helping to solve and control outbreaks from China to Zaire and from Ebola virus to 'Swine Flu'. Following a career with CDC and then WHO, where he became Assistant Director General, Dr Heymann is currently the Chair of the Health Protection Agency in England and Head of the Centre on Global Health Security at Chatham House, London.

1 Re-use of needles and emergence of viral haemorrhagic fever^{1–3}

Human intervention may have solved many infection problems, examples including small pox eradication and elimination of poliomyelitis in many parts of the world; but human negligence and ignorance continue to assist the formidable powers of Nature to present new infection dilemmas. To negligence, we must also add the lack of basic equipment that can assist the spread of an infectious disease. In Zaire (now Democratic Republic of the Congo) in 1976, a Belgian Mission hospital was chronically short of supplies, necessitating re-use of syringes and needles. If these had

been adequately sterilized, few infection problems would have occurred, but the equipment was only rinsed in distilled water. Treatment of a patient with epistaxis and symptoms of dysentery in the hospital's outpatient clinic led to a devastating outbreak with international implications. The patient, a headmaster, had followed the local custom of buying live animals to be butchered to provide fresh meat at home. This provided the opportunity for a virus to jump species and infect him with a new type of viral haemorrhagic fever. Two weeks later, several other patients and staff became ill: one was evacuated to a hospital at Kinshasa and samples were sent to the UK and CDC Atlanta, where a previously unknown filiform virus was isolated, later named Ebola virus. A rapidly developed diagnostic test provided a way of tracing how many patients had been infected, either by the re-used needles and syringes or close contact with infected persons and/or their body fluids. Closure of the hospital stopped the outbreak, but strains of the virus continue to emerge in Africa: sadly, hospital outbreaks of this highly infectious organism continue to occur. Identification of a strain non-pathogenic to humans in the Philippines (Reston virus) has raised concern that a disease currently confined to pigs (porcine reproductive and respiratory syndrome) may in some way mutate to also become a human pathogen.

Substandard infection control, trade ships and HIV^{4,5}

During the 1980s, the epidemiology of human immunosuppressive virus, HIV, was starting to unfold, not least in the demonstration of how easily it may be spread via re-used syringes and needles. An outbreak at a paediatric hospital in Kalmyk, Romania in 1989 was traced to a sailor from a Russian trade ship, which had visited the west coast of Africa. He had infected his wife: their newborn baby, who had also contracted HIV, was treated at the hospital. Intravenous antibiotics were administered by the same syringe for all patients: the tiny amount of blood drawn up each time was enough to infect several other children. Outbreaks subsequently occurred at Elista and Rostov-on-Don and investigation showed these to be due to a genetically similar strain of HIV. The practice of using pooled gammaglobulin in Romania was also shown to contribute to the spread of HIV in a cluster of over 1000 infected orphans who had been treated with gammaglobulin – and there are continued concerns about the role of routine immunisation programmes in spreading this virus.

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Virus by railway – SARS and civets^{6–12}

The global outbreak of SARS (Severe Acute Respiratory Syndrome), which emerged in Hong Kong in February 2002 presented yet another new human pathogen, traced eventually to a zoonotic corona virus that had jumped species. The main reservoir was thought to have been civets, used in cooking in China. Civets (cat-like animals not related to domestic cats) were regularly sold in live markets and somehow infected humans in the Guangdong Province of China, causing an atypical pneumonia with high mortality. A medical doctor who had treated patients with this atypical pneumonia travelled to Hong Kong by rail to attend a marriage, and stayed one night in a Hong Kong hotel. He had a high fever and cough when he arrived at the hotel, and several people staying in the same hotel were infected, with subsequent cases identified in other countries in Asia and as far as Europe and North America. So animal trading was only the source of infection, which then spread easily from human to human: the epidemic curve showed that infections in health care workers (for example, 10 in Singapore) had driven the transmission to family members and into the local community. This amplification of transmission was a further demonstration of the role of substandard infection control in health care facilities, including laboratory accidents. The SARS virus is thought to have been a single mutation from a strain of the virus that previously only caused disease in humans: animal traders showed evidence of being infected, but had no history of illness, prior to the SARS outbreak. Thanks mainly to a worldwide collaborative effort, the outbreak was contained by July 2003. Containment was facilitated by the low infectivity of the mutated virus: by contrast, the Influenza strain causing 'Swine flu' is much more infective and prevention will be the best way to contain the outbreaks it causes.

Cattle, El Niño and Rift Valley Fever^{13–16}

The importance of animal husbandry was demonstrated in the Sudan in 1998 with an outbreak of Rift Valley Fever, due to a viral infection in animals with the capacity to infect humans. The virus was identified in the 1930s and routine vaccination of cattle was well established in East Africa. Sudanese cattle were regularly taken across the Red Sea to Saudi Arabia and the Yemen to be traded. During the 1990s, a shortage of the vaccine occurred. While it was illegal for unvaccinated cattle to be traded, clandestine trading of the infected animals continued and flooding associated with the El Niño phenomenon provided excellent opportunities for the Rift Valley virus to spread. Flooded areas increased the breeding of the mosquito vector and the flooding forced humans and animals into closer proximity. Clandestine trade in animals and birds remains a potent way of taking viruses to new populations: in 2005, during the concern about 'bird flu', eagles smuggled from Thailand to Belgium were found to be healthy carriers of Influenza A (H₅N₁).

Where the answer is also the problem: polio vaccines^{17–20}

The Salk polio vaccine was enormously successful in controlling poliomyelitis, but the development of a cheaper vaccine that did not need to be injected in 1957 was widely welcomed. The advantages of the Sabin oral polio vaccine (OPV) included the gut and serum response in recipients, as well as a much greater production capacity and lower cost. It has become the vaccine of choice for eradication in endemic polio areas the risk of vaccine associated paralytic polio (VAPP) was not a major issue in comparison with the lives saved. With diminishing cases – many countries, including three WHO regions, being now free of the natural virus – VAPP has risen in importance, particularly as it

seems to occur in mostly healthy children and with the first dose. Circulating vaccine derived polio viruses have also risen in importance, caused by a mutation of the vaccine strain. Once polio has been eradicated, vaccination with OPV will have to be stopped and replaced by injectable inactivated polio vaccine to prevent VAPP and circulating vaccine derived polio viruses – raising difficult issues for countries with limited health budgets. It also highlights another ingredient from the 'cookbook': new interventions, such as vaccines, may bring in new risks that are not understood until problems occur.

The continuing lessons from 'Nature's Cookbook'

Dr Heymann amply demonstrated that all you need for outbreaks is a dose of negligence and poor infection control, a shot of climate change and a good pinch of illicit animal trading; but he added a further ingredient, that of inequitable access to medicines and vaccines. World leaders talk and plead for more equality of access to health interventions, but progress is slow; and Dr Snow would have surely commented on the continuing scandal of the lack of clean water and safe sanitation in many countries – another 'cookbook favourite' in the spread of pathogens. Roll on the establishment of 'International Pumphandle Day' to help to give this unwelcome cookbook more attention.

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Competing interests

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