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One Health

- an infectious disease perspective from CIDM-Public Health and the Sydney Emerging Infections and Biosecurity Institute (SEIB)

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The science and practice of infectious diseases has - like most other branches of medicine and medical science - negotiated many different phases over the last century and a new phase - known as "One Health" is emerging.

Phase of discovery: In the first part of the 20th century, in Europe, North America and Australasia, there was a rapid growth in understanding of the bacterial, protozoal, fungal and later viral, causes of infectious disease but, still, little that could be done to treat them. Doctors watched helplessly as children died from diphtheria, measles, meningitis and pneumonia and previously healthy young people succumbed to tuberculosis (TB) or, if they were soldiers, to gas gangrene, typhus or - in 1918-19 particularly - influenza. There had been important discoveries about modes of transmission, which allowed preventive measures to be implemented, the most important of which was to separate human waste from sources of drinking water, which largely controlled cholera and many other enteric infections; another was control of rats (and their lice) to prevent the spread of plague.

Phase of prevention and cure: A new phase began in the 1940s when vaccines against diphtheria, tetanus and whooping cough were introduced and the first of a bonanza of antibiotics were produced - starting with penicillin and streptomycin and the promise of a cure for many previously lethal diseases including pneumonia and TB. This led to a period of euphoria, culminating in the alleged (but unconfirmed) statement by the US Surgeon General, in 1967, that "it is time to close the book on infectious diseases". Whether he actually said it, or not, it was a widely held belief at the time. There were optimistic predictions that many diseases would be eradicated¹, a goal that has been, in fact, only ever achieved once, so far, with smallpox.

Phase of emerging and Re-emerging disease: (Figure 1). It was not long before the phase of "emerging infectious" began, in the 1970s and 80s, with another wave of new or newly discovered pathogens, of which the most devastating was human immunodeficiency virus (HIV). Of 1399 known species of human pathogens, 335 have been discovered since 1940 (reaching a peak in the 1980s¹) and 87 since 1980². More than 60% of these new pathogens were zoonotic and, of these, 70% originated from wildlife¹

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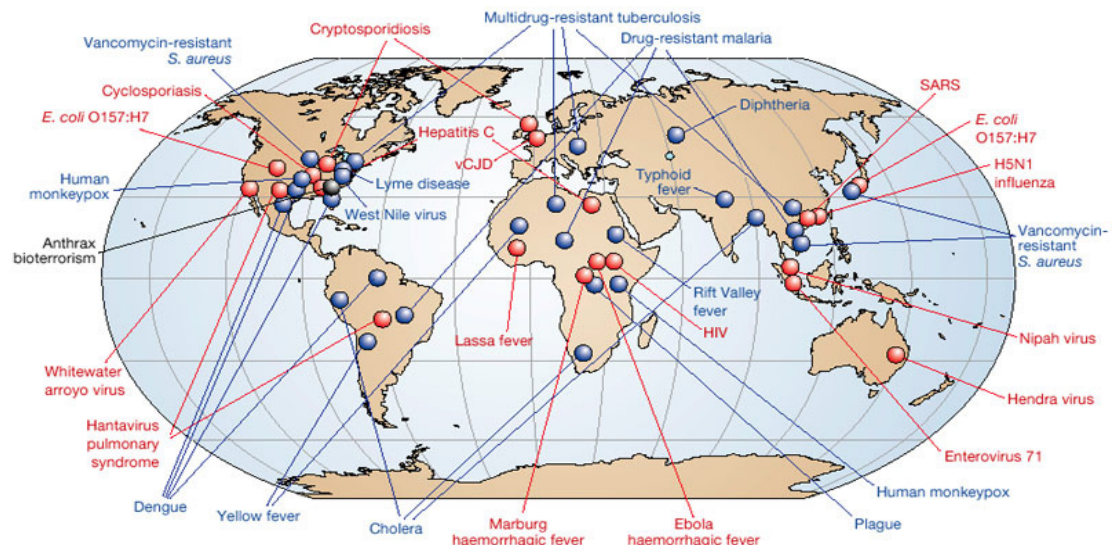


Figure 1. Red represents newly emerging diseases; blue, re-emerging/ resurging diseases; black, a 'deliberately emerging' disease. From: The challenge of emerging and re-emerging infectious diseases. **Morens DM, Folkers GK, Fauci AS.** Nature 430, 242-249. doi:10.1038/nature02759 (8 July 2004)

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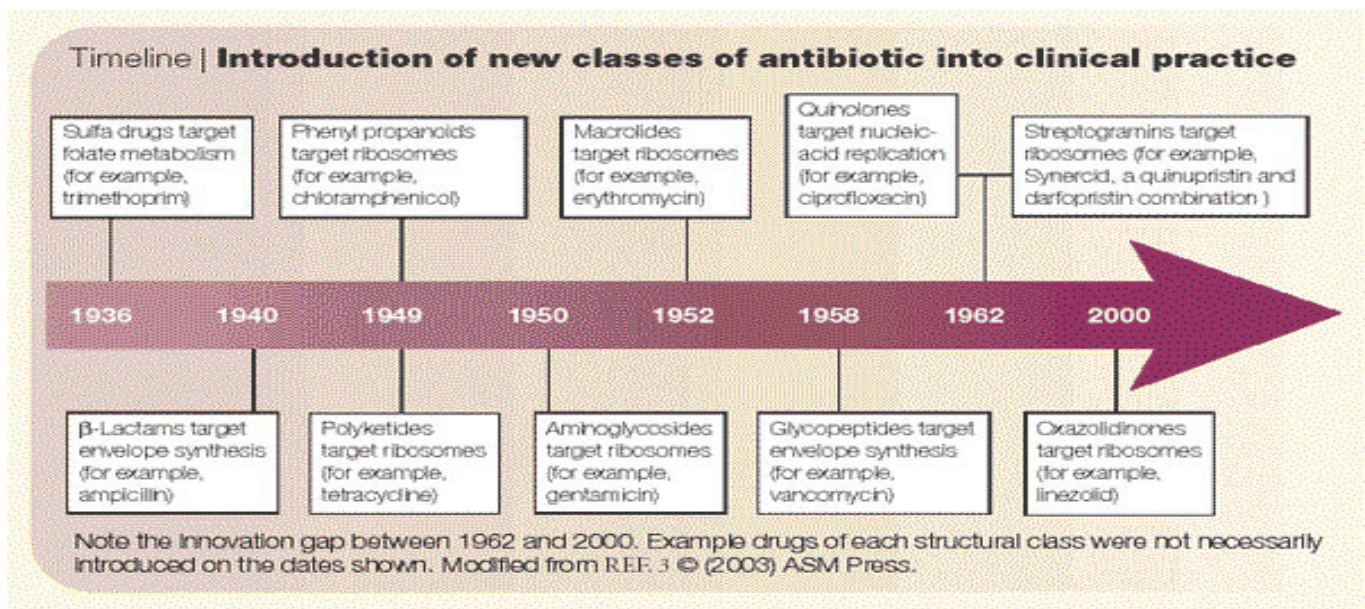


Figure 2. From: Walsh, C. Where will new antibiotics come from? *Nature Reviews Microbiology* 1, 65-70 doi:10.1038/nrmicro727 (October 2003)

At the same time, another phenomenon was gaining importance – that of antimicrobial drug resistance - which led to re-emergence of many traditional communicable diseases which had been relatively easily managed, including tuberculosis, gonorrhoea, pneumococcal disease, typhoid and malaria. This resulted from a combination of inappropriate antimicrobial use and failure or withdrawal of public health services so that treatment was no longer accessible or affordable by those who needed them most. Meanwhile, hospitals again became dangerous places - as the lying-in hospitals had been in the 19th century. There were increased numbers of highly vulnerable patients, who had survived previously lethal diseases, thanks to medical and surgical breakthroughs, only to succumb to opportunistic infections and, at the same time, an increased prevalence of multiresistant bacteria, for which no new antibiotics were in the offing (Figure 2).

Phase of understanding: In the last 20 years, there has been increasing recognition of two major common factors linking many of these emerging and re-emerging diseases, namely an animal origin and environmental changes due to human actions. Some of the latter include, *inter alia*:

- forest clearing for timber and agriculture with loss of wildlife habitat and increased human contact;
- construction of dams, with changes in bird and insect populations;
- gaps between demand for and production of meat protein leading to: more intensive farming of livestock, and a combination of antibiotic use for growth promotion and prophylaxis, overcrowding resulting in increased spread of pathogens and antibiotic resistance (AR) genes); increasing trade in “bush meat” and; household farming and human cohabitation with chickens and pigs;

- rapid international transport of people, animals, food (and, with them, insects, especially mosquitoes and AR genes);
- encroachment of human habitation into wild-life habitats;
- changing sexual practices, mores and contacts related to travel, employment, socioeconomic factors;
- excessive or inappropriate human use of antibiotics (including hospital and community prescribing and, in some countries, over-the-counter sales) and
- anthropogenic climate change

These and other factors have contributed to the emergence, re-emergence or spread of pathogens such as:

- HIV (transmission from African primates, spread by human sexual activity);
- West Nile virus (spread by birds from Africa to the USA);
- SARS coronavirus (from bats via civets in wet markets to humans);
- hantaviruses (from rodents to humans following drought)
- Nipah and Hendra viruses (from bats via domestic animals);
- *Borellia burgdorferii* (Lyme disease from deer mice and their ticks);
- bovine spongiform encephalitis (causing variant Creutzfeldt Jacob disease from cattle);
- highly pathogenic avian influenza H5N1 and pandemic H1N1 from birds and pigs, respectively.

The phase of "One Health". The recognition of these factors and increasing concern about their potential adverse effects, not only on human health, but also on that of domestic animals (causing food shortages, trade and economic instability, poor nutrition), wild life (loss of biodiversity and human exposure to new pathogens), food crops (plant diseases, replacement by biofuel plantations, driven by concerns about peak-oil and global warming) has been a driver for the "One Health Initiative", supported by the World Health Organization (WHO), Food and Agriculture Organization (FAO) and World Organization for Animal Health (OIE; formerly Office international des épizooties) - "..... a worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of human, animal and environmental welfare. The synergism achieved will advance health care for the 21st century and beyond by accelerating biomedical research discoveries, enhancing public health efficacy, expeditiously expanding the scientific knowledge base, and improving medical education and clinical care. When properly implemented, it will help protect and save untold millions of lives in our present and future generations."

(<http://www.onehealthinitiative.com/about.php>). The 1st International One Health Congress was held in Melbourne in February this year (<http://www.onehealth2011.com/>).

These initiatives have led to many innovative collaborations between medical, veterinary and environmental researchers such as: identification of the wildlife origins of SARS coronavirus and many other emerging viruses; surveillance of HPAI H5N1 in domestic and wild birds; investigation of Ebola virus outbreaks in apes - which threaten their survival and can spread to humans; control of human rabies and brucellosis by immunization of animals. It has also led to a reassessment of the ethical implications of potentially devastating effects of human activity – all of which are aggravated by anthropogenic climate change - such as:

- inappropriate and uncontrolled use of antimicrobial agents, insecticides, fertilizers and other environmental pollutants leading to resistance and environmental damage;
- unsustainable exploitation of the environment (land clearing, mining) and wildlife (poaching, loss of habitat), for financial gain, leading to loss of biodiversity, falling food production and spread of wildlife pathogens to domestic animals and humans;
- expansion of agribusiness and mining leading to loss of autonomy, land and livelihood by previously self-supporting farming populations, and increased migration to overcrowded cities;
- disproportionate socioeconomic effects on trade and tourism – often in countries that can least afford them - of pandemics such as SARS.

Clearly none of these problems can be successfully addressed by one profession or nation – the aim of "One Health" is to facilitate the international, multidisciplinary approaches that are needed to understand the behavioural and environmental factors that favour disease transmission and to develop more effective infection prevention and control strategies, new antimicrobials and vaccines.

The Sydney Institute for Emerging Infections and Biosecurity (SEIB) (<http://sydney.edu.au/seib/>), recently established at the University of Sydney will promote a "one health" approach to infectious diseases in Australia and our region, by collaboration between infectious disease researchers in various faculties and schools, including Agriculture, Food & Natural Resources, Architecture, Design and Planning, Arts, Economics & Business, Engineering & Information Technologies, Law (Sydney Law School), Medicine (Sydney Medical School, Sydney School of Public Health), Nursing & Midwifery (Sydney Nursing School), Pharmacy, Science and Veterinary Science

CIDM-Public Health and SEIB share many research interests and senior investigators and will work closely together in future, a collaboration that will be reflected in the Broad Street Pump, in future issues.

References.

1. Cockburn TA. Eradication of infectious diseases. *Science* 1961;133 (3458):1050-8.
2. Jones, KE, Patel NG, Levy MA, Storeygard A, Balk D, Gittleman JL, Daszak P. Global trends in emerging infectious diseases. *Nature*, 2008; 451:990-4. doi:10.1038/nature06536
3. Woolhouse M, Gaunt E. Ecological origins of human pathogens. *Critical Reviews in Microbiology*, 2007;33:231–242.

Upcoming Events.....

Laboratory Diagnosis of Infectious Diseases: From Basics to Molecular Methods Workshop 18-20 March 2011

Westmead Education & Conference Centre, Westmead Hospital

The goal of this workshop is to update pathology trainees and laboratory scientists on the spectrum of fundamental and new methods and tools for identification of clinically relevant bacteria, viruses and fungi. This workshop will also familiarize the participants with the requirements for design and governance of modern laboratory services for infectious disease diagnosis and control.

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