

## EDITORIAL

# Infectious diseases—past, present, and future

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In 1962 Sir McFarland Burnett stated, 'By the end of the Second World War it was possible to say that almost all of the major practical problems of dealing with infectious disease had been solved.' At that time, his statement was logical. Control and prevention measures had decreased the incidence of many infectious diseases, and with the ability to continue to identify new antibiotics, to handle new problems, and the ongoing development of appropriate vaccines, his statement appeared to be appropriate.

In the US, similar feelings were expressed and funding for infectious disease fellowships began to decline with federal resources being directed elsewhere.

The history of the world is intertwined with the impact that infectious diseases have had on populations. Evidence of smallpox has been found in 3000-year-old Egyptian mummies. Egyptian papyrus paintings depict infectious diseases such as poliomyelitis. Hippocrates wrote about the spread of disease by means of airs, water, and places, and made an association between climate, diet, and living conditions. Investigators described miasmas as the source of infections. Fracastoro discussed the germ theory in the 1500s and three routes of contagion were proposed—direct contact, fomites, and contagion from a distance (airborne). Epidemics of leprosy, plague, syphilis, smallpox, cholera, yellow fever, typhoid fever, and other infectious diseases were the norm.

The development of the microscope by Leeuwenhoek in the 1600s allowed scientists to visualize micro-organisms for the first time. The 1800s brought knowledge of the cultivation and identification of micro-organisms. Vaccines were developed and used which introduced specific methods to our storehouse of measures for control and prevention. Pasteurization was another important contribution to disease control. An appreciation of the environment and its relationship to infectious diseases resulted in implementation of broad control measures such as community sanitation, personal hygiene, and public health education. The importance of nutrition was appreciated for its impact on infectious diseases.

The 20th century brought chemotherapy and antibiotics into our infectious disease armamentarium. Greater dependency upon vaccination programmes and health education became important allies in our efforts at reducing the occurrence of infectious disease. So Sir McFarland's statement was not an off hand remark.

But we are now aware that emerging and re-emerging infections have become a significant worldwide problem. In 1991,

the Institute of Medicine of the National Research Council in the US appointed a 19-member multidisciplinary expert committee to study the emergence of microbial threats to health. Their report published in 1992 was entitled, '*Emerging Infections—Microbial Threats to Health in the United States*' but the concepts that they discussed certainly have worldwide application.<sup>1</sup> They concluded that six categories of factors could explain the emergence or re-emergence of infectious diseases. These factors are: Human demographics and behaviour; Technology and industry; Economic development and land use; International travel and commerce; Microbial adaptation and change; and Breakdown of public health measures.

There have been other groupings of causative factors proposed related to re-emerging infections and in some instances we do not yet have a clue as to how new agents have appeared in animal and human populations. The problem of emerging infections is well exemplified by the many examples of new and emerging infectious diseases that have impacted upon localized populations and/or geographical areas over the past several decades. Human immunodeficiency virus (HIV)/AIDS, first identified in 1981, portrays the significant impact that an infectious disease can have on the world. Presently HIV/AIDS is the fourth leading cause of death in the world and it remains the leading cause of death in Africa. The economic havoc it has created worldwide is frightening and its impact upon all peoples will remain embedded on mankind for decades. More geographically localized, but still creating worldwide concern, have been the haemorrhagic fevers, Nipah virus, and monkeypox. And more recently sudden acute respiratory syndrome (SARS) exemplifies how the occurrence of a new and dangerous infectious disease can monopolize governmental activities, cause fear and hysteria, have a significant impact on the economy throughout the world and on the freedom of movement of people.

We are bold in our attempts to control infectious diseases. We have eradicated one disease (smallpox) and two other diseases are in the final stages of eradication (poliomyelitis and dracunculiasis). These eradication programmes demonstrate how international collaboration and co-operation can significantly benefit the world. However, our goals must be realistic, that is, initiation of an eradication programme must be limited to the few diseases for which this is a valid goal. Control and prevention should be our main emphasis as we plan our ongoing commitment in our approach to infectious diseases.

In this issue of the *International Journal of Epidemiology*, a number of articles are included that exemplify the continuing problems with infectious diseases. Modelling has become an important ally in our attempts to project future occurrence of infectious diseases and can have a significant impact on our distribution of resources for purposes of control and prevention.

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Murray *et al.* studied behavioural changes among intravenous drug users in Australia as to the occurrence of HIV and hepatitis C virus (HCV) and, using a mathematical model, have made projections as to what the future prevalence of these two diseases will be.<sup>2</sup> Law and colleagues modelled HCV incidence in Australia, being concerned about the impact of hepatitis C infection on the development of chronic liver disease and increased mortality.<sup>3</sup> These two papers demonstrate the relationships between an infectious agent and chronic disease and the authors discuss their concern about the burden that these infections will have on future populations.

Pappalardo and colleagues are concerned about the relationship between pregnant women simultaneously infected with HIV and HCV and the impact upon the newborn infant.<sup>4</sup> Accurate evaluation of this risk has been hampered by small numbers in individual observational investigations. They conducted a meta-analysis and included 10 studies in their investigations. In developing larger groupings of cases for analysis they have concluded that infants born to HIV co-infected mothers increases the risk of HCV infection in these infants.

de los Angeles and colleagues conducted an investigation of seroprevalence of HIV in men who have sex with men in Argentina in order to determine the risk factors related to HIV infection.<sup>5</sup> Their analyses indicate that age, employment status, previous sexually transmitted disease history, and an HIV positive partner were all risk factors. The outcome of their investigations should impact upon the direction of HIV control and prevention activities.

Lagarde and colleagues have reported on their investigations of HIV in West Africa, pointing out the differences in the epidemiology of this infection from other parts of Africa.<sup>6</sup> They describe the relationship of mobility to the spread into rural areas, with rural migrants temporarily located in urban areas becoming infected and carrying HIV back to the rural areas. This is not a new finding but emphasizes the importance of instituting prevention measures, including health education, that can play a significant role in curbing this form of transmission.

Todd and colleagues looked at the use of randomized clinical trials to evaluate control and prevention measures for HIV infection.<sup>7</sup> They looked at homogeneity, and the number and size of the communities, and concluded that the power of community-randomized trials can be improved by selecting homogeneous communities or stratifying the communities prior to randomization.

Pezzotti and colleagues were interested in developing a more accurate estimate of the prevalence of HIV infection than could be ascertained from a single data source.<sup>8</sup> They cross-linked prevalence data from four sources and by applying capture–recapture methodology conclude that these methods can improve the accuracy of estimates of the prevalence of HIV infection.

Inigo and colleagues were concerned about improving the knowledge of the timing of transmission of tuberculosis (TB) in populations.<sup>9</sup> By comparing the molecular analysis of *Mycobacterium tuberculosis* organisms and conventional epidemiological information and using the capture–recapture method of analysis they were able to develop a better estimate of the timing of transmission of TB. This technology improves our ability to define the parameters of the spread of TB, which can have

an impact upon implementing control and prevention measures.

Hussain and colleagues investigated the prevalence of TB in prisoners in a province in Pakistan.<sup>10</sup> By use of skin tests and sputum smears they were able to define the extent of infection among the prisoners (prevalence of 48%) and determine the significance risk factors associated with infection. They recommend the following measures in order to control and prevent this problem: routine screening of prisoners on entry, using sputum smear and skin tests for diagnosis of active or latent TB respectively, clinical or prophylactic treatment as appropriate, reduction of overcrowding, education, and public health surveillance of long-term prisoners.

Lago and colleagues studied the detection of polioviruses in wastewater following a poliomyelitis immunization campaign in Cuba.<sup>11</sup> Their concern emanated from recent epidemics of poliovirus caused by the vaccine-derived virus and whether this virus could continue to circulate after ‘eradication’ of the wild virus. As a supplement to acute flaccid paralysis surveillance, the sampling of wastewaters may be an important ancillary method of surveillance. Their investigations reveal that virus detection from wastewater using PCR (polymerase chain reaction) was as sensitive for detection of poliovirus as the standard cell culture and neutralization methods. Poliovirus was identified in fecal specimens from children through the seventh week following vaccination and the same poliovirus was identified in wastewater up to 15 weeks after vaccination. Though this methodology needs to be evaluated for its sensitivity, it adds to our ability to evaluate the eradication of poliovirus from communities.

Cooper and Bird investigated the projected incidence of variant Creutzfeldt-Jakob disease (vCJD) associated with dietary exposure to bovine spongiform encephalopathy (BSE) in the UK for two birth cohorts (1942–1969 and post-1969).<sup>12</sup> They concluded that there is a greater risk of developing vCJD in the time period 2001–2005 for the post-1969 birth cohort than for the earlier cohort. However, very few onsets of vCJD are predicted to occur in the post-1969 birth cohort after 2010, whereas almost half of the onsets of vCJD are predicted to occur up to 2010 in the 1940–1969 birth cohort. The use of simulation models is well demonstrated in this paper and does allow for considering projections of the occurrence of this disease.

The events of the last several decades demonstrate that our infectious disease guard cannot be reduced. We are making progress in controlling and preventing infectious diseases but we must not become complacent. The infectious disease papers in this edition of the Journal amply portray the continuing impact that infectious disease has on the world. They also demonstrate how new research can be important in defining new methods of control and prevention.

As we focus on the problems of emerging and re-emerging infectious diseases, we must not underplay other diseases and health conditions that also significantly impact on all of us. With finite limits on our resources for disease control and prevention, we must learn how to better use these resources. Better planning, more attention to training, improved efficiency, and strengthening the collaboration and co-operation between countries will help in our efforts to reduce the burden of disease.

## References

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