

Foresight

Infectious Diseases: preparing for the future

OFFICE OF SCIENCE AND INNOVATION

**T10: Travel and Migration in relation to the
Detection and Identification of Infectious Diseases**

Foresight Project on Detection
and Identification of Infectious Diseases
Summary of a Workshop
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Introduction

Risk analysis shows that travel and migration are associated with increased risk of infectious disease. A consultation in the form of a workshop bringing together professionals with diverse perspectives was held on October 13 2005 to explore this risk. Participants had expertise in topics including: trends in migration; the regulatory implications of changing global migration patterns; the globalisation of business travel; leisure travel and eco-tourism; the globalisation of trade, especially in agricultural products; disease dynamics related to migration and travel; and related anthropological, social and geographical dimensions. The core questions underlying the workshop were: What are likely impacts of changing global patterns of travel and migration on future risk of infectious diseases, and what implications do these have for detection and identification technologies?

Key Changing Patterns of Travel and Trade

Travel is likely to increase, with changing origins and destinations.

Travel is continuing to grow. International tourist arrivals grew on average by around 4.5 per cent a year in the past decade, but 2003-4 witnessed an increase of 10 per cent. The World Tourism Organisation has estimated that in 2020 there will be 1.6 billion international tourist arrivals across the globe, more than twice the current figure. In 2004 there were an estimated 760 million international arrivals, an average of over 2 million people travelling outside their home country per day. Of the 760 million, 64 million were British, with many travelling to destinations outside Europe, North America and Australia. Tourists are travelling faster, and further afield.

Travellers are also coming from new starting points. Outbound tourism from the less economically developed countries has increased over the past few years as income levels have risen and leisure time increased. Outbound departures from China have been growing by more than 25 per cent a year. It is estimated that China will have 100 million outbound travellers, making it the fourth largest source of outbound travel, by 2020.

Adding to the growing variety of people and places, tourists are increasingly seeking new, out-of-the-ordinary destinations and experiences. In 1989, less economically developed countries accounted for only 22 per cent of international arrivals. This figure is now 42 per cent. This includes ecotourism which is growing faster than the global average but still accounts for a relatively small part of the market. Over the past decade the number of tourists visiting Africa has doubled and the figure is expected to quadruple between 1995 and 2020.

Adding to this picture are larger aircraft (800+ passenger jets are beginning to be built) and faster air travel with fewer or no stopovers. It is already possible to travel across the globe within 24 hours. This means that travel times will be

less than the incubation period of most diseases. Given the availability of aircraft and fuel, the trend towards increased travel is likely to continue.

But there are some influences which may work against the continuing growth of travel. These include energy consumption issues, political instability including terrorism, economic downturns, and possible changing perceptions as to what people do for holidays.

Travel exists on a number of scales, ranging from long-haul trips between countries to regional and local ones. South America, Africa and Southeast Asia each receive 50-75 per cent of their tourists from their own continent. Domestic tourism within individual nations is estimated to account for four to five times the number of international tourists and in China approximately 95 per cent of tourists are domestic. This means that once it is within a nation, a disease can propagate quickly.

A current trend is the building of roads which accelerate deforestation. By allowing more illegal hunting, the use of alternative food, and increased proximity of body fluids and foods between humans and animals, this particular sort of travel increases the chances of new infectious agents getting into the human system.

Other possible future trends might influence the risk of infectious disease. Business travel might decline as electronic communication improves and terrorism becomes more of a concern.

Leisure tourism includes not only tourists travelling to a variety of different destinations, but also migration-related VFR (Visiting Friends and Relations) traffic in which people go back and forth between new and ancestral home countries. Such visits often result in cases of disease such as malaria and TB seen when visitors to ancestral home countries return to the UK.

The socio-demographic composition of those travelling is also likely to change. With an ageing population, older, retired people might make up a bigger proportion of travellers, while emerging countries might produce more young travellers.

The trade in agricultural goods is also changing, as are the regimes for animal and plant health inspections during their transport. Possible future changes could include increased demand for more exotic foods, or, alternatively, an increased emphasis on self-sufficiency, eating local foods in the season in which they grow. Most probably, however, there will be a change in the distribution of food production from the EU to third world countries. This will raise questions of risk assessment for infectious disease and the possibility of cross-contamination when agricultural products are moved from one environment to another.

It is possible that we are now at a tipping point regarding the restriction of trade and travel. What is the future of border controls? How much unrestricted travel will be possible in future? Fears might lead to the contraction of borders and zones in which travel is unrestricted and there might be more policing.

When the newly revised WHO International Health Regulations come into effect in 2007, there may well be more potential stopping points and more border control to prevent the international spread of disease. But as controls tighten to prevent formal ingress, there is a risk that there will be more and different types of illegal and hidden immigration. In poorer countries, border controls and precautions are like to be less rigorous.

A key question is: In 2030, will the world remain a series of relatively self-contained areas, with efforts made to control movement, or will the world be treated as one global environment?

It is likely that many global trading barriers will be broken down 25 years from now, with less bureaucracy governing the trade or movement of items such as agricultural goods. One issue is the future balance between deregulation and the increasing freedom of trade and increasing control over the movement of people, which will have impacts on infectious disease. Within the EU, deregulation of trade and the movement of goods is a trend. But will the strengthening of border controls in response to the fear of terrorism lead to controls which are relevant to infectious disease? For political reasons, it is unlikely that the world will be treated as one entity for travel and trade. However, the growth in travel and trade may make it worthwhile to consider the world as one large pool for people and for disease. Indeed, WHO's International Health Regulations, established as an international legal framework to "ensure the maximum security against the international spread of diseases with minimum interference with world traffic", have been revised recently in recognition of increased cross-border travel and trade.

Changing Patterns of Migration

Migration can be any flux of populations and of course may carry along people who are incubating disease. There will be different types of migration, including formal migration and informal migration in terms of refugees and asylum seekers. The second is more difficult to control. There is the potential for centres of disease. For example, asylum seekers may have been subject to difficult situations in their home countries and might have an infectious disease. Understandably, they may be frightened to seek medical care. Once immigrants are settled in a new country, Family Chain Migration, whether through arranged marriages with people back home or frequent visits to countries of origin, especially by children born in the new country, can contribute to the risk of disease, although data on this are difficult to obtain.

Changing patterns of population growth and migration will lead to a greater proportion of the world's population being exposed to the biodiversity of the Tropics. Even by 2030, the world may well not have become peaceful. Small conflicts are becoming more common and act as a driver of migration. They also cause medical care to collapse. Infectious diseases are opportunistic and can take advantage of these situations to travel along migration routes. Currently, migration tends to be into cities. As other areas of the world develop they might or might not tend toward urbanisation. Where will work be

in 2030? In today's developed or developing countries? At home or in city centre settings?

Future Risks of Infectious Disease

Travel and migration increase the number of people coming into contact with a new environment. When new areas are opened up so that people come into contact with animals, new infectious diseases can arise and spread, with HIV and the Ebola virus as examples, while the patterns of travel that currently exist provided the opportunity for SARS to spread beyond being "just" a local problem. There may be occasions on which travel and migration lead to new mixtures of strains. But in most cases, the movement of people and goods will affect the spread of a disease and its level of impact.

If a new infectious disease appears or starts to spread, travel or migration will help to spread it further. But the complexity of the parameters affecting the spread of a disease makes it hard to predict specific impacts.

To appreciate travel and migration as drivers of disease, more needs to be known about patterns and scales of movement. Even in the UK, with a good surveillance system, information on travel from around the world, particularly in relation to disease, tends to be piecemeal.

Food, agriculture and related trade can be important drivers of disease. Diseases can arise and be spread in part by cultural and agricultural practices. These include eating different foods, such as bushmeat, eating parts of an animal banned elsewhere, preparing food in different ways, growing food with different sorts of fertilisers, raising animals in close proximity to people (as with poultry raised in urban homes), and the distribution of food products with varying levels of hygiene or varying assessments of their disease load. When people travel, they often carry "exotic" food products with them. People who have migrated generate a demand for food and other agricultural goods from home and tend to maintain food-related behaviours. It is very difficult to get information regarding cultural practices maintained within migrated communities. There is also a problem with cultural products being brought into the country and then being deposited as untreated waste.

Freight transport can pose a risk depending on the commodity, with raw meat and potatoes as examples. The industry takes some precautionary measures, such as international standards for plant movement and even for palleting, designed to minimise "stowaways" on wooden packing material. Sea containers are already more technologically advanced than they were but, due to the consumer demand for fresh as well as exotic food, food now accounts for 60 per cent of airfreight. Technologies have changed and are changing for preserving food and fending off infectious disease.

Trends in medical care may influence the degree of risk posed by travel and migration. Hope exists that new technologies may lead to advances by 2030 such as widely available, broadly protecting vaccines or anti-virals. Yet

delivery of health care and access to such medical capabilities, or to preventative medication, may still be an issue, for example in Africa. There may be populations who avoid vaccination and thus impact the spread of disease, even in countries with good health care. Furthermore, some current trends may increase the risk of serious impacts from infectious disease, with increased numbers of elderly and immuno-compromised individuals in the population. Another change may be less in-hospital care. If thousands of people were to be struck down with a flu pandemic, there might not be enough beds.

Other drivers which can interact with travel to affect the risk of infectious disease include violence against women, child prostitution, child trafficking around the world and the rise of resistance due to poor disease management or populations that are not properly treated. Wars, conflicts and disasters can lead to increased movement, often compounded by poor living conditions, and affect the risk, control and containment of infectious disease and the potential for serious impact.

Relationships between movement and disease must be looked at on a case by case basis. Decisions on prophylactic treatments or vaccinations for travellers must depend on the disease risk to which they are exposed, which in turn will be based on where they are going (e.g. malaria), and on what the traveller will be doing where, within a country (e.g. Japanese encephalitis).

Pathways and behaviours

Any mode of travel can be seen as a pathway for the spread of disease. In addition, some behaviours, while not pathways themselves, may pose challenges. For instance, there is likely to be increased market demand for certain foods and drugs by populations who have migrated. Social networking, family chain migration, and other connections form pathways.

As globalisation expands, more international gatherings of various sorts will take place. Major international conferences, religious events and other gatherings are likely to continue and they may increase in number. People with similar interests who are linked by the worldwide web may come together for large-scale international gatherings, concerts or other social events.

Hygiene can affect the spread of a disease, not only in the country of origin but also in destination countries. Cholera is an issue in refugee camps and other settings where large numbers of people live close together with poor sanitation. The nature of a destination country and its sanitation matter. In the UK polio and typhoid are not likely to be spread because of good faecal-oral hygiene and sanitation. Over the next 30 years there will probably be improvement in food and water that will reduce risk. Variables include: levels of hygiene, drifts of refugees to certain areas and greatly increased demand for water. Tourism has sometimes acted as a catalyst for increased sanitation and decrease in disease in resort destinations.

Risk Assessment and Management

An important vector for infectious disease is the movement of individuals. They often carry items across borders that may not be disposed of properly and can contribute to plant or animal disease.

The real challenge is a matter of risk management rather than risk elimination. Travel and migration will continue to occur, and people and goods infected with disease will cross borders. Assessment and management are crucial. Different countries treat the risk of infectious disease in different ways, especially where food and food products are concerned. Australia, for example, is very strict, while the EU deliberately allows more movement across borders of foodstuffs that individuals may feel are important to their culture. Even when regulations exist, guidance such as that found on government websites may not be clear, particularly to those who don't speak the language well. Certainly, egregious occasions do occur, as evidenced by the sighting of luggage oozing blood from meats brought into the UK. However, risk assessment conducted by the UK government views most importing of personal supply of foodstuffs as carrying relatively low risk.

For human disease, screening and detection will become more difficult as more people travel. Rather than using technology for port screening, it may be more important to have the capacity to detect cases of illness once they appear. If surveillance revealed 25 people scattered across different hospitals in the UK who had been to a certain area in Africa and were showing similar clinical symptoms, it might become possible to identify a problem disease in real time.

Furthermore, some types of infectious disease will not be detected. Even with screening; it is important to review priorities and conflicts. For example, the trade community feels aggrieved if port controls are burdensome when risk is low. There may be little or no hope of picking up an isolated foot and mouth source, for instance, but surveillance, identification and forecasting of its possible spread could be more effective in limiting the disease.

Systems need to be in place to deal with remote possibilities. Often perception plays an important part in decisions to act. It is difficult to balance possible expenditure on anticipating, planning and investing to mitigate disease risks under a variety of worst case scenarios. Many systems need to be maintained in the long term. It might be useful to have "cells of reaction" that allow a first response and have a second reaction planned and ready to go if the disease is not stopped by the first one.

Two examples were discussed at the workshop as illustrating worst case scenarios. One is an interruption of the food chain, as in the case of foot and mouth. There is now less animal production in Europe and more in developing countries. Likewise avian flu has caused international turbulence in the poultry industry. Problems can also arise with plant diseases. Over time it seems likely that there will be another disease which, although it would not ruin the entire food chain, could impose high economic costs. Another worst-

case scenario is a flu pandemic. The risk here may be moderate yet the burden would be huge.

Travel can be a major factor in the spread of an agent which is easily transmitted between humans and for which populations have no immunity, such as avian flu. So many unknowns exist that it is hard to categorise such an eventuality as high, moderate or low in risk, but it does seem inevitable that something will occur. On the other hand, increased mobility could perhaps reduce risk since there is greater shared experience of previous sub-types. The human population would be more homogeneous in its experience and its resistance levels.

Surveillance, Screening and Information Management

Screening raises many issues. Is it effective? Is it a waste of effort? What do you do if you find something? What human rights or ethical issues does it raise? As an example, is it worth screening at a frontier such as an airport: even if it were possible to detect that someone was incubating a disease, what could be done? What follow-on actions could be implemented? How would false positives and negatives be handled? What if carriers do not know that they are sick? What if they have sub-clinical symptoms? To what extent will borders be controlled? To what extent will it be feasible to control borders regarding infectious disease? Would testing in countries of origin be feasible and credible?

Between countries there may be some political balancing of priorities. WHO's International Health Regulations are fairly strict. They cover the movement of people and goods and aim to encourage balances of responsibilities across different countries.

The time-honoured surveillance of disease via clinical syndromes works better than methods targeting molecules. More real-time surveillance is needed, such as sentinel practices and geo-coded information from doctors when they report instances of disease. Coding disease occurrences according to where people are and where they have been could be the foundation of an early warning system.

Issues such as confidentiality can arise with surveillance systems. There are also practical difficulties in putting surveillance and information-gathering in place, in part due to resistance from the already-busy health community. Currently, surveillance systems for different illnesses are not standardised. A traveller's country and population of origin or recent travel status might not be noted. Related to surveillance for late-presenting infectious diseases are issues of anticipation, alerts and outreach. For migrated populations, the likelihood of response can be decreased by language problems and fear of compromising their position in the host country.

Some networks of data linkages already exist across countries and help to identify trends. But the information that can be obtained from different countries varies. The recent version of the International Health Regulations

includes reporting, sharing of information and moving towards a co-ordinated global response. The new authority includes multiple networks related to infectious diseases.

The potential for effective data linkages is enormous, yet, as with other technological developments, there will be new confidentiality or ethical concerns. This debate could evolve in the future. In the UK, people may come to regard data linkage as important for the greater public good. Along with disease databases, it will be important to create a database of patterns and projections of movement that can be tied in with surveillance findings.

Wish List for the Future

The group's "wish list" for 2030 included some broad but important global aims. Poverty will be eliminated, there will be more equitable distribution of resources, and so less forced migration, and there will be a better baseline of health with better access to medicine.

The general sense of the group was that the chief technological goal would not be screening technology for identifying infectious disease among travellers on the spot in an airport. Many infectious diseases are difficult to detect in the 24 hour time period within which people can travel about the globe. Individuals could be in an incubation period and not be picked up.

Instead, the recommended technological goal for the future would be improved surveillance. Ideally, this would include the implementation of a system to pick up early detection and characterisation of emerging virulent infectious diseases, informed sampling, networks that work together and databases that link with each other. Previously unknown diseases need surveillance of new syndromes and then need to be tracked, identified and characterised. Here there has already been some success. It took 2–3 years to identify HIV but only 2–3 months to identify SARS, with that change in capacity taking place over 20 years. With a mix of good epidemiology and appropriate sample taking, technology is needed, but so is medical information and information on population movement.

More specific, technology-related, objectives pertinent to surveillance, and related data linkage capacity, include:

- Continue to strengthen surveillance in developed countries
- Develop a new strong surveillance system for new threats in developing countries
- Have regional and international networks communicate in line with the International Health Regulations, which recommend a unified network of countries communicating with each other
- Since it is not always possible to eliminate the introduction of an infectious disease to the UK, help the UK by helping at the source in other countries

- Develop diagnostic tools, although point of entry is not the right stage
- Through surveillance and rapid diagnostics, identify emerging problems in immigrants and work with them via the health services at the primary health care delivery level
- Centralise information, with a singular policy for people and health as for trade. Countries would have responsibility coupled with the ability to link across countries, as is happening with trade
- Develop a database on patterns of movement that can be linked with databases on infectious diseases
- Implement good information sharing and good information management.

It would be useful if high-tech databases of the future could show red flags when key drivers or sources or pathways were involved with incidence of a particular disease, especially a new disease. This might build upon the usefulness of the Foresight Project's Risk Analysis influence diagram as a framework, perhaps making it automated as a software programme connected to databases and capable of giving early warnings.

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All the reports and papers produced within the Foresight project 'Infectious Diseases: preparing for the future,' may be downloaded from the Foresight website (www.foresight.gov.uk). Requests for hard copies may also be made through this website.

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