

## REVIEW

### Occupational infections

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#### Abstract

Many infections are associated with occupations. Involvement in a particular occupation may place the person at higher direct risk of contracting certain infections. In some instances the life-style associated with the occupation results in a higher risk of exposure to the infection. The link between the infection and the workplace is often missed by the attending physician. This may be due to a lack of awareness on the part of the physician. Sometimes a direct link can be difficult to prove without the use of sophisticated molecular epidemiological tests. This has led to gross under-diagnosis and under-reporting of such cases. It is however important that occupational infections be diagnosed as adequate preventive measures need to be implemented. Furthermore the patient may be eligible for monetary compensation under the relevant occupational safety laws of the country.

**Keywords:** Infection, occupation, infectious diseases

#### INTRODUCTION

An occupational infection is one that is contracted during the course of employment. Occupational infections have been recognized as long ago as 400 BC by Hippocrates who stated that a proper investigation of ailments should include looking into the patient's pursuits. The Father of Occupational Medicine, Bernardino Ramazzini (1633 – 1714) observed that persons who handled corpses are more likely to contract malignant fevers. Occupational infections are caused by transmissible agents including viruses, bacteria, fungi and parasites or by toxins produced by these agents. Some of the disease manifestations may also be the result of allergic reactions to the agents and their products.

Certain occupations are accompanied by a higher risk of contracting an occupational infection because of the nature of work and the work environment. Table 1 shows some occupational infections that are related to certain worker groups. However it should be stressed that the risk can vary even within the same worker category. A psychiatric nurse would be at lower risk of contracting an infection compared to a nurse in an infectious diseases unit. Also the risk of infection may not be directly related to the occupation. Fishermen in many developing countries (including Malaysia) are at higher risk

of HIV infection not because of fishing *per se* but because of the mobile or migratory nature of their work and the opportunities for multiple sex partners. The same holds true for truck drivers and military personnel.<sup>1</sup> Travel during the course of work, leisure or to fulfill a religious obligation like the Hajj may also expose a person to infections.

The number of occupational infections that occur each year is largely unknown as there is gross under-reporting. Britain reported an annual incidence of 1100 cases of occupational infections in 2003 but admitted that this is a gross underestimation.<sup>2</sup> Similar data from developing countries are largely unavailable.

#### Modes of transmission of infections

Occupations infections are transmitted by one of several ways.

##### (i) Contact

Transmission occurs when the person comes into contact with infected materials of humans or animals. The pathogenic organism enters the body either through wounds and lacerations on the skin or through the mucous membranes of the conjunctiva, oral mucosa, respiratory mucosa or urogenital mucosa. Contact precautions are taken to prevent spread of these infections.

**TABLE 1: Workers with risk of occupational infections**

Worker Group	Occupational Infections/Infectious Agent
Health-care workers	HIV, Hepatitis B, tuberculosis, SARS
Veterinarians and farm workers	Zoonoses including cryptosporidiosis, leptospirosis, salmonella infections, Q fever, rabies, anthrax, schistosomiasis
Abattoir workers	Nipah virus, Streptococcus suis, trichinosis, Q fever
Sex workers	Sexually transmitted infections
Sewer workers	Leptospirosis, Hantavirus infection, Hepatitis A, gastrointestinal pathogens
Forest rangers, forestry workers	Lyme disease, rabies, plague
Construction workers, demolition workers	Histoplasmosis
Miners, sandblasters, grinders, stone cutters, quarry workers, ceramic and foundry workers	Silicotuberculosis
Rice farmers	Melioidosis, “sawah itch”
Military personnel	Biological warfare agents including smallpox, anthrax and plague

(ii) *Airborne*

The pathogenic organisms are carried in the air and are either inhaled or comes into contact with the mucous membranes of the new host. The pathogenic organisms are expelled from the respiratory tract of the infected patient through coughing and sneezing. Transmission via *droplet contact* occurs when the micro-organisms are contained in large droplets and are often expelled within a range of 1 – 3 metres. Contact with surfaces contaminated by these droplets by the new host followed by autoinoculation (hand to mouth, hand to nose or hand to eye) completes the transmission. The majority of respiratory infections are transmitted by droplet contact and contact precautions are often sufficient to prevent spread. In some respiratory infections, the pathogenic organisms are carried on dried residua of larger respiratory droplets. They measure between 1 – 4 microns and are called *droplet nuclei*. Droplet nuclei can be suspended in air for long periods and may be carried by air currents for considerable distances. Tuberculosis, measles and chickenpox are spread by droplet nuclei and air-borne precautions are necessary to prevent spread.

(iii) *Oral*

The pathogenic organisms are ingested by the new host via contaminated food and drink.

(iv) *Inoculations and bites of arthropods*

The pathogenic organism is transmitted via injections or the bite of arthropods. Accidental needle-stick transmission of HIV and Hepatitis B in health-care workers would fall under this category.

**Airborne infections**

*Tuberculosis*

Tuberculosis is caused by *Mycobacterium tuberculosis*, an acid-fast bacillus. It is transmitted by the airborne route via droplet nuclei. Health care workers are at risk from tuberculosis. The risk varies from institution to institution but is significantly higher in exposed workers compared to non exposed workers. The recent resurgence of tuberculosis and the emergence of multi-resistant strains of *Mycobacterium tuberculosis* has also increased the importance of nosocomial tuberculosis.<sup>3</sup> Strategies to

control and prevent occupational tuberculosis should include a risk management programme, effective surveillance, environmental controls, the use of personal protective equipment and BCG vaccination.

Patients with chronic silicosis are at higher risk of tuberculosis (silicotuberculosis). Before the advent of anti tuberculous chemotherapy, tuberculosis was the main cause of death in patients with classical silicosis. Patients with silicotuberculosis tend to respond less satisfactorily to treatment. The reasons are not completely clear but silica is known to impair host macrophage function, an important immune mechanism against the tubercle bacillus. In addition, antituberculosis drugs may not penetrate well into silicotic lung nodules, thus preventing these drugs from achieving the optimum concentrations for full bactericidal effects.

#### *Meningococcal meningitis*

Meningococcal meningitis is caused by *Neisseria meningitides*, a gram-negative diplococcus. In recent years outbreaks of meningococcal meningitis had occurred among pilgrims performing the Hajj in Mecca. In 2000 a large outbreak caused by the W135 strain of the pathogen started in Mecca and spread to 13 other countries by returning pilgrims. There were over 300 cases and 77 deaths.<sup>4</sup> To prevent such outbreaks the Saudi authorities had made it mandatory for all pilgrims to have prior meningococcal vaccination. A Singapore study has shown a significantly higher rate of meningococcal carriage among returning pilgrims compared to departing pilgrims. Based on this finding the authors had recommended a course of antibiotic prophylaxis prior to departure from Mecca.<sup>5</sup>

#### *Legionellosis*

Legionnaires' disease is caused by *Legionella* sp, a gram-negative bacillus. More than 43 species of *Legionella* have been identified and more than 20 linked with human diseases. The bacteria is found in water and occurs commonly in lakes, streams, rivers, freshwater ponds, and mud. However the bacterial counts in natural sources are usually very low and are therefore not considered a risk for human disease. *Legionella* can however reach very high concentrations in made-man water systems including domestic plumbing systems and air-conditioning cooling towers.

The disease is transmitted via inhalation of aerosols, fine sprays and mists of water contaminated with the organism. Legionellosis presents as an atypical pneumonia with prominent systemic manifestations of fever, headache, myalgia and gastrointestinal symptoms. A milder version of the infection is called Pontiac fever.

Legionellosis more commonly affects the elderly, smokers and those with pre-existing pulmonary disease. Anyone who works in a building is potentially at risk if the building's water systems are contaminated and legionellosis is recognized as a cause of the sick building syndrome.<sup>6</sup> Outbreaks have been reported in industrial settings where workers are exposed to contaminated aerosols. They include outbreaks in an automotive plant, factories that used water to cool moulded plastics, and waste-water treatment facilities.<sup>7-9</sup>

Preventive measures should include steps to ensure that equipment and systems are kept as clean as possible and regularly disinfected. If possible, water temperatures should be kept either below 20 degrees C or above 50 degrees C. Biocides may be added to the water to prevent bacterial multiplication.

#### *Psittacosis*

Psittacosis is caused by *Chlamydia psittacci*, a bacterial organism which is commonly found in birds. Psittacosis is therefore a health hazard to pet owners, pet shop employees, poultry farmers (in particular turkey farm workers), workers in abattoirs and processing plants and veterinarians. Psittacosis is spread by the respiratory route, through direct contact or aerosols of infective discharges or dust. Human to human transmission is rare. The disease presents as a pneumonia but many other organ systems can also be involved. The treatment of choice is tetracycline or doxycycline.

#### *Bird Fancier's Lung*

Bird Fancier's Lung is a form of hypersensitivity pneumonitis or extrinsic allergic alveolitis caused by the inhalation of avian proteins found in droppings and feathers of birds such as pigeons, budgerigars (parakeets), parrots, turtle doves, turkeys and chickens. Occupations at risk of this condition would be similar to those for psittacosis (see above).

## Blood-borne infections

### *Hepatitis B*

Hepatitis B is caused by Hepatitis B virus (HBV) which is a DNA virus of the family Hepadnaviridae. Infected humans are the only reservoir of the infection. Primary HBV infections are usually self-limiting. Some infections become persistent and may be life-long. Newly acquired infections are often asymptomatic but may be accompanied by mild to severe hepatitis. Patients with chronic infections are at risk for cirrhosis and hepatocellular carcinoma. Hepatitis B is an occupational hazard for health-care workers. The risk of being infected after accidental exposure to HBV contaminated material is between 6 – 30%. The CDC estimates that 400 new occupational HBV infections occurred in 1995 among U.S. health care workers, down from 17,000 in 1983. This dramatic reduction is attributed primarily to the introduction of Hepatitis B immunization.<sup>10</sup> All health-care workers should be immunized against HBV. Standard precautions should be practiced at all times. The use of needleless systems and the proper disposal of sharps will also reduce the risks of sharp injuries.

### *Hepatitis C*

Hepatitis C is caused by the Hepatitis C virus (HCV) which is a RNA virus of the genus Hepacivirus. The disease was first recognized in the early 1970s, when it was noted that some cases of hepatitis associated with blood transfusions were not caused by either Hepatitis A or Hepatitis B. Hepatitis C infection causes progressive hepatic fibrosis which can lead to cirrhosis and hepatocellular carcinoma. HCV is spread through contact with blood or other body fluids of an infected person. The risk of being infected after accidental exposure involving HCV contaminated material is between 0.4 – 1.8 %. Most cases are acquired through intravenous drug use and sexual exposure. However the CDC estimated that about 4 percent of cases in the United States involve health care workers who contracted hepatitis C on the job. A seroprevalence study in high risk healthcare workers in the United Kingdom showed a prevalence of 2.05 per 1000 which is 2.9-fold higher than in blood donors.<sup>11</sup> Currently there is no vaccine against Hepatitis C. Prevention of transmission among health care workers is through strict adherence with standard precautions.

### *Human Immunodeficiency Virus (HIV) infection*

The Acquired Immunodeficiency Syndrome (AIDS) was first recognized in the United States in 1981 although it has been postulated that infections may have occurred in Africa as early as the 1930s. AIDS is caused by the Human Immunodeficiency Virus (HIV) which is a retrovirus. These are RNA viruses that replicate by the transcription of viral RNA into double-stranded DNA and subsequent integration into the host genome. UNAIDS has estimated that in 2006 there were 39.5 million HIV-infected people worldwide (2.6 million more than in 2004). The number of new infections in 2006 also rose to 4.3 million (400,000 more than in 2004). Sub-Saharan Africa remains the most affected region in the world.

Health care workers are at risk of HIV infection during the course of their work. The most common mode of transmission is exposure to HIV-infected blood via a sharp injury. Although the risk for HIV transmission after such exposure is only around 0.25% – 0.4% this is an area of great concern for many health care workers. The WHO estimated that 16,000 HCV, 66,000 HBV and 1,000 HIV infections may have occurred in the year 2000 worldwide among health care workers due to their occupational exposure to percutaneous injuries.<sup>12</sup> Prevention of transmission would be the same as for other blood-borne pathogens. Standard precautions must be strictly adhered to. Health care workers who are potentially exposed to HIV infection should be given post-exposure prophylaxis with antiretroviral agents. All health institutions should have standard operating procedures to be followed in the event of such events.

Sex workers are also at higher risk of contracting HIV. The prevalence of HIV infection among sex workers varies from country to country. The median HIV prevalence in sex workers in South Africa was as high as 50% in 2000.<sup>13</sup> The high rate of infection among sex workers in developing countries is due to a combination of factors. They include poverty, low educational level, limited access to healthcare services and preventive measures, limited ability to negotiate condom use; low social status and coexisting drug abuse.

## Food and water borne infections

### *Typhoid fever*

Typhoid fever occurs only in man. It is caused

by *Salmonella typhi* and is transmitted by the fecal-oral route. Typhoid fever is not common as an occupational infection. Typhoid fever has been recognized as a laboratory acquired infection for over a century. Clinicians and nurses may also acquire the infection from their patients. Sewer workers and other groups whose occupations involve coming into contact with human faeces may also be at higher risk. Travellers to countries with high endemicity are also at risk. Known typhoid carriers should be excluded from certain occupations like cooks and food handlers. Typhoid fever can be prevented by immunization, good personal hygiene and taking the necessary food and drinks precautions.

#### *Hepatitis A*

There continues to be little evidence of risk for Hepatitis A infection in the workplace. Health care workers are not considered to be at increased risk when they follow standard infection control procedures. Persons who work with hepatitis A virus-infected primates or with hepatitis A virus in a research laboratory setting may be at increased risk. A study in Israel identified religious studies students, day care center and kindergarten staff, food industry workers, teachers, physicians, dentists, therapists and medical technicians as being at higher risk of infection. Interestingly they found no higher risk among sewage workers and nurses.<sup>14</sup> Frequent occupational exposure to raw sewage was a significant risk factor for HAV infection in another study.<sup>15</sup> Hepatitis A can be prevented by immunization.

### **Contact infections**

#### *Leptospirosis*

Leptospirosis is a zoonotic infection that occurs globally. Leptospirosis is caused by *Leptospira interrogans*, a spirochaete. This single species is divided into 24 serogroups and over 200 serovars based on the outer envelope lipopolysaccharide (LPS). The disease is more common in tropical countries and males are affected more than females. The organism is also found in a wide variety of wild and domestic animals but rodents, cattle, dogs and pigs appear to be the predominant animal hosts in many countries. Different serogroups predominate in different countries but *icterohaemorrhagiae* is encountered in the majority of countries. The epidemiology of leptospirosis reflects the complex interaction between man, the animal

hosts and the environment. Socioeconomic status, occupation, association with animals, recreational activity, climate and rainfall are all linked to the occurrence of leptospirosis. Humans are infected through direct contact with infected animals or exposure to fresh water or soil contaminated by infected animal urine. Workers reported to be at higher risk of the infection are those that are exposed to animals or contaminated water and soil. They include farm workers, rice farmers, fish farmers, miners, sewage workers, rat catchers, soldiers and abattoir workers. An attack rate as high as 41.3% has been reported among pond cleaners in Thailand.<sup>16</sup> Preventive measures would include general hygienic measures, avoidance of contact with potentially contaminated water, protective clothing and footwear, rodent control and immunisation of livestock. Doxycycline 200 mg once weekly has been shown to be effective for chemoprophylaxis.<sup>17</sup> Currently there are no widely available vaccines for human use.

#### *Melioidosis*

Melioidosis is a bacterial infection caused by *Burkholderia pseudomallei*. This organism is found in soil and stagnant water in the tropics. Melioidosis commonly occurs in the countries of Southeast Asia and also northern Australia. Melioidosis has also been reported in non-endemic countries among persons who had previously resided in an endemic area. Humans are usually infected by traumatic inoculation of the organism from the soil or water. Rarely the disease may be acquired by inhalation or ingestion of contaminated material. The disease is protean in manifestation and may present as a community acquired pneumonia, localized abscesses both superficial and deep involving the internal organs, osteomyelitis and in its most severe form as a bacteremic illness. The mortality rate in the bacteremic form is very high despite adequate antibiotic treatment.

Occupations with a higher risk of melioidosis are those where the worker is exposed to water and soil in an endemic area like rice-farmers in Thailand.<sup>18</sup> Serological evidence of infection among Commonwealth soldiers serving in Malaysia has also been described.<sup>19</sup> Preexisting diabetes mellitus is also a major risk factor.

#### *Anthrax*

Anthrax is a zoonosis caused by spores of *Bacillus anthracis*. The spores are highly resistant

to inactivation and may persist in soil for a long time. Goats, sheep and cattle are among animals that may become infected. Over 95% of human infection are cutaneous, the spores entering via skin wounds and abrasions. Transmission through oral ingestion or inhalation is much less common. Anthrax occurs throughout the world but is uncommon except for some countries in Southeast Asia, Central Asia, the Middle East and Africa. The disease had attracted international attention recently because it is a potential biological weapon which may be used by terrorists. In 2001 an episode of deliberate exposure in the United States involving postal workers resulted in 22 cases and 4 deaths.<sup>20</sup>

Occupational exposure occurs in those who work with animal hides or hair, bone and wool and may result in cutaneous anthrax. Those at risk include farm workers, veterinarians, tannery and wool workers. Woolsorters' disease is pulmonary anthrax acquired through inhalation of spores in workers handling contaminated wool. It is now very rare. Cutaneous anthrax can usually be successfully treated with antibiotics and some antibiotics have also been approved for post-exposure prophylaxis.

The only known effective pre-exposure prevention against anthrax is the anthrax vaccine.

### *Schistosomiasis*

Schistosomiasis (Bilharzia) is caused by *Schistosoma*, a parasitic blood fluke. The intermediate hosts of *Schistosoma* are water snails, and man is infected through penetration of the skin by the cercarial form of the parasite in contaminated water. Schistosomiasis is the second most prevalent tropical disease in Africa after malaria. Worldwide some 200 million people are infected, and more than 650 million people live in endemic areas. The morbidity and mortality are considerable. WHO estimates that 70 million people may have haematuria associated with *Schistosoma haematobium* which also causes 150,000 deaths each year as a result of renal failure. Portal hypertension resulting from *S. mansoni* infection may contribute to 130 000 fatalities annually.

There are five major species of schistosomiasis which infect man. In infections due to *S. japonicum*, *S. mekongi*, *S. mansoni*, and *S. intercalatum*, the adult flukes inhabit the portal and mesenteric vessels while in *S. haematobium* infection, the adult flukes are found in the vesical

plexus. The eggs laid by the adult flukes induce chronic granulomatous lesions in the portal and intestinal systems or the urinary system depending on the species of the parasite.

Occupations that are at risk of schistosomiasis are those that involve working in contaminated water primarily agricultural workers in the endemic areas.

A form of cutaneous schistosomiasis (swimmer's itch, sawah itch) occurs most often when the human subject is infected by non-human *Schistosoma*. The cercariae are unable to complete their life cycle and die in the skin, producing an allergic dermatitis. In Malaysia rice-farmers are at risk of sawah itch, a cercarial dermatitis caused by *Schistosoma spindale*, a buffalo schistosome.<sup>21</sup>

### *Cat Scratch Disease*

Cat scratch disease is an infection caused by *Bartonella henselae*, a gram-negative organism. Almost half of all cats carry the bacterium at some time in their lives but cats do not suffer any disease. The majority of cases occur after a cat scratch. The initial skin lesions are cutaneous papules or pustules. The skin lesions recede after 1 – 3 weeks followed by a generalized painful lymphadenopathy. Systemic symptoms include fever, malaise, anorexia, nausea and headache. In the immunocompromised, predominantly HIV-infected patients, the organism causes bacillary angiomatosis, an infection characterized by vascular lesions in skin, subcutaneous tissues as well as deep-seated organs.<sup>22</sup> People who keep domestic cats are at risk of the disease especially during the birthing season as kittens are more likely to be infected.

### **Vector-borne diseases**

#### *Malaria*

Malaria occurs primarily in tropical and subtropical areas where the vector, the *Anopheles* mosquito can survive and multiply. Generally the malarial parasite, *Plasmodium* sp can complete its growth cycle in the mosquito at temperatures above 20°C. Between 300 – 350 million cases occur annually primarily in Sub-Saharan Africa. As an occupational infection malaria is principally related to forest-based occupations such as logging. Prevention of malaria is through avoiding mosquito bites and by using prophylactic anti-malarial drugs.

*Dengue*

Dengue is a mosquito-borne infection caused by *Flavivirus*, a RNA virus. Dengue is an emerging infection and the WHO has reported that the disease is now endemic in more than 100 countries in Africa, the Americas, the Eastern Mediterranean, South-east Asia and the Western Pacific. South-east Asia and the Western Pacific are most seriously affected. Some 2.5 billion people are now at risk from dengue and around 50 million cases occur worldwide every year. The principal vector is *Aedes aegypti* which breeds around human dwellings. Hence dengue is primarily an urban disease. Adult mosquitoes shelter indoors and bite during 1- to 2 hour intervals in the mornings and late afternoons.

There are 4 serotypes of dengue virus. Cross-immunity between the serotypes is not complete and outbreaks can occur whenever a new serotype is introduced into the community. The risk of dengue haemorrhagic fever is greater during a secondary infection with a different serotype. A high level of circulating viral antigen in the presence of pre-existing non-neutralising heterologous antibodies may activate complement and trigger off plasma leakage.<sup>23</sup> All persons living in endemic areas are at risk regardless of occupation. However expatriates living in endemic areas may be at higher risk as they are largely non-immune.<sup>24</sup>

*Scrub typhus*

Scrub typhus is an infection caused by a rickettsial organism, *Orientia tsutsugamushi*. The pathogen is transmitted via the bite of a mite, *Leptotrombidium* sp. which is found in scrub i.e. the secondary vegetation that is found in transitional terrain between forest and clearings. Occupational groups at risk would include agricultural workers. In Malaysia oil palm workers are at high risk and in one survey scrub typhus accounted for 46.8% of febrile illness in this group.<sup>25</sup> Another survey among Malaysian rubber plantation workers showed a 15% seroprevalence rate.<sup>26</sup>

*Japanese encephalitis*

Japanese encephalitis (JE) is an arboviral infection caused by a Flavivirus. The disease is endemic in East and South East Asia and the Indian subcontinent. The WHO estimates that between 30,000 – 50,000 cases occur annually. The infection is primarily one that affects children. As pigs play the role of amplifying

host, the disease is more common in rural areas. The virus is transmitted through the bite of an infected *Culex* mosquito. JE is a leading cause of severe central nervous system infection in Asia. Of these cases, about 30–35% are fatal, and 50% result in permanent neuropsychiatric sequelae.

Agricultural workers in rural endemic areas are at greater risk of JE. The occurrence of infection has been correlated with agricultural development and intensive rice cultivation supported by irrigation programmes. However in case-control studies in Vietnam rice farming and living in close proximity to rice fields were not identified as specific risk factors. Also having pigs on the premises did not appear to increase the risk of due probably to the very wide distribution of the vector.<sup>27</sup>

Prevention measures include vector control, the control of the infection in swine (vaccination and slaughter of infected pigs) and human vaccination. Widespread childhood immunization in China, Japan, Korea, and Taiwan has resulted in drastic decreases in the incidence of JE.

**Sexually transmitted diseases**

The commoner sexually transmitted diseases would include gonorrhoeae, non-specific urethritis, syphilis and HIV infection. Less commonly encountered infections include chancroid, lymphogranuloma venereum and granuloma inguinale. Apart from sex workers, the unskilled and unemployed on one hand and those employed in occupations, which require frequent travel outside the place of residence, constitute the high-risk groups.<sup>28</sup>

**Emerging infections***SARS*

SARS (Severe Acute Respiratory Syndrome) is a new viral infection caused by a coronavirus. SARS was first described in Hong Kong in 2002 with the index case being a Chinese man visiting from South China. He spread the infection to several other guests of the hotel he was staying in. As a result the outbreak spread worldwide when these guests returned to their home countries and infected other persons. China, Hong Kong, Taiwan, Singapore and Canada were among the countries most severely affected. WHO estimated that slightly over 8000 cases occurred worldwide with 774 reported deaths giving a case fatality rate of 9.6%. The origin of the virus is

still not established but recent studies suggest that bats may be the natural definitive hosts.<sup>29</sup> From bats the virus may have been transmitted to other wild animals including the civet cat which is sold in southern Chinese markets as an exotic food. SARS focused attention on the long neglected occupational and public health issue of processing wild game in southern China. The other major occupation at risk of infection was healthcare workers who treated SARS patients. According to official statistics, some 22% of SARS patients in Hong Kong were healthcare workers. The number elsewhere was even higher: 41% in Singapore and 34% in Guangdong.<sup>30</sup>

### Nipah

In 1998 an outbreak of severe febrile encephalitis occurred among pig farm workers in Malaysia.<sup>31</sup> Initially thought to be Japanese B encephalitis it was later shown to be a newly emergent paramyxovirus antigenically related to Hendra virus. The clinical presentation includes segmental myoclonus, areflexia, hypertension, and tachycardia, and histologic evidence includes endothelial damage and vasculitis of the brain and other major organs. The fruit bat (*Pteropus hypomelanus*) is a likely reservoir of this virus which transmitted the virus to pigs. The disease spread across several states in Peninsular Malaysia as a result of transport of infected pigs. Eleven abattoir workers in Singapore were also affected as a result of close contact with infected pigs imported from Malaysia.<sup>32</sup> The risk of transmission of the virus from patients to health care workers has been shown to be very low.<sup>33</sup>

### Avian Influenza (H5N1)

The first strain of highly pathogenic H5N1 virus was isolated from a farmed goose in Guangdong Province, China in 1996. However the first reported outbreak of avian influenza due to the H5N1 virus involving humans occurred in Hong Kong in 1997. There were 18 cases with 6 fatalities. Since then outbreaks of the virus in birds have occurred throughout most of Asia and has spread to Europe and Africa. Up to April 2007, WHO had reported 291 laboratory confirmed cases of human infections worldwide with 172 fatalities. Indonesia, Vietnam, China, Thailand and Egypt were among the most severely affected countries.

The infection is transmitted via direct contact with infected poultry, or surfaces and objects

contaminated by their droppings. A study conducted in Vietnam has identified preparing sick or dead poultry and having sick or dead poultry in the household as independent risk factors for acquiring the disease.<sup>34</sup> The risk of exposure is considered highest during slaughter, defeathering, butchering, and preparation of poultry for cooking. A study in Hong Kong has shown an increased risk of exposure among poultry workers.<sup>35</sup>

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