Global Climate Change & How Naturopaths Keep It Cool

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TALK OUTLINE

Basic Science of Global Climate Change

- How did it happen?
- How bad will it get?
- Current Examples

Health Effects of Global CC

- Direct Effects
  - Heat, cold, MVA
  - Loss of pollinators
  - Loss of predictable water
- Indirect Effects
  - contaminated waters
  - infectious disease vectors
  - re-emergence of old diseases
  - respiratory illness
  - contact derm

Will it affect me?

Will it affect my patients?

How will it affect my practice?

How can I help?

How do we respond as a community of aware and caring physicians?

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GLOBAL CLIMATE CHANGE & HOW NATUROPATHS KEEP IT COOL

YOUR CLINIC OPERATIONS

Switch to green power - In many areas, you can switch to energy generated by clean, renewable sources such as wind and solar. The Green Power Network, www.eere.energy.gov/greenpower, is a good place to start to figure out what's available in your area.

Calculate your clinic's Carbon Footprint - A Carbon Footprint is the amount of Carbon Dioxide your medical practice creates from its daily operations. This would include you and your employee's commutes to and from work. There are many new web-based programs to calculate how much your medical practice contributes to Global Warming. www.thegreenoffice.com

Use energy efficient office equipment - Obviously, you first want to establish that you actually need a new appliance or device, rather than simply falling for the sexy advertisements of new technology. Then, look for the Energy Star Label on all electronic equipment (copiers, computers, printers, refrigerators, microwave ovens,etc.) The U.S. EPA and U.S. Department of Energy have created this label to show a devices energy efficiency.

Use a power strip switch to "kill" Phantom Loads - computers, video monitors and other electronic devices all have instant on circuitry that wastes electricity when you are not using the device. You can stop this energy leak by unplugging the device by plugging all devices into a power strip and switching it off when they are not in use. or.

Purchase Recycled or "Tree-Free" and local office supplies - It takes less 70 to 90% less energy to make recycled paper and it prevents the loss of forests worldwide. When you order your supplies on-line, do a keyword search for "recycled" and that will bring up a list of paper and other goods with recycled content.

Avoid purchasing products from overseas - Shipping Chinese herbs or medical products across the Pacific creates a large carbon footprint for that product. Although one small box of Chinese Ginseng may not seem like much of an impact, you must think in terms of how many you prescribe per year, and how many other physicians and herbalists import these products. Cumulatively the impacts are enormous.

Use <u>local</u> / indigenous botanicals - American botanical medicine has deep roots (pun-intended) to regionally available herbs. It is time to return to this rich heritage and re-examine what and how we use to treat patients. Knowing where your medicines come from, how they are farmed, harvested, processed, and even being able to visit the farms and facilities in which this happens ALSO pro-

vides SECURITY. Recent contamination issues in food, consumer products and botanicals from overseas would be eliminated if locally produced goods were used.

Avoid Express Shipping and Air mail - Shipping products and documents by Express Air Mail, or Overnight delivery creates large amounts of pollution from airplane use. In most cases, careful planning ahead of time will eliminate the need to "absolutely-positively-have-to-have-it-overnight."

Support local farms - & Organic foods from the USA (not China) - encourage your patients to eat locally and organically. I place local first and organic second only because the there has been a great upsurge in imported organic food from South America and Asia. While these foods claim to be certified USDA organic, there is no point to shipping frozen peas overseas when our own farmers can produce peas here that are fresher, and more nutritious.

Offset your remaining footprint - Purchasing Renewable Energy Credits, or "Green Tags" or carbon offsets, mitigates your clinic's remaining footprint. Ideally we would reduce our footprints to zero or offset them using locally generated renewable energy. In the long term the whole world can not buy trees in Costa Rica to offset the emissions from inefficient cars and trucks, etc... Eventually we must change at a more fundamental level of re-connecting with nature and valuing its life-supporting function more than a new piece of electronic technology.

WHEN YOU RENOVATE OR BUILD NEW CLINIC

Build , remodel or renovate using "Green" techniques.
As a Green Building Consultant I have seen 70 - 90% reductions in energy use when people use smart or eco-design in construction. It is now possible to create a "Net Zero" building that creates as much energy (usually through solar and wind), as it uses. The Carbon Footprint of this type of construction its easy on the wallet and the planet.

Insulate and weatherize
Properly insulating your walls and ceilings can save 25% of your home heating bill and 2,000 pounds of carbon dioxide a year. Caulking and weather-stripping can save another 1,700 pounds per year. The Consumer Federation of America, www.buyenergyefficient.org, has more information on how to better insulate your home.

Get a clinic energy audit
Many utilities offer free home energy audits to find where your home is poorly insulated or energy inefficient. You can save up to 30% off your energy bill and 1,000 pounds of carbon dioxide a year. EnergyStar.gov can help you find an energy specialist.

Wrap your water heater in an insulation blanket
You'll save 1,000 pounds of carbon dioxide a year with this simple action. You can save another 550 pounds per year by setting the thermostat no higher than 120 degrees Fahrenheit.

Clean or replace filters on your furnace and air conditioner
Cleaning a dirty air filter can save 350 pounds of carbon dioxide a year.

Replace a regular incandescent light bulb with a compact fluorescent light bulb
CFLs use 70% less energy than a regular bulb. This simple switch will save about 300 pounds of carbon dioxide a year. If every family in the U.S. made the switch, we'd reduce carbon dioxide by more than 90 billion pounds! You can purchase CFLs online from the Energy Federation.org.

SOLUTIONS FOR YOU & YOUR PATIENT's LIVES

The other major areas that we can impact climate change are food, purchasing goods, and transportation. With that in mind, I give you a short list of how you can do a little for each.

Buy locally grown and produced foods
The average meal in the United States travels 1,200 miles from the farm to your plate. Buying locally will save fuel and keep money in your community.

Buy fresh foods instead of frozen
Frozen food uses 10 times more energy to produce.

Seek out and support local farmers markets
They reduce the amount of energy required to grow and transport the food to you by one fifth. You can find a farmer's market in your area at the USDA website, www.ams.usda.gov/farmersmarkets/map.htm.

Buy organic foods as much as possible
Organic soils capture and store carbon dioxide at much higher levels than soils from conventional farms. If we grew all of our corn and soybeans organically, we'd remove 580 billion pounds of carbon dioxide from the atmosphere!

Eat less meat
Methane is the second most significant greenhouse gas and cows are one of the greatest methane emitters. Their grassy diet and multiple stomachs cause them to produce methane, which they exhale with every breath.

Use FreeCycle
Freecycle is a free listing resource for exchanging goods with your neighbors and surroundig townfolk. You can ask for what you need and people will post what they ahve to offer. THen you arrange a pick-up. It saves searching on-line, and having to pay for things that you might not otherwise buy.

Reduce the number of miles you drive by walking, biking, carpooling or taking mass transit wherever possible
Avoiding just 10 miles of driving every week would eliminate about 500 pounds of carbon dioxide emissions a year! Sharing a ride with someone just 2 days a week will reduce your carbon dioxide emissions by 1,590 pounds a year. eRideShare.com runs a free national service connecting commuters and travelers. Check into Zip car sharing if you live in a big city, www.zipcar.com

Keep your car tuned up
Regular maintenance helps improve fuel efficiency and reduces emissions. When just 1% of car owners properly maintain their cars, nearly a billion pounds of carbon dioxide are kept out of the atmosphere.

Move your thermostat down 2° in winter and up 2° in summer
Almost half of the energy we use in our homes goes to heating and cooling. You could save about 2,000 pounds of carbon dioxide a year with this simple adjustment. The American Council for an Energy Efficient Economy, www.aceee.org, has more tips for saving energy on heating and cooling.

Use a clothesline instead of a dryer whenever possible
You can save 700 pounds of carbon dioxide when you air dry your clothes for 6 months out of the year.

Turn off & unplug electronic devices you're not using
Simply turning off your television, DVD player, stereo, and computer when you're not using them will save you 1,000s of pounds of carbon dioxide a year.

Even when turned off, things like hairdryers, cell phone chargers and televisions use energy. The energy used to keep display clocks lit and memory chips working accounts for 5 percent of total domestic energy consumption and spews 18 million tons of carbon into the atmosphere every year! (We plug TV, VCR and DVD and computer into a power strip and then turn off the strip.)

Be sure you're recycling at home
You can save 2,400 pounds of carbon dioxide a year by recycling half of the waste your household generates. Earth911.org can help you find recycling resources in your area.

Plant a tree
A single tree will absorb one ton of carbon dioxide over its lifetime. Shade provided by trees can also reduce your air conditioning bill by 10 to 15%. The Arbor Day Foundation, www.arborday.org, has information on planting and provides trees you can plant with membership.

Avoid heavily packaged products
Save 1,200 pounds of carbon dioxide if you cut down your garbage by 10%.

Center for Disease Control Fact Sheet:
West Nile Virus (WNV) Infection:

Information for Clinicians (2003)

Clinical Features

Mild Infection

Most WNV infections are mild and often clinically unapparent.

- Approximately 20% of those infected develop a generally mild illness (West Nile fever).
- The incubation period is thought to range from 3 to 14 days.
- Symptoms generally last 3 to 6 days.

Reports from earlier outbreaks describe the mild form of WNV infection as a **febrile illness of sudden onset** often accompanied by

malaise

headache

anorexia

myalgia

nausea

rash

vomiting

lymphadenopathy

eye pain

The full clinical spectrum of West Nile fever has not been determined in the United States.

Severe Infection

Approximately 1 in 150 infections will result in severe neurological disease.

- The most significant risk factor for developing severe neurological disease is advanced age.
- Encephalitis is more commonly reported than meningitis.

In recent outbreaks, symptoms occurring among patients hospitalized with severe disease include

fever

gastrointestinal symptoms

weakness

change in mental status

- A minority of patients with severe disease developed a maculopapular or morbilliform rash involving the neck, trunk, arms, or legs.
- Several patients experienced severe muscle weakness and flaccid paralysis.
- Neurological presentations included

ataxia and extrapyramidal signs

optic neuritis

cranial nerve abnormalities

polyradiculitis

myelitis

seizures

Although not observed in recent outbreaks, myocarditis, pancreatitis, and fulminant hepatitis have been described.

Clinical Suspicion

Diagnosis of WNV infection is based on a high index of clinical suspicion and obtaining specific laboratory tests.

- WNV, or other arboviral diseases such as St. Louis encephalitis, should be strongly considered in adults >50 years who develop unexplained encephalitis or meningitis in summer or early fall.
- The local presence of WNV enzootic activity or other human cases should further raise suspicion.
- Obtaining a recent travel history is also important.

Note: Severe neurological disease due to WNV infection has occurred in patients of all ages. Year-round transmission is possible in some areas. Therefore, WNV should be considered in all persons with unexplained encephalitis and meningitis.

Diagnosis and Reporting

Procedures for submitting diagnostic samples and reporting persons with suspected WNV infection vary among states and jurisdictions. Links to state and local websites are available at http://www.cdc.gov/ncidod/dvbid/westnile/city_states.htm

Diagnostic Testing

West Nile virus (WNV) testing for patients with encephalitis, meningitis, or other serious central nervous system infections can be obtained through local or state health departments. For WNV diagnosis, public health laboratories usually perform an IgM antibody capture enzyme-

linked immunosorbent assay (MAC-ELISA). Using this assay, virus-specific IgM can be detected in nearly all cerebrospinal fluid (CSF) and serum specimens received from WNV-infected patients at the time of their clinical presentation. Because serum IgM antibody may persist for more than a year, physicians must determine whether the antibody is the result of a WNV infection in the previous year and unrelated to the current clinical presentation. The following procedures are recommended:

- The most conclusive diagnostic method to identify persons with WNV infection of the central nervous system (CNS) is detecting WNV-specific IgM antibody in CSF using MAC-ELISA. This can be done with a CSF specimen obtained during initial clinical presentation. Because IgM antibody does not readily cross the blood-brain barrier, IgM antibody in CSF strongly suggests acute CNS infection
- If CSF is not obtained and serum samples are used to make the diagnosis, paired acute- and convalescent-phase serum samples should be acquired. The acute-phase specimen should be obtained during initial clinical presentation and the convalescent-phase specimen should be obtained 7-14 days later. Both samples should be tested with MAC-ELISA.
- If a convalescent-phase specimen cannot be obtained, the acute-phase specimen should be tested with MAC-ELISA. If the specimen is IgM-negative, then the illness is very unlikely to be an acute WNV infection. If the specimen is IgM-positive and the illness is clinically compatible, then it may be a recent WNV infection (presuming the test results for IgM antibody to St. Louis encephalitis (SLE) virus are significantly lower or negative; see below).

Ideally, MAC-ELISA testing should be performed, using both WNV and SLE virus. If the MAC-ELISA results for WNV and SLE are similar, it is necessary to use the plaque-reduction neutralization test (PRNT) to confirm either a WNV or SLE virus infection. *Note:* Patients who have been recently vaccinated against or recently infected with related flaviviruses (e.g., yellow fever, Japanese encephalitis, dengue) may have positive WNV MAC-ELISA results.

Reporting Suspected WNV Infection

Refer to local and state health department reporting requirements: http://www.cdc.gov/ncidod/dvbid/westnile/city_states.htm

- WNV encephalitis is on the list of designated nationally notifiable arboviral encephalitides.
- Aseptic meningitis is reportable in some jurisdictions.

The timely identification of persons with acute WNV or other arboviral infection may have significant public health implications and will likely augment the public health response to reduce the risk of additional human infections.

Laboratory Findings

Among patients in recent outbreaks

- Total leukocyte counts in peripheral blood were mostly normal or elevated, with lymphocytopenia and anemia also occurring.
- Hyponatremia was sometimes present, particularly among patients with encephalitis.
- Examination of the cerebrospinal fluid (CSF) showed pleocytosis, usually with a predominance of lymphocytes.
- Protein was universally elevated.
- Glucose was normal.
- Computed tomographic scans of the brain mostly did not show evidence of acute disease, but in about one-third of patients, magnetic resonance imaging showed enhancement of the leptomeninges, the periventricular areas, or both.

Treatment

Treatment is supportive, often involving hospitalization, intravenous fluids, respiratory support, and prevention of secondary infections for patients with severe disease.

- Ribavirin in high doses and interferon alpha-2b were found to have some activity against WNV in vitro, but no controlled studies have been completed on the use of these or other medications, including steroids, antiseizure drugs, or osmotic agents, in the management of WNV encephalitis.

For additional clinical information, please refer to Petersen LR and Marfin AA, "West Nile Virus: A Primer for the Clinician [Review]" *Annals of Internal Medicine* (August 6) 2002:137:173-9.

PDF (287 KB/7 pages)

For clinical and laboratory case definitions, see "Epidemic/Epizootic West Nile Virus in the United States: Revised Guidelines for Surveillance, Prevention, and Control, 2001," at http://www.cdc.gov/ncidod/dvbid/westnile/surv&control.htm

WORLD HEALTH ORGANIZATION FACTSHEET

No. 104 (2007)

Tuberculosis

Infection and transmission

Tuberculosis (TB) is a contagious disease. Like the common cold, it spreads through the air. Only people who are sick with TB in their lungs are infectious. When infectious people cough, sneeze, talk or spit, they propel TB germs, known as bacilli, into the air. A person needs only to inhale a small number of these to be infected.

Left untreated, each person with active TB disease will infect on average between 10 and 15 people every year. But people infected with TB bacilli will not necessarily become sick with the disease. The immune system "walls off" the TB bacilli which, protected by a thick waxy coat, can lie dormant for years. When someone's immune system is weakened, the chances of becoming sick are greater.

- Someone in the world is newly infected with TB bacilli every second.
- Overall, one-third of the world's population is currently infected with the TB bacillus.
- 5-10% of people who are infected with TB bacilli (but who are not infected with HIV) become sick or infectious at some time during their life. People with HIV and TB infection are much more likely to develop TB.

Global and regional incidence

The World Health Organization (WHO) estimates that the largest number of new TB cases in 2005 occurred in the South-East Asia Region, which accounted for 34% of incident cases globally. However, the estimated incidence rate in sub-Saharan Africa is nearly twice that of the South-East Asia Region, at nearly 350 cases per 100 000 population.

It is estimated that 1.6 million deaths resulted from TB in 2005. Both the highest number of deaths and the highest mortality per capita are in the Africa Region. The TB epidemic in Africa grew rapidly during the 1990s, but this growth has been slowing each year, and incidence rates now appear to have stabilized or begun to fall.

In 2005, estimated per capita TB incidence was stable or falling in all six WHO regions. However, the slow decline in incidence rates per capita is offset by population growth. Consequently, the number of new cases arising each year is still increasing globally and in the WHO regions of Africa, the Eastern Mediterranean and South-East Asia.

ESTIMATED TB INCIDENCE, PREVALENCE AND MORTALITY, 2005

Incidence[a]
Prevalence[a]
TB Mortality

All forms
Smear-positive[b]

WHO region
number (thousands)
per 100 000 pop
number (thousands)
per 100 000 pop
number (thousands)
per 100 000 pop
number (thousands)
per 100 000 pop
(% of global total)
Africa
2 529 (29)
343
1 088
147
3 773
511
544
74
The Americas
352 (4)
39
157
18
448
50
49
5.5
Eastern Mediterranean
565 (6)
104
253
47
881
163
112
21
Europe
445 (5)

	50
	199
	23
	525
	60
	66
	7.4
South-East Asia	
	2 993 (34)
	181
	1 339
	81
	4 809
	290
	512
	31
Western Pacific	
	1 927 (22)
	110
	866
	49
	3 616
	206
	295
	17
Global	
	8 811 (100)
	136
	3 902
	60
	14 052
	217
	1 577
	24

[a]*Incidence - new cases arising in given period; prevalence - the number of cases which exist in the population at a given point in time.*
[b]*Smear-positive cases are those confirmed by smear microscopy, and are the most infectious cases.*
pop indicates population.

HIV and TB

HIV and TB form a lethal combination, each speeding the other's progress. HIV weakens the immune system. Someone who is HIV-positive and infected with TB bacilli is many times more likely to become sick with TB than someone infected with TB bacilli who is HIV-negative. TB is a leading cause of death among people who are HIV-positive. In Africa, HIV is the single most important factor contributing to the increase in incidence of TB since 1990.

WHO and its international partners have formed the TB/HIV Working Group, which develops global policy on the control of HIV-related TB and advises on how those fighting against TB and HIV can work together to tackle this lethal combination. The interim policy on collaborative TB/HIV activities describes steps to create mechanisms of collaboration between TB and HIV/AIDS programmes, to reduce the burden of TB among people and reducing the burden of HIV among TB patients.

Drug-resistant TB

Until 50 years ago, there were no medicines to cure TB. Now, strains that are resistant to a single drug have been documented in every country surveyed; what is more, strains of TB resistant to all major anti-TB drugs have emerged. Drug-resistant TB is caused by inconsistent or partial treatment, when patients do not take all their medicines regularly for the required period because they start to feel better, because doctors and health workers prescribe the wrong treatment regimens, or because the drug supply is unreliable. A particularly dangerous form of drug-resistant TB is multidrug-resistant TB (MDR-TB), which is defined as the disease caused by TB bacilli resistant to at least isoniazid and rifampicin, the two most powerful anti-TB drugs. Rates of MDR-TB are high in some countries, especially in the former Soviet Union, and threaten TB control efforts.

While drug-resistant TB is generally treatable, it requires extensive chemotherapy (up to two years of treatment) with second-line anti-TB drugs which are more costly than first-line drugs, and which produce adverse drug reactions that are more severe, though manageable. Quality-assured second-line anti-TB drugs are available at reduced prices for projects approved by the Green Light Committee.

The emergence of extensively drug-resistant (XDR) TB, particularly in settings where many TB patients are also infected with HIV, poses a serious threat to TB control, and confirms the urgent need to strengthen basic TB control and to apply the new WHO guidelines for the programmatic management of drug-resistant TB.

The Stop TB Strategy, the Global Plan to Stop TB, 2006–2015 and targets for TB control

In 2006, WHO launched the new Stop TB Strategy. The core of this strategy is DOTS, the TB control approach launched by WHO in 1995. Since its launch, more than 22 million patients have been treated under DOTS-based services. The new six-point strategy builds on this success, while recognizing the key challenges of TB/HIV and MDR-TB. It also responds to access, equity and quality constraints, and adopts evidence-based innovations in engaging with private health-care providers, empowering affected people and communities and helping to strengthen health systems and promote research.

The six components of the Stop TB Strategy are:

- **Pursuing high-quality DOTS expansion and enhancement.** Making high-quality services widely available and accessible to all those who need them, including the poorest and most vulnerable, requires DOTS expansion to even the remotest areas. In 2004, 183 countries (including all 22 of the

high-burden countries which account for 80% of the world's TB cases) were implementing DOTS in at least part of the country.

- **Addressing TB/HIV, MDR-TB and other challenges.** Addressing TB/HIV, MDR-TB and other challenges requires much greater action and input than DOTS implementation and is essential to achieving the targets set for 2015, including the United Nations Millennium Development Goal relating to TB (Goal 6; Target 8).
- **Contributing to health system strengthening.** National TB control programmes must contribute to overall strategies to advance financing, planning, management, information and supply systems and innovative service delivery scale-up.
- **Engaging all care providers.** TB patients seek care from a wide array of public, private, corporate and voluntary health-care providers. To be able to reach all patients and ensure that they receive high-quality care, all types of health-care providers are to be engaged.
- **Empowering people with TB, and communities.** Community TB care projects have shown how people and communities can undertake some essential TB control tasks. These networks can mobilize civil societies and also ensure political support and long-term sustainability for TB control programmes.
- **Enabling and promoting research.** While current tools can control TB, improved practices and elimination will depend on new diagnostics, drugs and vaccines.

The strategy is to be implemented over the next 10 years as described in The Global Plan to Stop TB, 2006–2015. The Global Plan is a comprehensive assessment of the action and resources needed to implement the Stop TB Strategy and to achieve the following targets:

- Millennium Development Goal (MDG) 6, Target 8: Halt and begin to reverse the incidence of TB by 2015
- Targets linked to the MDGs and endorsed by the Stop TB Partnership:
    - by 2005: detect at least 70% of new sputum smear-positive TB cases and cure at least 85% of these cases
    - by 2015: reduce TB prevalence and death rates by 50% relative to 1990
    - by 2050: eliminate TB as a public health problem (1 case per million population)

Progress towards targets

In 2005, an estimated 60% of new smear-positive cases were treated under DOTS – just short of the 70% target.

Treatment success in the 2004 DOTS cohort of 2.1 million patients was 84% on average, close to the 85% target. However, cure rates in the African and European regions were only 74%.

The 2007 WHO report Global TB Control concluded that both the 2005 targets were met by the Western Pacific Region, and by 26 individual countries (including 3 of the 22 high-burden countries: China, the Philippines and Viet Nam.

The global TB incidence rate had probably peaked in 2005, and if the Stop TB Strategy is implemented as set out in the Global Plan, the resulting improvements in TB control should halve prevalence and death rates in all regions except Africa and Eastern Europe by 2015.

RELATED LINKS

- Global TB Control Report (2007)
- Tuberculosis
- Stop TB Partnership

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WORLD HEALTH ORGANIZATION FACTSHEET

Avian influenza (" bird flu")

February 2006

THE DISEASE IN BIRDS

Avian influenza is an infectious disease of birds caused by type A strains of the influenza virus. The disease occurs worldwide. While all birds are thought to be susceptible to infection with avian influenza viruses, many wild bird species carry these viruses with no apparent signs of harm.

Other bird species, including domestic poultry, develop disease when infected with avian influenza viruses. In poultry, the viruses cause two distinctly different forms of disease – one common and mild, the other rare and highly lethal. In the mild form, signs of illness may be expressed only as ruffled feathers, reduced egg production, or mild effects on the respiratory system. Outbreaks can be so mild they escape detection unless regular testing for viruses is in place.

In contrast, the second and far less common highly pathogenic form is difficult to miss. First identified in Italy in 1878, highly pathogenic avian influenza is characterized by sudden onset of severe disease, rapid contagion, and a mortality rate that can approach 100% within 48 hours. In this form of the disease, the virus not only affects the respiratory tract, as in the mild form, but also invades multiple organs and tissues. The resulting massive internal haemorrhaging has earned it the lay name of “chicken Ebola”.

All 16 HA (haemagluttinin) and 9 NA (neuraminidase) subtypes of influenza viruses are known to infect wild waterfowl, thus providing an extensive reservoir of influenza viruses perpetually circulating in bird populations. In wild birds, routine testing will nearly always find some influenza viruses. The vast majority of these viruses cause no harm.

To date, all outbreaks of the highly pathogenic form of avian influenza have been caused by viruses of the H5 and H7 subtypes. Highly pathogenic viruses possess a tell-tale genetic “trade mark” or signature – a distinctive set of basic amino acids in the cleavage site of the HA – that distinguishes them from all other avian influenza viruses and is associated with their exceptional virulence.

Not all virus strains of the H5 and H7 subtypes are highly pathogenic, but most are thought to have the potential to become so. Recent research has shown that H5 and H7 viruses of low pathogenicity can, after circulation for sometimes short periods in a poultry population, mutate into highly pathogenic viruses. Considerable circumstantial evidence has long suggested that wild waterfowl introduce avian influenza viruses, in their low pathogenic form, to poultry flocks, but do not carry or directly spread highly pathogenic viruses. This role may, however, have changed very recently: at least some species of migratory waterfowl are now thought to be carrying the H5N1 virus in its highly pathogenic form and introducing it to new geographical areas located along their flight routes.

Apart from being highly contagious among poultry, avian influenza viruses are readily transmitted from farm to farm by the movement of live birds, people (especially when shoes and other clothing are contaminated), and contaminated vehicles, equipment, feed, and cages. Highly pathogenic viruses can survive for long periods in the environment, especially when temperatures are low. For example, the highly pathogenic H5N1 virus can survive in bird faeces for at least 35 days at low temperature (4oC). At a much higher temperature (37oC), H5N1 viruses have been shown to survive, in faecal samples, for six days.

For highly pathogenic disease, the most important control measures are rapid culling of all infected or exposed birds, proper disposal of carcasses, the quarantining and rigorous disinfection of farms, and the implementation of strict sanitary, or "biosecurity", measures. Restrictions on the movement of live poultry, both within and between countries, are another important control measure. The logistics of recommended control measures are most straightforward when applied to large commercial farms, where birds are housed indoors, usually under strictly controlled sanitary conditions, in large numbers. Control is far more difficult under poultry production systems in which most birds are raised in small backyard flocks scattered throughout rural or periurban areas.

When culling – the first line of defence for containing outbreaks – fails or proves impracticable, vaccination of poultry in a high-risk area can be used as a supplementary emergency measure, provided quality-assured vaccines are used and recommendations from the World Organisation for Animal Health (OIE) are strictly followed. The use of poor quality vaccines or vaccines that poorly match the circulating virus strain may accelerate mutation of the virus. Poor quality animal vaccines may also pose a risk for human health, as they may allow infected birds to shed virus while still appearing to be disease-free.

Apart from being difficult to control, outbreaks in backyard flocks are associated with a heightened risk of human exposure and infection. These birds usually roam freely as they scavenge for food and often mingle with wild birds or share water sources with them. Such situations create abundant opportunities for human exposure to the virus, especially when birds enter households or are brought into households during adverse weather, or when they share areas where children play or sleep. Poverty exacerbates the problem: in situations where a prime source of food and income cannot be wasted, households frequently consume poultry when deaths or signs of illness appear in flocks. This practice carries a high risk of exposure to the virus during slaughtering, defeathering, butchering, and preparation of

poultry meat for cooking, but has proved difficult to change. Moreover, as deaths of birds in backyard flocks are common, especially under adverse weather conditions, owners may not interpret deaths or signs of illness in a flock as a signal of avian influenza and a reason to alert the authorities. This tendency may help explain why outbreaks in some rural areas have smouldered undetected for months. The frequent absence of compensation to farmers for destroyed birds further works against the spontaneous reporting of outbreaks and may encourage owners to hide their birds during culling operations.

THE ROLE OF MIGRATORY BIRDS

During 2005, an additional and significant source of international spread of the virus in birds became apparent for the first time, but remains poorly understood. Scientists are increasingly convinced that at least some migratory waterfowl are now carrying the H5N1 virus in its highly pathogenic form, sometimes over long distances, and introducing the virus to poultry flocks in areas that lie along their migratory routes. Should this new role of migratory birds be scientifically confirmed, it will mark a change in a long-standing stable relationship between the H5N1 virus and its natural wild-bird reservoir.

Evidence supporting this altered role began to emerge in mid-2005 and has since been strengthened. The die-off of more than 6000 migratory birds, infected with the highly pathogenic H5N1 virus, that began at the Qinghai Lake nature reserve in central China in late April 2005, was highly unusual and probably unprecedented. Prior to that event, wild bird deaths from highly pathogenic avian influenza viruses were rare, usually occurring as isolated cases found within the flight distance of a poultry outbreak. Scientific studies comparing viruses from different outbreaks in birds have found that viruses from the most recently affected countries, all of which lie along migratory routes, are almost identical to viruses recovered from dead migratory birds at Qinghai Lake. Viruses from Turkey's first two human cases, which were fatal, were also virtually identical to viruses from Qinghai Lake.

COUNTRIES AFFECTED BY OUTBREAKS IN BIRDS

The outbreaks of highly pathogenic H5N1 avian influenza that began in south-east Asia in mid-2003 and have now spread to a few parts of Europe, are the largest and most severe on record. To date, nine Asian countries have reported outbreaks (listed in order of reporting): the Republic of Korea, Viet Nam, Japan, Thailand, Cambodia, the Lao People's Democratic Republic, Indonesia, China, and Malaysia. Of these, Japan, the Republic of Korea, and Malaysia have controlled their outbreaks and are now considered free of the disease. Elsewhere in Asia, the virus has become endemic in several of the initially affected countries.

In late July 2005, the virus spread geographically beyond its original focus in Asia to affect poultry and wild birds in the Russian Federation and adjacent parts of Kazakhstan. Almost simultaneously, Mongolia reported detection of the highly pathogenic virus in wild birds. In October 2005, the virus was reported in Turkey, Romania, and Croatia. In early December 2005, Ukraine reported its first outbreak in domestic birds. Most of these newer outbreaks were detected and reported quickly. Further spread of the virus along the migratory routes of wild waterfowl is, how-

ever, anticipated. Moreover, bird migration is a recurring event. Countries that lie along the flight pathways of birds migrating from central Asia may face a persistent risk of introduction or re-introduction of the virus to domestic poultry flocks.

Prior to the present situation, outbreaks of highly pathogenic avian influenza in poultry were considered rare. Excluding the current outbreaks caused by the H5N1 virus, only 24 outbreaks of highly pathogenic avian influenza have been recorded worldwide since 1959. Of these, 14 occurred in the past decade. The majority have shown limited geographical spread, a few remained confined to a single farm or flock, and only one spread internationally. All of the larger outbreaks were costly for the agricultural sector and difficult to control.

THE DISEASE IN HUMANS

History and epidemiology. Influenza viruses are normally highly species-specific, meaning that viruses that infect an individual species (humans, certain species of birds, pigs, horses, and seals) stay "true" to that species, and only rarely spill over to cause infection in other species. Since 1959, instances of human infection with an avian influenza virus have been documented on only 10 occasions. Of the hundreds of strains of avian influenza A viruses, only four are known to have caused human infections: H5N1, H7N3, H7N7, and H9N2. In general, human infection with these viruses has resulted in mild symptoms and very little severe illness, with one notable exception: the highly pathogenic H5N1 virus.

Of all influenza viruses that circulate in birds, the H5N1 virus is of greatest present concern for human health for two main reasons. First, the H5N1 virus has caused by far the greatest number of human cases of very severe disease and the greatest number of deaths. It has crossed the species barrier to infect humans on at least three occasions in recent years: in Hong Kong in 1997 (18 cases with six deaths), in Hong Kong in 2003 (two cases with one death) and in the current outbreaks that began in December 2003 and were first recognized in January 2004.

A second implication for human health, of far greater concern, is the risk that the H5N1 virus – if given enough opportunities – will develop the characteristics it needs to start another influenza pandemic. The virus has met all prerequisites for the start of a pandemic save one: an ability to spread efficiently and sustainably among humans. While H5N1 is presently the virus of greatest concern, the possibility that other avian influenza viruses, known to infect humans, might cause a pandemic cannot be ruled out.

The virus can improve its transmissibility among humans via two principal mechanisms. The first is a "reassortment" event, in which genetic material is exchanged between human and avian viruses during co-infection of a human or pig. Reassortment could result in a fully transmissible pandemic virus, announced by a sudden surge of cases with explosive spread.

The second mechanism is a more gradual process of adaptive mutation, whereby the capability of the virus to bind to human cells increases during subsequent infections of humans. Adaptive mutation, expressed initially as small clusters of human

cases with some evidence of human-to-human transmission, would probably give the world some time to take defensive action, if detected sufficiently early.

During the first documented outbreak of human infections with H5N1, which occurred in Hong Kong in 1997, the 18 human cases coincided with an outbreak of highly pathogenic avian influenza, caused by a virtually identical virus, in poultry farms and live markets. Extensive studies of the human cases determined that direct contact with diseased poultry was the source of infection. Studies carried out in family members and social contacts of patients, health workers engaged in their care, and poultry cullers found very limited, if any, evidence of spread of the virus from one person to another. Human infections ceased following the rapid destruction – within three days – of Hong Kong's entire poultry population, estimated at around 1.5 million birds. Some experts believe that that drastic action may have averted an influenza pandemic.

All evidence to date indicates that close contact with dead or sick birds is the principal source of human infection with the H5N1 virus. Especially risky behaviours identified include the slaughtering, defeathering, butchering and preparation for consumption of infected birds. In a few cases, exposure to chicken faeces when children played in an area frequented by free-ranging poultry is thought to have been the source of infection. Swimming in water bodies where the carcasses of dead infected birds have been discarded or which may have been contaminated by faeces from infected ducks or other birds might be another source of exposure. In some cases, investigations have been unable to identify a plausible exposure source, suggesting that some as yet unknown environmental factor, involving contamination with the virus, may be implicated in a small number of cases. Some explanations that have been put forward include a possible role of peri-domestic birds, such as pigeons, or the use of untreated bird faeces as fertilizer. At present, H5N1 avian influenza remains largely a disease of birds. The species barrier is significant: the virus does not easily cross from birds to infect humans. Despite the infection of tens of millions of poultry over large geographical areas since mid-2003, fewer than 200 human cases have been laboratory confirmed. For unknown reasons, most cases have occurred in rural and periurban households where small flocks of poultry are kept. Again for unknown reasons, very few cases have been detected in presumed high-risk groups, such as commercial poultry workers, workers at live poultry markets, cullers, veterinarians, and health staff caring for patients without adequate protective equipment. Also lacking is an explanation for the puzzling concentration of cases in previously healthy children and young adults. Research is urgently needed to better define the exposure circumstances, behaviours, and possible genetic or immunological factors that might enhance the likelihood of human infection.

Assessment of possible cases. Investigations of all the most recently confirmed human cases, in China, Indonesia, and Turkey, have identified direct contact with infected birds as the most likely source of exposure. When assessing possible cases, the level of clinical suspicion should be heightened for persons showing influenza-like illness, especially with fever and symptoms in the lower respiratory tract, who have a history of close contact with birds in an area where confirmed outbreaks of highly pathogenic H5N1 avian influenza are occurring. Exposure to an environment that may have been contaminated by faeces from infected birds is a

second, though less common, source of human infection. To date, not all human cases have arisen from exposure to dead or visibly ill domestic birds. Research published in 2005 has shown that domestic ducks can excrete large quantities of highly pathogenic virus without showing signs of illness. A history of poultry consumption in an affected country is not a risk factor, provided the food was thoroughly cooked and the person was not involved in food preparation. As no efficient human-to-human transmission of the virus is known to be occurring anywhere, simply travelling to a country with ongoing outbreaks in poultry or sporadic human cases does not place a traveller at enhanced risk of infection, provided the person did not visit live or "wet" poultry markets, farms, or other environments where exposure to diseased birds may have occurred.

Clinical features [1]. In many patients, the disease caused by the H5N1 virus follows an unusually aggressive clinical course, with rapid deterioration and high fatality. Like most emerging disease, H5N1 influenza in humans is poorly understood. Clinical data from cases in 1997 and the current outbreak are beginning to provide a picture of the clinical features of disease, but much remains to be learned. Moreover, the current picture could change given the propensity of this virus to mutate rapidly and unpredictably.

The incubation period for H5N1 avian influenza may be longer than that for normal seasonal influenza, which is around two to three days. Current data for H5N1 infection indicate an incubation period ranging from two to eight days and possibly as long as 17 days. However, the possibility of multiple exposure to the virus makes it difficult to define the incubation period precisely. WHO currently recommends that an incubation period of seven days be used for field investigations and the monitoring of patient contacts.

Initial symptoms include a high fever, usually with a temperature higher than 38oC, and influenza-like symptoms. Diarrhoea, vomiting, abdominal pain, chest pain, and bleeding from the nose and gums have also been reported as early symptoms in some patients. Watery diarrhoea without blood appears to be more common in H5N1 avian influenza than in normal seasonal influenza. The spectrum of clinical symptoms may, however, be broader, and not all confirmed patients have presented with respiratory symptoms. In two patients from southern Viet Nam, the clinical diagnosis was acute encephalitis; neither patient had respiratory symptoms at presentation. In another case, from Thailand, the patient presented with fever and diarrhoea, but no respiratory symptoms. All three patients had a recent history of direct exposure to infected poultry.

One feature seen in many patients is the development of manifestations in the lower respiratory tract early in the illness. Many patients have symptoms in the lower respiratory tract when they first seek treatment. On present evidence, difficulty in breathing develops around five days following the first symptoms. Respiratory distress, a hoarse voice, and a crackling sound when inhaling are commonly seen. Sputum production is variable and sometimes bloody. Most recently, blood-tinted respiratory secretions have been observed in Turkey. Almost all patients develop pneumonia. During the Hong Kong outbreak, all severely ill patients had primary viral pneumonia, which did not respond to antibiotics. Limited data on patients in the current outbreak indicate the presence of a primary viral pneumonia in

H5N1, usually without microbiological evidence of bacterial supra-infection at presentation. Turkish clinicians have also reported pneumonia as a consistent feature in severe cases; as elsewhere, these patients did not respond to treatment with antibiotics.

In patients infected with the H5N1 virus, clinical deterioration is rapid. In Thailand, the time between onset of illness to the development of acute respiratory distress was around six days, with a range of four to 13 days. In severe cases in Turkey, clinicians have observed respiratory failure three to five days after symptom onset. Another common feature is multiorgan dysfunction. Common laboratory abnormalities, include leukopenia (mainly lymphopenia), mild-to-moderate thrombocytopenia, elevated aminotransferases, and with some instances of disseminated intravascular coagulation.

Limited evidence suggests that some antiviral drugs, notably oseltamivir (commercially known as Tamiflu), can reduce the duration of viral replication and improve prospects of survival, provided they are administered within 48 hours following symptom onset. However, prior to the outbreak in Turkey, most patients have been detected and treated late in the course of illness. For this reason, clinical data on the effectiveness of oseltamivir are limited. Moreover, oseltamivir and other antiviral drugs were developed for the treatment and prophylaxis of seasonal influenza, which is a less severe disease associated with less prolonged viral replication. Recommendations on the optimum dose and duration of treatment for H5N1 avian influenza, also in children, need to undergo urgent review, and this is being undertaken by WHO.

In suspected cases, oseltamivir should be prescribed as soon as possible (ideally, within 48 hours following symptom onset) to maximize its therapeutic benefits. However, given the significant mortality currently associated with H5N1 infection and evidence of prolonged viral replication in this disease, administration of the drug should also be considered in patients presenting later in the course of illness.

Currently recommended doses of oseltamivir for the treatment of influenza are contained in the product information at the manufacturer's web site. The recommended dose of oseltamivir for the treatment of influenza, in adults and adolescents 13 years of age and older, is 150 mg per day, given as 75 mg twice a day for five days. Oseltamivir is not indicated for the treatment of children younger than one year of age.

As the duration of viral replication may be prolonged in cases of H5N1 infection, clinicians should consider increasing the duration of treatment to seven to ten days in patients who are not showing a clinical response. In cases of severe infection with the H5N1 virus, clinicians may need to consider increasing the recommended daily dose or the duration of treatment, keeping in mind that doses above 300 mg per day are associated with increased side effects. For all treated patients, consideration should be given to taking serial clinical samples for later assay to monitor changes in viral load, to assess drug susceptibility, and to assess drug levels. These samples should be taken only in the presence of appropriate measures for infection control.

In severely ill H5N1 patients or in H5N1 patients with severe gastrointestinal symptoms, drug absorption may be impaired. This possibility should be considered when managing these patients.

COUNTRIES WITH HUMAN CASES IN THE CURRENT OUTBREAK

To date, human cases have been reported in six countries, most of which are in Asia: Cambodia, China, Indonesia, Thailand, Turkey, and Viet Nam. The first patients in the current outbreak, which were reported from Viet Nam, developed symptoms in December 2003 but were not confirmed as H5N1 infection until 11 January 2004. Thailand reported its first cases on 23 January 2004. The first case in Cambodia was reported on 2 February 2005. The next country to report cases was Indonesia, which confirmed its first infection on 21 July. China's first two cases were reported on 16 November 2005. Confirmation of the first cases in Turkey came on 5 January 2006, followed by the first reported case in Iraq on 30 January 2006. All human cases have coincided with outbreaks of highly pathogenic H5N1 avian influenza in poultry. To date, Viet Nam has been the most severely affected country, with more than 90 cases.

Altogether, more than half of the laboratory-confirmed cases have been fatal. H5N1 avian influenza in humans is still a rare disease, but a severe one that must be closely watched and studied, particularly because of the potential of this virus to evolve in ways that could start a pandemic.

[1]*This section has been reviewed by a virtual network of clinicians experienced in the treatment of H5N1 infections and other severe respiratory diseases. The network was convened for the first time on 16 January 2006. Physicians from Yüzüncü Yil University, Faculty of Medicine, Van, Turkey participated in the exchange of information and experiences. Other institutions represented include the University of Hong Kong (China); the Hospital for Tropical Diseases, Ho Chi Minh City (Viet Nam); and the University of Virginia, Charlottesville, Virginia (USA).*

RELATED LINKS

- Avian influenza

WORLD HEALTH ORGANIZATION FACTSHEET

Cholera

Cholera is an acute intestinal infection caused by the bacterium *Vibrio cholerae.* It has a short incubation period, from less than one day to five days, and produces an enterotoxin that causes a copious, painless, watery diarrhoea that can quickly lead to severe dehydration and death if treatment is not promptly given. Vomiting also occurs in most patients.

Most persons infected with *V. cholerae* do not become ill, although the bacterium is present in their faeces for 7-14 days. When illness does occur, more than 90% of episodes are of mild or moderate severity and are difficult to distinguish clinically from other types of acute diarrhoea. Less than 10% of ill persons develop typical cholera with signs of moderate or severe dehydration.

BACKGROUND

The vibrio responsible for the seventh pandemic, now in progress, is known as *V. cholerae* O1, biotype El Tor. The current seventh pandemic began in 1961 when the vibrio first appeared as a cause of epidemic cholera in Celebes (Sulawesi), Indonesia. The disease then spread rapidly to other countries of eastern Asia and reached Bangladesh in 1963, India in 1964, and the USSR, Iran and Iraq in 1965-1966.

In 1970 cholera invaded West Africa, which had not experienced the disease for more than 100 years. The disease quickly spread to a number of countries and eventually became endemic in most of the continent. In 1991 cholera struck Latin America, where it had also been absent for more than a century. Within the year it spread to 11 countries, and subsequently throughout the continent.

Until 1992, only *V. cholerae* serogroup O1 caused epidemic cholera. Some other serogroups could cause sporadic cases of diarrhoea, but not epidemic cholera. Late that year, however, large outbreaks of cholera began in India and Bangladesh that were caused by a previously unrecognized serogroup of *V. cholerae*, designated O139, synonym Bengal. Isolation of this vibrio has now been reported from 11 countries in South-East Asia. It is still unclear whether *V. cholerae* O139 will extend to other regions, and careful epidemiological monitoring of the situation is being maintained.

TRANSMISSION

Cholera is spread by contaminated water and food. Sudden large outbreaks are usually caused by a contaminated water supply. Only rarely is cholera transmitted by direct person-to-person contact. In highly endemic areas, it is mainly a disease of young children, although breastfeeding infants are rarely affected.

Vibrio cholerae is often found in the aquatic environment and is part of the normal flora of brackish water and estuaries. It is often associated with algal blooms (plankton), which are influenced by the temperature of the water. Human beings are also one of the reservoirs of the pathogenic form of *Vibrio cholerae.*

TREATMENT

When cholera occurs in an unprepared community, case-fatality rates may be as high as 50% -- usually because there are no facilities for treatment, or because

treatment is given too late. In contrast, a well-organized response in a country with a well established diarrhoeal disease control programme can limit the case-fatality rate to less than 1%.

Most cases of diarrhoea caused by *V. cholerae* can be treated adequately by giving a solution of oral rehydration salts (the WHO/UNICEF standard sachet). During an epidemic, 80-90% of diarrhoea patients can be treated by oral rehydration alone, but patients who become severely dehydrated must be given intravenous fluids.

In severe cases, an effective antibiotic can reduce the volume and duration of diarrhoea and the period of vibrio excretion. Tetracycline is the usual antibiotic of choice, but resistance to it is increasing. Other antibiotics that are effective when *V. cholerae* are sensitive to them include cotrimoxazole, erythromycin, doxycycline, chloramphenicol and furazolidone.

EPIDEMIC CONTROL AND PREVENTIVE MEASURES

When cholera appears in a community it is essential to ensure three things: hygienic disposal of human faeces, an adequate supply of safe drinking water, and good food hygiene. Effective food hygiene measures include cooking food thoroughly and eating it while still hot; preventing cooked foods from being contaminated by contact with raw foods, including water and ice, contaminated surfaces or flies; and avoiding raw fruits or vegetables unless they are first peeled. Washing hands after defecation, and particularly before contact with food or drinking water, is equally important.

Routine treatment of a community with antibiotics, or "mass chemoprophylaxis", has no effect on the spread of cholera, nor does restricting travel and trade between countries or between different regions of a country. Setting up a *cordon sanitaire* at frontiers uses personnel and resources that should be devoted to effective control measures, and hampers collaboration between institutions and countries that should unite their efforts to combat cholera.

Limited stocks of two oral cholera vaccines that provide high-level protection for several months against cholera caused by *V. cholerae* O1 have recently become available in a few countries. Both are suitable for use by travellers but they have not yet been used on a large scale for public health purposes. Use of this vaccine to prevent or control cholera outbreaks is not recommended because it may give a false sense of security to vaccinated subjects and to health authorities, who may then neglect more effective measures.

In 1973 the WHO World Health Assembly deleted from the International Health Regulations the requirement for presentation of a cholera vaccination certificate. Today, no country requires proof of cholera vaccination as a condition for entry, and the International Certificate of Vaccination no longer provides a specific space for recording cholera vaccinations.

TRADE IN FOOD PRODUCTS COMING FROM CHOLERA-INFECTED REGIONS

The publication "Guidelines for Cholera Control", available through WHO's Distribution and Sales Unit, states the following:

"Vibrio cholerae 01 can survive on a variety of foodstuffs for up to five days at ambient temperature and up to 10 days at 5-10 degrees Celsius. The organism can also survive freezing. Low temperatures, however, limit proliferation of the organism and thus may prevent the level of contamination from reaching an infective dose.

"The cholera vibrio is sensitive to acidity and drying, and commercially prepared acidic (ph 4.5 or less) or dried foods are therefore without risk. Gamma irradiation and temperatures above 70 degrees Celsius also destroy the vibrio and foods processed by these methods, according to the standards of the Codex Alimentarius, and

"The foods that cause greatest concern to importing countries are seafood and vegetables that may be consumed raw. However, only rare cases of cholera have occurred as a result of eating food, usually seafood, transported across international borders by individuals.

"...Indeed, although individual cases and clusters of cases have been reported, WHO has not documented a significant outbreak of cholera resulting from commercially imported food."

In summary, although there is a theoretical risk of cholera transmission with international food trade, the weight of evidence suggests that this risk is very small and can normally be dealt with by means other than an embargo on importation.

WHO believes that the best way to deal with food imports from cholera-affected areas is for importing countries to agree, with food exporters, on good hygienic practices which need to be followed during food handling and processing to prevent, eliminate or minimize the risk of any potential contamination; and to set up arrangements to obtain assurance that these measures are adequately carried out.

At present, WHO has no information that food commercially imported from affected countries has been implicated in outbreaks of cholera in importing countries. The isolated cases of cholera, that have been related to imported food, have been associated with food which had been in the possession of individual travellers. Therefore, it may be concluded that food produced under good manufacturing practices poses only a negligible risk for cholera transmission. Consequently, WHO believes that food import restrictions, based on the sole fact that cholera is epidemic or endemic in a country, are not justified.

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WORLD HEALTH ORGANIZATION FACTSHEET

No.103 (2004)

Ebola haemorrhagic fever

Ebola virus, Filoviridae family, is comprised of four distinct subtypes: Zaïre, Sudan, Côte d'Ivoire and Reston. Three subtypes, occurring in the Democratic Republic of the Congo (formerly Zaire), Sudan and Côte d'Ivoire, have been identified as causing illness in humans. Ebola haemorrhagic fever (EHF) is a febrile haemorrhagic illness which causes death in 50-90% of all clinically ill cases. Human infection with the Ebola Reston subtype, found in the Western Pacific, has only caused asymptomatic illness, meaning that those who contract the disease do not experience clinical illness. The natural reservoir of the Ebola virus seems to reside in the rain forests of the African continent and in areas of the Western Pacific .

Ebola outbreak chronology

TRANSMISSION

- The Ebola virus is transmitted by direct contact with the blood, secretions, organs or other bodily fluids of infected persons.
- Burial ceremonies where mourners have direct contact with the body of the deceased person can play a significant role in the transmission of Ebola.
- The infection of human cases with Ebola virus has been documented through the handling of infected chimpanzees, gorillas, and forest antelopes--both dead and alive--as was documented in Côte d'Ivoire, the Republic of Congo and Gabon. The transmission of the Ebola Reston strain through the handling of cynomolgus monkeys has also been reported.
- Health care workers have frequently been infected while treating Ebola patients, through close contact without the use of correct infection control precautions and adequate barrier nursing procedures.

Incubation period: two to 21 days.

SYMPTOMS

Ebola is often characterized by the sudden onset of fever, intense weakness, muscle pain, headache and sore throat. This is often followed by vomiting, diarrhoea, rash, impaired kidney and liver function, and in some cases, both internal and external bleeding. Laboratory findings show low counts of white blood cells and platelets as well as elevated liver enzymes.

DIAGNOSIS

Specialized laboratory tests on blood specimens detect specific antigens and/or genes of the virus. Antibodies to the virus can be detected, and the virus can be isolated in cell culture. Tests on samples present an extreme biohazard risk and are only conducted under maximum biological containment conditions. New developments in diagnostic techniques include non-invasive methods of diagnosis (testing saliva and urine samples) and testing inactivated samples to provide rapid laboratory diagnosis to support case management during outbreak control activities.

THERAPY AND VACCINE

- Severe cases require intensive supportive care, as patients are frequently dehydrated and in need of intravenous fluids or oral rehydration with solutions containing electrolytes.
- No specific treatment or vaccine is yet available for Ebola haemorrhagic fever. Several vaccine candidates are being tested but it could be several years before any are available. A new drug therapy has shown early promise in laboratory studies and is currently being evaluated further. However, this too will take several years.
- Experimental studies involving the use of hyper-immune sera on animals have demonstrated no protection against the disease.

CONTAINMENT

- Suspected cases should be isolated from other patients and strict barrier nursing techniques implemented.
- Contact tracing and follow-up of people who may have been exposed to Ebola through close contact with other cases is essential.
- All hospital personnel should be briefed on the nature of the disease and its routes of transmission. Particular emphasis should be placed on ensuring that invasive procedures such as the placing of intravenous lines and the handling of blood, secretions, catheters and suction devices are carried out under strict barrier nursing conditions. Hospital staff should have individual gowns, gloves, masks and goggles. Non-disposable protective equipment must not be reused unless they have been properly disinfected.
- Infection may also be spread through contact with the soiled clothing or bed linens from a patient with Ebola. Disinfection is therefore required before handling these items.
- Communities affected by Ebola should make efforts to ensure that the population is well informed, both about the nature of the disease itself and about necessary outbreak containment measures, including burial of the deceased. People who have died from Ebola should be promptly and safely buried.

CONTACTS

- As the primary mode of person-to-person transmission is contact with contaminated blood, secretions or body fluids, any person who has had close physical contact with patients should be kept under strict surveillance, i.e. body temperature checks twice a day, with immediate hospitalization and strict isolation recommended in case of the onset of fever.
- Hospital personnel who come into close contact with patients or contaminated materials without barrier nursing attire must be considered as contacts and followed up accordingly.

HISTORY

The Ebola virus was first identified in a western equatorial province of Sudan and in a nearby region of Zaïre (now the Democratic Republic of the Congo) in 1976 after significant epidemics in Yambuku, northern Democratic Republic of the Congo, and Nzara, southern Sudan.

- Between June and November 1976, the Ebola virus infected 284 people in Sudan, causing 151 deaths. In the Democratic Republic of the Congo, there were 318 cases and 280 deaths in September and October. An isolated case occurred in the Democratic Republic of the Congo in 1977, and there was another outbreak in Sudan in 1979 (33 cases, including 22 deaths).
- In 1989, an Ebola virus subtype Reston, was isolated in quarantined laboratory cynomolgus monkeys (Macacca fascicularis) in Reston, Virginia, USA. From 1989 to 1996, several outbreaks caused by the Ebola Reston subtype occurred in monkeys imported from the Philippines to the USA (Reston in Virginia, Alice in Texas and Pennsylvania) and to Italy. Investigations traced the source of all Ebola Reston outbreaks to one export facility near Manila in the Philippines, but the mode of contamination of this facility was not determined. Several monkeys died, and at least four people were infected, although none of them suffered clinical illness.
- One human case of Ebola haemorrhagic fever of the Cote d'Ivoire subtype and several cases in chimpanzees were confirmed in Côte d'Ivoire in November 1994.
- A large epidemic occurred in Kikwit, the Democratic Republic of the Congo in 1995 with 315 cases, 250 of which had fatal outcomes.
- In Gabon, Ebola haemorrhagic fever was first documented in 1994 (19 cases including 9 deaths). Successive outbreaks occurred in February (37 cases including 21 deaths) and July of 1996 (60 cases including 45 deaths).
- In October 2000, Ebola was reported in Gulu district in northern Uganda. Between September 2000 and January 2001, the Sudan subtype of the Ebola virus infected 425 cases, including 224 deaths, making this the largest epidemic so far documented of Ebola. This was the first reported emergence of the Sudan Ebola virus since 1979.
- From October 2001 to December 2003, several EHF outbreaks of the Zaïre subtype, were reported in Gabon and the Republic of Congo with a total of 302 cases and 254 deaths: Mékambo-Mbomo-Kéllé 2001-2002, Kéllé-Mbomo 2003 and Mbandza-Mbomo 2003.

Approximately 1,850 cases with over 1,200 deaths have been documented since the Ebola virus was discovered.

NATURAL RESERVOIR

- The natural reservoir of the Ebola virus is unknown despite extensive studies, but seems to reside in the rain forests on the African continent and in the Western Pacific.
- Although non-human primates have been a source of infection for humans, they are not thought to be the reservoir. They, like humans, are believed to be infected directly from the natural reservoir or through a chain of transmission from the natural reservoir.

- On the African continent, Ebola infections of human cases have been linked to direct contact with gorillas, chimpanzees, monkeys, forest antelope and porcupines found dead in the rainforest. So far, the Ebola virus has been detected in the wild in carcasses of chimpanzees (in Côte-d'Ivoire and Republic of Congo), gorillas (Gabon and Republic of Congo) and duikers (Republic of Congo).
- Different hypotheses have been developed to try to explain the origin of Ebola outbreaks. Laboratory observation has shown that bats experimentally infected with Ebola do not die, and this has raised speculation that these mammals may play a role in maintaining the virus in the tropical forest.
- Extensive ecological studies are underway in the Republic of Congo and Gabon to identify the Ebola's natural reservoir.

(Chart removed due to formating issues)

[1]A fourth virus subtype, Ebola-Reston, was detected in October 1989 in Reston, Virginia (USA) in a colony of cynomolgus monkeys (Macacus fascicularis) imported from the Philippines, and in November 1989 in Philadelphia, Pennsylvania, also in monkeys imported from the same supplier. Subsequent outbreaks of Reston-Ebola disease in nonhuman primates occurred in 1990 in the USA (Reston, Virginia and Alice, Texas), in 1992 in Italy (Sienna), and in 1996 in the USA (Alice, Texas). Investigations traced the source of all outbreaks caused by the Reston strain to one export facility in the Philippines (Laguna Province), but the mode of contamination of this facility was not elucidated. Although highly pathogenic for nonhuman primates, the Reston strain has not to date caused illness in humans.

[2]This case was a nurse involved in the treatment of an Ebola patient transferred from Gabon to South Africa.

LABORATORY ACCIDENTS

1976: Microbiological Research Establishment, Porton, UK Needlestick injury, recovered

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WORLD HEALTH ORGANIZATION FACTSHEET

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Enterohaemorrhagic Escherichia coli (EHEC)

Escherichia coli (E. coli) is a bacterium that is commonly found in the gut of humans and warm-blooded animals. Most strains of E. coli are harmless. Some strains however, such as enterohaemorrhagic E. coli (EHEC), can cause severe foodborne disease. It is transmitted to humans primarily through consumption of contaminated foods, such as raw or undercooked ground meat products and raw milk. Its significance as a public health problem was recognized in 1982, following an out-

break in the United States of America. EHEC produces toxins, known as verotoxins or Shiga-like toxins because of their similarity to the toxins produced by Shigella dysenteriae. EHEC can grow in temperatures ranging from from 7°C to 50°C, with an optimum temperature of 37°C. Some EHEC can grow in acidic foods, down to a pH of 4.4, and in foods with a minimum water activity (Aw) of 0.95. It is destroyed by thorough cooking of foods until all parts reach a temperature of 70°C or higher. E. coli O157:H7 is the most important EHEC serotype in relation to public health; however, other serotypes have frequently been involved in sporadic cases and outbreaks.

The diseases caused by EHEC

Symptoms of the diseases caused by EHEC include abdominal cramps and diarrhoea that may in some cases progress to bloody diarrhoea (haemorrhagic colitis). Fever and vomiting may also occur. The incubation period can range from three to eight days, with a median of three to four days. Most patients recover within 10 days, but in a small proportion of patients (particularly young children and the elderly), the infection may lead to a life-threatening disease, such as haemolytic uraemic syndrome (HUS). HUS is characterized by acute renal failure, haemolytic anaemia and thrombocytopenia. It is estimated that up to 10% of patients with EHEC infection may develop HUS, with a case-fatality rate ranging from 3% to 5%. Overall, HUS is the most common cause of acute renal failure in young children. It can cause neurological complications (such as seizure, stroke and coma) in 25% of HUS patients and chronic renal sequelae, usually mild, in around 50% of survivors.

The incidence of EHEC infections varies by age group, with the highest incidence of reported cases occurring in children aged under 15 years (0.7 cases per 100 000 in the United States). Sixty-three to 85% of cases are a result of exposure to the pathogen through food. The percentage of EHEC infections which progress to HUS varies between sporadic cases (3%-7%) and those associated with outbreaks (20% or more). In epidemiological terms, there is generally a background of sporadic cases, with occasional outbreaks. Some of these outbreaks have involved a high number of cases, such as in Japan in 1996, where an outbreak linked to contaminated radish sprouts in school lunches caused 9 451 cases. Data on the situation in developing countries are limited, as surveillance for this pathogen is not done routinely.

Sources of infection

Most available information relates to serotype O157:H7, since it is easily differentiated biochemically from other E. coli strains. The reservoir of this pathogen appears to be mainly cattle and other ruminants such as camels. It is transmitted to humans primarily through consumption of contaminated foods, such as raw or undercooked ground meat products and raw milk. Faecal contamination of water and other foods, as well as cross-contamination during food preparation (with beef and other meat products, contaminated surfaces and kitchen utensils), will also lead to infection. Examples of foods implicated in outbreaks of E. coli O157:H7 include undercooked hamburgers, dried cured salami, unpasteurized fresh-pressed apple cider, yogurt, cheese and milk. An increasing number of outbreaks are associated with the consumption of fruits and vegetables (sprouts, lettuce, coleslaw, salad)

whereby contamination may be due to contact with faeces from domestic or wild animals at some stage during cultivation or handling. EHEC has also been isolated from bodies of water (ponds, streams), wells and water troughs, and has been found to survive for months in manure and water-trough sediments. Waterborne transmission has been reported, both from contaminated drinking-water and from recreational waters.

Person-to-person contact is an important mode of transmission through the oral-faecal route. An asymptomatic carrier state has been reported, where individuals show no clinical signs of disease but are capable of infecting others. The duration of excretion of EHEC is about one week or less in adults, but can be longer in children. Visiting farms and other venues where the general public might come into direct contact with farm animals has also been identified as an important risk factor for EHEC infection.

Control and prevention methods

The prevention of infection requires control measures at all stages of the food chain, from agricultural production on the farm to processing, manufacturing and preparation of foods in both commercial establishments and the domestic environment. Available data are not sufficient to enable the recommendation of specific intervention methods on the farm in order to reduce the incidence of EHEC in cattle. However, risk assessments conducted at national level have predicted that the number of cases of disease might be reduced by various mitigation strategies for ground beef (for example, screening the animals preslaughter to reduce the introduction of large numbers of pathogens in the slaughtering environment). Good hygienic slaughtering practices reduce contamination of carcasses by faeces, but do not guarantee the absence of EHEC from products. Education in hygienic handling of foods for abattoir workers and those involved in the production of raw meat is essential to keep microbiological contamination to a minimum. Similarly, prevention of contamination of raw milk on the farm is virtually impossible, but the education of farm workers in principles of good hygienic practice should be carried out in order to keep contamination to a minimum. The only effective method of eliminating EHEC from foods is to introduce a bactericidal treatment, such as heating (e.g. cooking or pasteurization) or irradiation. Some countries implement the policy that raw ground beef is considered contaminated if it is found to contain E. coli O157:H7.

Preventive measures for E. coli O157:H7 infection are similar to those recommended for other foodborne diseases (see basic food hygiene practice described below). However, some of the measures may need to be reinforced for EHEC, particularly in view of its importance in vulnerable groups such as children and the elderly. Since a number of EHEC infections have been caused by contact with recreational water, it is also important to protect such water areas, as well as drinking-water sources, from animal wastes.

Recommendations to reduce the public health risk

To ensure that those who come directly or indirectly into contact with food are not likely to contaminate it with EHEC, food handlers should follow the Recommended

International Code of Practice, General Principles of Food Hygiene (CAC/RCP 1-1969, Rev. 3-1997, Amd. (1999); Section VII - Establishment: personal hygiene), contained in: Joint FAO/WHO Food Standards Programme, Codex Alimentarius Commission. General requirements (food hygiene). FAO/WHO, Rome, 2001 (Second edition) .

Basic good food hygiene practice, as described in the WHO Five keys to safer food , can prevent the transmission of pathogens responsible for many foodborne diseases, and also protect against foodborne diseases caused by EHEC. Such recommendations should in all cases be implemented, especially "Cook thoroughly" so that at least the centre of the food reaches 70°C.

Specific recommendations to sprout producers

In recent years, the popularity of sprouted seeds has increased significantly owing to their nutritional value. However, reports of foodborne outbreaks associated with such raw vegetable sprouts have raised concerns among public health agencies and consumers. Outbreak investigations have indicated that pathogens found on sprouts most likely originate from the seeds. The seed may be contaminated in the field or during harvesting, storage or transportation. During the germination process in sprout production, low levels of pathogens present on seeds may quickly reach levels high enough to cause disease. Therefore specific care is needed. Guidance is available in the *Codex Code of Hygienic Practice for Fresh Fruits and Vegetables,* Annex for sprout production (document CAC/RCP 53-2003 which can be obtained on request from the Secretariat of the Codex Alimentarius Commission, codex@fao.org).

PUBLICATIONS CITED

- Recommended International Code of Practice, General Principles of Food Hygiene [pdf 91kb]
- WHO Five keys to safer food

RELATED LINKS

- Escherichia coli infections
- Food safety

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WORLD HEALTH ORGANIZATION

No. 285 (2005)

Legionellosis

History and overview

Legionellosis is a serious and sometimes fatal form of pneumonia. It is caused by the bacterium *Legionella pneumophila* and other legionella species. These bacteria are found naturally in the environment and thrive in warm water and warm damp places. They are commonly found in lakes, rivers, creeks, hot springs and other bodies of water. They can also be found in soil and potting mix.

The bacterium *Legionella pneumophila* was first identified in 1977, as the cause of an outbreak of severe pneumonia in a convention centre in the USA in 1976. It has since been associated with outbreaks linked to poorly maintained artificial water systems, particularly cooling towers or evaporative condensers associated with air conditioning and industrial cooling, hot and cold water systems in public and private buildings, and whirlpool spas.

The dose of legionella necessary for infection is unknown, but the infective dose for susceptible humans can be assumed to be low, as patients have been known to be infected after exposure of only a few minutes to the sources of some outbreaks, and at up to 3.2 km from the source of others. Infection depends on the water contamination level by bacteria, the effectiveness of formation and dissemination of bacteria through air, host factors and the virulence of the particular strain of *Legionella*.

The disease and its effect on people

Legionellosis is a generic term describing the pneumonic and non-pneumonic forms of infection with *Legionella*.

The non-pneumonic form is an acute, self-limiting influenza-like illness usually lasting 2-5 days. The incubation period is from a few and up to 48 hours. The main symptoms are fever, chills, headache, malaise and muscle pain (myalgia). No deaths are associated with this type of infection.

Legionnaires' disease has an incubation period of two to ten days (but up to 16 days has been recorded in some recent well-documented outbreaks). Initially, symptoms are fever, loss of appetite, headache, malaise and lethargy. Some patients may also have muscle pain, diarrhoea and confusion. There is also usually an initial mild cough, but as many as 50% of patients can present phlegm. Blood-streaked phlegm or hemoptysis occurs in about one-third of the patients. The severity of disease ranges from a mild cough to a rapidly fatal pneumonia. Death occurs through progressive pneumonia with respiratory failure and/or shock and multi-organ failure.

Untreated Legionnaires' disease usually worsens during the first week. In common with other risk factors causing severe pneumonia, the most frequent complications

of legionellosis are respiratory failure, shock and acute kidney and multi-organ failure. Recovery always requires antibiotic treatment, and is usually complete, after several weeks or months. In rare occasions, severe progressive pneumonia or ineffective treatment for pneumonia can result brain in sequelae.

The death rate as a result of legionnella is dependent on: the severity of the disease, the appropriateness of initial anti-microbial treatment, the setting where legionella was acquired, and host factors (i.e. the disease is usually more serious in patients with immuno-suppression). The case fatality rate may be as high as 40 - 80 per 100 in untreated immuno-suppressed patients and can be reduced to 5 - 30 per 100 through appropriate case management and depending on the severity of the clinical signs and symptoms. For persons able to develop an immune response the death rate is usually within the range of 10 - 15%.

The cause

The causative agents, legionellae, are freshwater bacteria that are found in aquatic environments worldwide but artificial water systems sometimes provide environments conducive to the growth of *Legionella* bacteria. These bacteria survive within or between the cells as parasites of free-living protozoa and within biofilms which develop in water systems where bacteria survive. They can cause human infections by infecting other human cells utilizing a similar mechanism to that used to infect protozoa. *L. pneumophila* is the species most frequently isolated from patients with either community, travel-associated or hospital-acquired legionellosis.

Distribution

Legionnaires' disease is believed to occur worldwide.

How the disease is transmitted

Legionella organisms can be spread by aerosols such as wind. Infection results from inhalation of contaminated water sprays or mists. Infection can also occur by inhalation, particularly during outbreaks in hospital. The bacteria live in water and colonize hot and cold water systems at temperatures of 20 to 50 degrees Celsius (optimal 35 degrees Celsius). They contaminate air conditioning cooling towers, hot and cold water systems, humidifiers, whirlpool spas and other water-containing devices. There is no direct human-to-human transmission.

Extent of the disease

The incidence of community-acquired Legionnaires' disease varies widely according to the setting investigated and the diagnostic methodology applied. Since many countries lack appropriate methods of diagnosing the infection or surveillance systems capable of monitoring the situation, the real magnitude of the problem is unknown. In 2003, 34 countries (population: 467.76 million) out of the 36 in the European Working Group for Legionella Infections reported a total of 4578 cases, meaning an average rate across Europe of 9.8 per million population. Based on findings from Denmark where a high level of testing for legionella in patients with pneumonia is developed, a more realistic incidence would be closer to 10 000 cases a year for the same 36 countries.

Risk factors for community-acquired and travel-associated Legionellosis include: male, over 50 years, smoker, a history of heavy drinking, pulmonary related deaths, immuno-suppression, and chronic debilitating illnesses.

Risk factors for hospital-acquired pneumonia in the host are: recent surgery, intubation, which is the process of placing a tube in the trachaea, mechanical ventilation, aspiration, presence of nasogastric tubes, and the use of respiratory therapy equipment. The most susceptible hosts are immuno-compromised patients, including organ transplant recipients and those receiving corticosteroid treatment.

Delay in diagnosis and administration of appropriate antibiotic treatment, increasing age and presence of co-existing diseases are predictors of death from Legionnaires' disease.

Prevention

There is no vaccine currently available for Legionnaires' disease.

Patients with the non-pneumonic form of infection do not require any antibiotic treatment and the symptomatic approach is sufficient. Patients with Legionnaires' disease always require antibiotic treatment, following laboratory confirmation of diagnosis.

The public health threat posed by legionellosis can be addressed via preventive measures. Although it is impossible to eradicate the source of infection, it is possible to reduce the risks substantially. Prevention of Legionnaires' disease depends on good maintenance of possible sources, including regular cleaning and disinfection and the application of other physical (temperature) or chemical measures (biocide) to minimise growth. Some examples are: the regular cleaning and disinfection of cooling towers together with frequent or continuous addition of biocides; maintaining an adequate level of a biocide such as chlorine in a spa pool along with a complete drain and clean of the whole system at least weekly; keeping hot and cold water systems clean and either keeping the hot water at 60°C and the cold below 20°C or alternatively treating them with a suitable biocide to limit growth. Applying such controls particularly in hospitals, industrial sites, hotels, leisure centres, etc will greatly reduce the risk of legionella contamination and prevent the occurrence of sporadic cases.

Such control and prevention measures must be accompanied by proper vigilance on the part of general practitioners and community health services for the detection of cases.

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WORLD HEALTH ORGANIZATION FACTSHEET

No. 261 (2001)

Nipah virus

OVERVIEW

Nipah virus is a newly recognized zoonotic virus. The virus was 'discovered' in 1999. It has caused disease in animals and in humans, through contact with infectious animals. The virus is named after the location where it was first detected in Malaysia. Nipah is closely related to another newly recognized zoonotic virus (1994), called Hendra virus, named after the town where it first appeared in Australia. Both Nipah and Hendra are members of the virus family *Paramyxoviridae.* Although members of this group of viruses have only caused a few focal outbreaks, the biologic property of these viruses to infect a wide range of hosts and to produce a disease causing significant mortality in humans has made this emerging viral infection a public heath concern.

NATURAL HOST

It is currently believed that certain species of fruit bats are the natural hosts of both Nipah and Hendra viruses. They are distributed across an area encompassing northern, eastern and south-eastern areas of Australia, Indonesia, Malaysia, the Philippines and some of the Pacific Islands. The bats appear to be susceptible to infection with these viruses, but do not themselves become ill. It is not known how the virus is transmitted from bats to animals.

TRANSMISSION

The mode of transmission from animal to animal, and from animal to human is uncertain, but appears to require close contact with contaminated tissue or body fluids from infected animals. Nipah antibodies have been detected in pigs, other domestic and wild animals. The role of species other than pigs in transmitting infection to other animals has not yet been determined.

It is unlikely that Nipah virus is easily transmitted to man, although previous outbreak reports suggest that Nipah virus is transmitted from animals to humans more readily than Hendra virus. Despite frequent contact between fruit bats and humans there is no serological evidence of human infection among bat carers. Pigs were the apparent source of infection among most human cases in the Malaysian outbreak of Nipah, but other sources, such as infected dogs and cats, cannot be excluded. Human-to-human transmission of Nipah virus has not been reported.

CLINICAL FEATURES

The incubation period is between 4 and 18 days. In many cases the infection is mild or inapparent (sub-clinical). In symptomatic cases, the onset is usually with "influenza-like" symptoms, with high fever and muscle pains (myalgia). The disease may progress to inflammation of the brain (encephalitis) with drowsiness, disorientation, convulsions and coma. Fifty percent of clinically apparent cases die.

TREATMENT

No drug therapies have yet been proven to be effective in treating Nipah infection. Treatment relies on providing intensive supportive care. There is some evidence that early treatment with the antiviral drug, ribavirin, can reduce both the duration of feverish illness and the severity of disease. However, the efficacy of this treatment in curing disease or improving survival is still uncertain.

PROTECTION OF HEALTH CARE PROFESSIONALS

The risk of transmission of Nipah virus from sick animals to humans is thought to be low, and transmission from person-to-person has not yet been documented, even in the context of a large outbreak. Therefore, the risk of transmission of Nipah virus to health care workers is thought to be low. However, transmission without percutaneous exposure (through a break in the skin barrier) is theoretically possible, as respiratory secretions contain the virus. This is why it has been categorized as a biohazardous agent that should be managed in a high-level biosecurity laboratory. It is recommended that close contact with body fluids and infected tissues be avoided if Nipah infection is suspected.

OUTBREAKS OF NIPAH AND HENDRA VIRUSES

From September 1998 - April 1999, there was a large outbreak of encephalitis in Malaysia. During the investigation of this outbreak, Nipah virus, a previously unrecognized virus, was identified as the causal agent. A total of 265 people were infected, of whom 105 died. Ninety-three percent of cases had occupational exposure to pigs. An associated outbreak among abattoir workers in Singapore during March 1999 led to 11 cases, with 1 death. These workers had been handling pigs that had been imported from the outbreak areas in Malaysia.

There have been 3 recognized outbreaks of Hendra virus in Australia in 1994, 1995 and1999. Three human cases, leading to 2 deaths were recorded in the 1994 and 1995 outbreaks. In 1995 a horse was infected, with associated human cases. The precise mode of virus transmission to the three Australian patients is not fully understood. All 3 individuals appear to have acquired their infection as a result of close contact with horses which were ill and later died.

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WORLD HEALTH ORGANIZATION FACTSHEET

No. 267 (2005)

Plague

Overview

Plague is a zoonotic disease circulating mainly among small animals and their fleas. The bacteria *Yersinia pestis* can also infect humans. It is transmitted between animals and humans by the bite of infected fleas, direct contact, inhalation and rarely, ingestion of infective materials. Plague can be a very severe disease in people, with a case-fatality ratio of 30%-60% if left untreated.

Infected persons usually start with “flu-like” symptoms after an incubation period of 3-7 days. Patients typically experience the sudden onset of fever, chills, head and body-aches and weakness, vomiting and nausea. Clinical plague infection manifests itself in three forms depending on the route of infection: bubonic, septicaemic and pneumonic.

- Bubonic form is the most common form of plague resulting from the bite of an infective flea. Plague bacillus enters the skin from the site of the bite and travels through the lymphatic system to the nearest lymph node. The lymph node then becomes inflamed because the plague bacteria, *Yersinia pestis* or *Y. pestis*, will replicate here in high numbers. The swollen lymph node is called a "bubo" which is very painful and can become suppurated as an open sore in advanced stage of infection;
- Septicaemic form of plague occurs when infection spreads directly through the bloodstream without evidence of a "bubo". More commonly advanced stages of bubonic plague will result in the presence of *Y. pestis* in the blood. Septicaemic plague may result from flea bites and from direct contact with infective materials through cracks in the skin.
- Pneumonic form of plague is the most virulent and least common form of plague. Typically, pneumonic form is due to a secondary spread from advanced infection of an initial bubonic form. Primary pneumonic plague results from inhalation of aerosolized infective droplets and can be transmitted from human to human without involvement of fleas or animals. Untreated pneumonic plague has a very high case-fatality ratio.

Plague is endemic in many countries in Africa, in the former Soviet Union, the Americas and Asia. In 2003, 9 countries reported 2118 cases and 182 deaths. 98.7% of those cases and 98.9% of those deaths were reported from Africa. Today the distribution of plague coincides with the geographical distribution of its natural foci.

Treatment

Rapid diagnosis and treatment is essential to reduce complications and fatality. Effective treatment methods enable almost all plague patients to be cured if diagnosed in time. These methods include the administration of antibiotics and supportive therapy.

Prevention

The objective of preventive measures is to inform people to be aware of the areas where zoonotic plague is active and to take precautions against flea bites and handling carcass while in plague-endemic areas. People should avoid having direct contact with infective tissues, or from being exposed to patients with pneumonic plague.

Case recognition, medical intervention and field investigation

- Identify the most likely source of infection in the area where the human case(s) was exposed, typically looking for clustered areas with large numbers of small animal die-offs. Institute appropriate sanitation and control measures to stop the exposure source;
- Ensure dissemination of information concerning areas with active plague transmission, the clinical features of plague and the case definition to health workers;
- Verify that patients have been placed on appropriate antibiotic treatment and that local supplies of antibiotics are adequate to handle further cases;
- Isolate pneumonic plague patients;
- Obtain specimens for laboratory confirmation.

Laboratory testing

Diagnosis and confirmation of plague requires laboratory testing. Recovery and identification of *Y. pestis* culture from a patient sample is optimum for confirmation. Depending on the presentation of the form on plague: bubo aspirates, blood, and sputum are the most appropriate specimens for rapid testing and culture. Serum taken during the early and late stages of infection can be examined to confirm infection. Rapid dipstick tests have been validated for field use to quickly screen for *Y. pestis* antigen in patients. Specimens should be collected and forwarded to laboratories for plague testing.

Vaccination

Plague vaccines at one time were widely used but have not proven to be an approach that could prevent plague effectively. Vaccines are not recommended for immediate protection in outbreak situations. Vaccination is only recommended as a prophylactic measure for high-risk groups (e.g. laboratory personnel who are constantly exposed to the risk of contamination).

Surveillance and control

- Conduct investigation to identify animals and flea species that are implicated in the plague enzootic cycle in the region and develop a programme on environmental management to limit its potential spread.

- Active long-term surveillance of zoonotic foci and rapid response to reduce exposure during epizootic outbreaks have been successful in reducing human plague.

RELATED LINKS

- Plague

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WORLD HEALTH ORGANIZATION FACTSHEET

No. 207 (2000)

Rift Valley fever

OVERVIEW

Rift Valley Fever (RVF), is a zoonosis (a disease which primarily affects animals, but occasionally causes disease in humans). It may cause severe disease in both animals and humans leading to high morbidity and mortality. The death of RVF-infected livestock often leads to substantial economic losses.

Since 1930, when the virus was first isolated during an investigation into an epidemic amongst sheep on a farm in the Rift Valley of Kenya, there have been outbreaks in sub-Saharan and North Africa. In 1997-98, there was a major outbreak in Kenya and Somalia. In September 2000, RVF was for the first time reported outside of the African Continent. Cases were confirmed in Saudi Arabia and Yemen. This virgin-soil epidemic in the Arabian Peninsula raises the threat of expansion into other parts of Asia and Europe.

Many different species of mosquitoes are vectors for the RVF virus. There is, therefore, a potential for epizootics (epidemics amongst animals) and associated human epidemics following the introduction of the virus into a new area where these vectors are present. This has been demonstrated in the past and remains a concern.

RVF VIRUS

The virus, which causes RVF, is a member of the *Phlebovirus* genus, one of the five genera in the family *Bunyaviridae*.

RVF VECTORS

- RVF virus is primarily spread amongst animals by the bite of infected mosquitoes.
- A wide variety of mosquito species may act as the vector for transmission of the RVF virus; in different regions a different species of mosquito may prove to be the predominant vector. In addition, the various vector species play differing roles in sustaining transmission of the virus.
- *Aedes* mosquitoes, for example, may acquire the virus from feeding on infected animals, and are capable of transovarial transmission (transmission of the virus from infected female mosquitoes to offspring via eggs), so new generations of infected mosquitoes may hatch from their eggs.

This provides a durable mechanism for maintaining the virus in nature, as the eggs of these mosquitoes may survive for periods of up to several years in dry conditions. During periods of inundation of larval habitats by rainfall, for example, in the rainy season, the eggs will hatch, and the mosquito population will increase and spread the virus to the animals on which they feed.

Previously uninfected *Aedes* and other species of mosquitoes will feed on infected, viraemic (virus circulating in the bloodstream) animals and thus amplify and perpetuate the outbreak by transmitting the virus to the animals on which they subsequently feed.

RVF VIRUS NON-HUMAN HOSTS

- Many types of animals may be infected with RVF, and disease may be severe in many domesticated animals including cattle, sheep, camels and goats. Sheep appear to be more susceptible than cattle and goats are less susceptible.
- Exotic breeds, which have been recently introduced into an endemic area, fare worse than breeds long adapted to local conditions.
- Animals of different ages also differ in their susceptibility to severe illness: over 90% of lambs infected with RVF die, whereas mortality amongst adult sheep can be as low as 10%.
- The abortion rate amongst pregnant, infected ewes is almost 100%. An epizootic (epidemic animal disease) of RVF is usually first manifested as a wave of unexplained abortions amongst livestock. This may signal the start of an epidemic.

TRANSMISSION TO HUMANS

- During epizootics, people may become infected with RVF either by being bitten by infected mosquitoes, or through contact with the blood, other body fluids or organs of infected animals.
- Such contact may occur during the care or slaughtering of infected animals, or possibly from the ingestion of raw milk.
- The virus may infect humans through inoculation (e.g., if the skin is broken, or through a wound from an infected knife), or through inhalation as an aerosol. The aerosol mode of transmission has also led to infection in laboratory workers

CLINICAL FEATURES

- The incubation period (interval from infection to onset of symptoms) of RVF varies from two to six days.
- There then follows an influenza-like illness, with sudden onset of fever, headache, myalgia (muscle pain) and backache. Some patients also develop neck stiffness, photophobia (the patient finds exposure to light uncomfortable) and vomiting; in these patients the disease, in the early stages, may be mistaken for meningitis.
- The symptoms of RVF usually last from four to seven days, after which time the immune response to infection becomes detectable with the appearance of IgM and IgG antibodies, and the disappearance of circulating virus from the bloodstream.

CLINICAL FEATURES OF SEVERE CASES

- While most human cases are relatively mild, a small proportion of patients develops a much more severe disease. This generally appears as one of several recognizable syndromes: eye disease, meningoencephalitis (inflammation of the brain and surrounding tissue) or haemorrhagic fever. The proportion of patients developing these three types of complications is about 0.5-2% for eye disease, and less than 1% for meningoencephalitis and haemorrhagic fever syndrome.
- The fever and other symptoms described in the preceding section, Clinical Features, may appear in association with eye disease, which characteristically manifests itself in retinal lesions. The onset of eye disease is usually one to three weeks after the first symptoms appear. When the lesions are in the macula, some degree of permanent visual loss will result. Death in patients with only ocular disease is uncommon.
- Another syndrome manifests itself with acute neurological disease, meningoencephalitis. The onset of this syndrome is also usually one to three weeks after the first symptoms appear. Death in patients with only meningoencephalitis is uncommon.
- RVF may also manifest itself as haemorrhagic fever. Two to four days after the onset of illness, the patient shows evidence of severe liver disease, with jaundice and haemorrhagic phenomena, such as vomiting blood, passing blood in the faeces, developing a purpuric rash (a rash caused by bleeding in the skin), and bleeding from the gums. Patients with the RVF-haemorrhagic fever syndrome may remain viraemic for up to 10 days. The case-fatality rate for patients developing haemorrhagic disease is high at approximately 50%.
- Most fatalities occur in patients who have developed haemorrhagic fever. The total case fatality rate has varied widely in the various documented epidemics, but, overall, is less than 1%.

DIAGNOSIS AND TREATMENT

- Several approaches may be used in diagnosing acute RVF. Serological tests such as enzyme-linked immunoassay (the "ELISA" or "EIA" methods) may demonstrate the presence of specific IgM antibodies to the virus. The virus itself may be detected in blood during the viremia phase of illness or postmortem tissues by a variety of techniques including virus propagation (in cell cultures or inoculated animals), antigen detection tests, and PCR, a molecular method for detecting the viral genome.

- Most human cases of RVF are relatively mild and of short duration, so will not require any specific treatment. For the more severe cases, the mainstay of treatment is general supportive therapy

PREVENTION AND CONTROL

- RVF can be prevented by a sustained program of animal vaccination. Both live, attenuated, and killed vaccines have been developed for veterinary use. The live vaccine requires only one dose and produces long-lived immunity, but the presently-available vaccine may cause abortion if given to pregnant animals. The killed vaccines do not cause these unwanted effects, but multiple doses must be given to produce protective immunity. This may prove problematic in endemic areas.
- An inactivated vaccine has been developed for human use. This vaccine is not licensed and is not commercially available, but has been used experimentally to protect veterinary and laboratory personnel at high risk of exposure to RVF. Other candidate vaccines are under investigation.
- The risk of transmission from infected blood or tissues exists for people working with infected animals or people during an outbreak. Gloves and other appropriate protective clothing should be worn, and care taken when handling sick animals or their tissues. Healthcare workers looking after patients with suspected or confirmed RVF should employ universal precautions when taking and processing specimens from patients. Hospitalized patients should be nursed using barrier techniques. As noted above, laboratory workers are at risk, so samples taken for diagnosis from suspected human and animal cases of RVF should be handled by trained staff and processed in suitably equipped laboratories.
- Other approaches to the control of disease involve protection from and control of the mosquito vectors. Personal protection is important and effective. Where appropriate, individuals should wear protective clothing, such as long shirts and trousers, use bednets and insect repellent, and avoid outdoor activity at peak biting times of the vector species. Measures to control mosquitoes during outbreaks, e.g., use of insecticides, are effective if conditions allow access to mosquito breeding sites.

New systems that monitor variations in climatic conditions are being applied to give advance warning of impending outbreaks by signalling events which may lead to increases in mosquito numbers. Such warnings will allow authorities to implement measures to avert an impending epidemic.

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