Emerging Infectious Diseases

Dr Arthur Jackson Consultant in Infectious Diseases September 2015

 "The time has come to close the book on infectious diseases. We have basically wiped out infection in the United States."

 Dr William Stewart, Surgeon General, USA, 1967

Travel time to major cities: A global map of Accessibility



Globalisation ... global health

- Recent issue of connectedness
- Problems and solutions can travel rapidly
- Networking is important
- · Information sharing is paramount

Internet traffic ... note Africa



Emerging infections

- Newly identified, previously unknown infections causing public health problems
- Re-emerging
 - ... perhaps an old infection in a new locality ...
 - Infection which had fallen to such low levels but now are rising again in incidence/prevalence

Reasons for emergence ...

- Microbial adaptation/change
 - Resistance
 - Pathogen resistance to antimicrobials
 Vector resistance to control methods
- New/increased co-existence of humans and pathogens/vectors
 Encroachment of farming and housing territories
 Climatechange
 Increased need to provide food (urbanisation, deforestation)

 - Increased travel opportunites
 - Displaced people: war, natural disasters
- Immunosupression (eg HIV)
- Mechanised food industry handling and processing

Emerging infections

- 2/3 have animal reservoirs
 - Influenza
 - Lassa
 - Malaria, dengue ...

Global Examples of Emerging and Re-Emerging Infectious Diseases

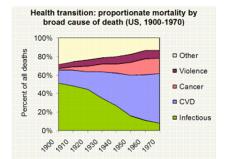


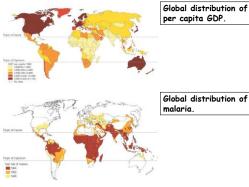
● Newly emerging ● Re-emerging/resurging ● "Deliberately emerging" entropy for the sensitive se

Progress in control of Infections

- Recognition of microbes as pathogens
- Sanitation, hygiene, vector control
- Antimicrobials
- Vaccines
- · Advances in detection
- Communications
- Nutrition

Declining infections as a cause of mortality in richer settings





Feb 2005

Global distribution of malaria.

Poverty

- approximately 1.4 billion people in the world live in extreme poverty, with incomes so low that they cannot fill their basic needs
- If population increases so does the number living in poverty and ill health





Percentage of Population Without Reasonable Access to Safe Drinking Water



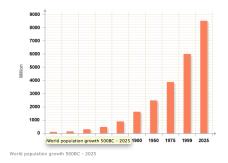
Source: http://www.theglobaleducationproject.org UNDP, UNICEF

Connected world

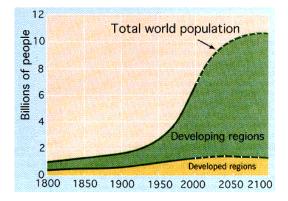
- Global health becomes local health – Returning travellers
- Local problems become global problems – Global economy, globalization ...
- Local economy determines income group
- Income group affects health (as seen with mortality data)

Increasing population, globalization, and Climate change









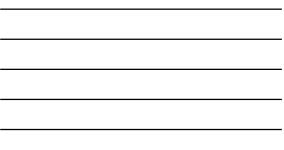


Globalization, Climate Change, and Human Health

Anthony J. McMichael, M.B., B.S., Ph.D. N Engl J Med 2013; 368:1335-1343 | April 4, 2013 | DOI: 10.1056/NEJMra1109341

Temperature rising over time





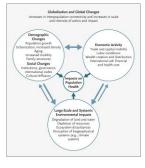
Globalisation and Health

- Interconnectedness
 - Economic intensity
 - Consequent environmental and social changes
- Interrelated pressures, stresses, and tensions arising from an overly large world population
- · environmental impact of
 - Economic activies
 - Urbanization
 - Consumerism
- Widening gap between rich and poor

Changes

- The loss of biodiversity
- human-induced climate change

SOCIAL, ECONOMIC, ENVIRONMENTAL DOMAINS : Influences on health



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Environment change

- Excessive population pressure on regional environments
 - soil exhaustion
 - water depletion
 - loss of various wild animal and plant food species
- "Vicious Cycle"
 - Potentiates poverty/disadvantage
 - Poverty assoc with high birth rate

Infections and globalisation

- Freshwater shortages
 - River flows threatened with climate change and industrialisation of rivers/diversions
- Growing food/crops to feed an increasing world population:
 - land degradation, water shortages, and climate change

- Is technology just
 - "kicking the can down the street"?
- Need education
- Need societal change

Examples ...

Disease	Vector	Population at risk (million) ¹	Number of people currently infected or new cases per year	Present distribution	Likelihood of atere distribution
Malaria	Mosquito	2,4002	309-500 million	Tropics and Subtropics	
Schistosomiasis	Water snall	600	200 million	Tropics and Subtropics	
ymphatic Filariasis	Mosquito	1 0949	117 million	Tropics and Subtropics	
African Trypanosomiasis Sleeping sickness)	Taotae By	55*	250 000 to 300 000 cases per year	Tropical Africa	
Dracumculiasis (Guinea worm)	Crustacean (Copepod)	100 ⁴	100 000 per year	South Asia, Arabian Peninsula, Central-West Africa	0
elstmaniasis	Phiebotomine sand fly	350	12 million infected, 500 000 new cases per year ⁴	Asia, Southern Europe Atrica, Americas	
Onchocercizais (River blindness)	Black fly	123	17.5 million	Africa, Latin America	
American Trypanosomiasis (Chagas disease)	Triatomine bug	1007	18 million	Central and South America	
Dengue	Mosquito	1,800	10-30 million per year	All Tropical countries	
Yellow Fever	Mosquito	450	more than 5 000 cases per year	Tropical South America Africa	

Climate change and infections

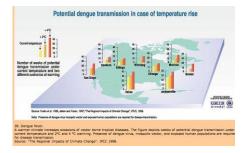
• Example

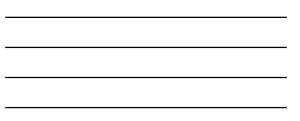
– China:

- medium-scenario warming model
 - schistosomiasis will extend northward
 - 20 million MORE people at risk by 2050

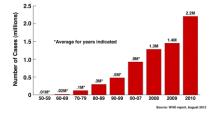
– Dengue

• Spread of habitat for the vector (Aedes mosquito)





Number of Dengue and Severe Dengue Cases Reported to WHO Annually, 1950-2010

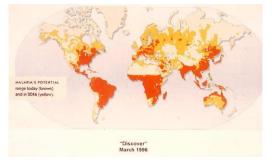


Chikungunya Virus: An Emerging Threat



Chikungunya – painful joint infection viral infection; mosquito-borne

- Prior to 2006, chikungunya virus disease was rarely identified in U.S. travelers.
- From 2006–2013, studies identified an average of 28 people per year in the United States. All were travelers visiting or returning to the United States from affected areas in Asia, Africa, or the Indian Ocean
- In late 2013, the first local transmission of chikungunya virus in the Americas was identified in Caribbean countries and territories. Local transmission means that mosquitoes in the area have been infected with the virus and are spreading it to people.
- Beginning in 2014, chikungunya virus disease cases were reported among U.S. travelers returning from affected areas in the Americas and local transmission was identified in Florida, Puerto Rico, and the U.S. Virgin Islands



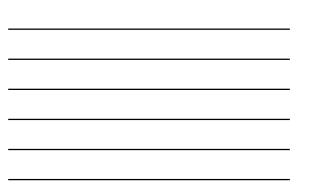
Global Warming and Malaria

HIV

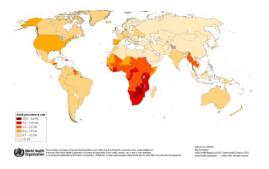
Worldwide disease





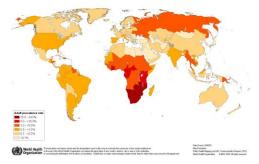


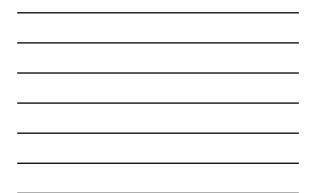
Adult (15-49) HIV prevalence rate (%), 1995

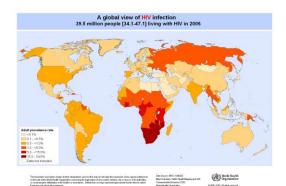




Adult (15-49) HIV prevalence rate (%), 2005









TUBERCULOSIS!!



14

The TB Epidemic in the Western World

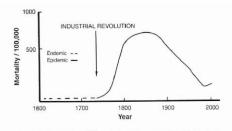
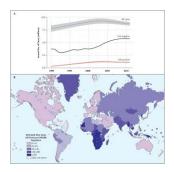


Figure 2. Tuberculosis morbidity as it changes from an endemic infection to an epidemic disease, as it did in Europe during the Industrial Revolution.

Stead, WW. THE ORIGIN AND ERRATIC GLOBAL SPREAD OF TUBERCULOSIS. How the Past Explains the Present and Is the Key to the Future. Clinics in Chest Medicine 1997; 18: 65-77

Tuberculosis

- 95% of all TB cases occur in developing countries
- 9-43% of the world's population is infected
- 8 million new cases/year
 - 3 million deaths/yr
 - 7% of total worldwide mortality rate
- 23% of active cases are estimated to receive appropriate anti-TB treatment



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Tuberculosis

- Ireland
 - 230 notifications per 100,000 population in 1952 (first records kept)
 - 9.7 per 100,000 in 2001
 - 11.3 per 100,000 in 2007
 9.2 per 100,000 in 2010
- In 2010, 40.7% of cases were born outside Ireland compared to 43.0% in 2009 and 43.3% in 2008
 - GLOBAL INTERCONNECTEDNESS
- WHO:
 - Reduce the global incidence of active TB to less than 1 case per million by 2050

Resurgence Of Tuberculosis

Factors leading to an increase in TB:

- Failure to tackle poverty in society and . . .
- ΗIV Africa
- Decaying Pubic Health Infrastructure Eastern Europe
- Migration Ireland / Europe

MultiDrug Resistant Tuberculosis (MDR TB)

- Acquired drug resistance: found in a patient who has received at least 1 month of prior antiTB drug treatment
- Primary resistance: presence of resistant strains of M Tuberculosis in a patient with no history of such prior treatment
- *Multidrug resistance* (MDR): resistance to at least Isoniazid and Rifampicin.



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2003 Spread of SARS from Hotel Metropole



Cumulative Reported Cases of Severe Acute Respiratory Syndrome (SARS), Sept. 26, 2003

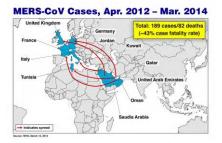


Isolation of a Novel Coronavirus from a Man with Pneumonia in Saudi Arabia

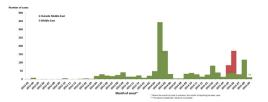
Al M. Zaki, M.D., Ph.D., Sander van Boheemen, M.Sc., Theo M. Bestebroer, B.Sc., Abert D.M.E. Osterhaus, D.V.M., Ph.D., and Ron A.M. Fouchier, Ph.D. N. Engl J.M. 2012, 587:154 - 1520 [November 8, 2012] DOI: 10.1056/NEJMoa1211721

MersCoV





Mers CoV: 1545 cases; 588 deaths: [March 2012 – 2 September 2015]



Note S Korea; note connectedness: All cases reported from outside the Middle East have either had a recent travel history to the Middle East or could be linked to a case with a travel history to the Middle East



MERSCoV - to date

- Approx 800 cases
- Approx 200 deaths
- Droplet precautions should be added to standard precautions when providing care to all patients with symptoms of acute respiratory infection.
- Contact precautions and eye protection should be added when caring for suspected or confirmed cases of MERS-COV infection.
- Airborne precautions should be applied when performing aerosol-generating procedures.

- WHO recommends:
- "... avoid drinking raw camel milk or camel urine ..."





Classification

Arenaviridae Bunyaviridae Filoviridae Flaviviridae

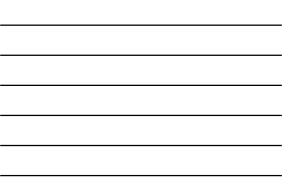
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Junin	Crimean- Congo H.F.	Ebola	k ⁱ yasanur Forest Disease
Machupo	Hantavirus	Marburg	Omsk H.F.
Sabia		ſ	Yellow Fever
Guanarito			
Lassa			

Common process - multifactorial

• Vascular damage

- Viral invasion
- Complement/cytokine activation
 Immune complex deposition
- Coagulation problems
 - Low platelets
 Reduced clotting factors
 - DIC
- Immune failure
- End organ damage
 - Viral cytopathy - Host response







Hemorrhagic Fever Symptoms

If you have recently developed the following symptoms, go to the hospital now:

- Marked Fever
 Muscle Aches
- Fatigue
 Loss of Strength
- Dizziness
 Exhaustion



- Filovirus
- RNA virus



Ebola

- 1976
 - First documented outbreaks
 - Simultaneously in Zaire (=Congo) and Sudan
- Subsequently
 - Rare/intermittent outbreaks in Africa
 Mainly central Africa
 - <500 cases
 - 30% cases were healthcare workers in Zaire, 1995
 - 7% in Uganda, 2000

Recent outbreaks

- Uganda 2012
- West Africa 2013/14/15
 - Difficult to control
 - Connectedness
 - Education
 - Communication

EbolaTransmission

- Reservoir is UNKNOWN
 - Bats implicated
 - Infected non-human primates ("bushmeat")
- Requires close contact with Ebola patient
- Nosocomial transmission
 - Reuse of needles and syringes
 - Exposure to infectious tissues, excretions, and hospital wastes



Current Ebola Outbreak

- August 8, 2014: WHO:
 - "International Public Health Emergency"
 - "the outbreak is an extraordinary event and a public health risk to other states"
 - ...serious in view of the virulence of the virus, the intensive community and health facility transmission patterns and the weak health systems in the currently affected countries
 - a coordinated international response is deemed essential to stop the spread of ebola"

Current Ebola outbreak

- Probable "index cases" December 2013
- Initial cases noted:
 - February 2014:
 in forested areas of Southwestern Guinea
 - In forested areas of Southwestern Guinea
 Spread to Liberia, Sierra Leone
 - (Nigeria fewer cases)
 - Mainly rural, but including some large, densely populated cities (e.g. Monrovia)
 - Many healthcare workers infected
 Compounding problem patients not wishing to attend hospitals



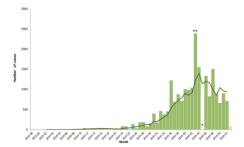
Distribution of cases as of 28 December 2014

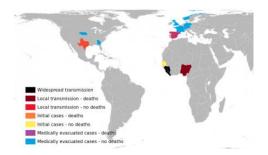
Countries with intense transmission:

- Guinea: 2 707 cases and 1 709 deaths,
- Liberia: 8 018 cases and 3 423 deaths,
 Sierra Leone: 9 446 cases and 2 758 deaths

- Countries without intesnse transmission: UK one confirmed case on 29 December United States: four cases including one death. The last case tested negative on 11 November 2014 in New York.
- Mali: eight cases, six deaths.
- Nigeria, Senegal and Spain are declared free of EVD after having cases related to this current epidemic in West Africa.

Situation in specific West African countries





Current update

- As of 23 August 2015

 28 041 cases of Ebola virus disease in West Africa
 11 302 deaths
- 3 confirmed cases of EVD were reported in the week up to 23 August, all reported from Guinea
- For the second consecutive week, no new confirmed cases have been reported from Sierra Leone
- Liberia has reported no new cases

High Mortality

• 70%

• ?% in Western Centres

- Much lower

Fear

Contagion

- Preparedness of patient pathway

• Exactly how and where the patient goes

- Preparedness of staff:

• PPE

- Training
- Buddy system
- Rostering avoiding fatigue
 Minimizing unnecessary patient contact

Clinical

• Expert opinion rather than clinical trial based

However

- Supportive care predominates

Clinical and Lab findings

- 2 21 days incubation Mean 4-10 days
- Early symptoms
 - Fever, headache, myalgia, sore throat, chest pain
 Lymphadenopathy

 - Gl symptoms very common
 Can be cholera like; initially non-bloody
- Later in the disease add:
 - Bleeding, petechia
 - (although bleeding is often not a major finding)
 - Shock, multiorgan failure

[Be aware of differential diagnosis]

- Same features as malaria, general sepsis
- These patients will likely have malaria risk
- (Malaria will be more likely than Ebola, and if untreated can kill)
- · Malaria test should also be done on all patients presenting with a syndrome that is possibly Ebola

Treatment

- Address fluid issues:
 - Ensure adequate volume: IV or oral fluids

 - ORS if tolerating
 IV line needed if not tolerating oral or hypotension
 Ringers Lactate (20 ml/kg boluses), may need albumin if huge volumes
 May need potassium / bicarb added to fluids esp if severe diarrheea
 - Metabolic/electrolyte abnormalities
 - Coagulation support for DIC
 - Nutrution
 - Antibiotics if secondary infection develops

Experimental

- Serum from recovering/recovered patient appears good, but unproven
- Inhibitory RNA, Monoclonal antibodies experimental
- Vaccine

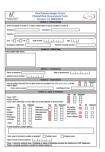
• Ethical questions regarding use of experimental agents and fast-tracking possible therapeutics

Vaccine news ... Lancet August 2015

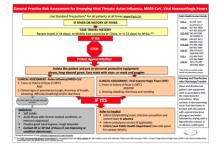
Henao-Restrepo et al. July, 2015 <u>http://dx.doi.org/10.1016/S0140-6736(15)61117-</u>

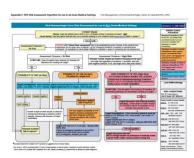
- Phase III vaccine efficacy trial conducted in Guinea
 VSV-EBOV vaccine is likely to be highly effective against Ebola
 None of the 2014 contacts of Ebola patients who were vaccinate
- None of the 2014 contacts of Ebola patients who were vaccinated immediately after exposure developed disease more than 10 days after vaccination.
- Sixteen of the 2380 persons in the contact group who were vaccinated three weeks after exposure, developed the disease.
- Being trialled among younger ages now as well as healthworkers
- The VSV-EBOV vaccine used in the trial is based on an animal virus called vesicular stomatitis virus (VSV) that is combined with a portion of the protein covering the Zaire Ebola virus.
- Recommendations on how the vaccine will be used are expected soon from the WHO expert committee on immunization (SAGE). Likely biggest use will be to break the ongoing transmission around a case

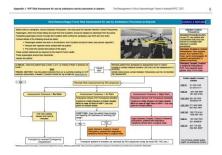
- Returning traveller is different from patient in an outbreak
- Main principles
 - Identify, diagnose and treat patient
 - Limit further spread
 - Identify other at-risk patients



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Key Tasks in Dealing with Emerging Diseases

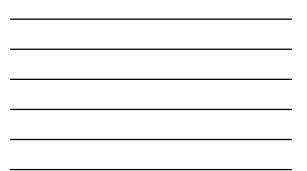
- Surveillance at national, regional, global level

 epidemiological,
 laboratory
 ecological
 anthropological
- Investigation and early control measures
- Implement prevention measures
 - behavioural, political, environmental
- Monitoring, evaluation

Dr. KANUPRIYA CHATURVEDI

What skills are needed?











WHO. Ebsia outreak in Democratic Republic of Congo alabi

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An outstreak of Eliola vitus disease in the Democratic Republic of Congr. (Sungo CR) has stabilised, with no new deaths or them a seek, its Vitorii Health Organization (WCI) deate on Taka 20 20 2011. For the part 15 days, the death of them the Hearth has instrated of all ont new cases the been regularised. The WOI acts in a Nubbh. That issues of Polyabiliation bit 10 2021, accessing to the statement waveaut to the poses of Takabay 20 20 2012. A statis of 15 people are believed inflamed on the finality with the Austream act of all poses of Takabay 20 2012/12, Austra (H2) people are believed inflamed on the finality with the Austream act of all poses.



22 Oct 2012 Hemorrhagic fever wirenal synd - Russia: (22 Oct 2012 Undiagnosed deaths, porcine - Ukraine: RF

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Conclusion

- Emerging infections are likely to remain a feature in a globally connected world with an increasing population
 - Multifactorial
 - Far reaching consequences
- Complex, resource-intense, multifaceted management required
 - for individual cases and overall control

Is there hope in a connected world?

- Connectedness makes all infectious diseases applicable to all of us
- It also makes scientific advances applicable to all, even remote, populations
- And facilitates coordination of efforts