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### Self-introduction

Peter O'Donoghue  
University of  
Queensland  
Brisbane

Tropical Medicine  
perspective:

- personalized
- narcissitic

### MY FAMILY'S TROPICAL ODYSSEY

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### Background

Irish

Scottish

Oz  
hybrid

→ moved to  
Brisbane  
(almost-tropics)

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### Familial experiences with 'TROPICS'

Uncle Sean	Scotland → India (tea plantations)	died!

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### Familial experiences with 'TROPICS'

Uncle David	Germany → Africa (cattle)	died!

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**Familial experiences with 'TROPICS'**

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Uncle Jean-Paul      France → Egypt      died!  
 (work on dam)

7

**Familial experiences with 'TROPICS'**

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Uncle Rutger      Holland → East Indies      died!  
 (spice plantations)

8

**Familial experiences with 'TROPICS'**

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Uncle Clint      USA → Panama      died!  
 (work on canal)

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**Familial experiences with 'TROPICS'**

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Uncle Jet      China → New Guinea      died!  
 (gold mines)

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**Tropics can be dangerous!**

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Presence of nasty infectious diseases

(six exemplars linked to colonial development)

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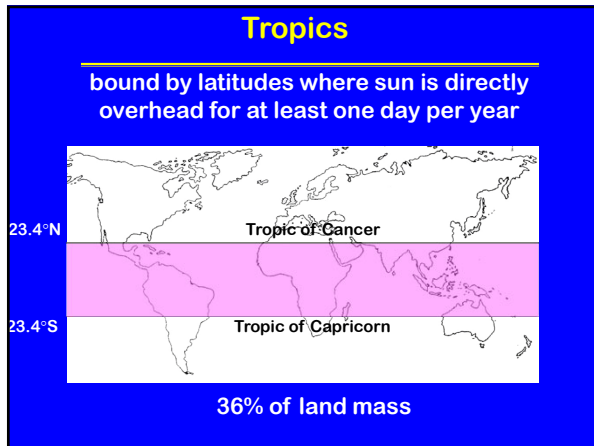
**Tropical Medicine**

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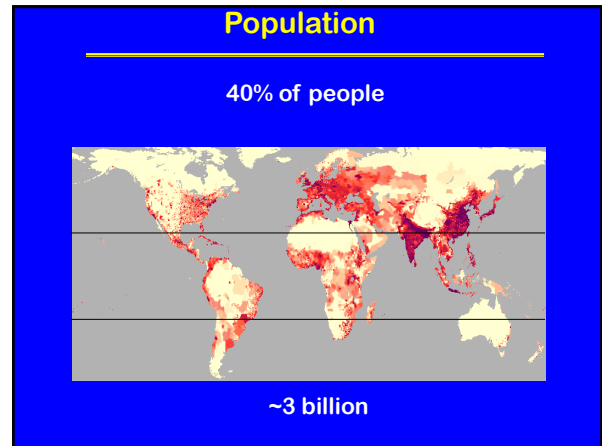
Field developed to protect health of colonists

early Schools/Institutes not in tropics

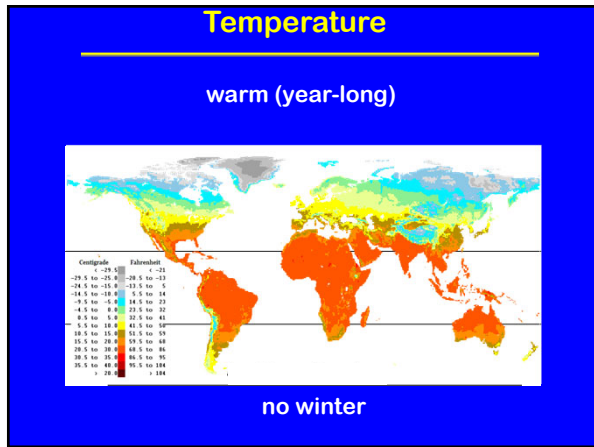
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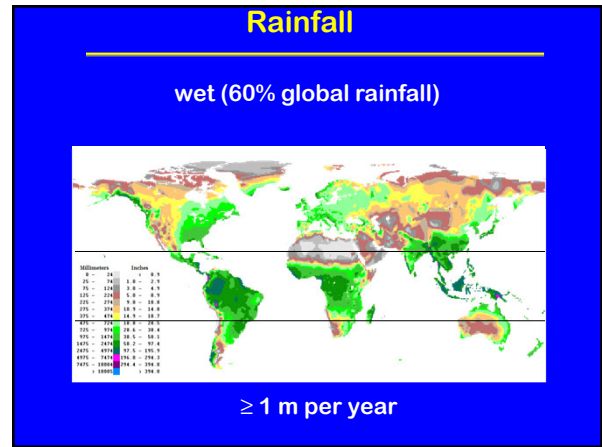
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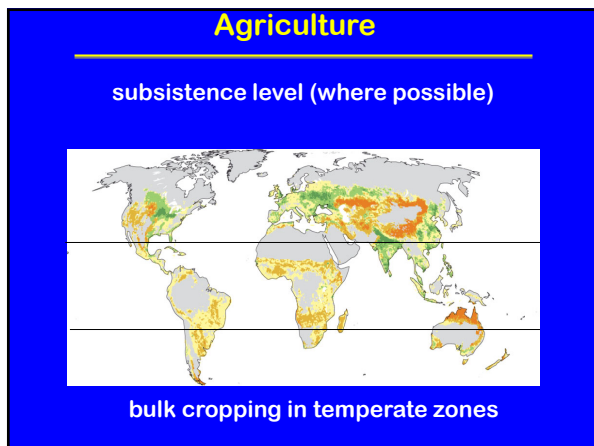
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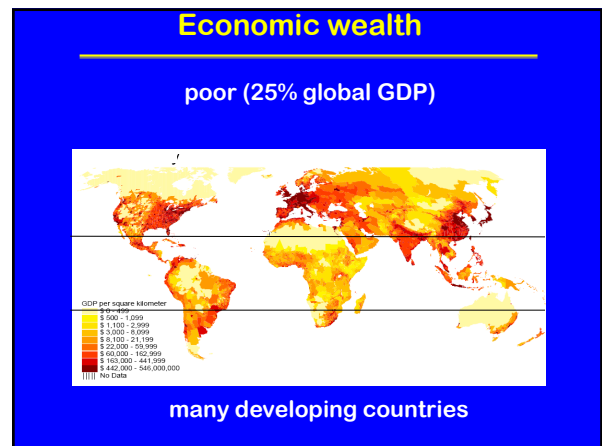
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### VIRUS CLASSIFICATION BY STRUCTURE

NA	strands	envelope	family	diseases
DNA	double	present	Herpes- <i>viridae</i>	herpes, chickenpox
		absent	Pox/Adeno/Papo	smallpox, tumors, warts
	single	absent	Parvo-	animal viruses
RNA	double	absent	Reo-	Colorado tick fever
	single	present	Toga/Retro	rubella, dengue, AIDS
		absent	Picorna-	polio, hepatitis

### VIRUS CLASSIFICATION BY TISSUE TROPHISM

group	tissues affected	diseases
pneumotrophic	respiratory system	influenza, RSV, colds
dermotrophic	skin/subcutaneous	smallpox, herpes, mumps, measles/rubella
viscerotrophic	blood/viscera	yellow fever, dengue, hepatitis, AIDS
neurotrophic	nervous system	rabies, polio

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### PNEUMOTROPHIC VIRUSES

#### Influenza (ssRNA virus)


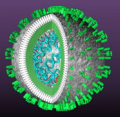
[envelope with Haemagglutinin (16 types) and Neuraminidase (9 types)]

Flu, multiple symptoms, may develop into bronchitis or pneumonia  
Highly contagious, spread by respiratory droplets and fomites  
Highest risk for elderly and immunocompromised individuals

Type A (humans, animals, birds) - every 2-3 years  
Type B (humans only) - every 4-6 years

Overall mortality ~ 1% BUT epidemics (pandemics)


H1N1 Spanish flu	(1918)	40m deaths
H2N2 Asian flu	(1957)	2m deaths
H3N2 Hong Kong flu	(1968)	1m deaths
H1N1 Russian flu	(1977)	no pandemic
H5N1 bird flu	(1997)	6 deaths

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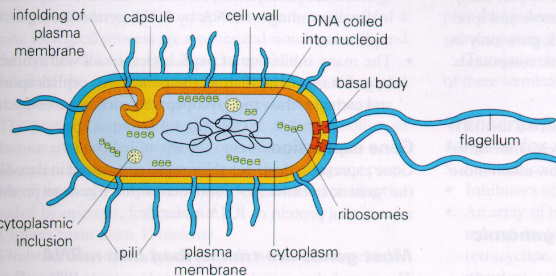
### EVOLUTION OF NEW INFLUENZA VIRUS

- cross infection of human & avian influenza in pigs (e.g. H3N2 & H5N1)
- leading to reassortment of genes and new strains (e.g. parental strains + H3N1 + H5N2)



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### Bacteria are primitive nuts! (= prokaryotes)



Coccus	-coccus (sphere)	Gram stain	
Rod	- rod (bacillus)	Gram+ (blue)	
Spirillum	- spirillum (spiral)	Gram- (pink)	

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### Bacteria grouped according to major mode of transmission

Transmission	disease	agent	organ	signs
<b>airborne</b>	diphtheria	Gram+ rod	resp. tract	pseudomembrane
	legionellosis	Gram- rod	lungs	pneumonia
	tuberculosis	acid-fast rod	lungs	tubercle
<b>food/water</b>	botulism	Gram+ rod	nerve ends	paralysis
	typhoid	Gram- rod	gi tract	ulcers, fever
	cholera	Gram- rod	intestine	diarrhoea
<b>soilborne</b>	anthrax	Gram+ rod	blood	haemorrhages
	tetanus	Gram+ rod	nerve ends	spasms
<b>arthropodborne</b>	bubonic plague	Gram-rod	lymph nodes	buboes
	Lyme disease	spirochaete	skin	lesions
<b>sexually</b>	syphilis	spirochaete	skin	chancre
	gonorrhoea	Gram- coccus	urethra	discharge
<b>contact</b>	leprosy	acid-fast rod	skin	tumours
	yaws	spirochaete	skin	lesions
	'staph'	Gram+ coccus	skin, blood	abscesses, fever

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### Air-borne diseases

#### Tuberculosis (re-emergence)

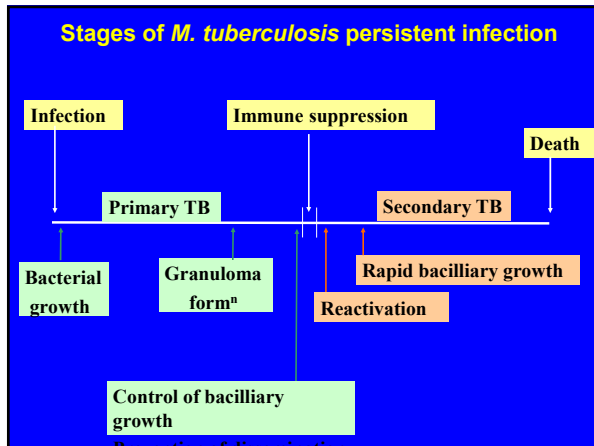
- Gram+ rod *Mycobacterium tuberculosis*
- globally, someone is infected with TB every second (~30m)
- slow progressive, insidious, chronic disease
- asymptomatic - granuloma - tubercle - fatal
- highly infectious via aerosol droplets
- each person with active TB infects 10-15 people per year

#### Problems

- diagnosis (skin test, X-ray, culture, PCR)
- timely treatment (long-term)
- treatment failure (MDR, XDR-TB)
- vaccination rationale



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### FUNGI are not plants or animals!

- no chlorophyll, chitinous walls, heterotrophic
- complex life-cycles involving spore formation

filamentous fungi      ovoid yeasts

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### Important fungal diseases

type	location	disease	genera
superficial	cutaneous	tinea	<i>Malassezia</i>
		ringworm	<i>Microsporium/Trichophyton</i>
subcutaneous	subcutaneous	sporotrichosis	<i>Sporothrix</i>
		mycetoma	various
deep	systemic	histoplasmosis	<i>Histoplasma</i>
		blastomycosis	<i>Blastomyces</i>
opportunistic	systemic	cryptococcosis	<i>Cryptococcus</i>
		candidiasis	<i>Candida</i>
		aspergillosis	<i>Aspergillus</i>

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### SUPERFICIAL MYCOSES

tropics haven for fungi  
(warm, moist environments, nutrient-rich substrates)

Causes of tinea	Anthropophilic (human sources)	Zoophilic (animal sources)	Geophilic (soil sources)
<i>Trichophyton</i>	✓	✓	
<i>Microsporium</i>	✓	✓	✓
<i>Epidermophyton</i>	✓		

**Dermatophytes**

- infections spread by contact with arthrospores
- keratin-loving organisms (skin, nails, hair)
- annular scaling patches, pruritis, alopecia
- treatment radically improved (topical/oral)

**Problems:**

- timely diagnosis, increasing incidence
- long-term treatment (1 week – 1 year)

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### PROTOZOA are single-celled animals!

flagellates	amoebae	sporozoa	ciliates
whip-like flagella	temporary pseudopodia	non-motile 'spores'	hair-like cilia

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### *Plasmodium* spp. (malaria)

zoites-schizonts      salivarian transmission      mosquitoes

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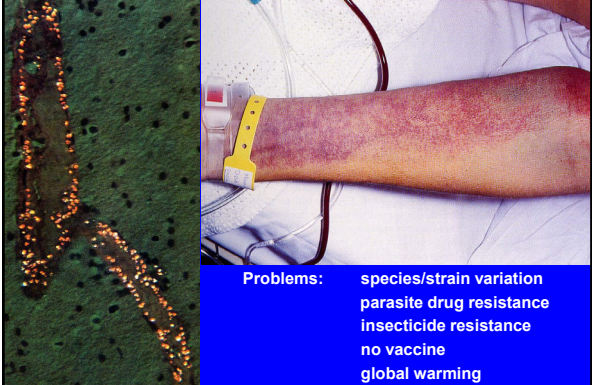


### haemolysis – anaemia - fever



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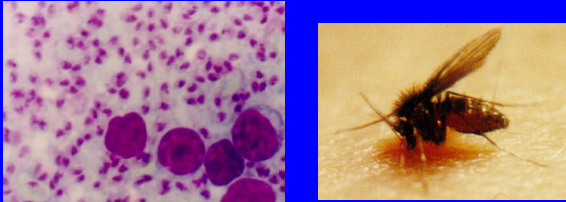
### cytoadherence - ischaemia



Problems: species/strain variation  
parasite drug resistance  
insecticide resistance  
no vaccine  
global warming

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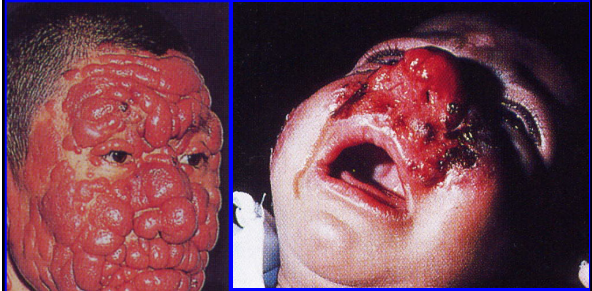
### *Leishmania* spp. cutaneous/visceral leishmaniasis



amastigotes      vector transmission      sand flies

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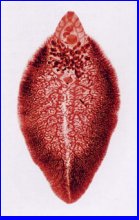
### cutaneous - mucocutaneous



Problems: animal reservoirs  
treatment failure  
reconstruction

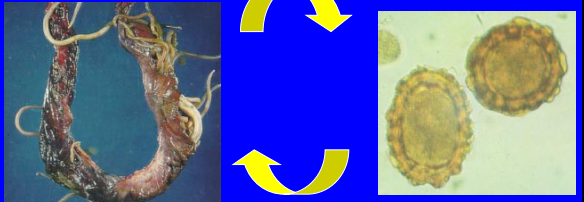
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### HELMINTHS are multicellular worms

nematodes	cestodes	trematodes
		
roundworms	tapeworms	flukes

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### *Ascaris* (roundworm)



adult worms 15-30 cm  
(in small intestinal lumen)

egg 60 x 40  $\mu$ m  
mammillated coat

important species in humans and pigs


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### Pathogenesis

- allergic reactions (urticaria, eosinophilia)
- larval migration (pneumonitis)
- mechanical blockage (gut obstruction)
- malnutrition

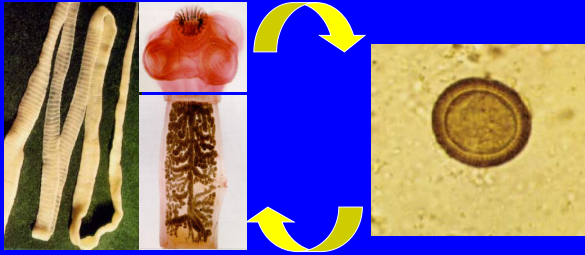
Problems:

- aggregated distribution
- re-infection



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### *Taenia solium* (‘pork’ tapeworm)



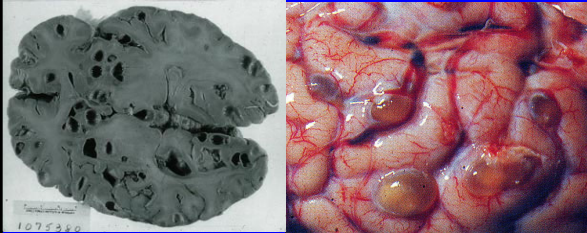
adult worm in human gut      egg shed in faeces

- humans become infected by eating infected pork
- pigs become infected by eating eggs, BUT.....

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### Cysticercosis

- encysted larvae develop in tissues of pigs (AND humans)
- esp. brain & muscles (with associated symptoms/signs)





Problems:

- beware ‘gift pigs’
- autologous infection

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### PARASITIC ARTHROPODS

ARACHNIDS	INSECTS
	
8 legged freaks (ticks, mites)	6 legged bities (lice, fleas, flies)

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### HUMAN HEAD LICE


#### *Pediculus humanus capitus*

(cooties, greybacks, mechanized dandruff)

- attach to hair (esp. back of neck and behind ears)
- infestations associated with crowding
- bites cause red papules
- intense pruritis
- dermatitis
- secondary infection


Problems

- emerging resistance to chemicals
- resurgence in schools
- clean hair/girls



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### *Sarcoptes spp.* (scabies/mange mites)



adult mites burrow in skin and lay eggs resulting in vesicles/crusts

Problems: inflammation, crusted scabies  
timely diagnosis and treatment

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### List of infectious diseases

		37% bacterial (86)	29% viral (65)
		13% helminth (30)	15% fungi (26)
		7% protozoan (17)	2% arthropod (6)

<b>Acanthamoeba</b>	<b>Chlamydia</b>	<b>Haemophilus influenzae</b>	<b>Meningococcal disease</b>	<b>Schistosomiasis</b>
<b>African trypanosomiasis</b>	<b>Clostridium difficile colitis</b>	<b>Hantavirus pulmonary syndrome</b>	<b>Molluscum contagiosum</b>	<b>Simplicis</b>
<b>Acquired immunodeficiency syndrome</b>	<b>Colorado tick fever</b>	<b>Heartland virus disease</b>	<b>Mumps</b>	<b>Singapore</b>
<b>Anisakiasis</b>	<b>Crimean-Congo haemorrhagic fever</b>	<b>Henipavirus</b>	<b>Myxomatosis</b>	<b>Smallpox</b>
<b>Anthrax</b>	<b>Cryptosporidiosis</b>	<b>Hepatitis A</b>	<b>Neisseria meningitidis</b>	<b>Staphylococcal food poisoning</b>
<b>Arboviral haemorrhagic fever</b>	<b>Cytoplasts</b>	<b>Hepatitis B</b>	<b>Norovirus</b>	<b>Streplococcal</b>
<b>Azithromycin-resistant pneumococcal pneumonia</b>	<b>Delegatella</b>	<b>Hepatitis C</b>	<b>Parasitosis</b>	<b>Syphilis</b>
<b>Bacterial meningitis</b>	<b>Demodex</b>	<b>Hepatitis D</b>	<b>Parvovirus B19</b>	<b>Syphilis</b>
<b>Bacterial sepsis</b>	<b>Diphtheria</b>	<b>Hepatitis E</b>	<b>Peritonitis</b>	<b>Tetanus</b>
<b>Bacterial vaginosis</b>	<b>Dysentery</b>	<b>Hirschsprung's disease</b>	<b>Picornavirus</b>	<b>Tick-borne encephalitis</b>
<b>Bacterial yaws</b>	<b>Earliest human disease</b>	<b>Human bocavirus</b>	<b>Poliovirus</b>	<b>Toxic shock syndrome</b>
<b>Bacteroides fragilis</b>	<b>Ebola haemorrhagic fever</b>	<b>Human coronavirus</b>	<b>Polymicrobial infection</b>	<b>Toxigenic Escherichia coli</b>
<b>Beriberi</b>	<b>Enterovirus</b>	<b>Human enterovirus</b>	<b>Post-polio syndrome</b>	<b>Trichinosis</b>
<b>BK virus</b>	<b>Escherichia coli</b>	<b>Human immunodeficiency virus</b>	<b>Pre-eclampsia</b>	<b>Trichomoniasis</b>
<b>Bluetongue virus</b>	<b>Enterococcus</b>	<b>Human parainfluenza virus</b>	<b>Prion disease</b>	<b>Trichuriasis</b>
<b>Bovine spongiform encephalitis</b>	<b>Enterovirus</b>	<b>Influenza</b>	<b>Prionoses</b>	<b>Trichuriasis</b>
<b>Botulism</b>	<b>Erythema infectiosum (fifth disease)</b>	<b>Erythema infectiosum (fifth disease)</b>	<b>Primary amoebic meningoencephalitis</b>	<b>Trichuriasis</b>
<b>Brucella abortus</b>	<b>Fascioliasis</b>	<b>Fascioliasis</b>	<b>Progressive multifocal leukoencephalopathy</b>	<b>Tuberculosis</b>
<b>Brucella melitensis</b>	<b>Fascioliasis</b>	<b>Fascioliasis</b>	<b>Rabies</b>	<b>Typhoid fever</b>
<b>Brucella suis</b>	<b>Fatal familial insomnia</b>	<b>Fatal familial insomnia</b>	<b>Rabies</b>	<b>Typhoid fever</b>
<b>Burkholderia pseudomallei</b>	<b>Fascioliasis</b>	<b>Fascioliasis</b>	<b>Respiratory syncytial virus</b>	<b>Unexplained encephalitis</b>
<b>Calicivirus (Norovirus, Sapovirus)</b>	<b>Fascioliasis</b>	<b>Fascioliasis</b>	<b>Rabies</b>	<b>Unexplained encephalitis</b>
<b>Calicivirus (Norovirus, Sapovirus)</b>	<b>Fascioliasis</b>	<b>Fascioliasis</b>	<b>Respiratory syncytial virus</b>	<b>Unexplained encephalitis</b>
<b>Chagas disease</b>	<b>Giardiasis</b>	<b>Giardiasis</b>	<b>Rabies</b>	<b>Unexplained encephalitis</b>
<b>Chikungunya</b>	<b>Giardiasis</b>	<b>Giardiasis</b>	<b>Respiratory syncytial virus</b>	<b>Unexplained encephalitis</b>
<b>Chlamydia pneumoniae</b>	<b>Giardiasis</b>	<b>Giardiasis</b>	<b>Rabies</b>	<b>Unexplained encephalitis</b>
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<b>Chlamydia pneumoniae</b>	<b>Giardiasis</b>	<b>Giardiasis</b>	<b>Rabies</b>	<b>Unexplained encephalitis</b>
<b>Chlamydia pneumoniae</b>	<b>Giardiasis</b>	<b>Giardiasis</b>	<b>Respiratory syncytial virus</b>	<b>Unexplained encephalitis</b>

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### Cost of tropical diseases

Most common causes of mortality due to infectious diseases (where cause of death is known, ~ 16 million per annum):

- acute respiratory infections 4,000,000
- acquired immunodeficiency syndrome 3,000,000
- diarrhoeal diseases 1,800,000
- tuberculosis (TB) 1,600,000
- malaria 1,000,000
- measles 700,000
- pertussis (whooping cough) 700,000
- tetanus 700,000
- meningitis 600,000
- hepatitis 500,000
- haemorrhagic fever 200,000
- rabies 160,000
- syphilis 150,000
- brucellosis 100,000
- dengue 20,000
- malaria 15,000
- Japanese encephalitis 14,000
- dengue 13,000
- other communicable diseases 1,700,000

**TOO MANY!**

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### Know your enemy!

**Pause for:**

- breath
- sugar

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### "GERM WARFARE"

Our battle with infectious micro-organisms

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### How do we survive? IMMUNE SYSTEMS!

<p><b>first line</b> <b>BARRIER</b></p> <p>external coverings &amp; secretions</p> <p>nonspecific</p>	<p><b>second line</b> <b>INNATE</b></p> <p>phagocytes &amp; inflammation</p> <p>nonspecific</p>	<p><b>third line</b> <b>ADAPTIVE (ACQUIRED)</b></p> <p>cell-mediated &amp; humoral responses</p> <p>specific</p>
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### Herd immunity

susceptible population      partially-resistant population

Depends on history of infection:

- host susceptibility, protective immunity, population density, sociology
- pathogen incidence, infectivity, virulence, transmission frequency

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## Epidemiology

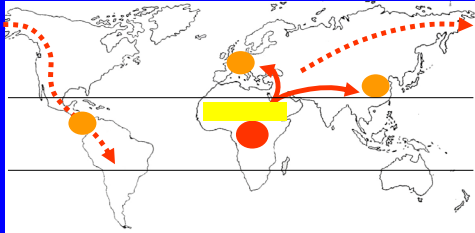
Followed 3 main periods in human history:

1. Foundation (thousands of years ago)
2. Empire (hundreds of years ago)
3. Second Foundation (tens of years ago)

apologies to Asimov

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## 1. FOUNDATION



- ★ Humanoid African origins > 10,000 YA (fossil records) hunter/gatherers savannah Old World diseases (fevers, dysentery, lesions)
- ★ Out-of-Africa migrations >7,000 YA herders → farmers → villagers → cities New World 'crowd' diseases (rashes, poxes, plagues, pneumonias)
- ★ Separation of New and Old Worlds by deserts (Sahara)

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## Old World diseases

<u>FEVERS</u>			
• malaria	<i>Plasmodium</i>	vector-borne	fever
• yellow fever	flavivirus	vector-borne	fever
• typhus	<i>Rickettsia</i>	vector-borne	fever
• Lassa fever	arenavirus	rodents	fever
<u>DYSENTERY</u>			
• amoebic	<i>Entamoeba</i>	faecal-oral	diarrhoea
• bacillary	<i>Shigella</i>	faecal-oral	diarrhoea
<u>OTHER</u>			
• anthrax	<i>Bacillus</i>	soil/hides/bones	lesions

⇒ ZOONOSES (animal and human correlations)

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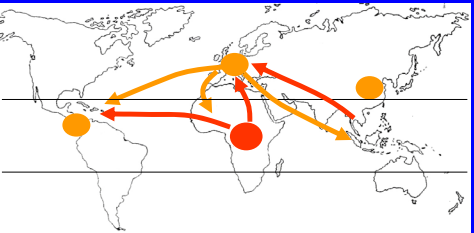
## New World diseases

<u>POXES</u>			
• smallpox	poxvirus	contact/resp.	rash/pustules
• syphilis	<i>Treponema</i>	venereal	rash/lesions
<u>PLAGUES</u>			
• bubonic	<i>Yersinia</i>	contact	buboes
• leprosy	<i>Mycobacterium</i>	contact	lesions
<u>OTHER</u>			
• measles	paramyxovirus	respiratory	rash
• rubella	togavirus	contact	systemic
• cholera	<i>Vibrio</i>	faecal-oral	diarrhoea
• tuberculosis	<i>Mycobacterium</i>	respiratory	lesions
• diphtheria	<i>Corynebacterium</i>	respiratory	lesions
• pertussis	<i>Bordetella</i>	respiratory	cough

⇒ COMMUNICABLE ('crowd') diseases

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## 2. EMPIRE



- ★ >300 YA Explorers 'discover' tropical lands colonists encounter Old World diseases, spread New World diseases
- ★ 200 YA Colonies needed labour force resistant to tropical diseases ('slave trade') mixing of New and Old World peoples and diseases

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## Spread of diseases

OLD World with 'herd immunity' to tropical diseases

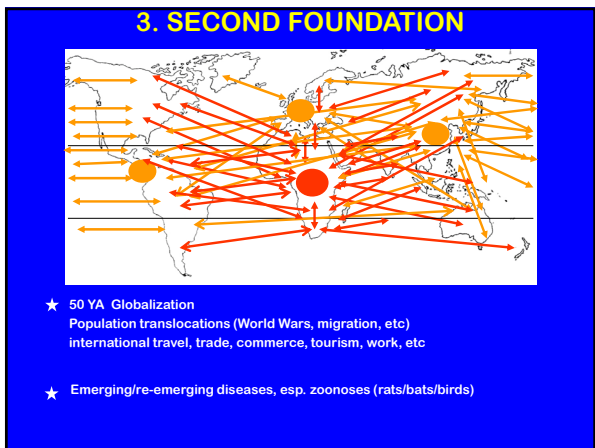
- survived malaria, yellow fever, etc, still able to work
- But no exposure, hence immunity, to crowd diseases
- decimated by measles, STDs, respiratory ailments

ASSIMILATION

- cultural/social integration slow, expatriate nationalism
- genetic interbreeding inevitable, but variable
- 'mixing pot' – selection for disease resistance

SECOND ENCOUNTER of Old World and New World slowly reconstituted gene pool

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### New Wave diseases

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#### RE-EMERGING DISEASES

- influenza orthomyxovirus respiratory pneumonia
- giardiasis *Giardia* faecal-oral diarrhoea
- tuberculosis *Mycobacterium* respiratory lesions

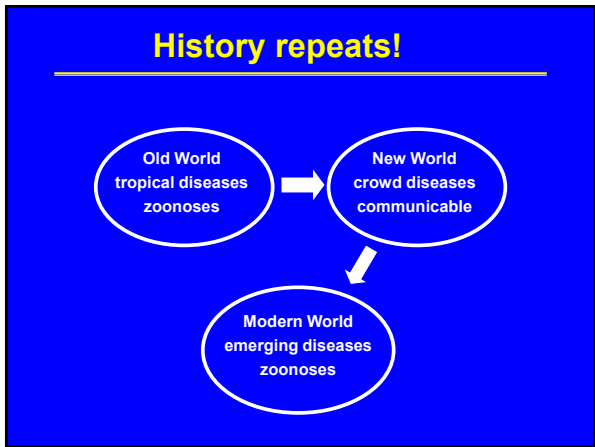
#### EMERGING DISEASES

- Legionnaires *Legionella* respiratory pneumonia
- HIV retrovirus sexual/blood AIDS
- West Nile virus vector-borne encephalitis
- SARS coronavirus respiratory pneumonia

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⇒ ZOOZOSES (animal to human spread)  
(contact with wildlife/vectors, extension of host range)

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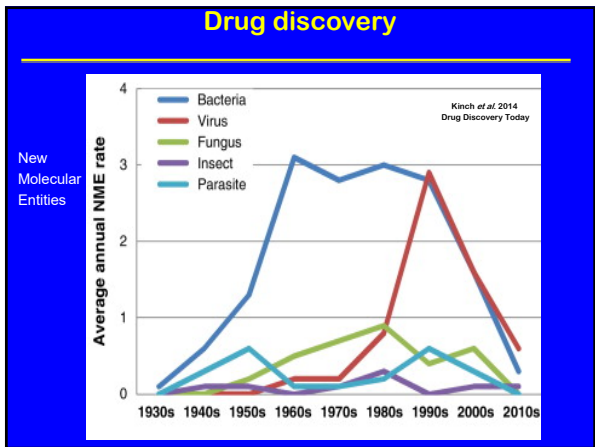
### What can be done?

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#### Disease management through:

- Drugs
- Vaccines
- Biological interventions

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### Infectious diseases (n=240)

<i>Acinetobacter</i>	<i>Chromoblastomycosis</i>	<i>Haemophilus influenzae</i>	Menigitococcal disease	<i>Schistosomiasis</i>
<i>Actinomyces</i>	<i>Coccidioidomycosis</i>	Hand, foot & mouth disease	Meningitis	<i>Shigellosis</i>
<i>African trypanosomiasis</i>	<i>Clostridium difficile</i> colitis	Hand-foot & mouth disease	Microsporidiosis	<i>Shingles</i>
<i>Acquired immunodeficiency syndrome</i>	<i>Coccidioidomycosis</i>	Hantavirus pulmonary syndrome	<i>Molluscum contagiosum</i>	<i>Smallpox</i>
<i>Amoebiasis</i>	<i>Colorado tick fever</i>	Hantavirus syndrome	<i>Mononucleosis</i>	<i>Sporadic</i>
<i>Anisakiasis</i>	<i>Common cold (colds)</i>	<i>Haemorrhagic fever with renal syndrome</i>	<i>Murine typhus (endemic)</i>	<i>Staphylococci</i>
<i>Anthrax</i>	<i>Cryptosporidiosis</i>	<i>Crimean-Congo haemorrhagic fever</i>	<i>Myxomatosis</i>	<i>Staphylococcal food poisoning</i>
<i>Arboviruses</i>	<i>Cryptosporidiosis</i>	<i>Cryptosporidiosis</i>	<i>Neisseria meningitidis</i>	<i>Streptococci</i>
<i>Ascariasis</i>	<i>Cyclosporiasis</i>	<i>Cyclosporiasis</i>	<i>Neisseria meningitidis</i>	<i>Syphilis</i>
<i>Ascariasis</i>	<i>Cyclosporiasis</i>	<i>Cyclosporiasis</i>	<i>Neisseria meningitidis</i>	<i>Tuberculosis</i>
<i>Ascaridiasis</i>	<i>Dacryocystitis</i>	<i>Dacryocystitis</i>	<i>Neisseria meningitidis</i>	<i>Typhoid fever</i>
<i>Ascaridiasis</i>	<i>Dacryocystitis</i>	<i>Dacryocystitis</i>	<i>Neisseria meningitidis</i>	<i>Typhoid fever</i>
<i>Ascaridiasis</i>	<i>Dacryocystitis</i>	<i>Dacryocystitis</i>	<i>Neisseria meningitidis</i>	<i>Typhoid fever</i>
<i>Ascaridiasis</i>	<i>Dacryocystitis</i>	<i>Dacryocystitis</i>	<i>Neisseria meningitidis</i>	<i>Typhoid fever</i>

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# Cardinal Rule

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# 1.

73



74



75



76

# Why?

g-i parasites

- vomiting
- diarrhoea
- dysentery

A large, irregular, reddish-brown mass, likely representing a parasite, is shown on a wooden surface.

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# Management

wide reaching implications for:

- agriculture ('nightsoil')
- town planning (upstream)
- sanitation (effluent)
- treatment (sewage, water)
- food preparation (hygiene)
- education (germ theory)

Two images are shown side-by-side. The left image shows several terracotta water storage containers. The right image shows a person working in a field, possibly related to agriculture or water management.

78



**Cardinal Rule**

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**2.**

79



80



81



82



83



84



## Why?

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bite site

- annoyance
- blood loss

blood parasites

- fever
- coma
- lesions



85

## Management

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- parasite control
  - drug resistance
- vector control
  - insecticide resistance
- scale of problem
  - geographic, economic




86

## Cardinal Rule

---

3.

87

## Don't eat raw meat!



88

## Cook food!




89

## Why?

---

tissue parasites

- lesions
- disrupt structure
- disrupt function
- complications

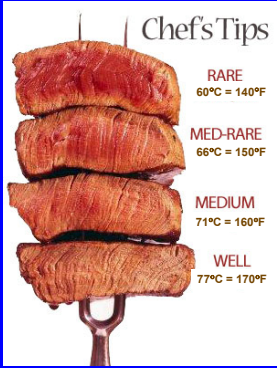


90

## Management

- difficult to change traditions, esp. diet

Remember:  
meat browns at temperature lethal to parasites



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## Survival in tropics

Three simple rules:

1. Avoid coprophagy
2. Avoid haematophagy
3. Sensible zoophagy

Relax and enjoy!  
Price of popularity!



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## Biological interventions

Target:

- hygiene
- sanitation
- vectors
- reservoir hosts
- environments
- behaviours

'night-soil' pots



It is all about **education!** → **communication**

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## Life in the tropics is tough!



94

## Q. What is required for the future?

### A. PEOPLE!

esp. healthcare workers  
(redress "Flight from Science")

- train next generation (clinicians, care-givers, researchers)
- enhance global awareness/citizenship



95


## NURSING (3P's)

- Provide care (therapy)
- Prevent illness (prophylaxis)
- Promote health (educate)

Work independently + cooperatively:

- to assess, plan, implement and evaluate care
- for individuals, families, and communities

Be cognizant of risk of infectious diseases  
(standard/universal/quarantine precautions)



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