Emerging & Re-emerging Diseases

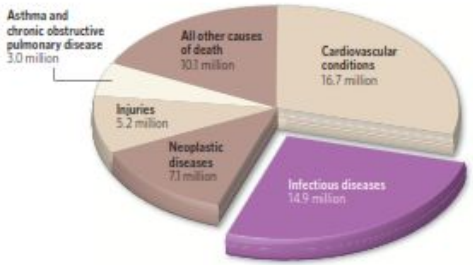
Dr.B.D.W.Jayamanne
Department of Public Health

Outline

- Introduction
- Causes
- Epidemiology
- Examples
- Control Measures
- Challenges
-

Introduction

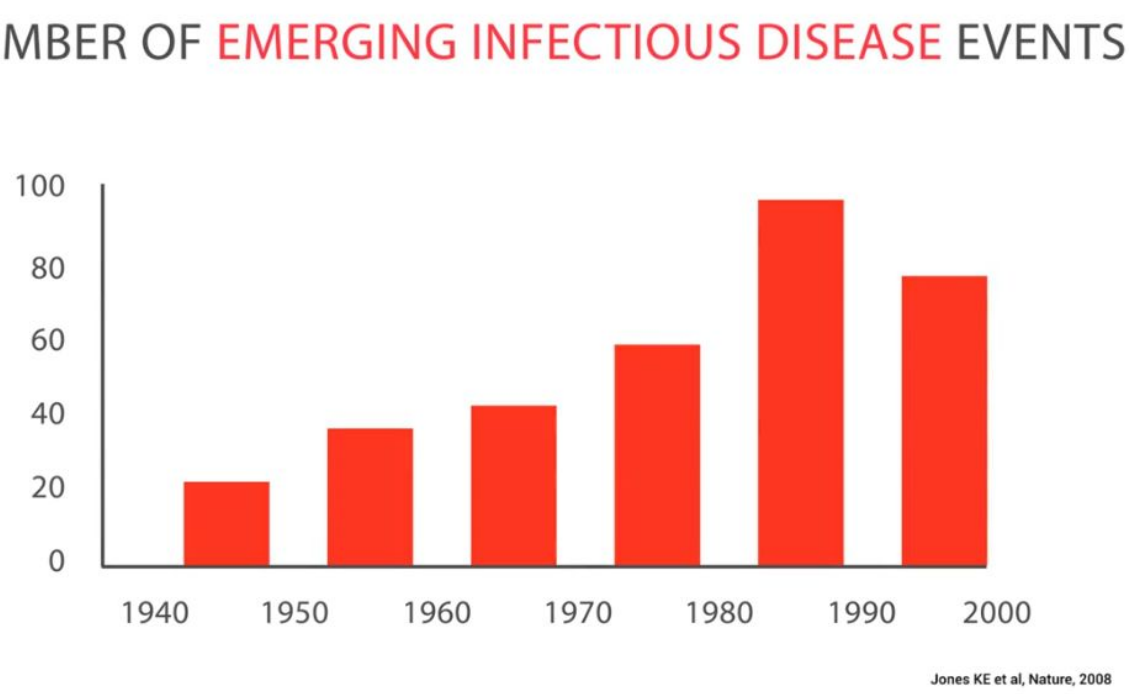
- Disease - Infections,Genetic,Toxines
  - “conditions that impair normal tissue function”
  - Eg: cystic fibrosis, atherosclerosis, measles,etc
- Infectious disease
  - A disease that is caused by the invasion of a host by agents whose activities harm the host's tissues
  - Can be transmitted to other individuals -infectious
  - “harm the host's tissues” -disease
  - Infectious diseases have for centuries ranked with wars and famine as major challenges to human progress and survival (*Morens et al.2014,Nature*)



Infectious diseases	Annual deaths (millions)
Respiratory infections	3.96
HIV/AIDS	2.77
Diarrhoeal diseases	1.80
Tuberculosis	1.56
Vaccine-preventable childhood diseases	1.12
Malaria	1.27
STDs (other than HIV)	0.18
Meningitis	0.17
Hepatitis B and C	0.16
Tropical parasitic diseases	0.13
Dengue	0.02
Other infectious diseases	1.76

Introduction…

- Infectious diseases are the 2nd leading cause of mortality in the world
- 15% of all deaths worldwide
- Emergence of new infections -continuous process
-



Introduction…

- What are Neglected Tropical Diseases ?
  - A diverse group of communicable diseases that prevail in tropical and subtropical conditions in 149 countries
  - Affect more than one billion people and cost developing economies billions of dollars every year
  - Populations living in poverty, without adequate sanitation and in close contact with infectious vectors and domestic animals and livestock are those worst affected.

http://www.who.int/neglected_diseases/diseases/en/

Introduction…

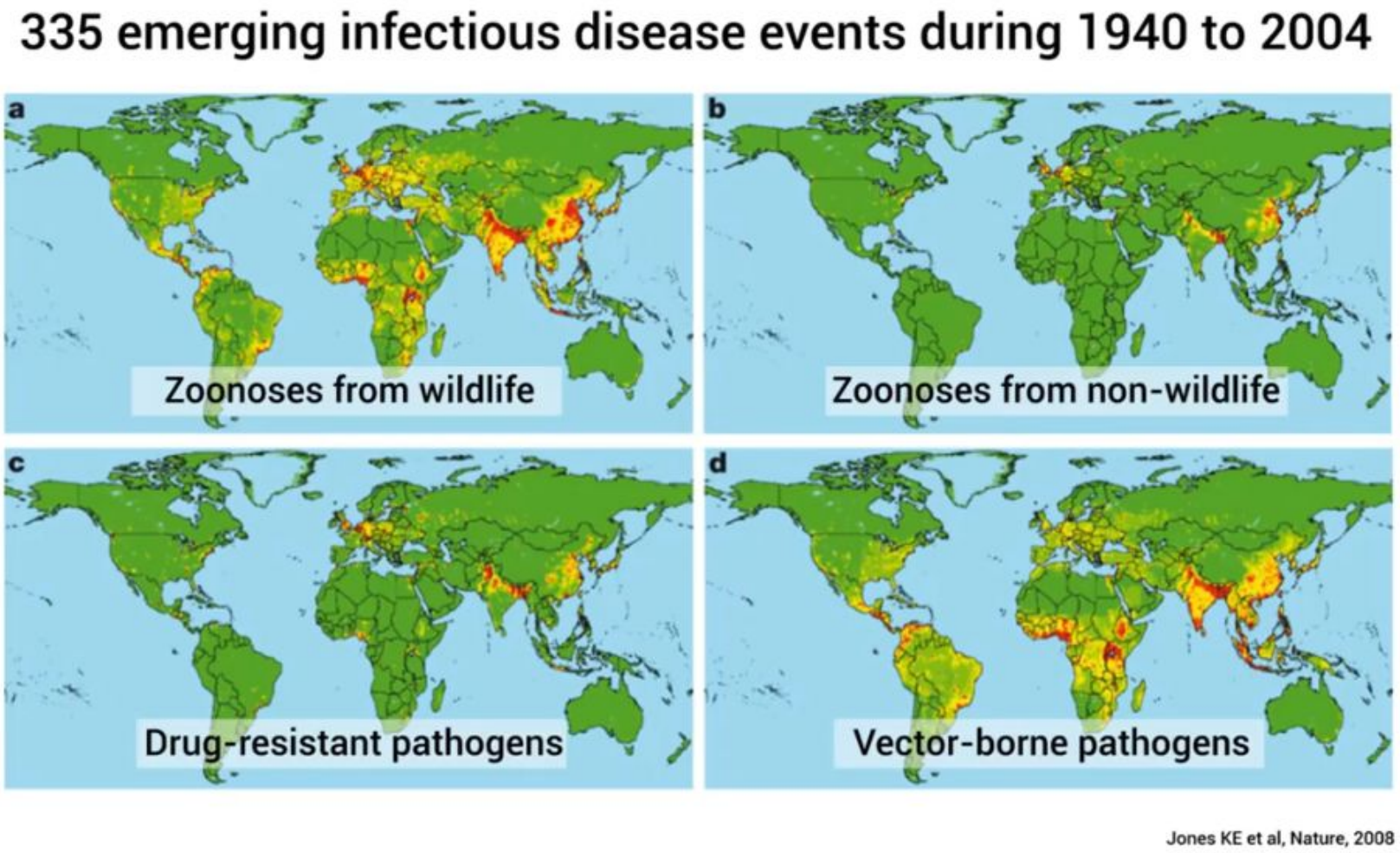
- Who defines an emerging or re-emerging infectious disease ?
  - National Institute of Allergy and Infectious Disease (NIAID),Bethesda, U.S.A. (Established in 1887)
- Emerging Infectious Disease (EID)
  - A completely new infection or has recently increased in incidence or impact and severity, affected newer geographical locations, or is an existing disease that has recently developed new clinical pattern, or developed resistance to existing therapy

    (Daszak at. el. Anthropogenic change, biodiversity loss, and a new agenda for emerging diseases. J Parasitol Suppl. 2003;89:37–41)
  - During past 2 decades

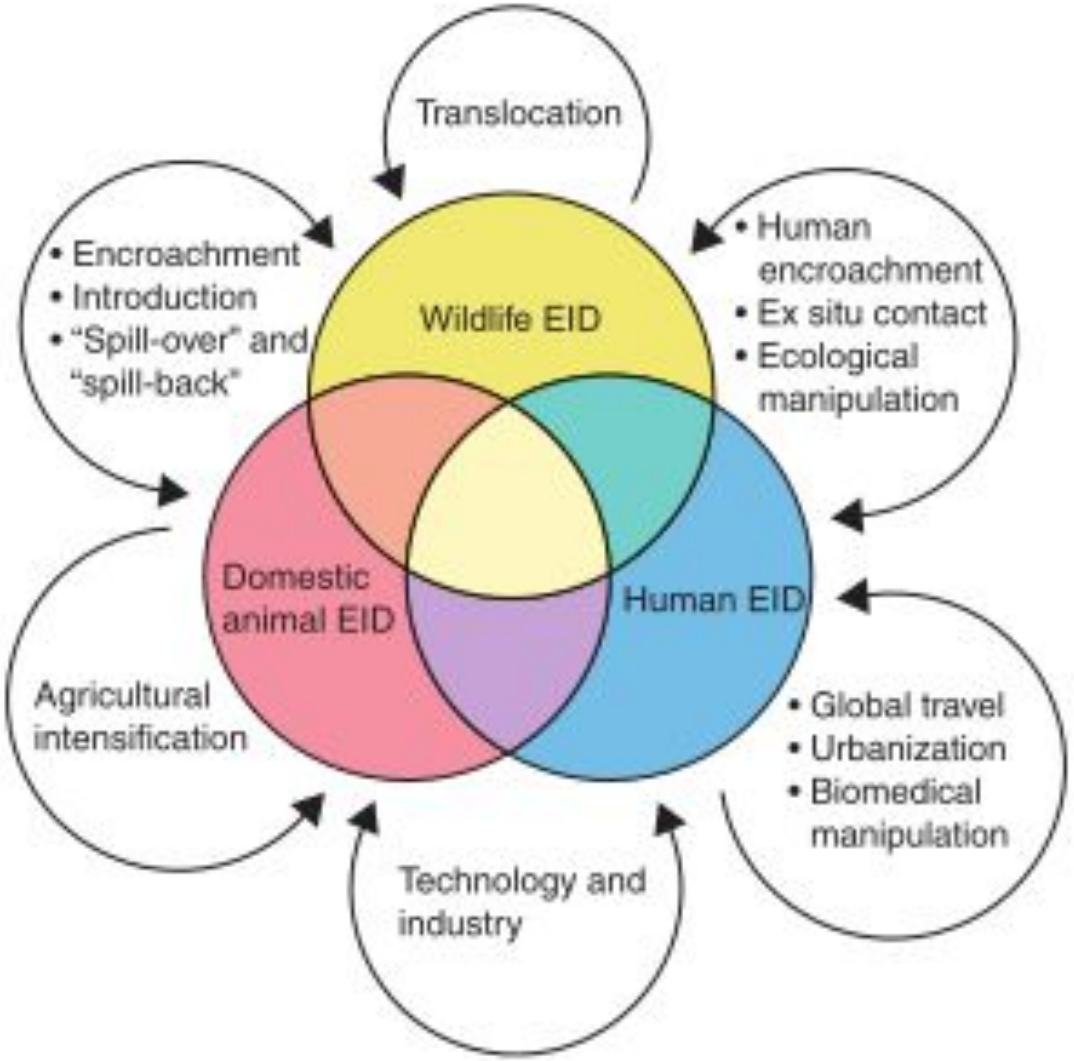
Introduction…

- Emerging Infectious Disease (EID)
  - Previously unknown or known infectious diseases whose incidence in humans has significantly increased in the past 2 decades
  - Eg: SARS ,Novel Influenza(H1N1) ,Avian Influenza,MERS
- Re-emerging Infectious Diseases
  - Known infectious diseases that have reappeared after a significant decline in incidence
  - Eg: Multidrug resistant TB(MDR-TB),MRSA,VRE,PRSP

Introduction…



Causes

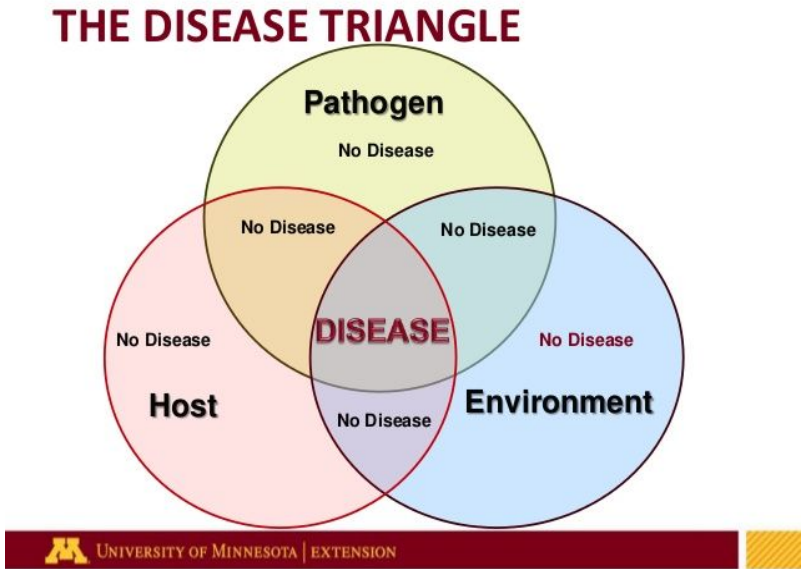


Dasazak P *et. al*. 2000s (Science)

Causes…

- Antibiotic resistance and bacterial evolution
  - Eg TB - 1940 Streptomycin -> 1980 resistance -> MD -TB
  - 1970 -Hope to eradicate TB ???
  - 1993 -TB -Global Health emergency by WHO
  - MRSA, “pan resistant” Klebsiella pneumoniae
- Insecticide resistance
  - 1960s -Sri Lanka eliminated Malaria with DDT
  - 1970 - Resistant mosquitoes to DDT
- Vaccine driven evolution
  - Vaccine induced immunity -Hep.B,Strep. pneumoniae
- Vaccine refusal
  - MMR,DPT
  - Due to side effects
  - Cause outbreaks

Contributing Factors



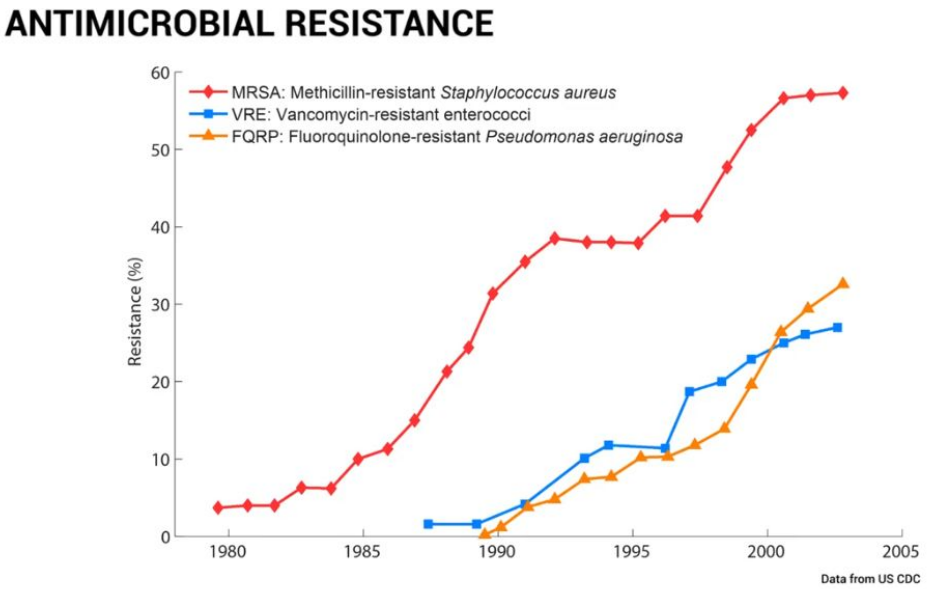
- HOST
  - Human demographic change (inhabiting new areas)
  - Human behaviour (sexual activity & drug use)
  - Human susceptibility to infection (Immunosuppression)
  - Poverty & social inequality
  - Increased international travel

Contributing Factors…

- ENVIRONMENT
  - Climate & changing ecosystems (El Nino,deforestation , Global warming,etc)
  - Economic development & Land use (urbanization, deforestation)
  - Technology & industry (food processing, food trade & handling)
  - International travel & commerce
  - Breakdown of public health measure (war, unrest, overcrowding)
  - Deterioration in surveillance systems (lack of political will)

Contributing Factors…

- AGENT
  - Evolution of pathogenic infectious agents (microbial adaptation & change, virulence)
    - High replication rate -new generations
  - Development of resistance to drugs
  - Resistance of vectors to pesticides- behavioural change- Malaria- bed nets



Pathogen Groups

- Pathogens -
  - Group I - Pathogens newly recognized during past 2 decades
  - Group II - Re-emerging pathogens
  - Group III - Agents with Bioterrorism potential (NIAID classification)
    - NIAID Category A Priority (person to person transmitted agents + Viral Haemorrhagic Fevers)
    - NIAID Category B Priority(food and water borne + Viral Encephalitis)
    - NIAID Category C Priority(Emerging infectious diseases)

Pathogen Groups…

- Group I pathogens

  - Acanthamebiasis
  - Australian bat lyssavirus
  - Babeasia (Atypical)
  - Bartonella henselae
  - Ehrlichiosis
  - Hepatitis C (new in FY14)
  - Hepatitis E (new in FY14)
  - Human herpesvirus 6
  - Human herpesvirus 8
  - Parvovirus(B19)
  - Borrelia mayonii (new in FY18)
  - Borrelia miyamotoi (new in FY14)
  - Helicobacter pylori
  - etc.

- Group II pathogens

  - Enterovirus 71
  - Clostridium difficile
  - Mumps virus
  - Streptococcus Group A
  - Staphylococcus aureus
  -

Pathogen Groups…

Group III- Cat.A

- Can be easily disseminated or transmitted from person to person
- Result in high mortality rates and have the potential for major public health impact
- Might cause public panic and social disruption
- Require special action for public health preparedness

Group III- Cat. B

- Are moderately easy to disseminate
- Result in moderate morbidity rates and low mortality rates
- Require specific enhancements for diagnostic capacity and enhanced disease surveillance

GroupIII- Cat. C

- Emerging pathogens that could be engineered for mass dissemination in the future because of
  - Availability
  - Ease of production and dissemination
  - Potential for high morbidity and mortality rates and major health impact

Category A Priority Pathogens

Pathogen Groups…

Group III- Cat.A

- Bacillus anthracis (anthrax)
- Clostridium botulinum toxin (botulism)
- Yersinia pestis (plague)
- Variola major (smallpox) and other related pox viruses
- Francisella tularensis (tularemia)
- Viral hemorrhagic fevers
  - Arenaviruses
    Junin, Machupo, Guanarito, Chapare (new in fiscal year (FY14), Lassa, Lujo (new in FY14)
  - Bunyaviruses
    Hantaviruses causing Hanta Pulmonary syndrome, Rift Valley Fever, Crimean Congo Hemorrhagic Fever
  - Flaviviruses
    Dengue
  - Filoviruses
    Ebola
    Marburg

www.niaid.nih.gov/research/emerging-infectious-diseases-pathogens

Pathogen Groups…

Group III- Cat. B

- Burkholderia pseudomallei (melioidosis),Coxiella burnetii (Q fever)
- Brucella species (brucellosis),Burkholderia mallei(glanders)
- Chlamydia psittaci (Psittacosis)
- Ricin toxin (Ricinus communis),Epsilon toxin (Clostridium perfringens), Staphylococcus enterotoxin B
- Typhus fever (Rickettsia prowazekii)
- Food- and waterborne pathogens
  -Bacteria,Diarrheagenic E.coli ,Pathogenic Vibrios,Shigella species, Salmonella, Listeria monocytogenes, Campylobacter jejuni,Yersinia enterocolitica
  -Viruses,Caliciviruses,Hepatitis A, Protozoa,Cryptosporidium parvum, Cyclospora cayatanensis
  -Giardia lamblia,Entamoeba histolytica,Toxoplasma gondii,Naegleria fowleri (new in FY14),Balamuthia mandrillaris (new in FY14)
  Fungi - Microsporidia
  -Mosquito-borne viruses - West Nile virus (WNV),LaCrosse encephalitis (LACV), California encephalitis,Venezuelan equine encephalitis (VEE),Eastern equine encephalitis (EEE),Western equine encephalitis (WEE),Japanese encephalitis virus (JE),St. Louis encephalitis virus (SLEV),Yellow fever virus (YFV),Chikungunya virus Zika virus

www.niaid.nih.gov/research/emerging-infectious-diseases-pathogens

Pathogen Groups…

GroupIII- Cat. C

- Nipah and Hendra viruses
- Additional hantaviruses
- Tick Borne hemorrhagic fever viruses
  - Bunyaviruses -Severe Fever with Thrombocytopenia Syndrome virus (SFTSV), Heartland virus
  - Flaviviruses Omsk Hemorrhagic Fever virus, Alkhurma virus, Kyasanur Forest virus
- Tickborne encephalitis complex flaviviruses
- Tickborne encephalitis viruses - European subtype,Far Eastern subtype,Siberian subtype,Powassan/Deer Tick virus
- Tuberculosis, including drug-resistant TB
- Influenza virus
- Other Rickettsias
- Rabies virus
- Prions
- Coccidioides spp.
- Severe acute respiratory syndrome associated coronavirus (SARS-CoV),
- MERS-CoV, and other highly pathogenic human coronaviruses (new in FY14)

www.niaid.nih.gov/research/emerging-infectious-diseases-pathogens

Introduction…

NTD's

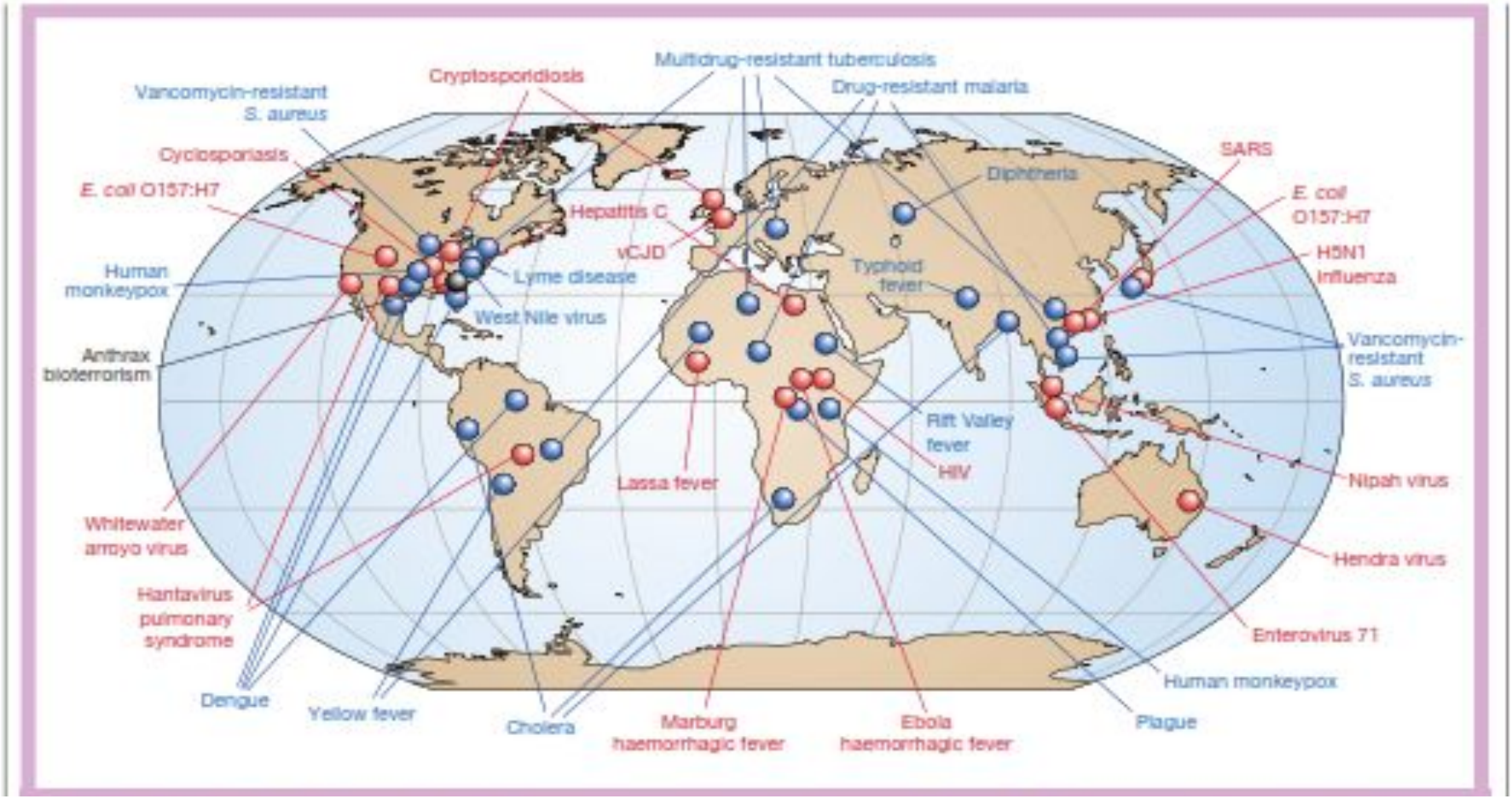
1.Buruli ulcer
2.Chagas disease
3.Dengue and Chikungunya
4. Dracunculiasis (guinea-worm disease)
6.Echinococcosis
7.Foodborne trematodiases
8.Human African trypanosomiasis (sleeping sickness)
9.Leishmaniasis
10.Leprosy(Hansen's disease)
11.Lymphatic filariasis
12.Mycetoma,chromoblastomycosis and other deep mycoses
13.Onchocerciasis (river blindness)
14.Rabies
15.Scabies and other ectoparasites
16.Schistosomiasis
17.Soil-transmitted helminthiases
18.Snakebite envenoming
19.Taeniasis/Cysticercosis
20.Trachoma
21.Yaws (Endemic treponematoses)

http://www.who.int/neglected_diseases/diseases/en/

Epidemiology…

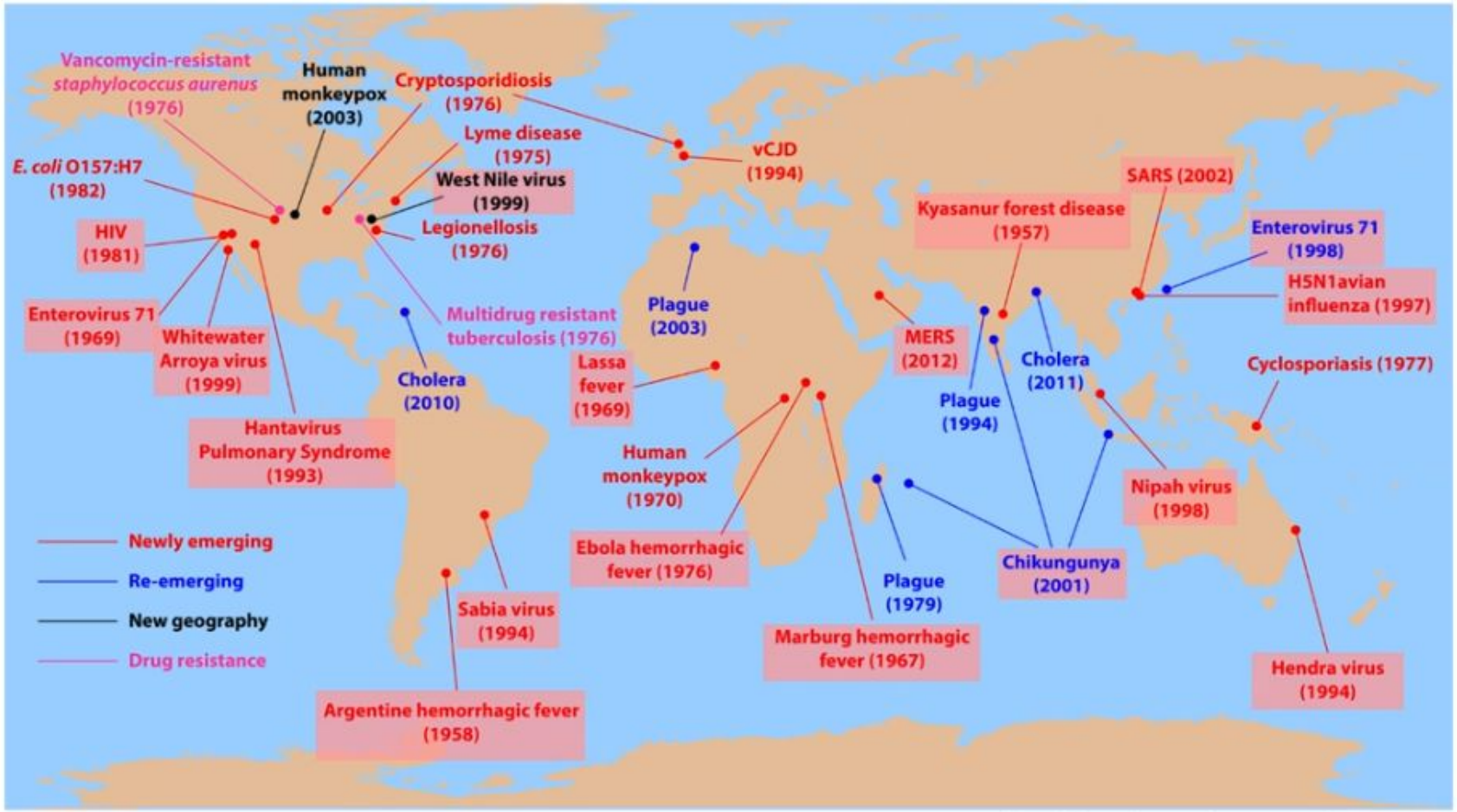
- 61% of human infections derived from wildlife(Zoonotic diseases)
  - Eg.Bubonic plague (14th century) - ⅓ of human population died -transmitted through rat flea
  - Smallpox- ?rodents -10,000 years ago
  - Influenza (1918) - 100 million deaths - Birds-> humans & pigs
  - HIV 1 -Million deaths per year-Chimpanzee
  - Dengue -primates (by Aedes mosquito)
- Many of them RNA viruses
  - High mutation rate -enzymes that replicate RNA viruses are more prone to error
  - More agile at change- when they cross barriers- adapting to new hosts

Epidemiology



(*Morens et al.2014,Nature*)

Emerging and re-emerging infectious diseases
Many are caused by RNA viruses



Adapted from Figure 1 of Morens et al, Nature, 2004

Epidemiology…

- Can be
  - Region specific
  - Country specific
  - Local area specific
  - Time/Period specific
  - Regions
    - Latin America
    - South East Asia
    - China
    - Africa
- But can be a global problem

Emergent zoonotic virus diseases

Table 1. **Examples of novel, emergent zoonotic virus diseases**

Year of isolation	Place of isolation	Virus	Reservoir/spillover host
1991	Venezuela	Guanarito virus[20]	Rodents
1992	Slovenia	Dobrava virus[21]	Rodents
1993	United States	Sin Nombre virus[22]	Rodents (*Peromyscus maniculatus*)
1994	Brisbane, Australia	Hendra virus[23]	Fruit bats (*Pteropus sp.*)/horses*
	Sao Paolo, Brazil	Sabia virus[24]	Rodents
1995	Florida, USA	Black Creek Canal virus[25]	Rodents
1996	Ballina, Australia	Australian bat lyssavirus[26]	Fruit and insectivorous bats
	Argentina	Andes virus[27]	Rodents
1997	Hong Kong (China)	Influenza H5N1[28]	Wild birds/domestic poultry*
	Menangle, Australia	Menangle virus[29]	Fruit bats
	Saudi Arabia	Alkhurma virus[30,31]	Camels and sheep†
1999	Peninsular Malaysia	Nipah virus[32,33]	Fruit bats/pigs*
2000	Peninsular Malaysia	Tioman virus[34]	Fruit bats
2002–2003	China, Hong Kong (China)	SARS coronovirus[35-38]	Bats/civets?*
2003–2004	Viet Nam, China	Influenza H5N1[39,40]	Wild birds/domestic poultry*
2007	Melbourne, Australia	Dandenong arenavirus[41]	Rodents?
	Peninsular Malaysia	Melaka virus[42]	Fruit bats?
	Uganda	Bundibugyo ebolavirus[43]	Fruit bats?/various animals (bush meat)*
2008	Lukasa, Zambia	Lujo virus[44]	Unidentified rodents
	Perak, Malaysia	Kampar virus[45]	Fruit bats?

* Spillover host; † Tick-borne

Ref: WPSAR Vol 2, No 1. 2011 | Responding to Emerging Infectious Diseases

Challenges

- Preparedness
- Early & accurate surveillance
- Rapid response
- Prevention and control measures
- Early identification of pathogen
- Multi-sectoral cooperation
- Political commitment to invest of the uncertainty
- Cross-border issues

Sri Lanka -CDC

EMERGING INFECTIOUS DISEASES®

ISSN: 1080-6059

EID journal
September 2018
Manuscript Submission
About the Journal +
Past Issues
Subscribe
Ahead of Print / In Press
Advanced Article Search
Articles by Country Search
Author Resource Center +
Medscape CME
Podcasts
Announcements +
EIDeas for the Public
More Content +

CDC

<< Return to Article Map

Article Information — Sri Lanka

All Issues

Click column headers to sort.

Show 50 entries Search:

Title	Volume	Issue	Article Type	Year	Month
Dengue Virus Type 2 in Travelers Returning to Japan from Sri Lanka, 2017	23	11	Research Letter	2017	11
Lyssavirus in Indian Flying Foxes, Sri Lanka	22	8	Dispatch	2016	8
Reemergence and Autochthonous Transmission of Dengue Virus, Eastern China, 2014	21	9	Dispatch	2015	9
Molecular Epidemiology of Influenza A(H1N1)pdm09 Virus among Humans and Swine, Sri Lanka	20	12	Dispatch	2014	12
Dengue Virus Transmission by Blood Stem Cell Donor after Travel to Sri					

https://wwwnc.cdc.gov/eid/ArticleMap/LKA

Pandemic

- An epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting large number of people
- WHO requirements
  - Ability to infect humans
  - Ability to cause disease in humans
  - Spread from human to human
- Pandemic phase groupings

1. Predominantly animal infections; few human infections (phases 1-3)
2. Sustained human-to-human transmission (phase 4)
3. Widespread human infection (phases 5-6/pandemic)
4. Possibility of recurrent events (post peak)
5. Disease activity at seasonal levels (post pandemic)

Emerging diseases - in 21st century

- SARS (1st to emerge in 21st century)
- Highly Pathogenic Avian Influenza (H5N1)
- Novel Swine origin Influenza A (H1N1)
- Ebola virus disease
- Middle East Respiratory Syndrome (MERS)
- HIV
- H.Pylori
- Listeriosis
- Zika
- Nipah Virus

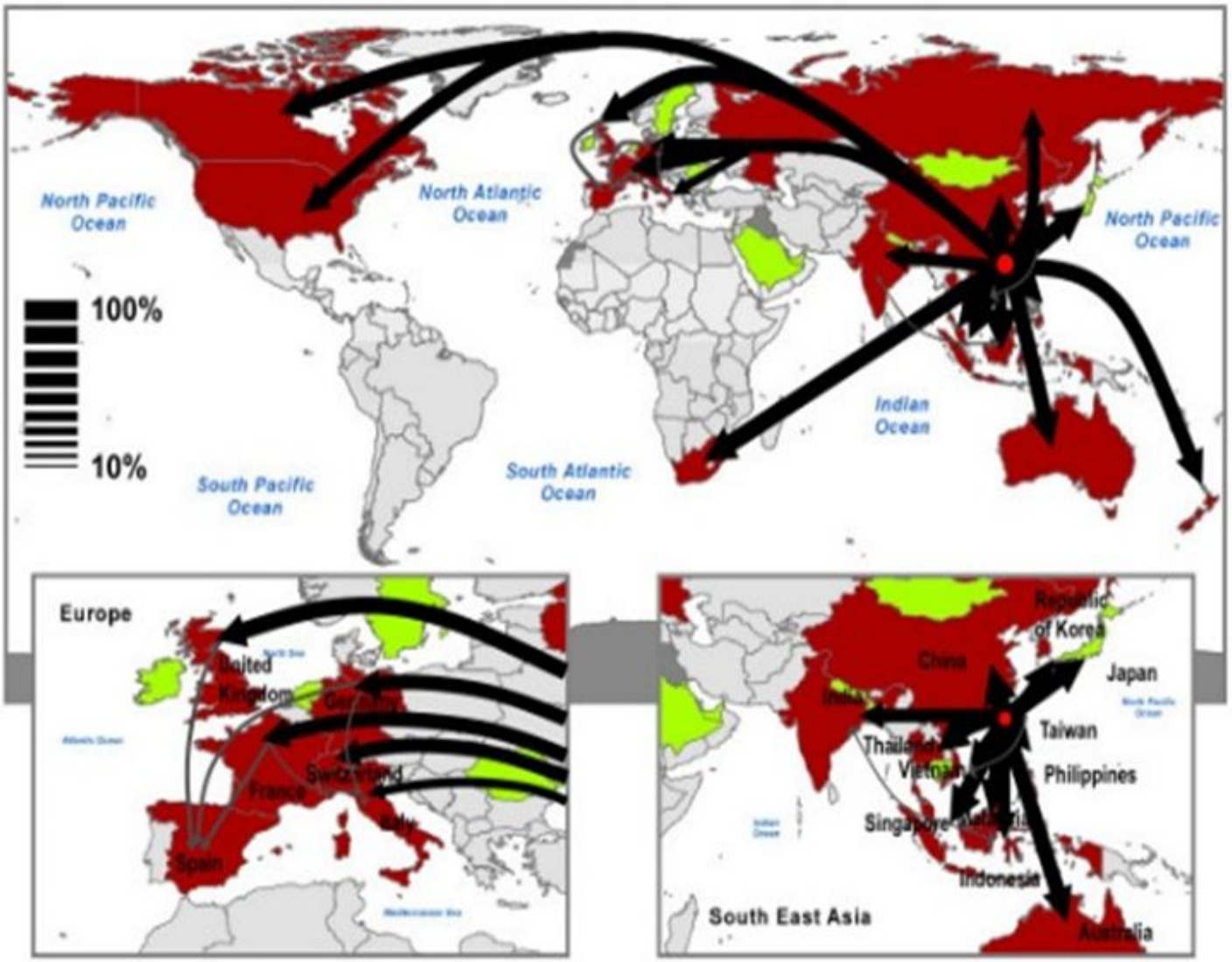
Re-emerging Diseases

- Diphtheria - Early 1990s epidemic in Eastern Europe(1980- 1% cases; 1994- 90% cases)
- Cholera - in 1998 (new strain eltor, 0139)
- Human Plague - India (1994) after 15-30 years absence
- Dengue/ DHF- Over past 40 years, 20-fold increase to nearly 0.5 million
- Polio -
- TB
- Malaria -Drug resistant
- Leptospirosis

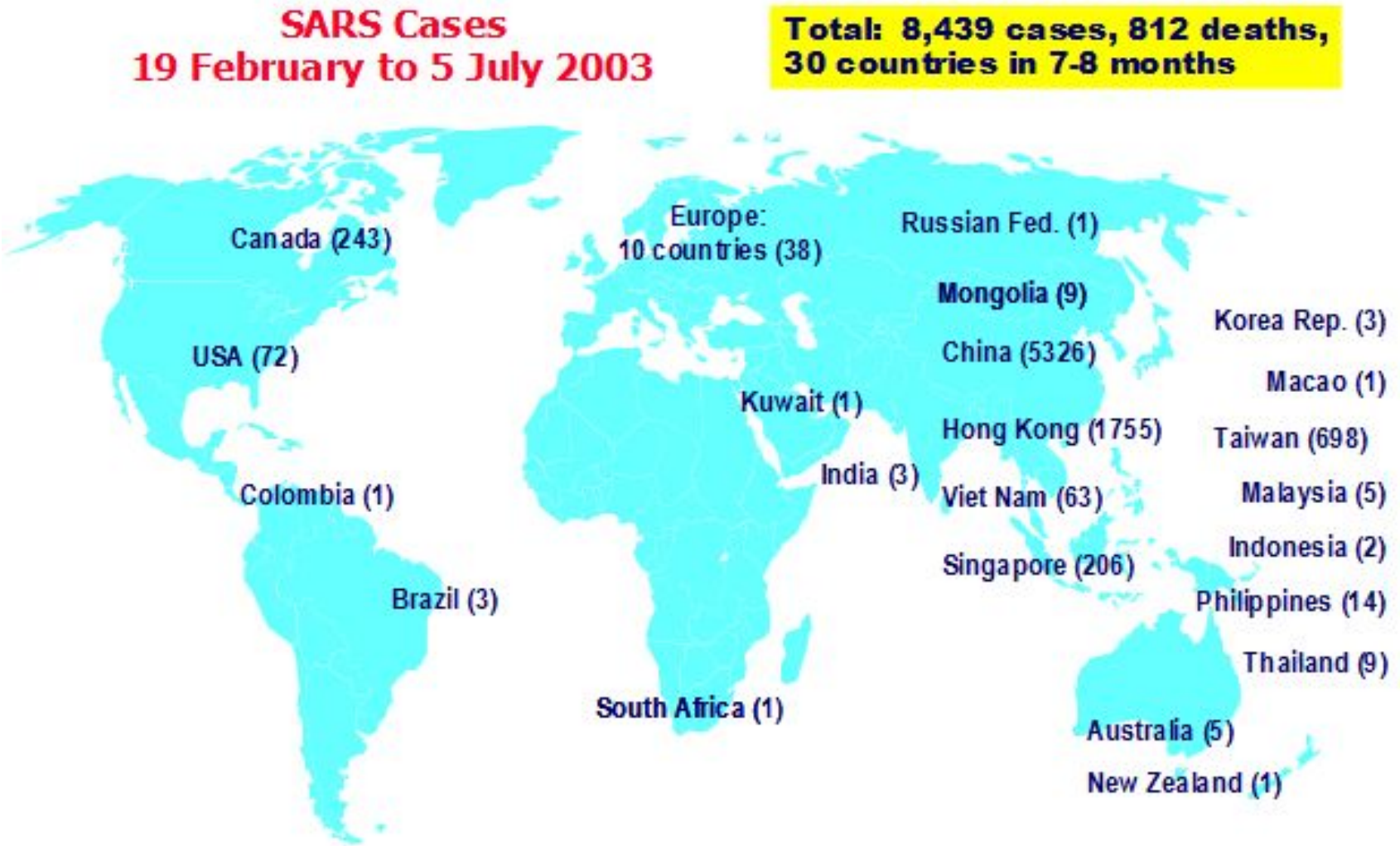
SARS: The First Emerging Infectious Disease Of The 21st Century

- Severe Acute Respiratory Syndrome (SARS) emerged in 2002/ 2003.
- First case was recognized in Hanoi, Vietnam in February 2003 in a businessman who had travelled from Guandong Province, China through Hong Kong.
- Cases reported from November 2002 to July 2003
- Origin – Guandong Province, China

SARS- Spread


North Pacific Ocean
North Atlantic Ocean
North Pacific Ocean
100%
10%
Indian Ocean
South Pacific Ocean
South Atlantic Ocean
Europe
United Kingdom
France
Spain
China
Japan
Taiwan
Philippines
Indonesia
South East Asia
Australia

SARS…



Source: www.who.int.csr/sars

SARS - Prevention

- Hand hygiene in both healthcare settings and the community
- Cough etiquette
- Protective barriers
- Good waste disposal

Dr Carlo Urbani (1956-2003)

- Italian microbiologist and expert on communicable diseases
- Worked for WHO in Vietnam was the first to identify SARS as an emerging infectious disease
- His work led to strengthening of global surveillance and preventive activities worldwide and ultimately to the control of the epidemic
- He died of SARS on 29th March 2003

Lesson learnt from SARS

- An infectious disease in one country is a threat to all
- Important role of air travel in international spread
- Tremendous negative economic impact on trade, travel and tourism, estimated loss of $ 30 to $150 billion
- High level commitment is crucial for rapid containment
- WHO can play a critical role in catalyzing international cooperation and support
- Global partnerships & rapid sharing of data/information enhances preparedness and response

Highly Pathogenic Avian Influenza (H5N1)

- First infected humans in 1997 in China
- Re-emerged in 2003-2004
- Since Nov 2003, avian influenza H5N1 in birds affected 60 countries across Asia, Europe, Middle-East & Africa
- >220 million birds killed by AI virus or culled to prevent further spread
- Majority of human H5N1 infection due to direct contact with birds infected with virus

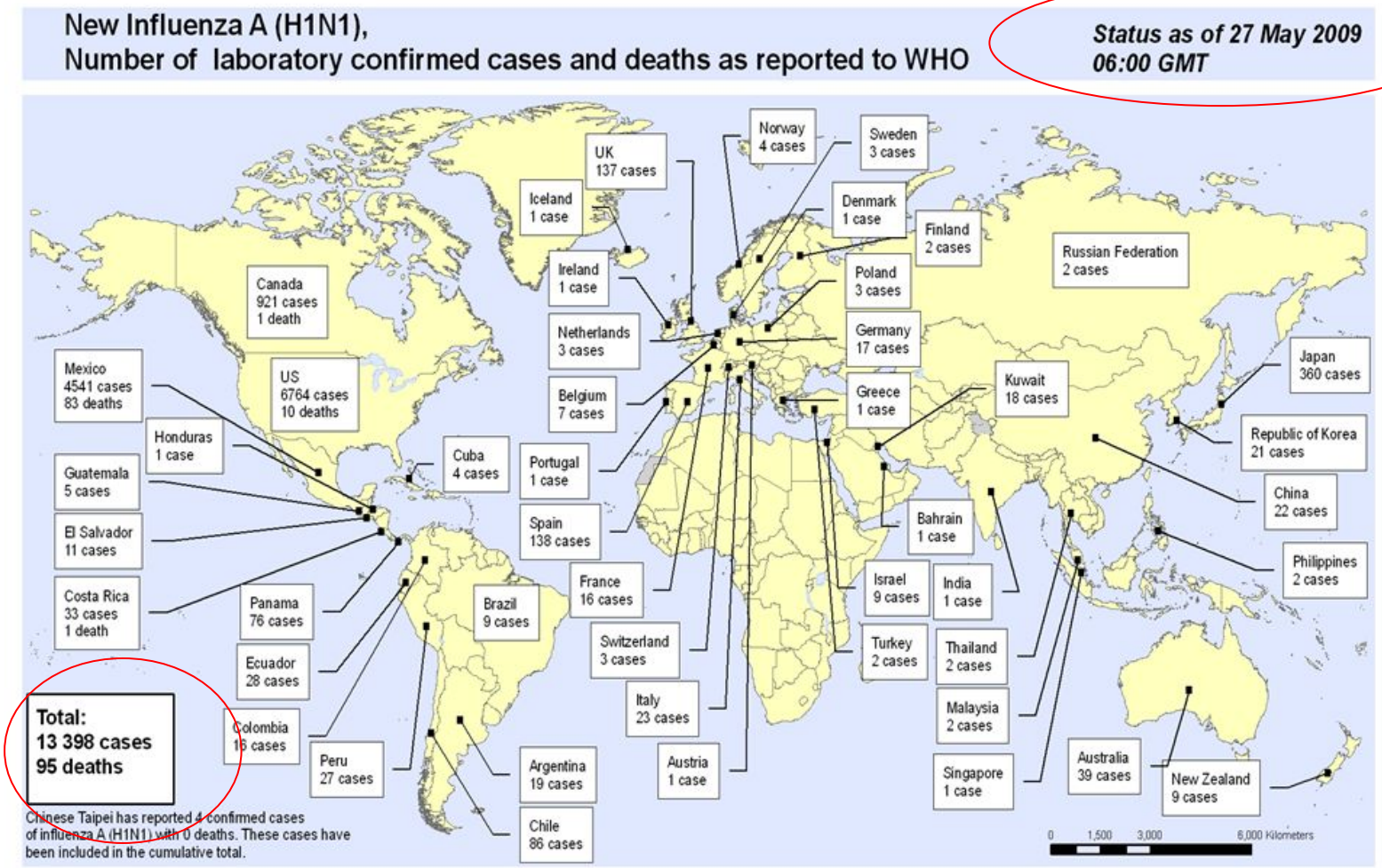
Novel Swine origin Influenza A (H1N1)

- Swine flu causes respiratory disease in pigs – high level of illness, low death rates
- Pigs can get infected by human, avian and swine influenza virus
- Occasional human swine infection reported
- In US from December 2005 to February 2009, 12 cases of human infection with swine flu reported
- Outbreak occurred in 2009 in Mexico & USA
- Spread across states in USA
- Cases also recorded in Canada, Germany, Spain and UK

Novel Swine origin Influenza A (H1N1)…

- April 15th CDC identifies H1N1 (swine flu)
- April 25th WHO declares public health emergency
- April 27th Pandemic alert raised to phase 4
- April 29th Pandemic alert raised to phase 5
- By May 5th more than 1000 cases confirmed in 21 countries
- Screening at airports for flu like symptoms (especially passengers coming from affected area)
- Schools closed in many states in USA
- May 16th India reports first confirmed case
- Stockpiling of antiviral drugs and preparations to make a new effective vaccine

Novel Swine origin Influenza A (H1N1)...



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Public Health Information and Geographic Information Systems (GIS)
World Health Organization

World Health Organization

Map produced: 27 May 2009 06:30 GMT

Novel Swine origin Influenza A (H1N1)…

Worldwide- 162,380 cases
1,154 deaths

India- 558 cases
1 death

Ebola Virus Disease (EVD)

- Acute serious illness with high fatality
- Two simultaneous outbreaks in 1976 – Sudan and Congo
- Emerged close to Ebola river in Congo
- Case fatality rate is around 50%. (varied from 25% to 90% in past outbreaks)
- Declared a 'Public Health Emergency of International Concern' in 2005
- First case notified in West Africa in March 2014
- Spread across the continent through air & land travel
- Spread to Guinea, Sierra Leone, Liberia, Nigeria, USA, Senegal & Mali

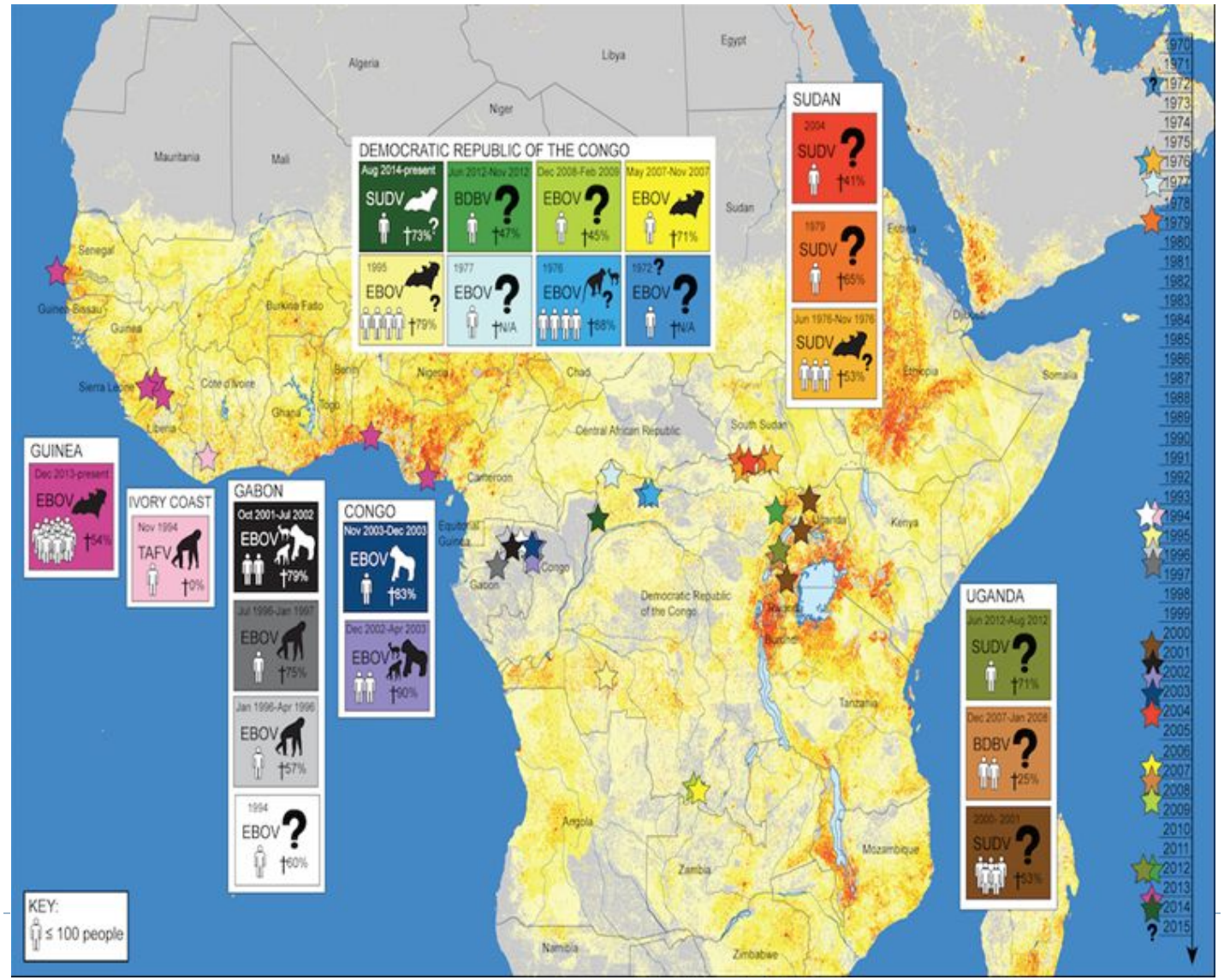
EVD - Recent outbreaks

World Health Organization | About us | Health topics | News | Countries

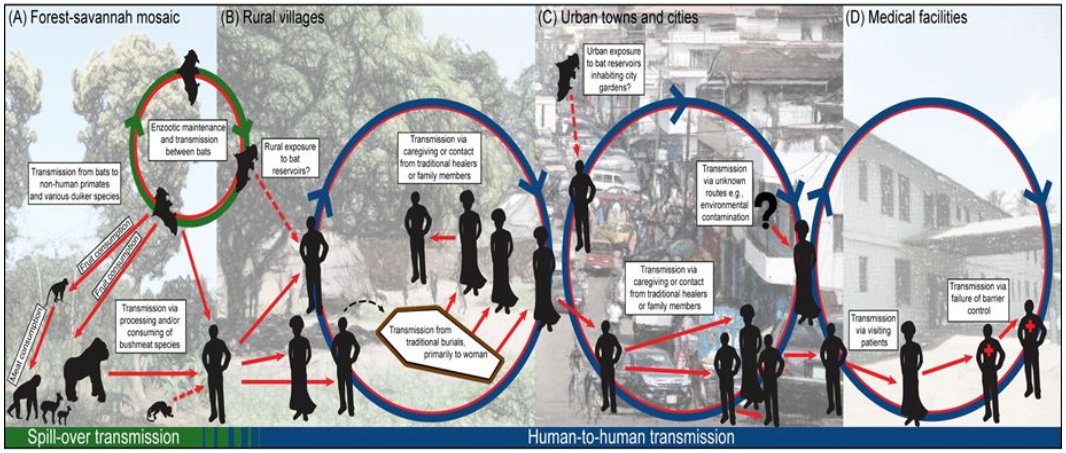
Table: Chronology of previous Ebola virus disease outbreaks

Year	Country	Ebolavirus species	Cases	Deaths	Case fatality
2015	Italy	Zaire	1	0	0%
2014	DRC	Zaire	66	49	74%
2014	Spain	Zaire	1	0	0%
2014	UK	Zaire	1	0	0%
2014	USA	Zaire	4	1	25%
2014	Senegal	Zaire	1	0	0%
2014	Mali	Zaire	8	6	75%
2014	Nigeria	Zaire	20	8	40%
2014-2016	Sierra Leone	Zaire	14124*	3956*	28%
2014-2016	Liberia	Zaire	10675*	4809*	45%
2014-2016	Guinea	Zaire	3811*	2543*	67%
2012	Democratic Republic of Congo	Bundibugyo	57	29	51%
2012	Uganda	Sudan	7	4	57%
2012	Uganda	Sudan	24	17	71%
2011	Uganda	Sudan	1	1	100%
2008	Democratic Republic of	Zaire	32	14	44%

EVD -Spread


Algeria
Libya
Egypt
Niger
Mauritania
Mali
Sudan
Senegal
Guinea-Bissau
Guinea
Burkina Faso
Sierra Leone
Côte d'Ivoire
Liberia
Ghana
Togo
Benin
Nigeria
Chad
Central African Republic
South Sudan
Cameroon
Equatorial Guinea
Gabon
Congo
Democratic Republic of the Congo
Kenya
Uganda
Tanzania
Angola
Zambia
Mozambique
Namibia
Zimbabwe
Ethiopia
Somalia
DEMOCRATIC REPUBLIC OF THE CONGO
Aug 2014-present SUDV †73%?
Jun 2012-Nov 2012 BDBV †47%
Dec 2008-Feb 2009 EBOV †45%
May 2007-Nov 2007 EBOV †71%
1995 EBOV †79%
1977 EBOV †N/A
1976 EBOV †68%
1972? EBOV †N/A
SUDAN
2004 SUDV †41%
1979 SUDV †65%
Jun 1976-Nov 1976 SUDV †53%
GUINEA
Dec 2013-present EBOV †54%
IVORY COAST
Nov 1994 TAFV †0%
GABON
Oct 2001-Jul 2002 EBOV †79%
Jul 1996-Jan 1997 EBOV †75%
Jan 1996-Apr 1996 EBOV †57%
1994 EBOV †60%
CONGO
Nov 2003-Dec 2003 EBOV †83%
Dec 2002-Apr 2003 EBOV †90%
UGANDA
Jun 2012-Aug 2012 SUDV †71%
Dec 2007-Jan 2008 BDBV †25%
2000- 2001 SUDV †53%
KEY:
≤ 100 people
1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

EVD -Transmission



- Natural hosts are fruit bats
- Human to human transmission through direct contact with blood, secretions, organs or other bodily fluids of infected people
- Contamination through surfaces and material (eg: bedding, clothing)
- No formal evidence of sexual transmission

EVD -Prevention

- Personal hygiene – hand washing following contact with body fluids
- Avoid handling items with possible contact with infected person
- Avoid funeral or burial rituals that require handling infected dead persons
- Avoid contact with bats or non-human primates or body fluids
- Avoid facilities where patients are treated
- Prevent sexual contact with a person recovered from EVD

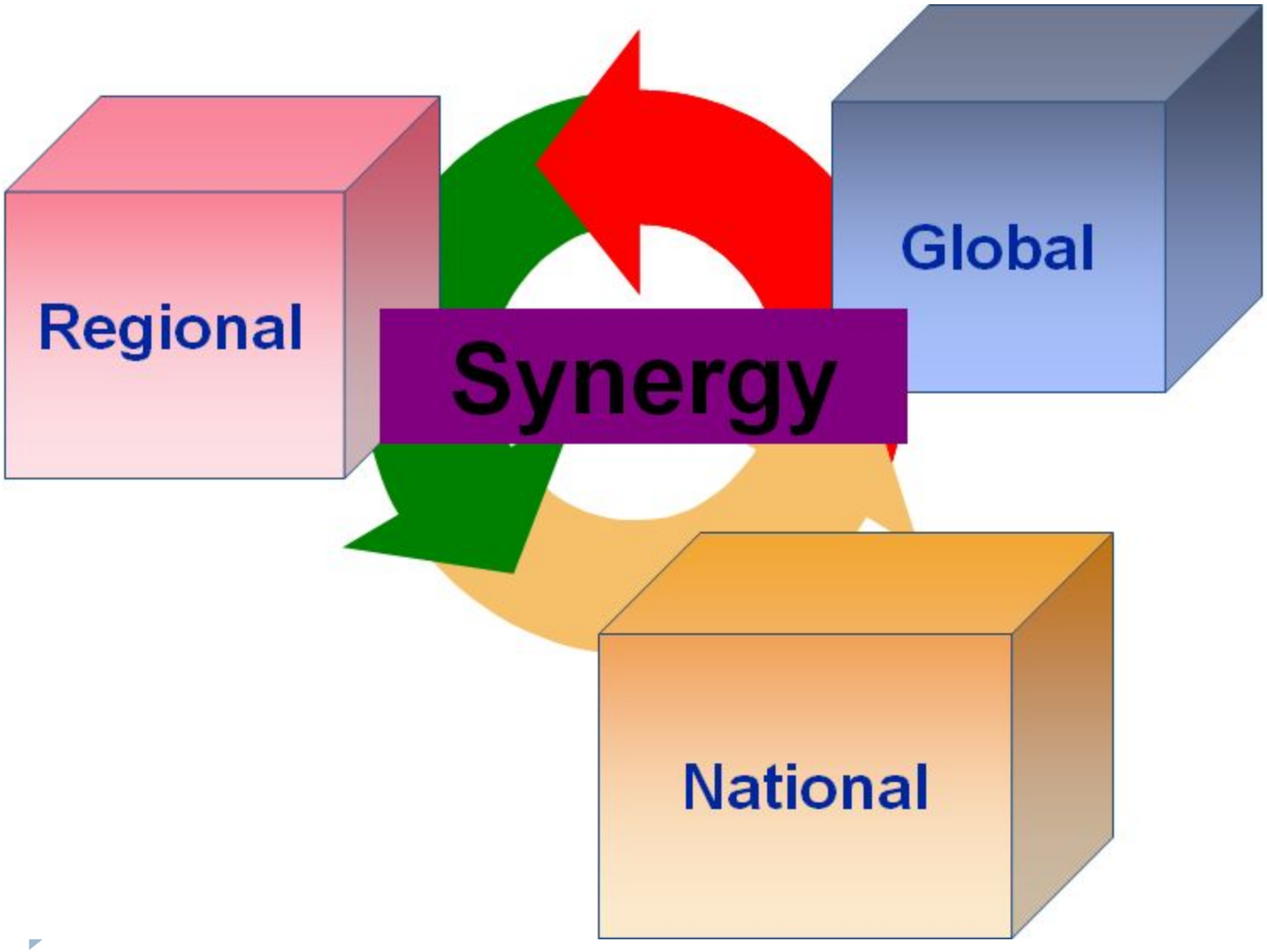
Others

- Hanta viral disease
  - Hantavirus pulmonary syndrome(HPS)
  - Haemorrhagic fever with renal syndrome
- Bovine Spongiform Encephalopathy (Mad Cow Disease) -1986 -UK
- vCJD (Transmissible Spongiform Encephalopathy (TSE))- Novel Prion disease - 1995

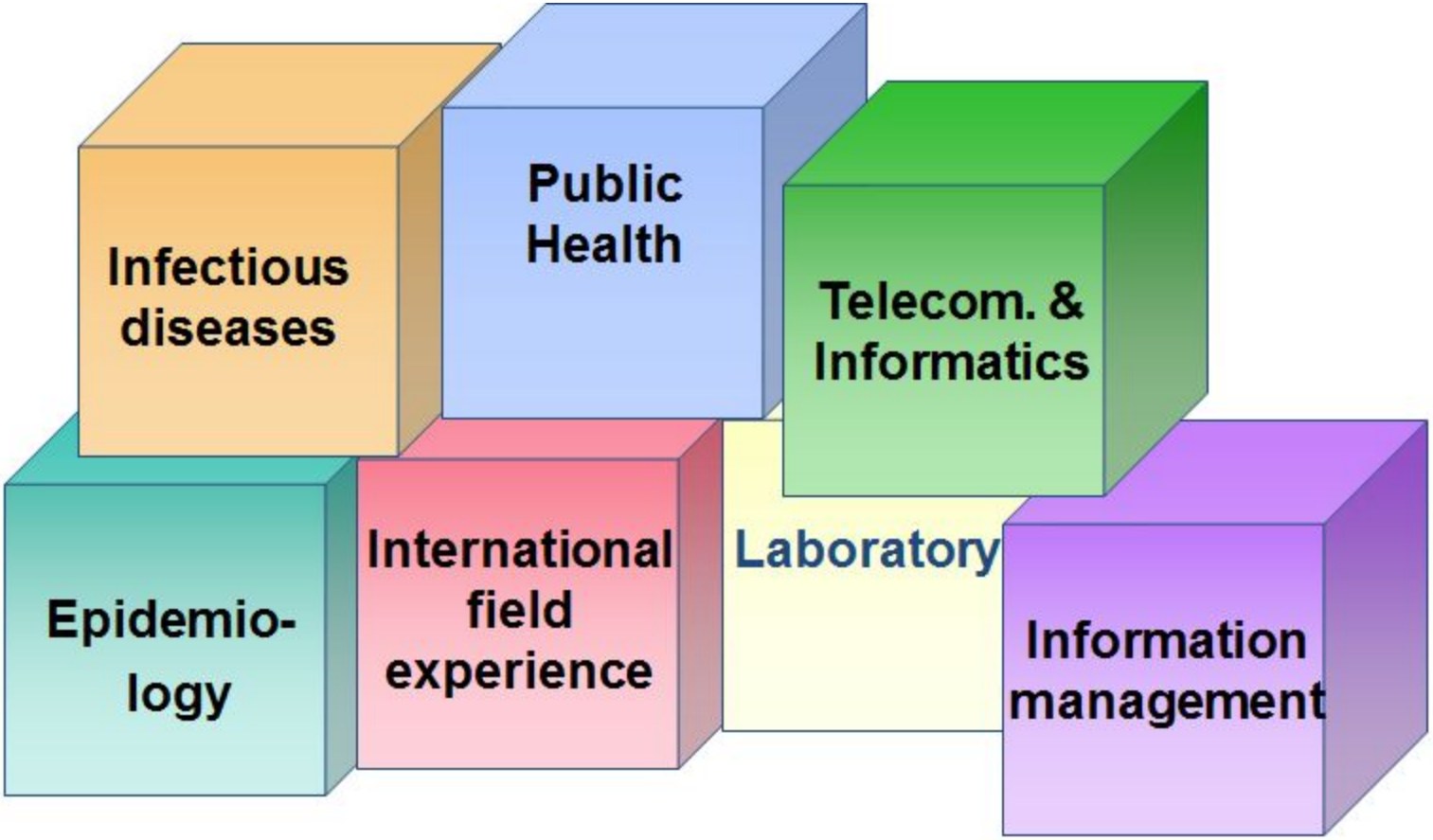
Sri Lanka??

- Leishmaniasis
  - First locally transmitted CL case reported in Ambalantota in 1992
  - First VL case reported in 2006 in Anuradhapura
  - Reported in clusters around Hambantota & Polonnaruwa district
  - 940 suspected cases of CL by end of 2011
    A notifiable Disease
- Risk factors
  - Socioeconomic conditions – poverty, poor housing
  - Malnutrition – vitamin A, Zinc and protein deficiency
  - Population mobility
  - Environmental change – urbanization
  - Climate change

Key tasks - carried out by whom?



What skills are needed?



Multiple expertise needed !

"Today's world is truly a global village – one can safely predict that infectious diseases will continue to emerge"

"Depending on the adequacy of our response and reactions to this threat, … the situation could lead to a catastrophic storm of microbial threats"

Thank you