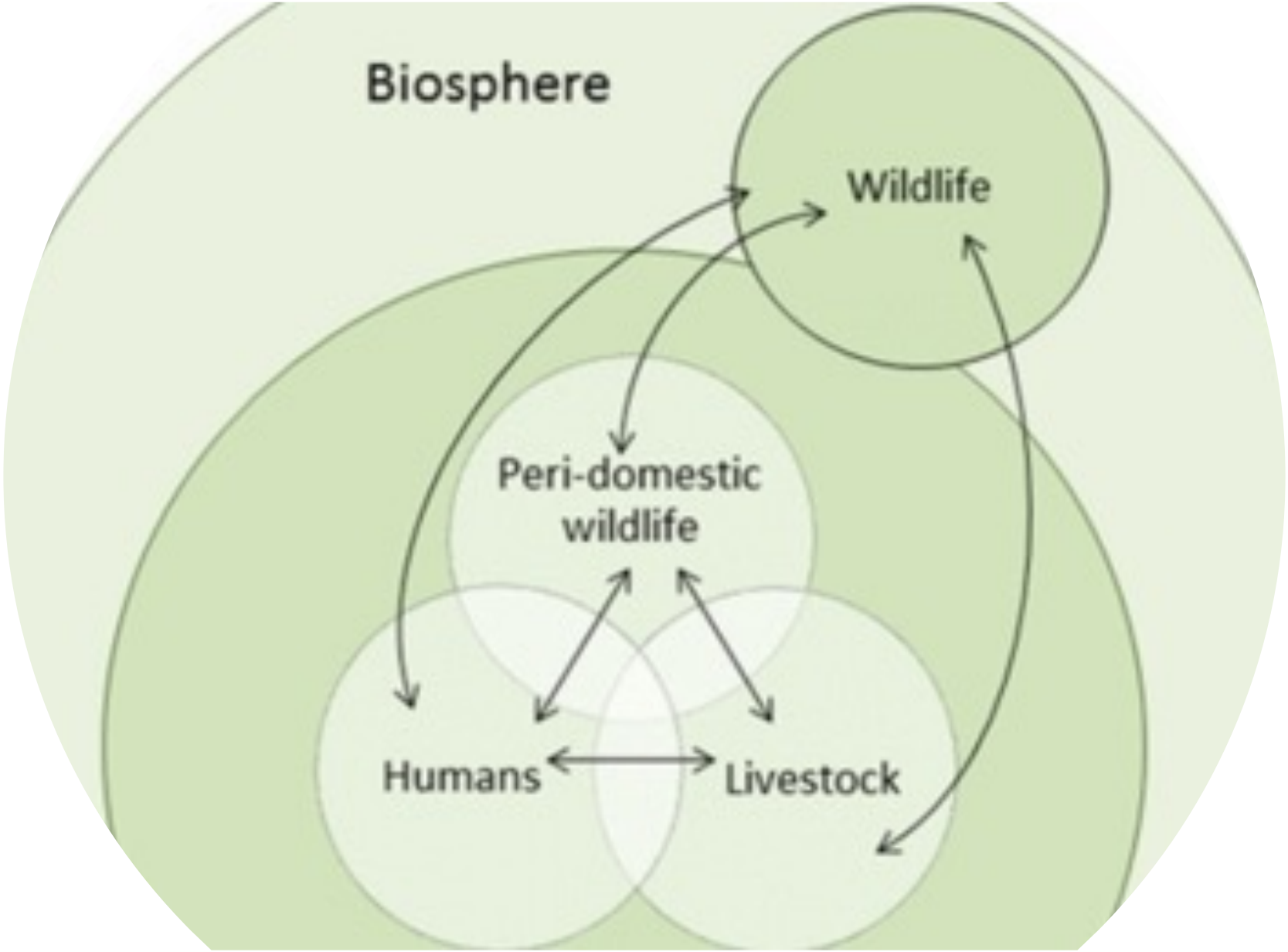
From One medicine to One Health

Alessandra Scagliarini
DIMES- Università di Bologna
Centro Studi internazionale sulla salute Unica

The outline

- Health in a shared ecosystem
- From one medicine to one health
- Global health challenges in anthropocene
- Climate change and health
- Sustainable development and health


Biosphere
Wildlife
Peri-domestic wildlife
Humans
Livestock

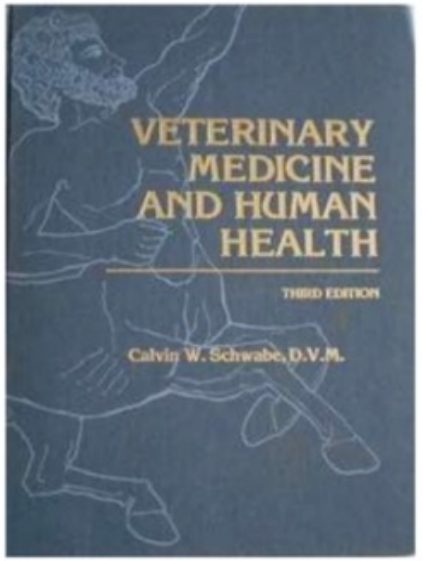

comparative-medicine
health-
global
veterinary-public
public-
health
medicine-medicine
health-veterinary
health-comparative
health-circular
circular-health
health-
planetary
medicine-
health-health
-
undefined
planetary-health
global-
health

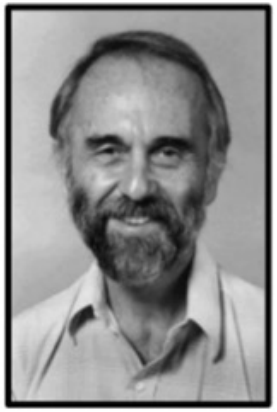
One Medicine

Rudolph Carl Virchow
(1821 – 1902)

"Between animal and human medicine there is no dividing line-nor should there be.

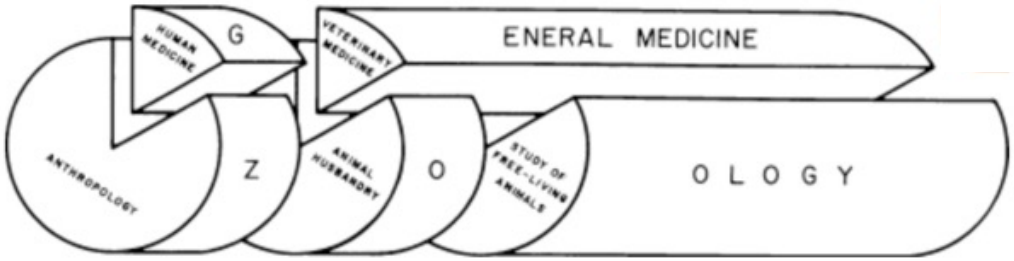
The object is different but the experience obtained constitutes the basis of all medicine."





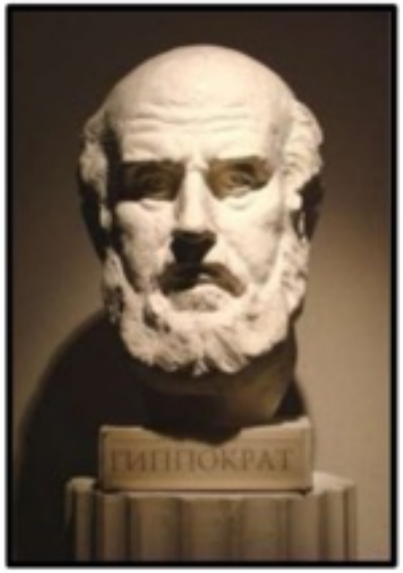
Calvin Schwabe, DVM

From One Medicine to One Health



Calvin Schwabe's "one medicine" as general medicine of humans, domestic and free-living animals (reproduced with permission from Schwabe, 1984).

One Health

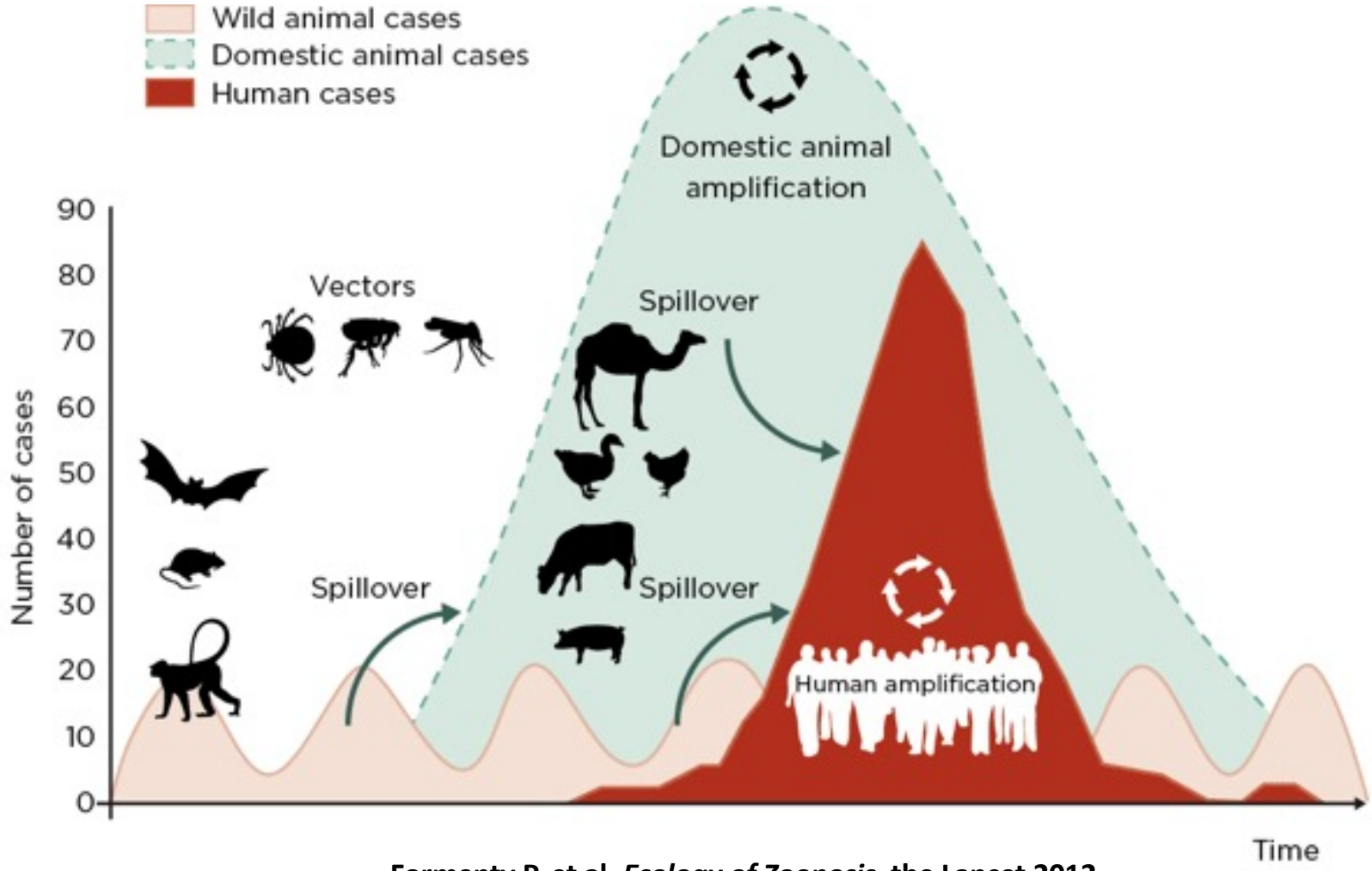


Hippocrates

The Greek physician Hippocrates (c. 460 BCE – c. 370 BCE) text *"On Airs, Waters, and Place"*.

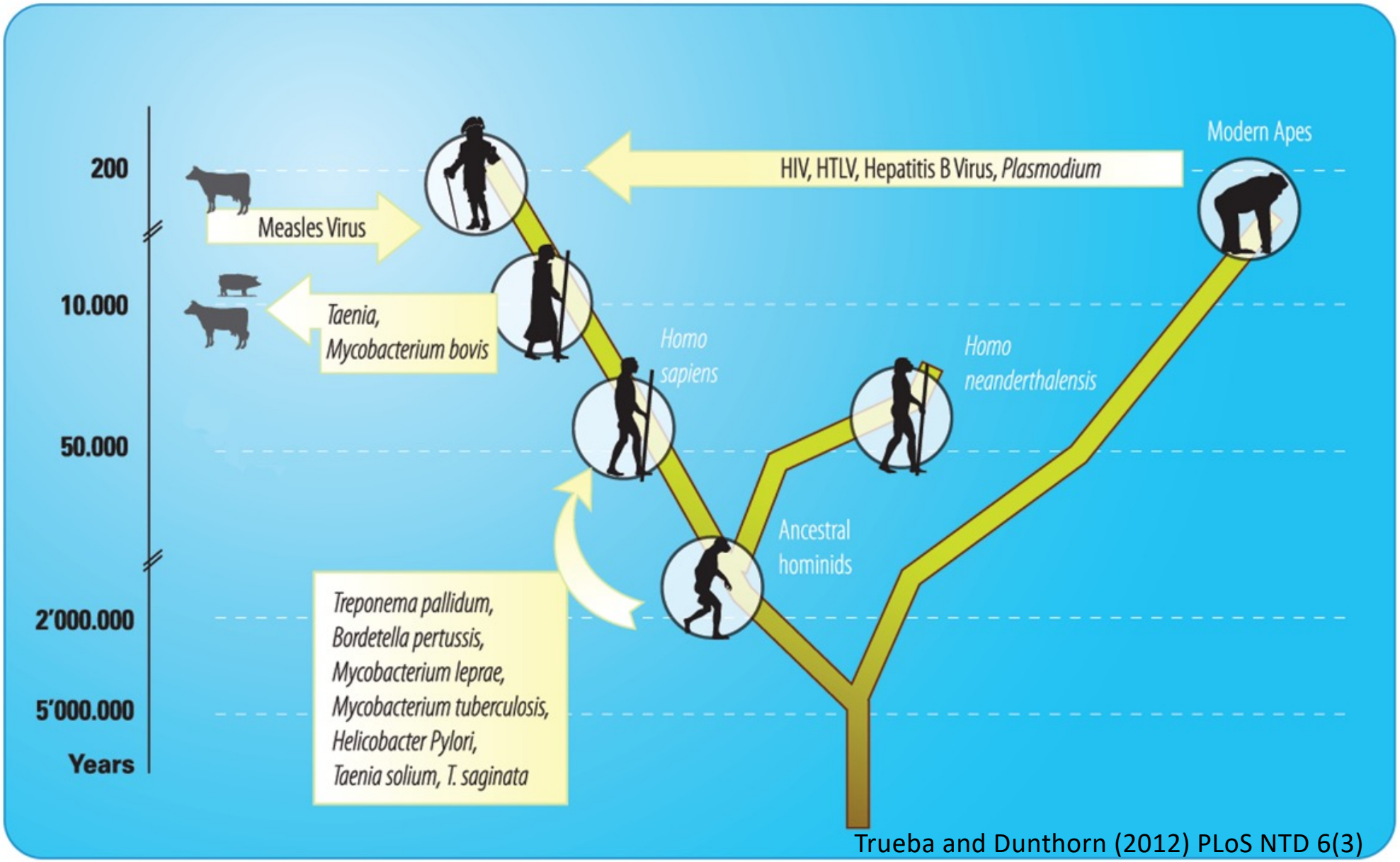
Promoted the concept that public health depended on a clean environment.

1. there are global and interspecies connections regarding health problems and concerns. "
2. a focus on the inclusive and shared determinants of health and a unifying theory
3. collaborative, multisectoral, and trans-disciplinary approach - working at local, regional, national, and global levels - to achieve optimal health and well-being outcomes

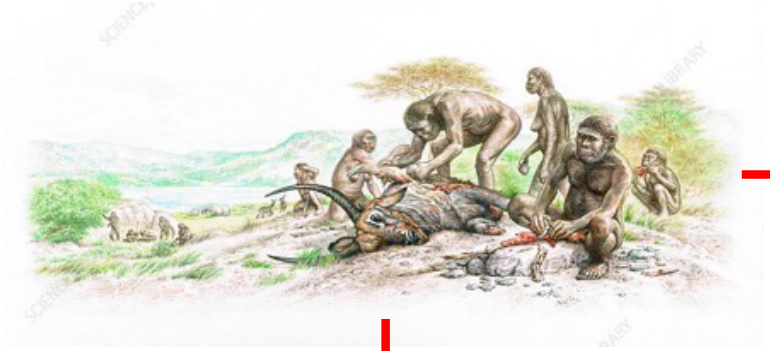


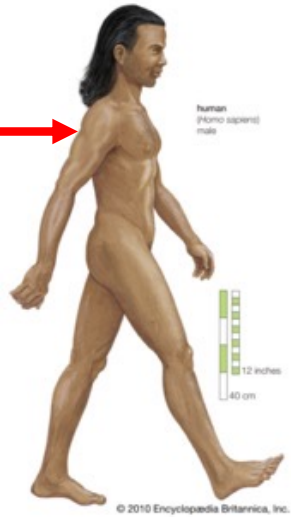
Formenty P. et al. *Ecology of Zoonosis*, the Lancet 2012

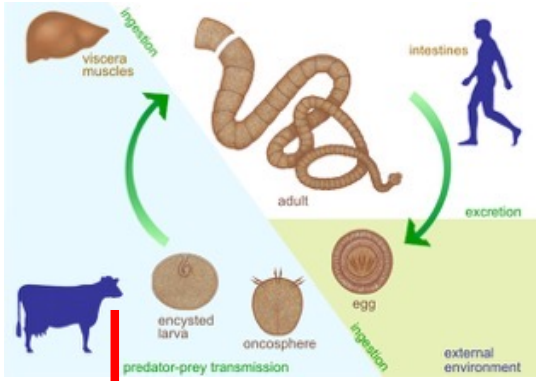
Paleolithic

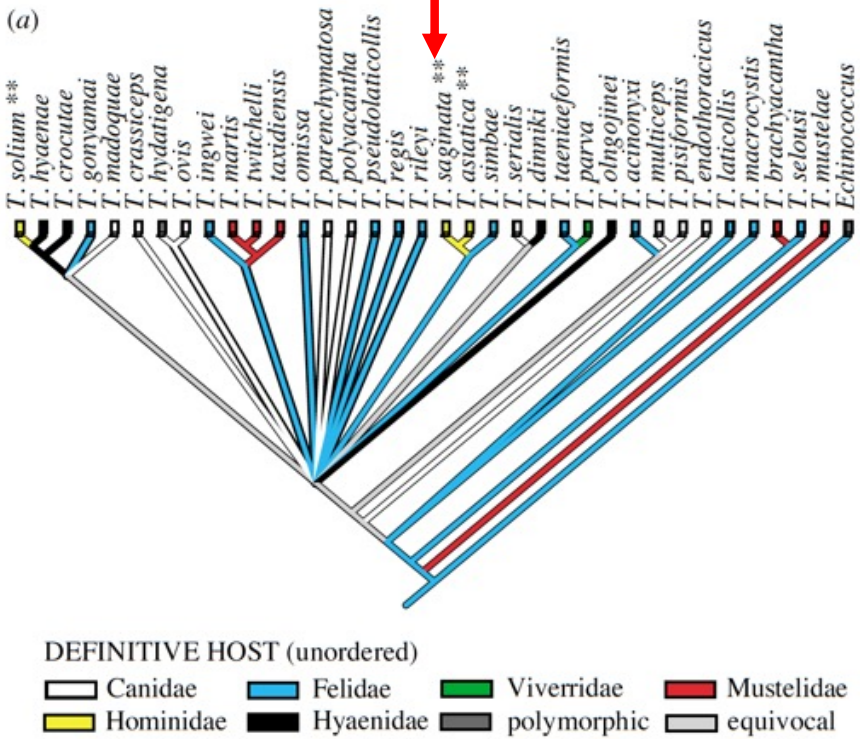


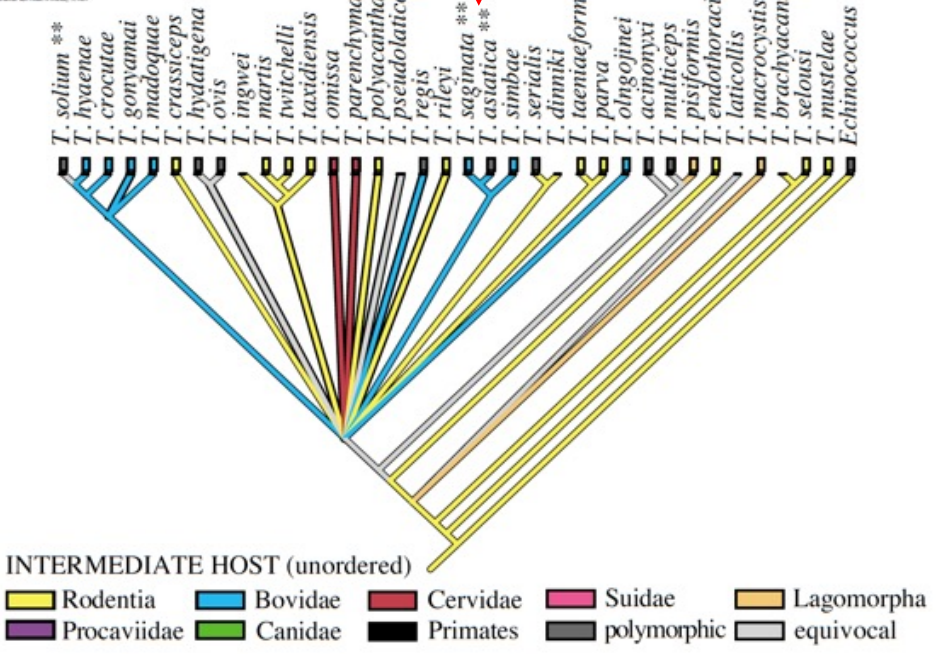
Trueba and Dunthorn (2012) PLoS NTD 6(3)

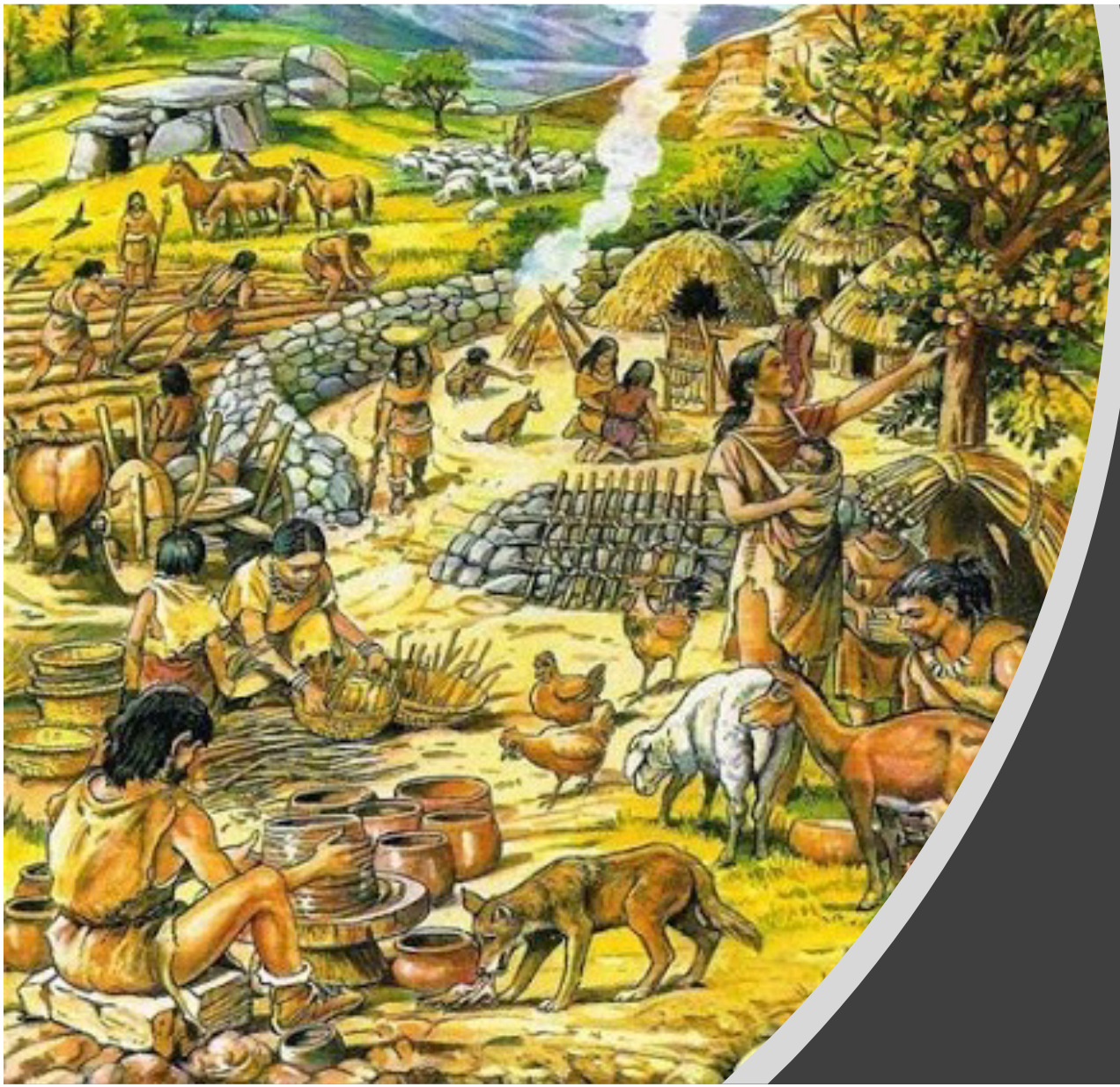



human
(Homo sapiens)
male
12 inches
40 cm
© 2010 Encyclopædia Britannica, Inc.


ingestion
viscera
muscles
intestines
adult
excretion
egg
encysted
larva
oncosphere
ingestion
external
environment
predator-prey transmission

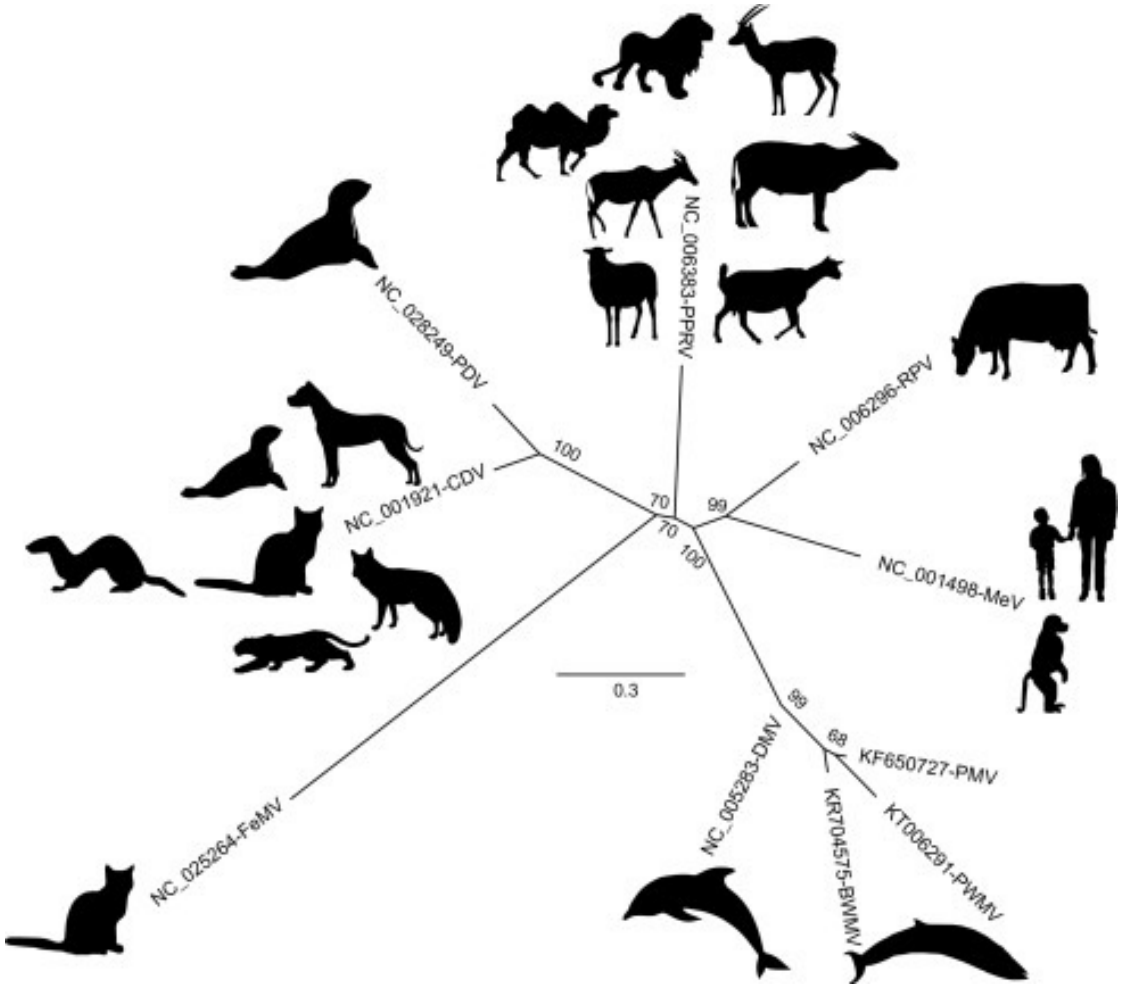

(a)
T. solium **
T. hyaenae
T. crocutae
T. gonyamai
T. madoquae
T. crassiceps
T. hydatigena
T. ovis
T. ingwei
T. martis
T. twitchelli
T. taxidiensis
T. omissa
T. parenchymatosa
T. polyacantha
T. pseudolaticollis
T. regis
T. rileyi
T. saginata **
T. asiatica **
T. simbae
T. serialis
T. dinniki
T. taeniaeformis
T. parva
T. olngojinei
T. acinonyxi
T. multiceps
T. pisiformis
T. endothoracicus
T. laticollis
T. macrocystis
T. brachyacantha
T. selousi
T. mustelae
Echinococcus
DEFINITIVE HOST (unordered)
Canidae
Felidae
Viverridae
Mustelidae
Hominidae
Hyaenidae
polymorphic
equivocal

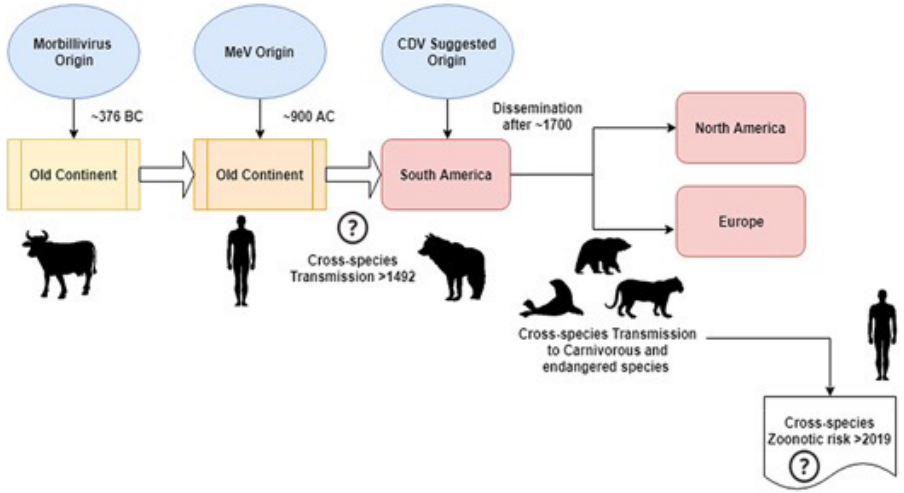

T. solium **
T. hyaenae
T. crocutae
T. gonyamai
T. madoquae
T. crassiceps
T. hydatigena
T. ovis
T. ingwei
T. martis
T. twitchelli
T. taxidiensis
T. omissa
T. parenchymatosa
T. polyacantha
T. pseudolaticollis
T. regis
T. rileyi
T. saginata **
T. asiatica **
T. simbae
T. serialis
T. dinniki
T. taeniaeformis
T. parva
T. olngojinei
T. acinonyxi
T. multiceps
T. pisiformis
T. endothoracicus
T. laticollis
T. macrocystis
T. brachyacantha
T. selousi
T. mustelae
Echinococcus
INTERMEDIATE HOST (unordered)
Rodentia
Bovidae
Cervidae
Suidae
Lagomorpha
Procaviidae
Canidae
Primates
polymorphic
equivocal



Neolithic

Zoonosis

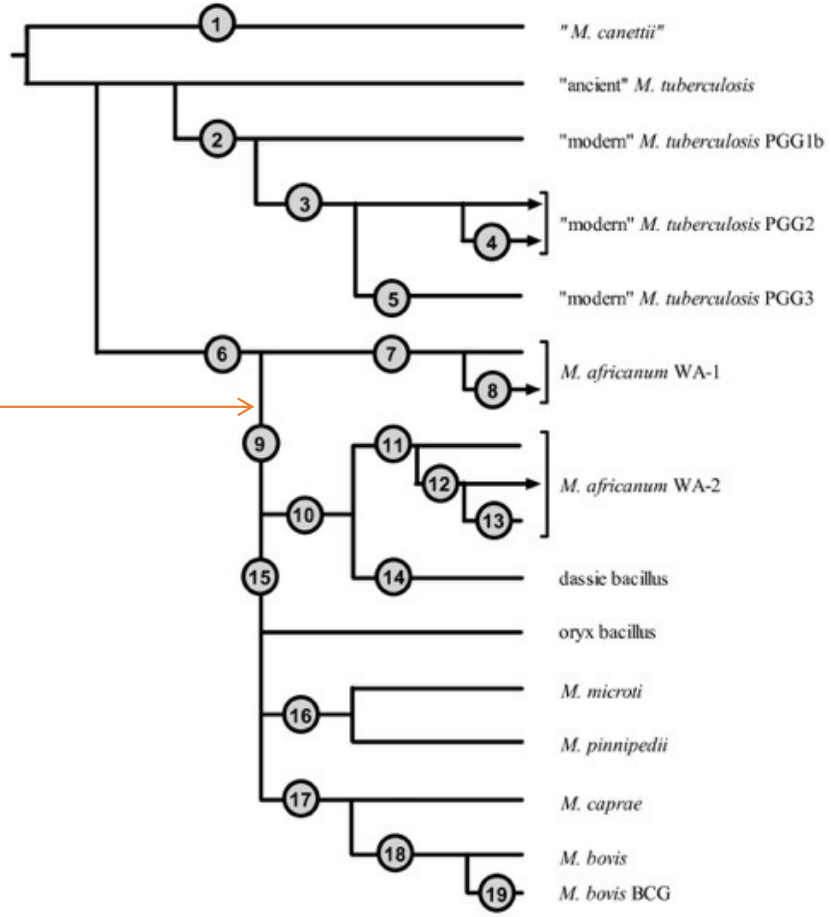


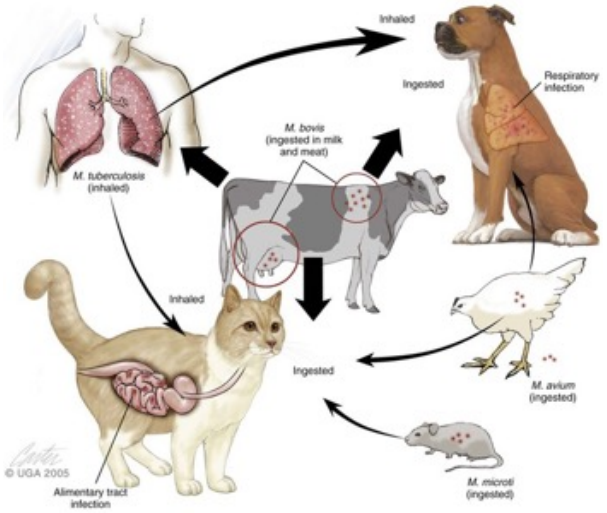


Quintero-Gil C. et al 2019 Front. Microbiol
doi: 10.3389/fmicb.2019.01982

Reverse zoonosis

10.000 anni fa





Many of the agents of these diseases have since adapted to the human species and now recognise humans as their only host

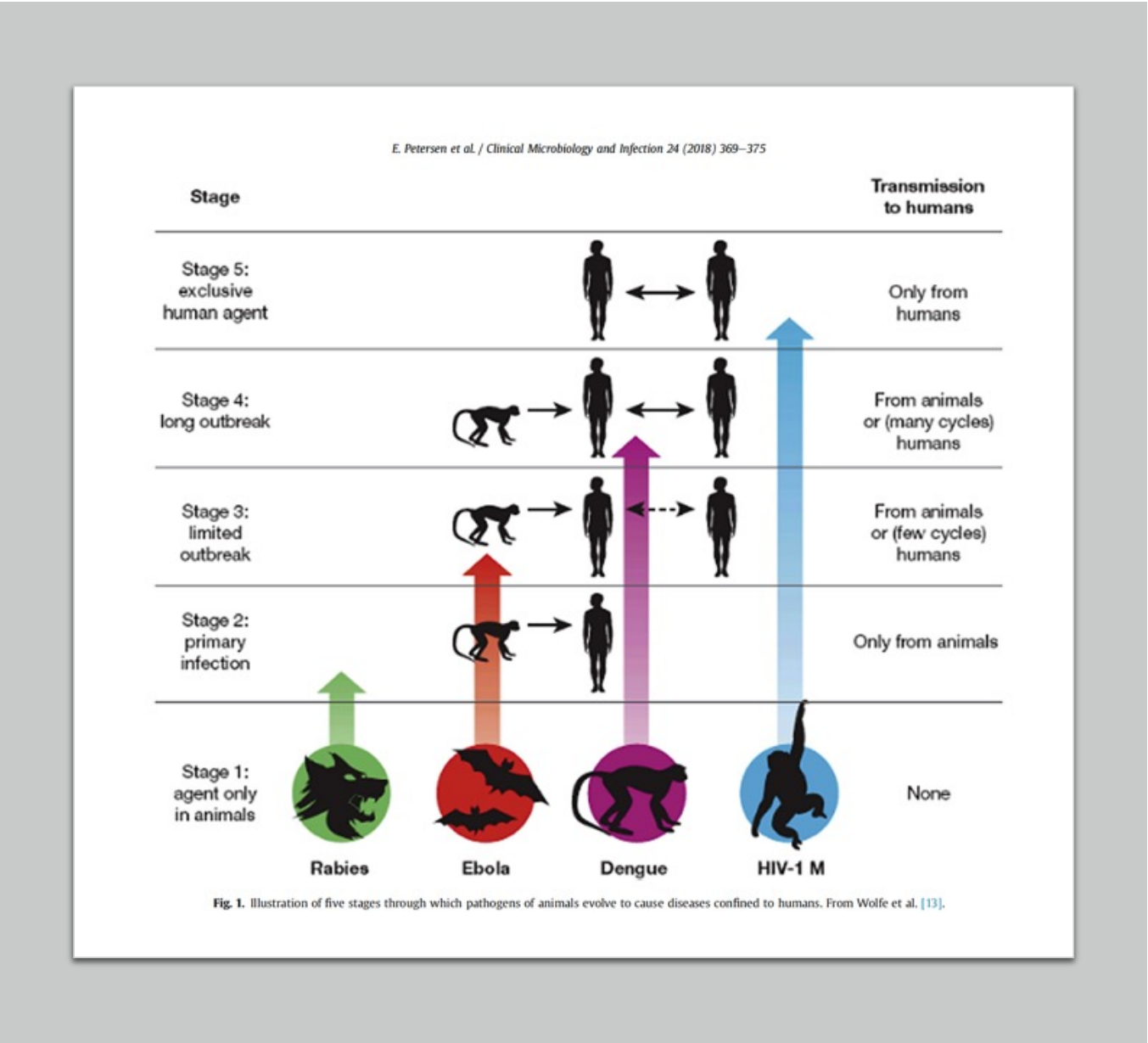
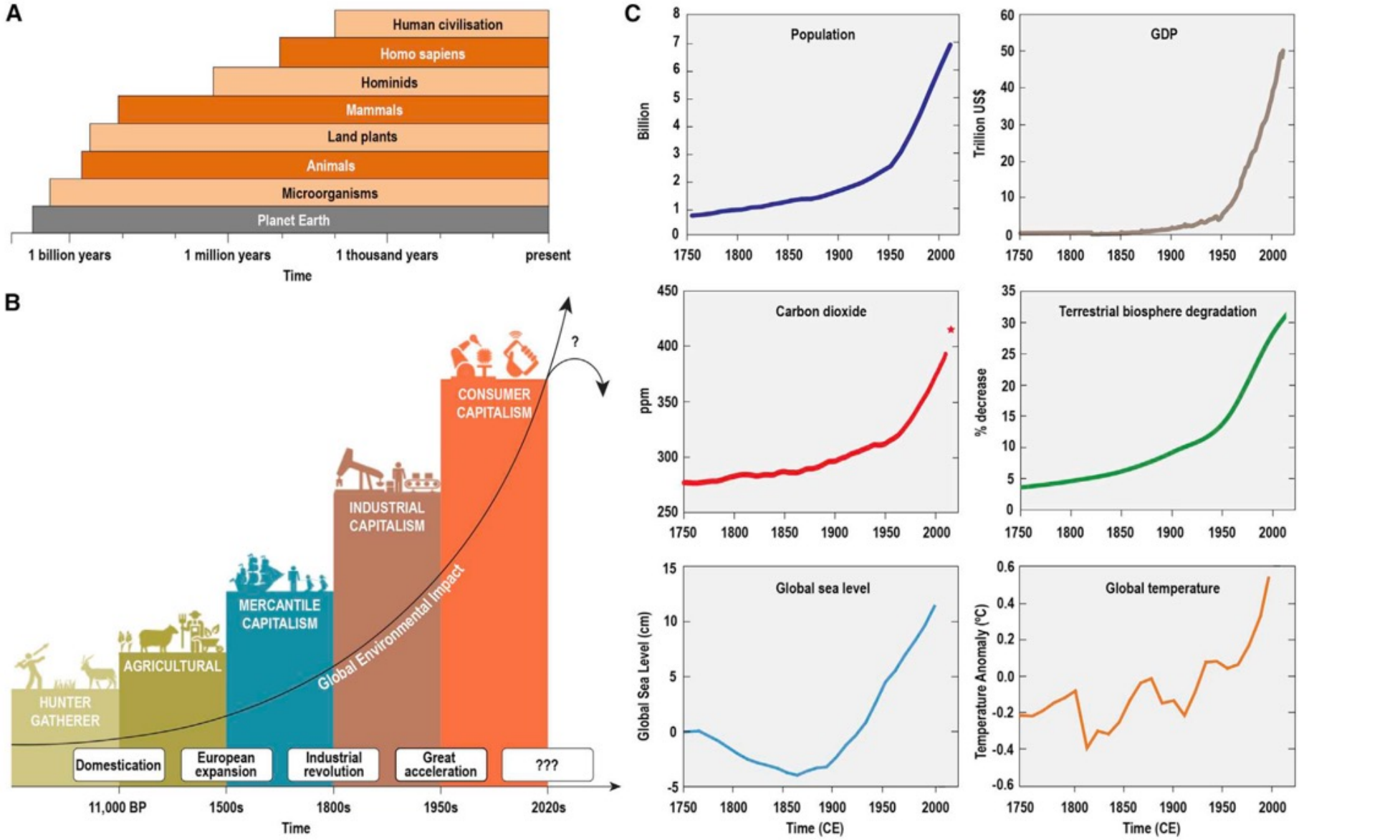
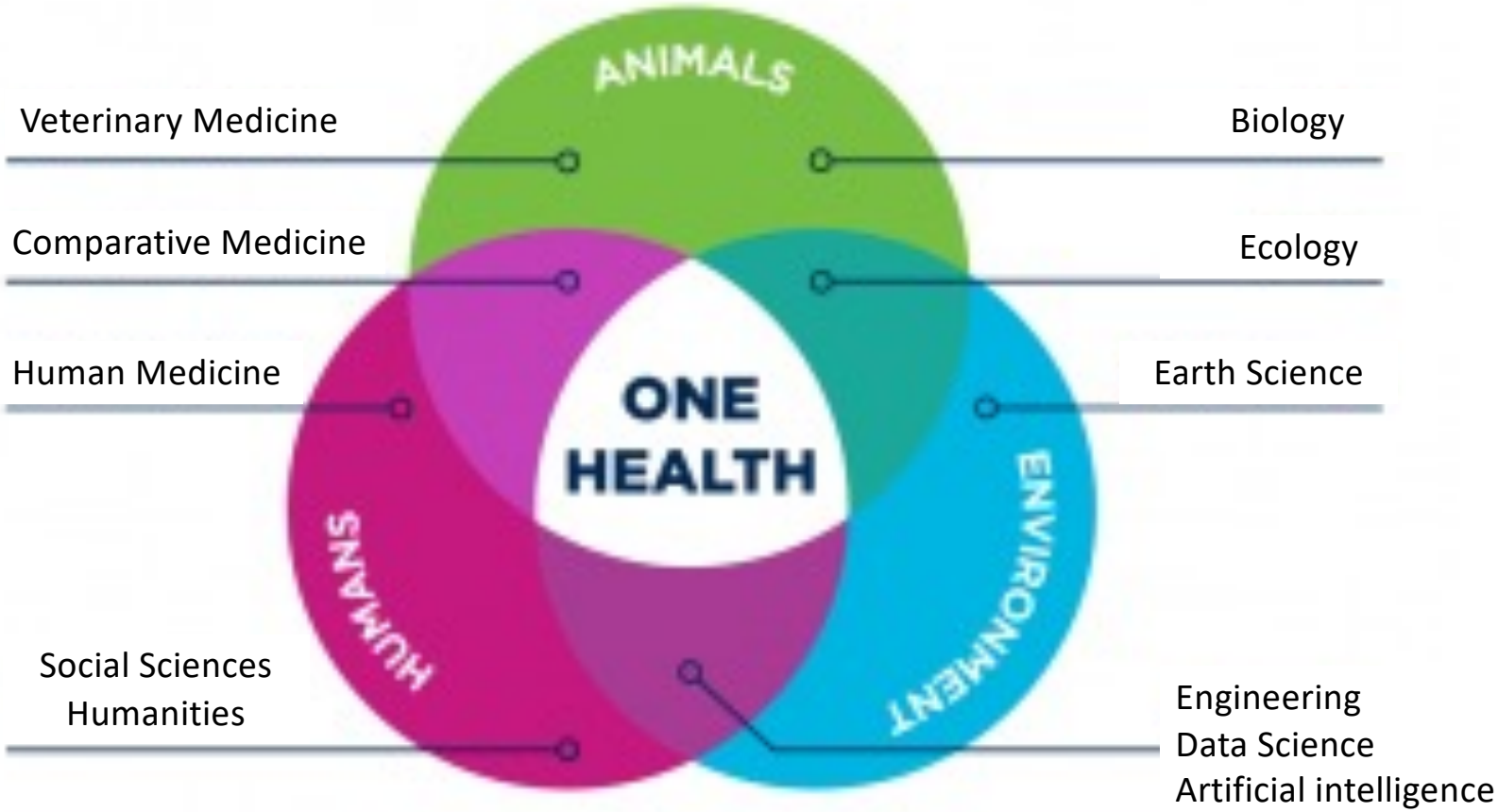


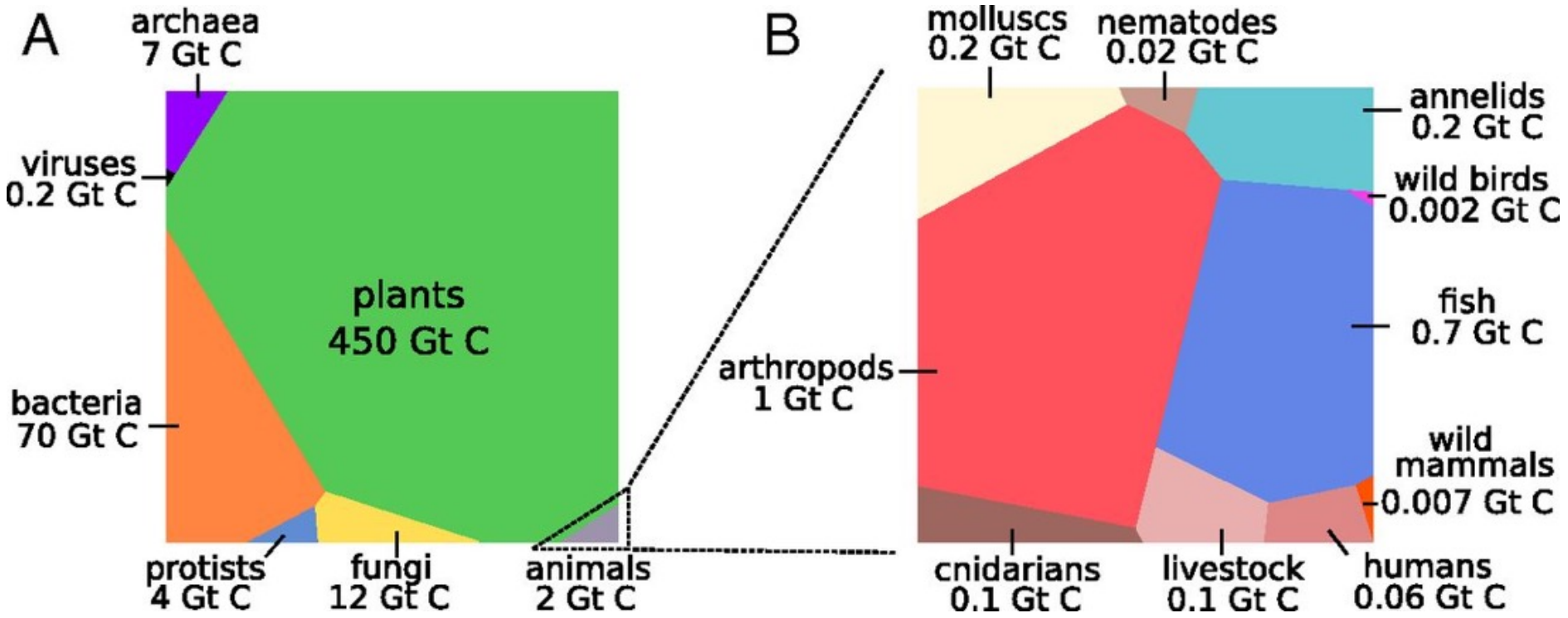
Fig. 1. Illustration of five stages through which pathogens of animals evolve to cause diseases confined to humans. From Wolfe et al. [13].


A
Human civilisation
Homo sapiens
Hominids
Mammals
Land plants
Animals
Microorganisms
Planet Earth
1 billion years
1 million years
1 thousand years
present
Time
B
HUNTER GATHERER
AGRICULTURAL
MERCANTILE CAPITALISM
INDUSTRIAL CAPITALISM
CONSUMER CAPITALISM
?
Global Environmental Impact
Domestication
European expansion
Industrial revolution
Great acceleration
???
11,000 BP
1500s
1800s
1950s
2020s
Time
C
Population
Billion
GDP
Trillion US$
Carbon dioxide
ppm
Terrestrial biosphere degradation
% decrease
Global sea level
Global Sea Level (cm)
Global temperature
Temperature Anomaly (°C)
1750
1800
1850
1900
1950
2000
Time (CE)


A
N
T
H
R
O
P
O
C
E
N
E

Global Change Syndromes





Bar-On et al PNAS 2018

Human biomass 0.06 GtC

Wild mammals biomass0.007 GtC

Livestock biomass0.1 GtC

Bar-On et al 2018

0.05 GtC

0.02 GtC


Microorganisms

60% of existing human infectious diseases are zoonotic

At least 75% of emerging infect diseases of humar (including Ebola, and influenza) have an animal or

ZOONOSICENE?

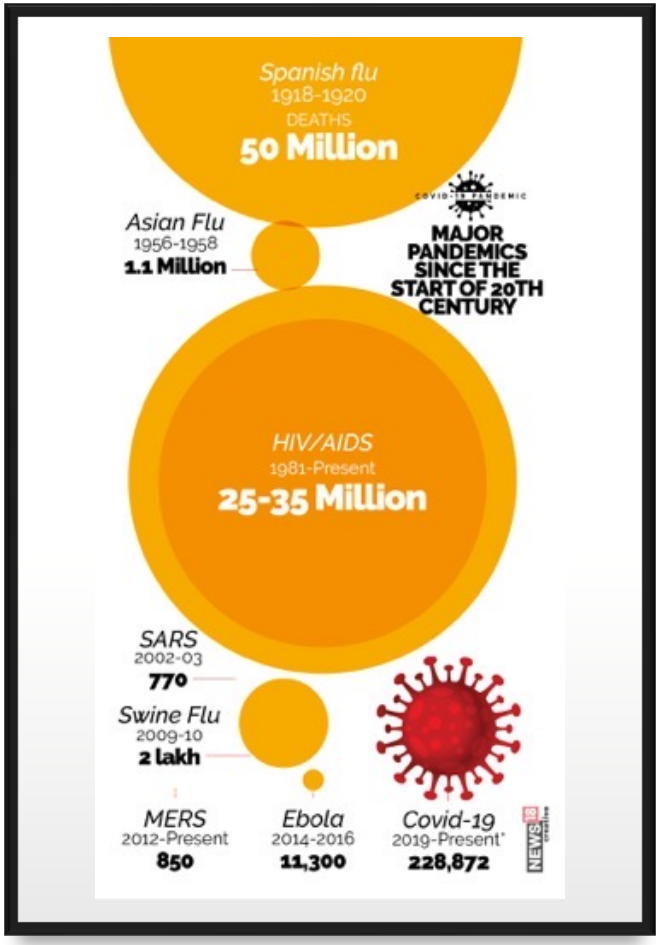
5 new human diseases appear every year. Three are of animal origin

80% of agents with potential bioterro use are zoonotic pathogens

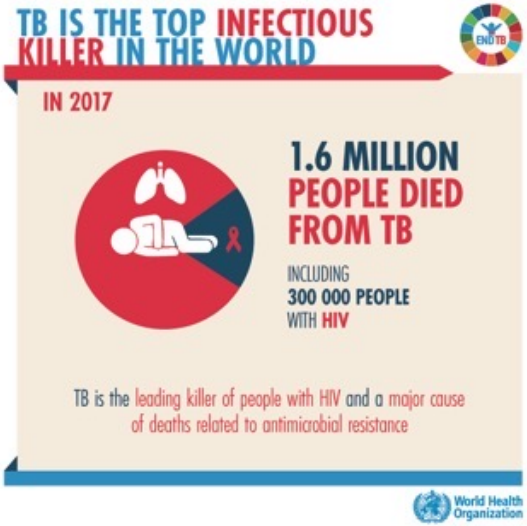
The post-infectious era

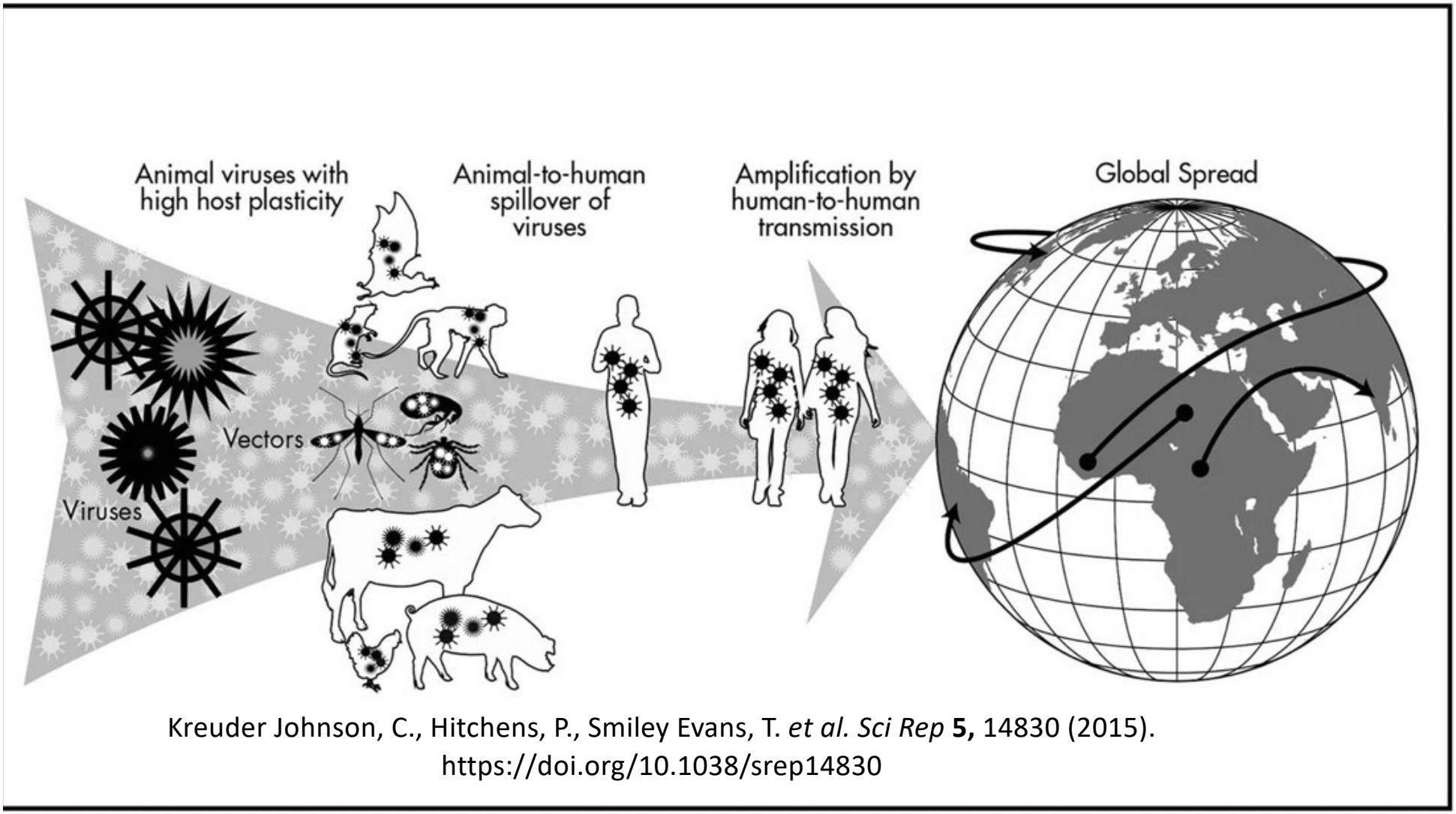
EIDs and re-EIDs

- the invasion of virgin territories
- close contact between humans and wildlife removed from its natural ecosystems
- the destruction or disappearance of natural barriers

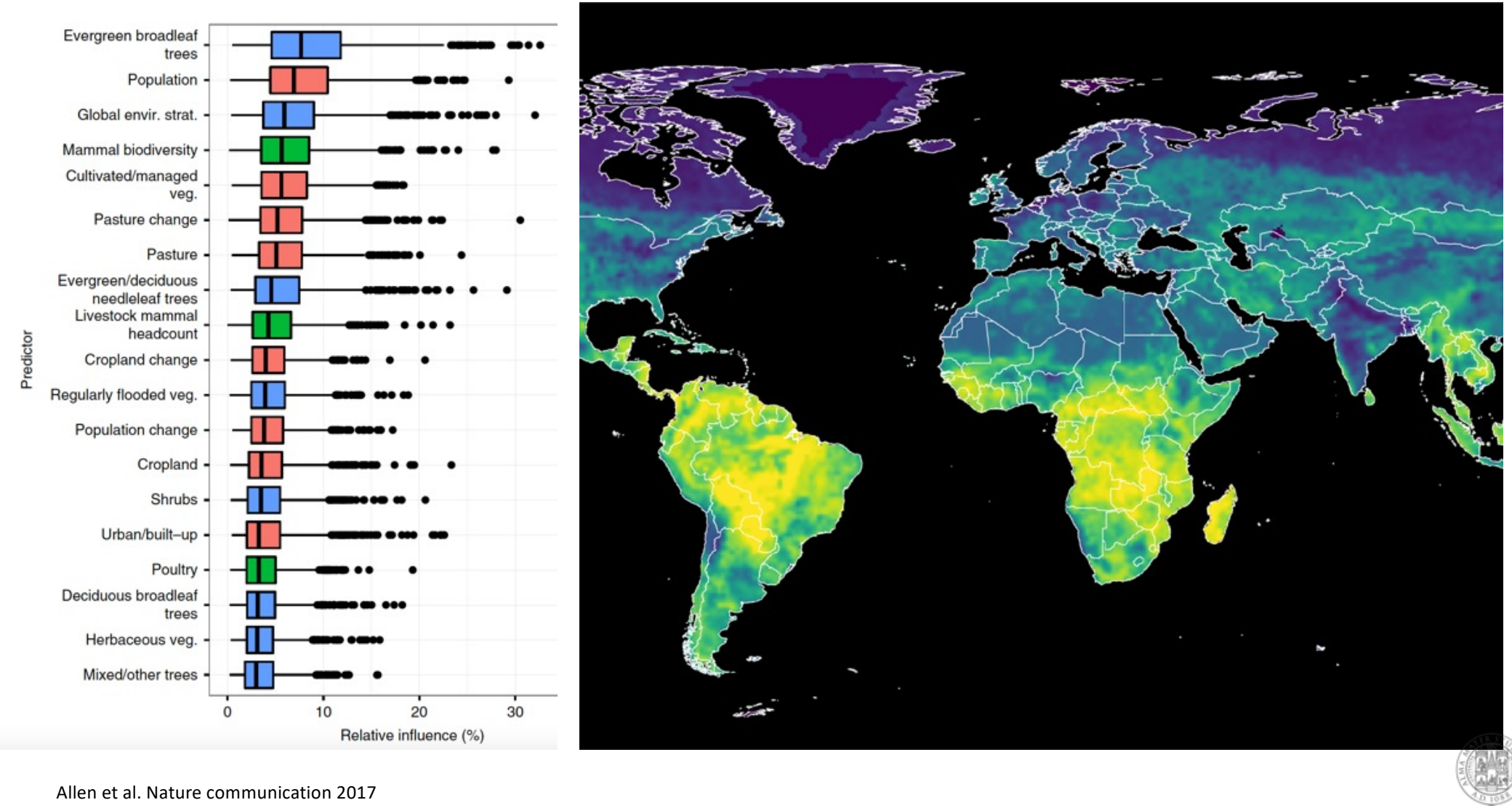

Spanish flu
1918-1920
DEATHS
50 Million
Asian Flu
1956-1958
1.1 Million
MAJOR PANDEMICS SINCE THE START OF 20TH CENTURY
HIV/AIDS
1981-Present
25-35 Million
SARS
2002-03
770
Swine Flu
2009-10
2 lakh
MERS
2012-Present
850
Ebola
2014-2016
11,300
Covid-19
2019-Present*
228,872


Rabies occurs in more than
150 countries and territories
It is the #1 killer among all zoonotic diseases— diseases spread from animals to humans
More than 59,000 deaths a year— more than 95% in Asia & Africa
Almost 50% of rabies deaths are among children under the age of 15
CDC

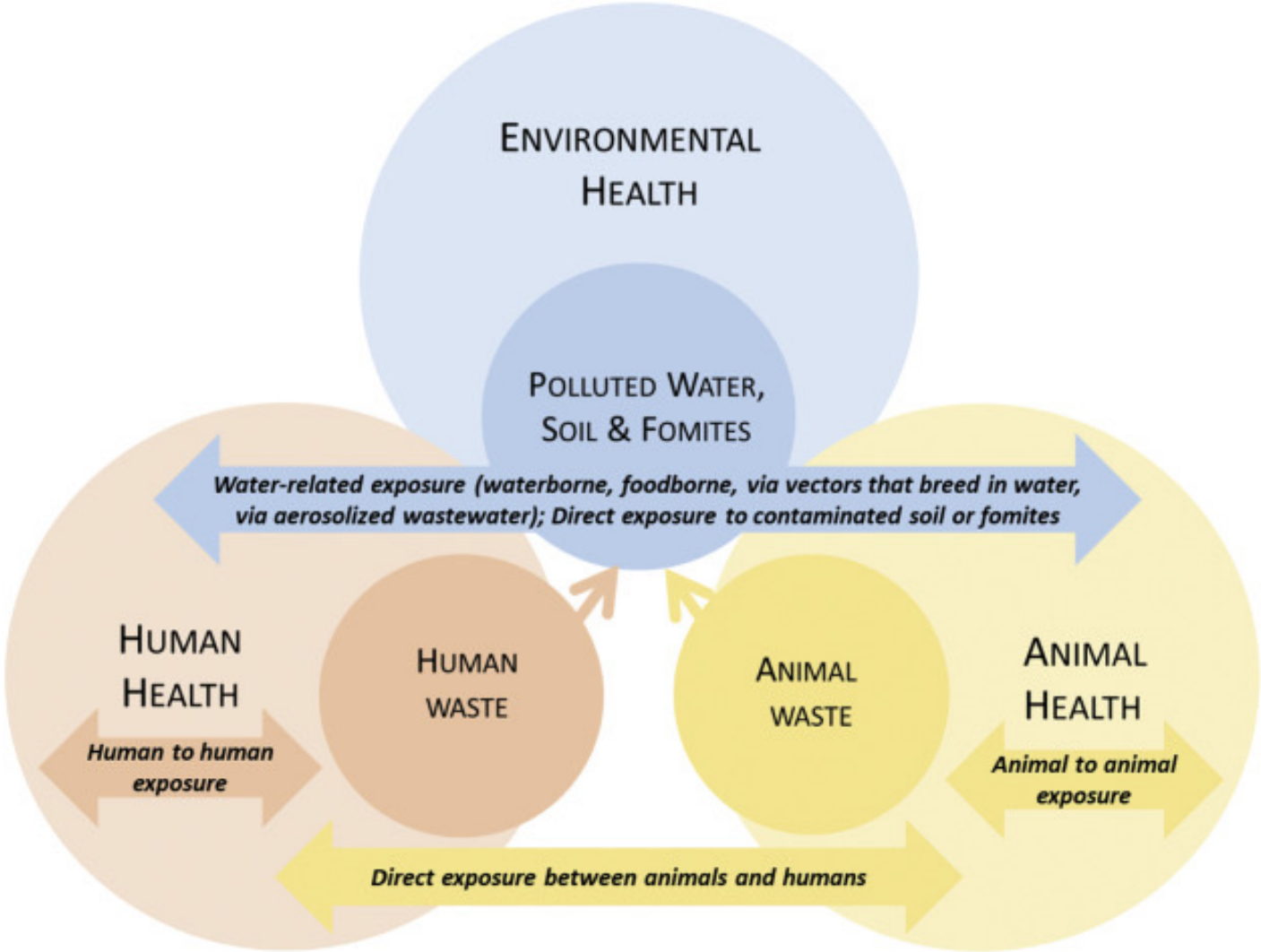

TB IS THE TOP INFECTIOUS KILLER IN THE WORLD
END TB
IN 2017
1.6 MILLION PEOPLE DIED FROM TB
INCLUDING 300 000 PEOPLE WITH HIV
TB is the leading killer of people with HIV and a major cause of deaths related to antimicrobial resistance
World Health Organization

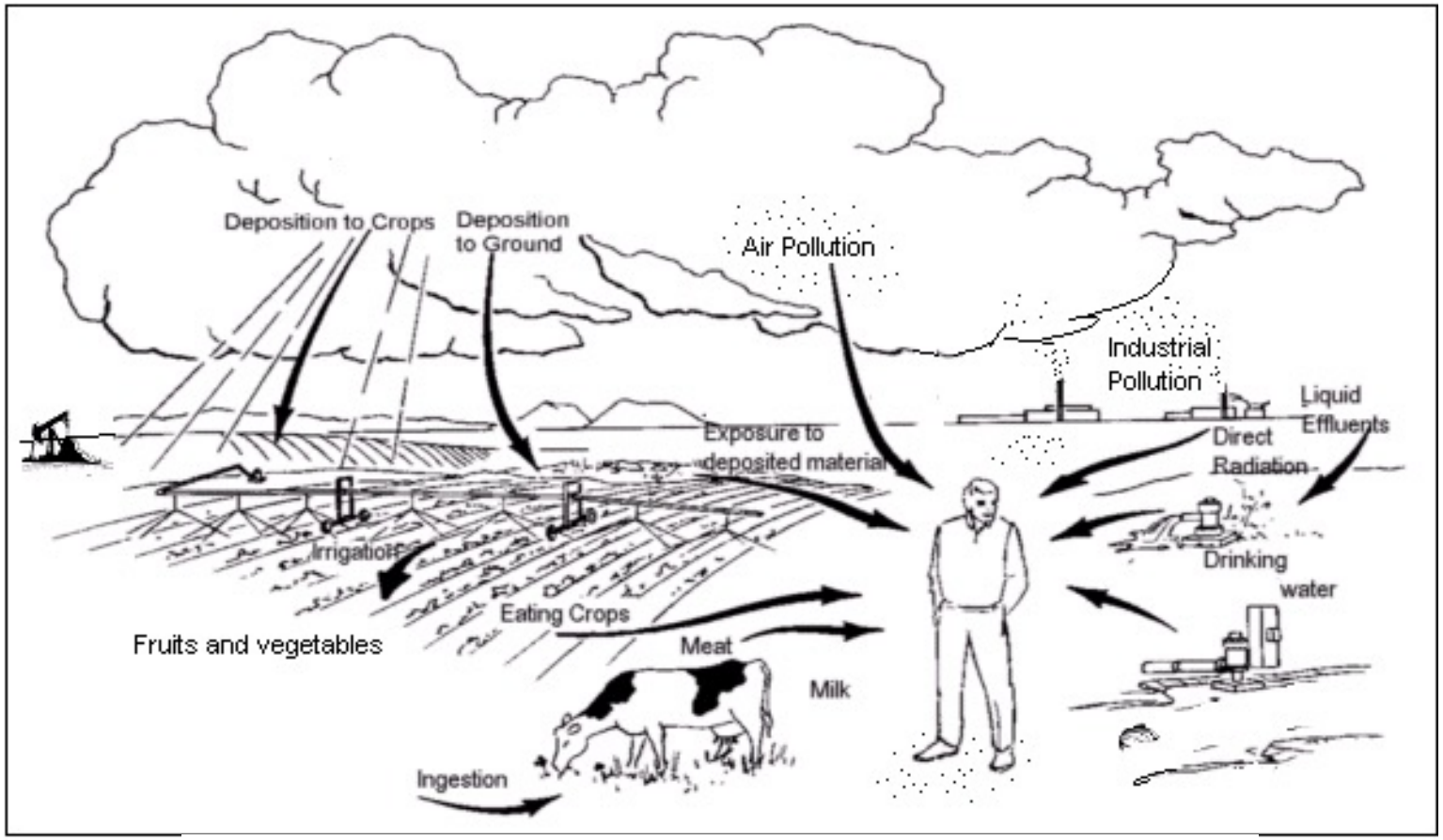


Kreuder Johnson, C., Hitchens, P., Smiley Evans, T. *et al. Sci Rep* **5,** 14830 (2015). https://doi.org/10.1038/srep14830



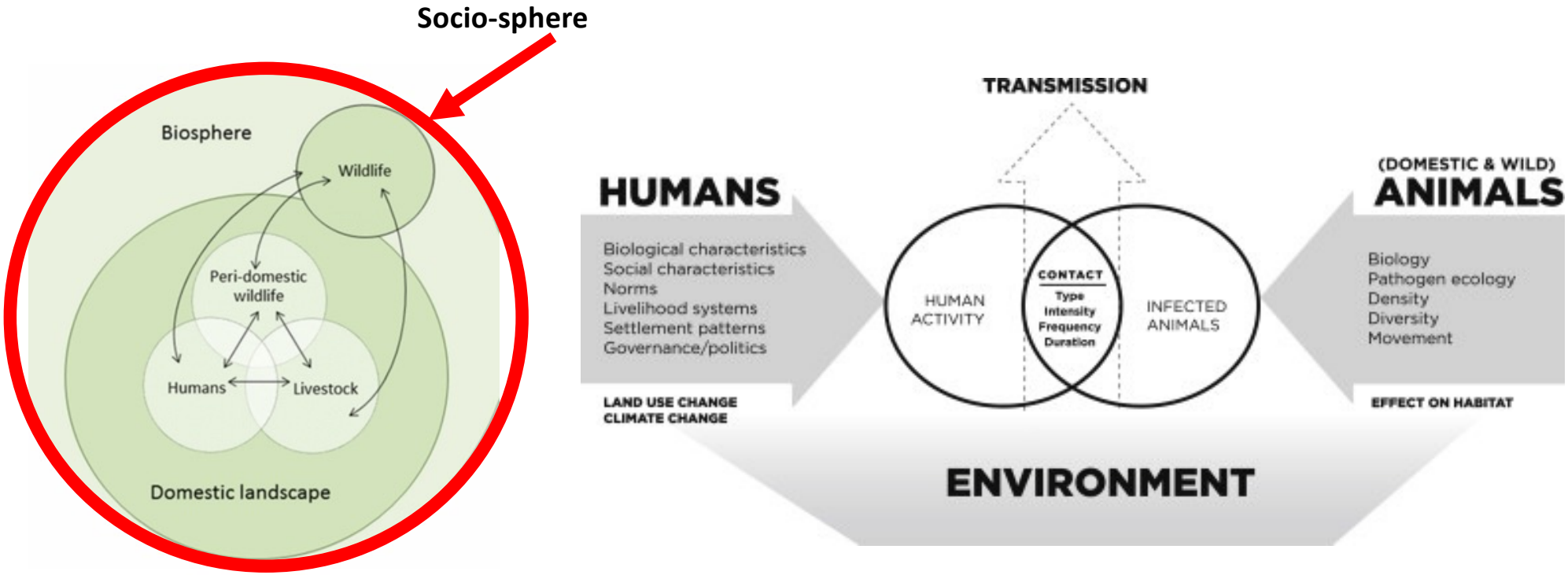
Allen et al. Nature communication 2017


ENVIRONMENTAL HEALTH
POLLUTED WATER, SOIL & FOMITES
Water-related exposure (waterborne, foodborne, via vectors that breed in water, via aerosolized wastewater); Direct exposure to contaminated soil or fomites
HUMAN HEALTH
Human to human exposure
HUMAN WASTE
ANIMAL WASTE
ANIMAL HEALTH
Animal to animal exposure
Direct exposure between animals and humans



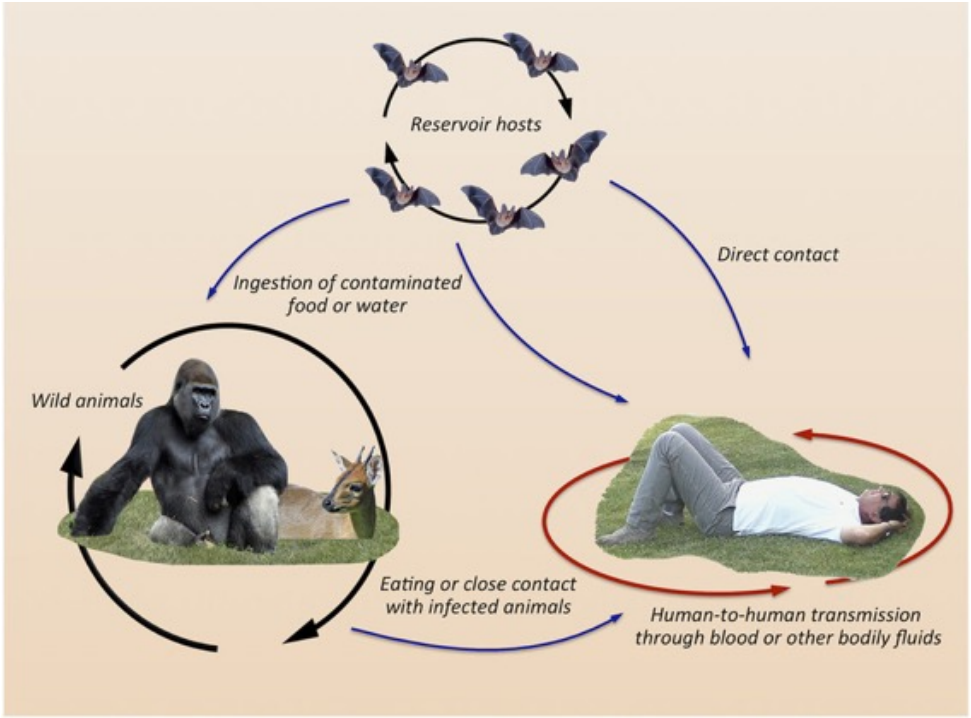
23% of human premature deaths (12.6 million deaths every year) can be attributed to modifiable environmental factors

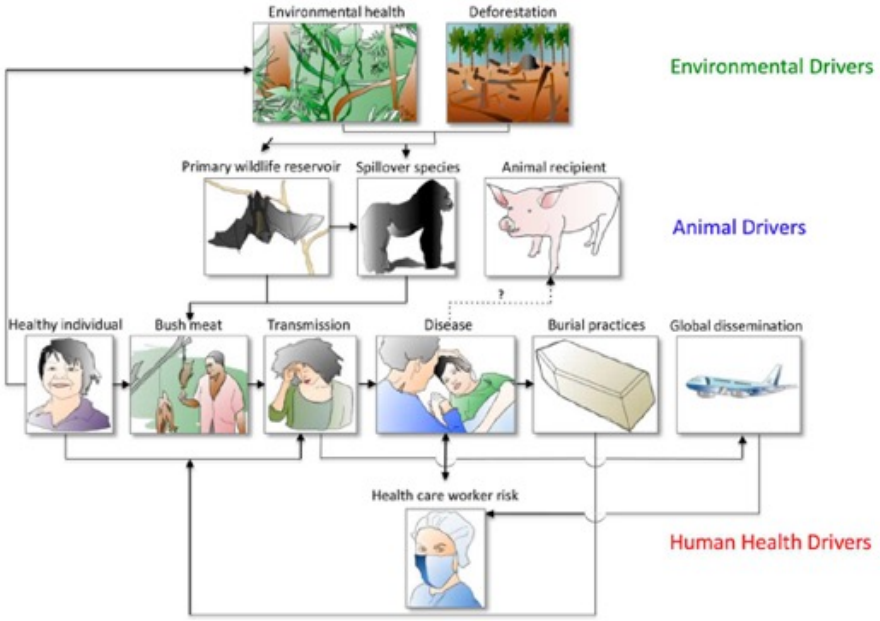
Pollution



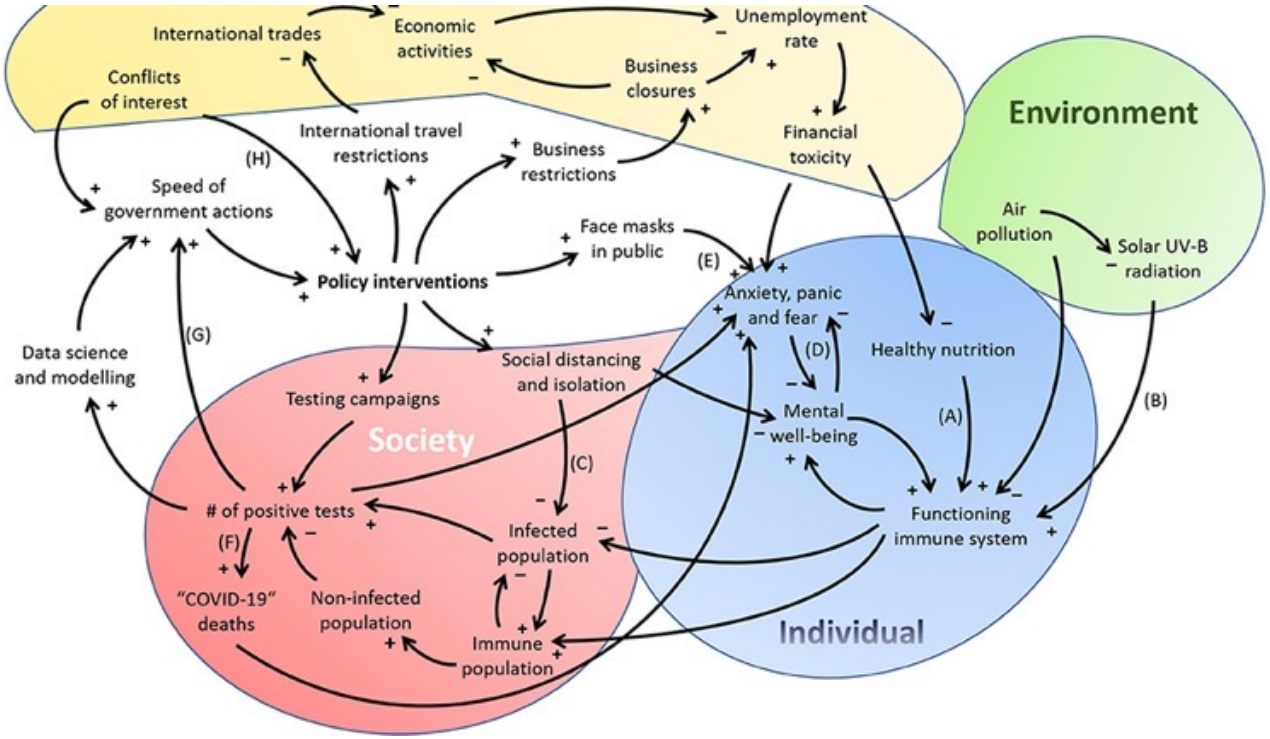
Health in social ecological systems (HSES)

ONE HEALTH APPROACH TO EBOLA





COVID-19
syndemic vs pandemic



the importance of working the interface of science and policy

GLOBAL

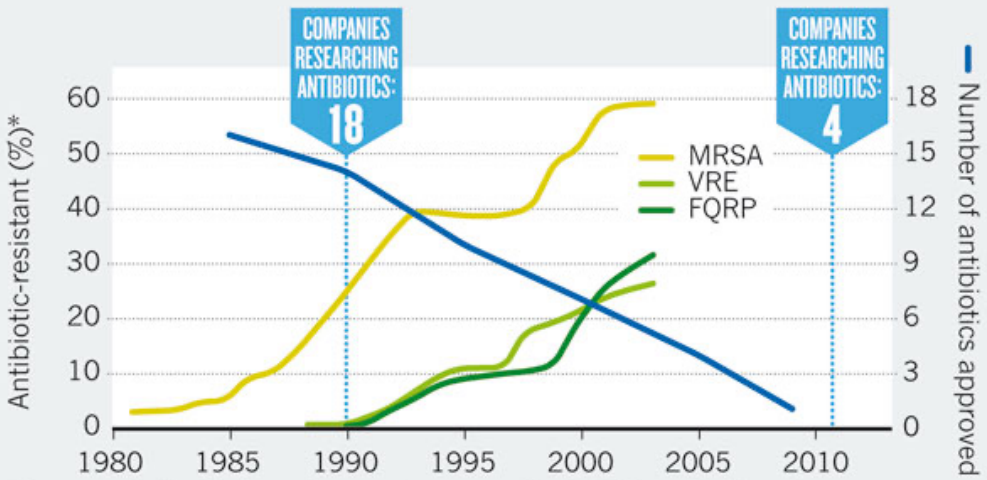
A failure to address the problem of antibiotic resistance could result in:

10m deaths by 2050

Costing £66 trillion

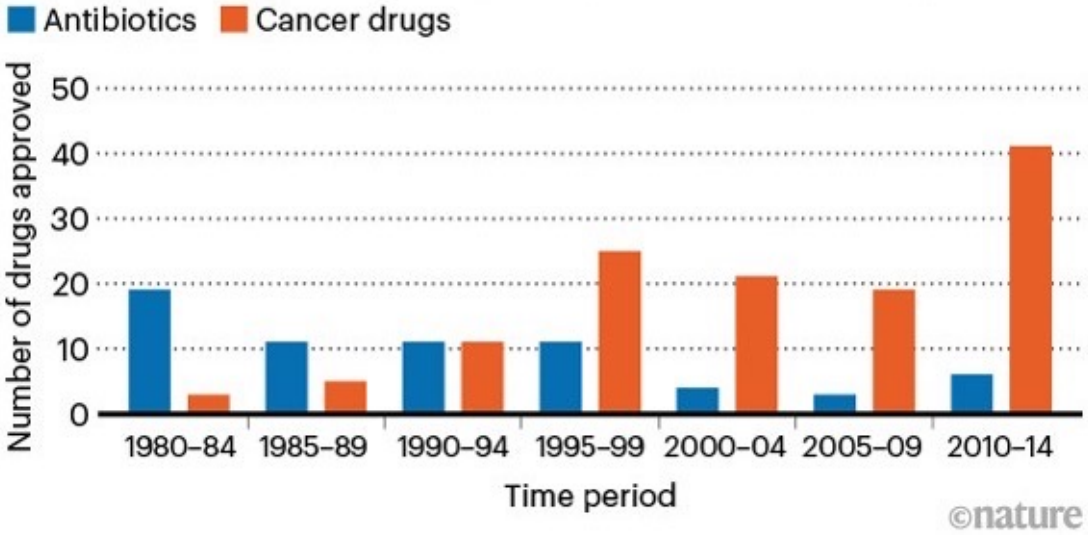
A PERFECT STORM

As bacterial infections grow more resistant to antibiotics, companies are pulling out of antibiotics research and fewer new antibiotics are being approved.



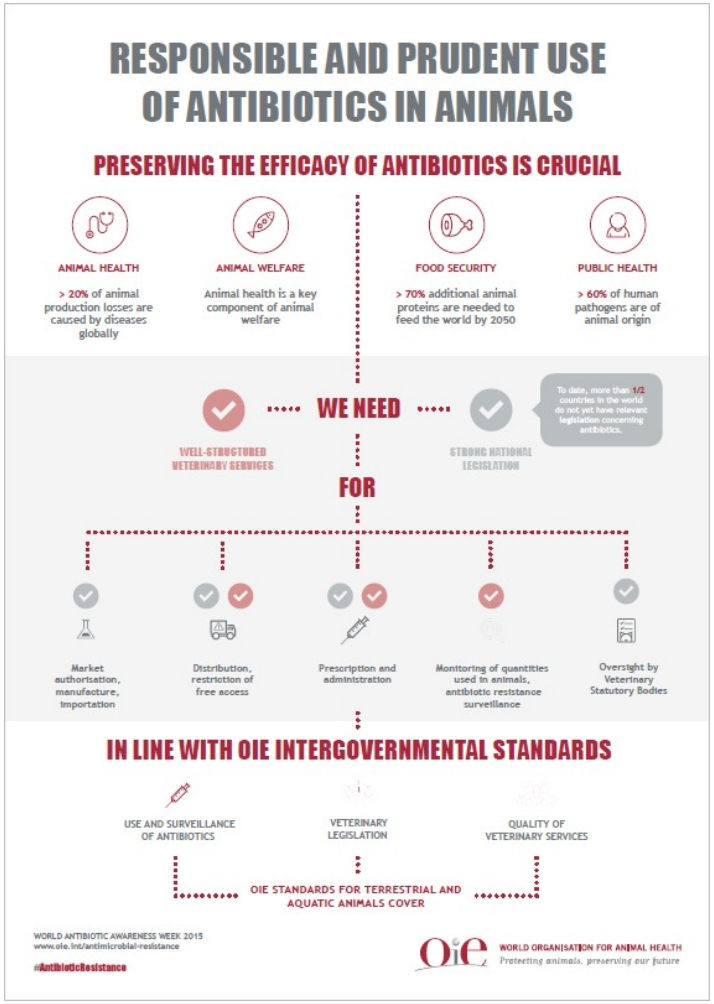
*Proportion of clinical isolates that are resistant to antibiotic. MRSA, methicillin-resistant *Staphylococcus aureus*. VRE, vancomycin-resistant *Enterococcus*. FQRP, fluoroquinolone-resistant *Pseudomonas aeruginosa*.

In the United States, the number of new antibiotics approved for use declined between 1980 and 2014, but approvals for cancer drugs rose.



https://www.nature.com/articles/d41586-020-02884-3


ACTING AGAINST
ANTIBIOTIC RESISTANCE
IS A SHARED RESPONSIBILITY
HANDLE
ANTIBIOTICS
WITH CARE
Everyone can help reduce the spread of antibiotic resistance
Policy-makers
Health workers
General public
Pharmaceutical industry
Farmers and veterinarians
#AntibioticResistance
http://www.euro.who.int/amr
© WHO 11/2017
World Health Organization
Europe


RESPONSIBLE AND PRUDENT USE OF ANTIBIOTICS IN ANIMALS
PRESERVING THE EFFICACY OF ANTIBIOTICS IS CRUCIAL
ANIMAL HEALTH
> 20% of animal production losses are caused by diseases globally
ANIMAL WELFARE
Animal health is a key component of animal welfare
FOOD SECURITY
> 70% additional animal proteins are needed to feed the world by 2050
PUBLIC HEALTH
> 60% of human pathogens are of animal origin
WE NEED
WELL-STRUCTURED VETERINARY SERVICES
STRONG NATIONAL LEGISLATION
To date, more than 1/2 countries in the world do not yet have relevant legislation concerning antibiotics.
FOR
Market authorisation, manufacture, importation
Distribution, restriction of free access
Prescription and administration
Monitoring of quantities used in animals, antibiotic resistance surveillance
Oversight by Veterinary Statutory Bodies
IN LINE WITH OIE INTERGOVERNMENTAL STANDARDS
USE AND SURVEILLANCE OF ANTIBIOTICS
VETERINARY LEGISLATION
QUALITY OF VETERINARY SERVICES
OIE STANDARDS FOR TERRESTRIAL AND AQUATIC ANIMALS COVER
WORLD ANTIBIOTIC AWARENESS WEEK 2015
www.oie.int/antimicrobial-resistance
#AntibioticResistance
OIE
WORLD ORGANISATION FOR ANIMAL HEALTH
Protecting animals, preserving our future

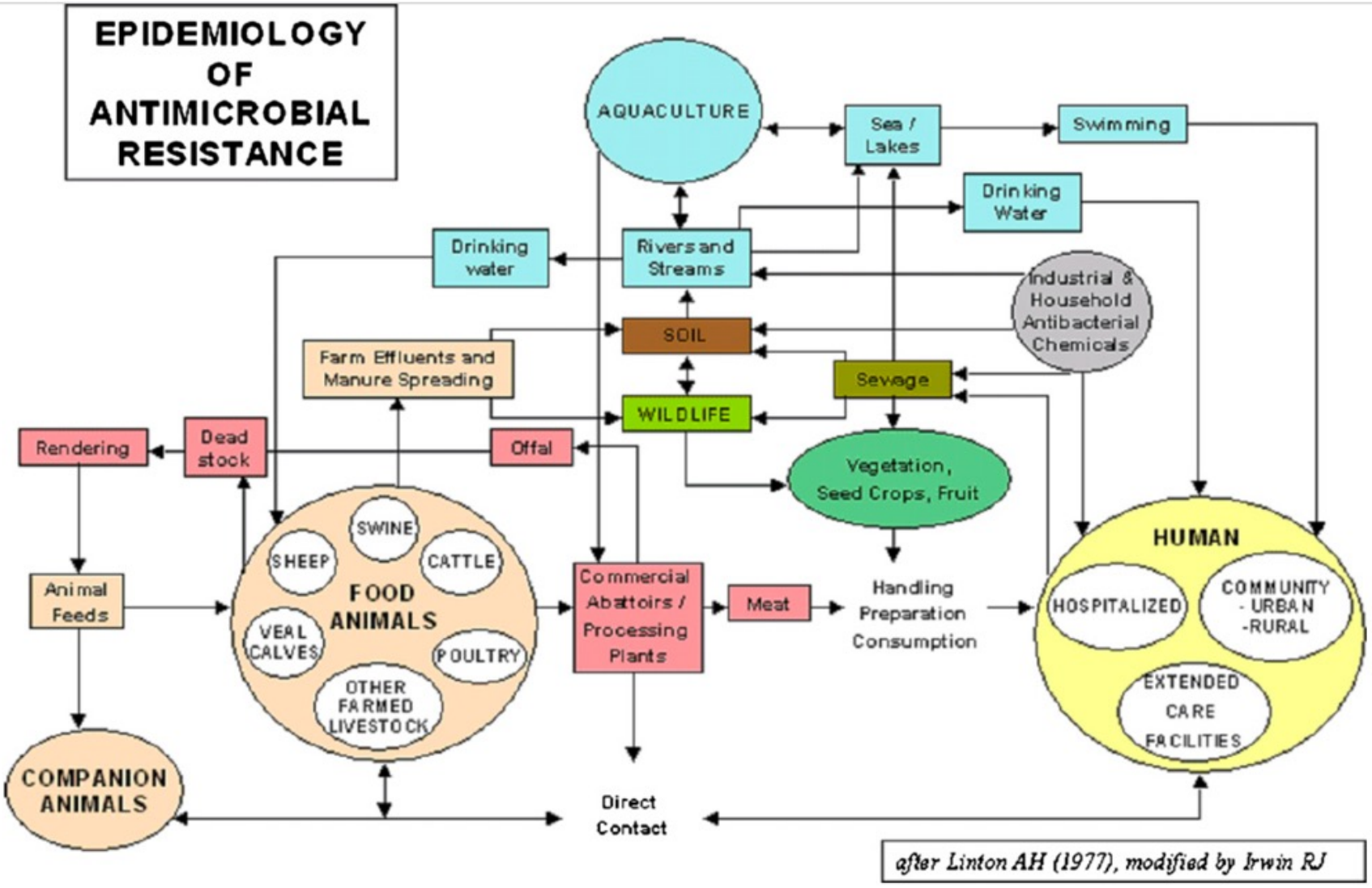
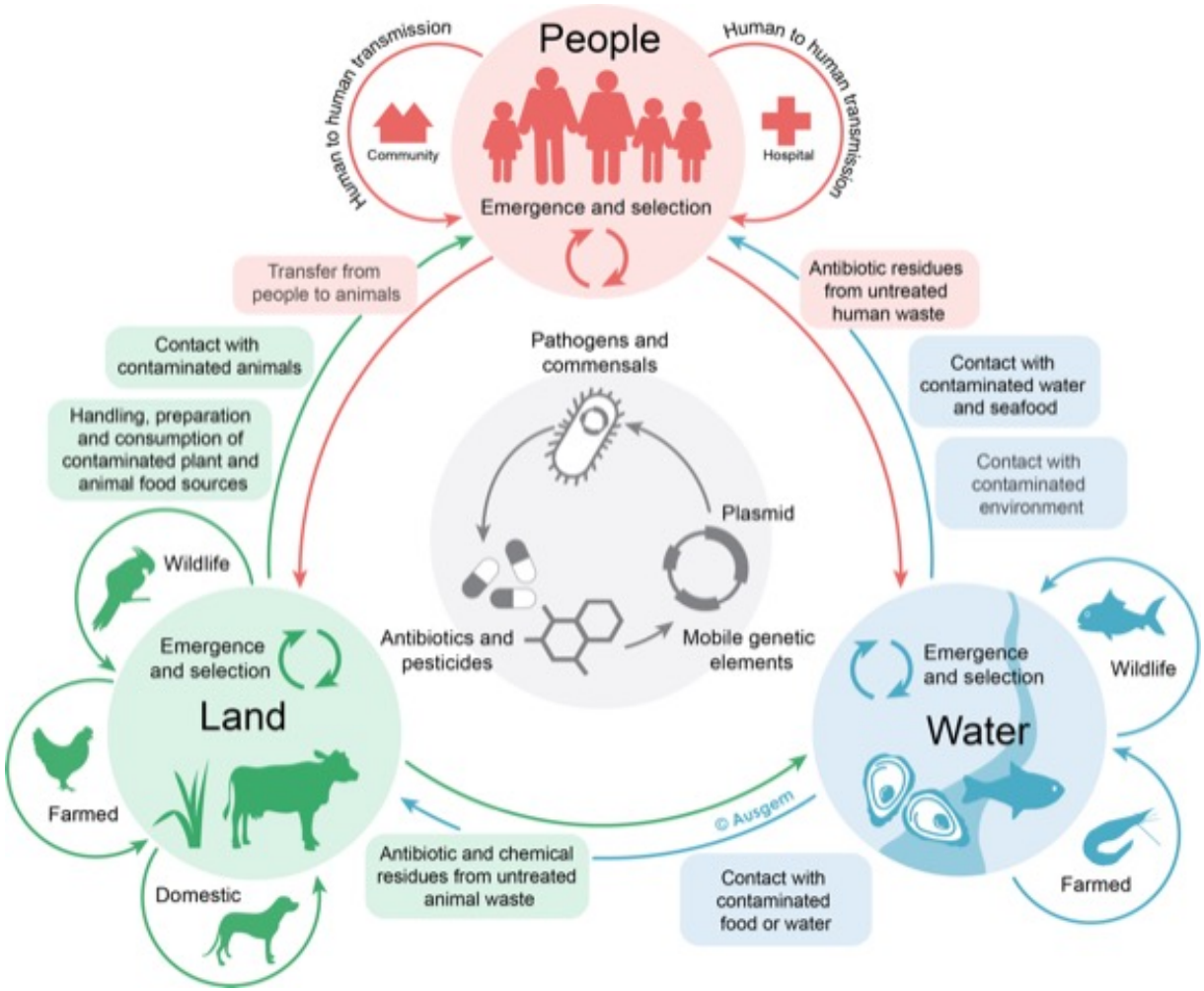
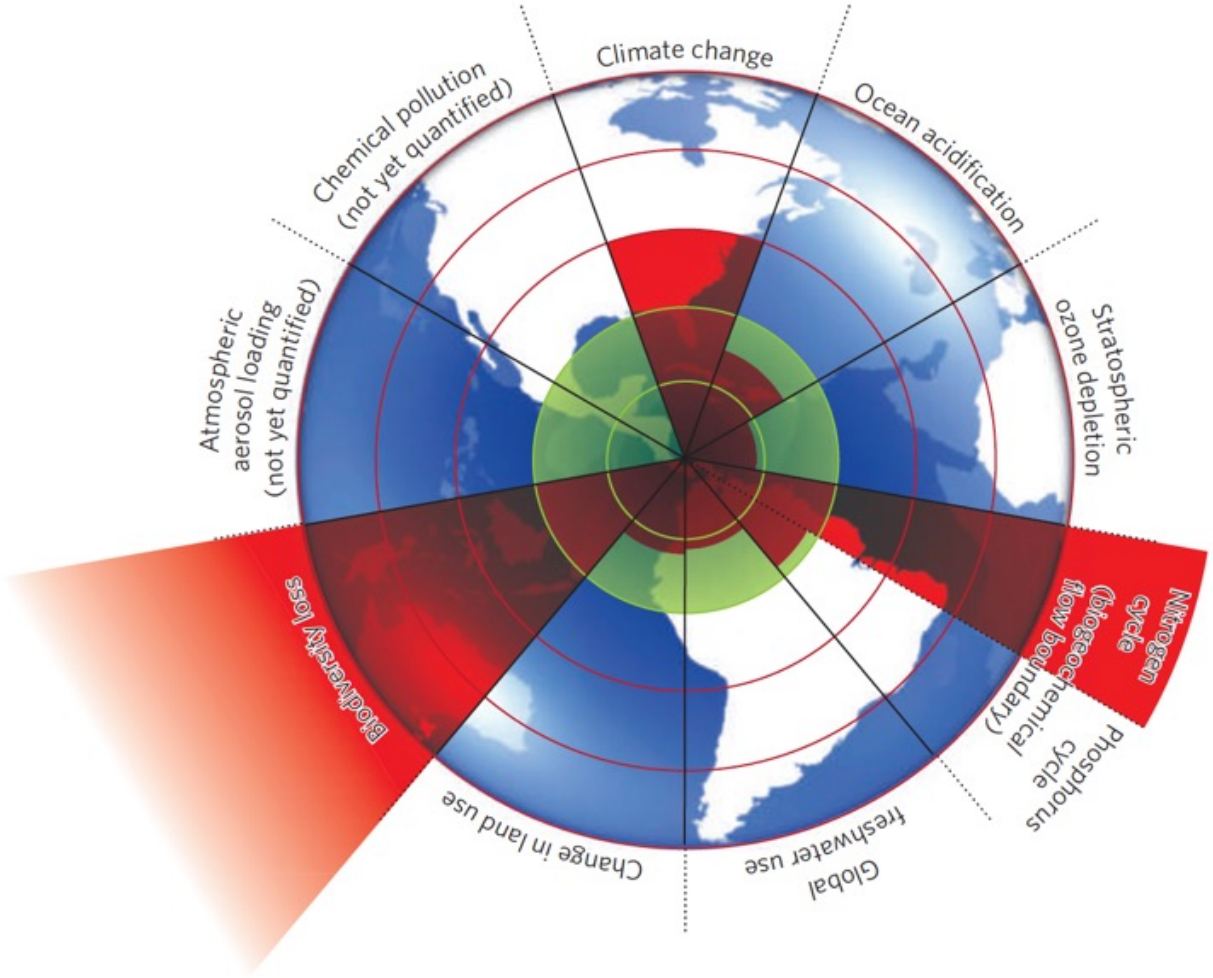


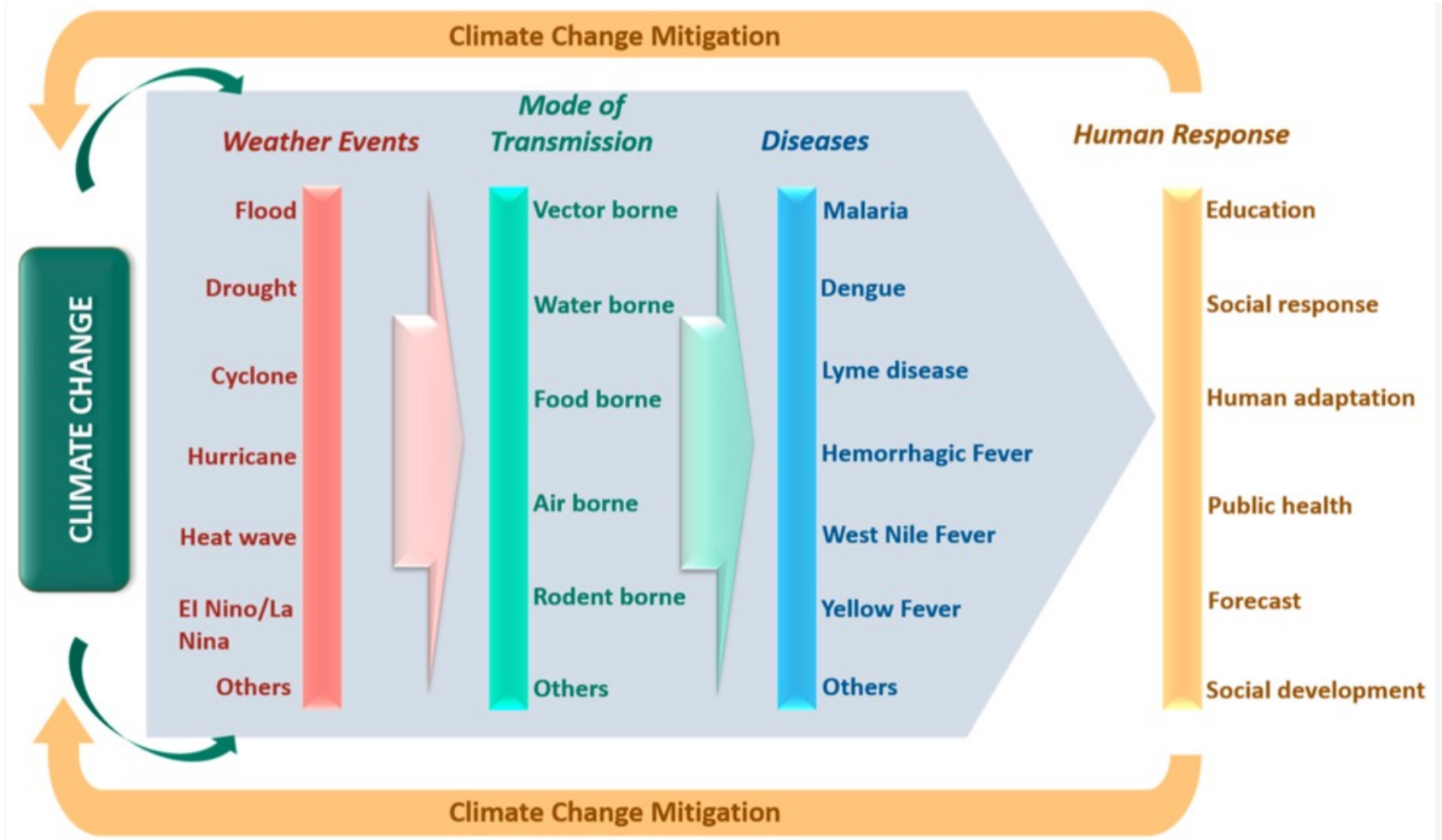
Fig. 5. Flow chart of antimicrobial resistance of the Canadian Integrated Programme for Antimicrobial Resistance Surveillance (CIPARS) www.phac-aspc.gc.ca/cipars-picra/index-eng.php. Irwin (2005) adapted from Linton (1977) (personal communication by Rebecca Irwin 07.21.2010).


People
Human to human transmission
Community
Human to human transmission
Hospital
Emergence and selection
Transfer from people to animals
Antibiotic residues from untreated human waste
Contact with contaminated animals
Pathogens and commensals
Contact with contaminated water and seafood
Handling, preparation and consumption of contaminated plant and animal food sources
Contact with contaminated environment
Plasmid
Wildlife
Emergence and selection
Land
Antibiotics and pesticides
Mobile genetic elements
Emergence and selection
Water
Wildlife
Farmed
© Ausgem
Antibiotic and chemical residues from untreated animal waste
Contact with contaminated food or water
Farmed
Domestic

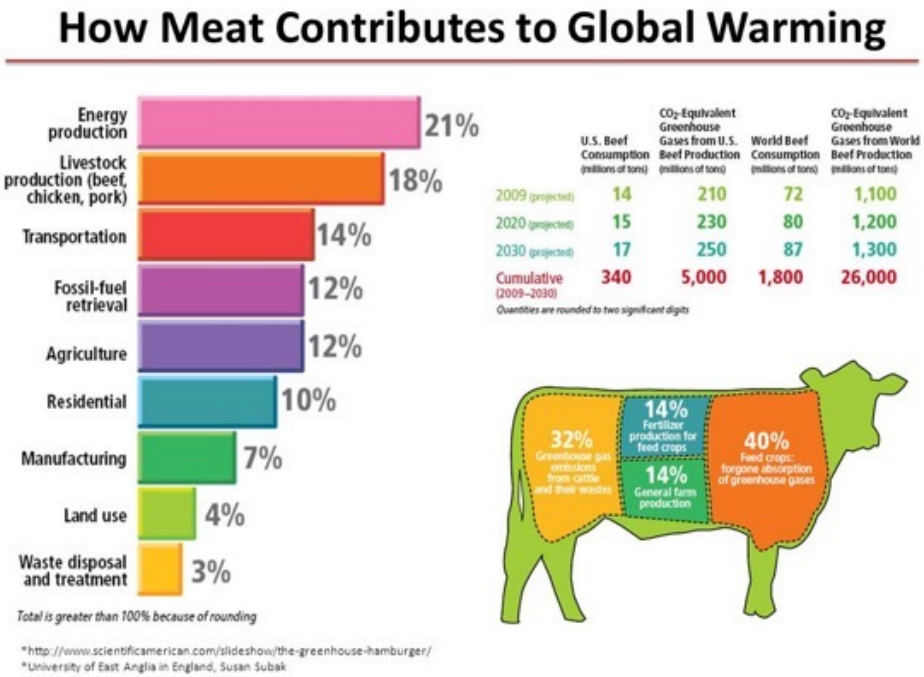
Climate change and Health



Rockstrom et al Nature Vol 461|24 September 2009

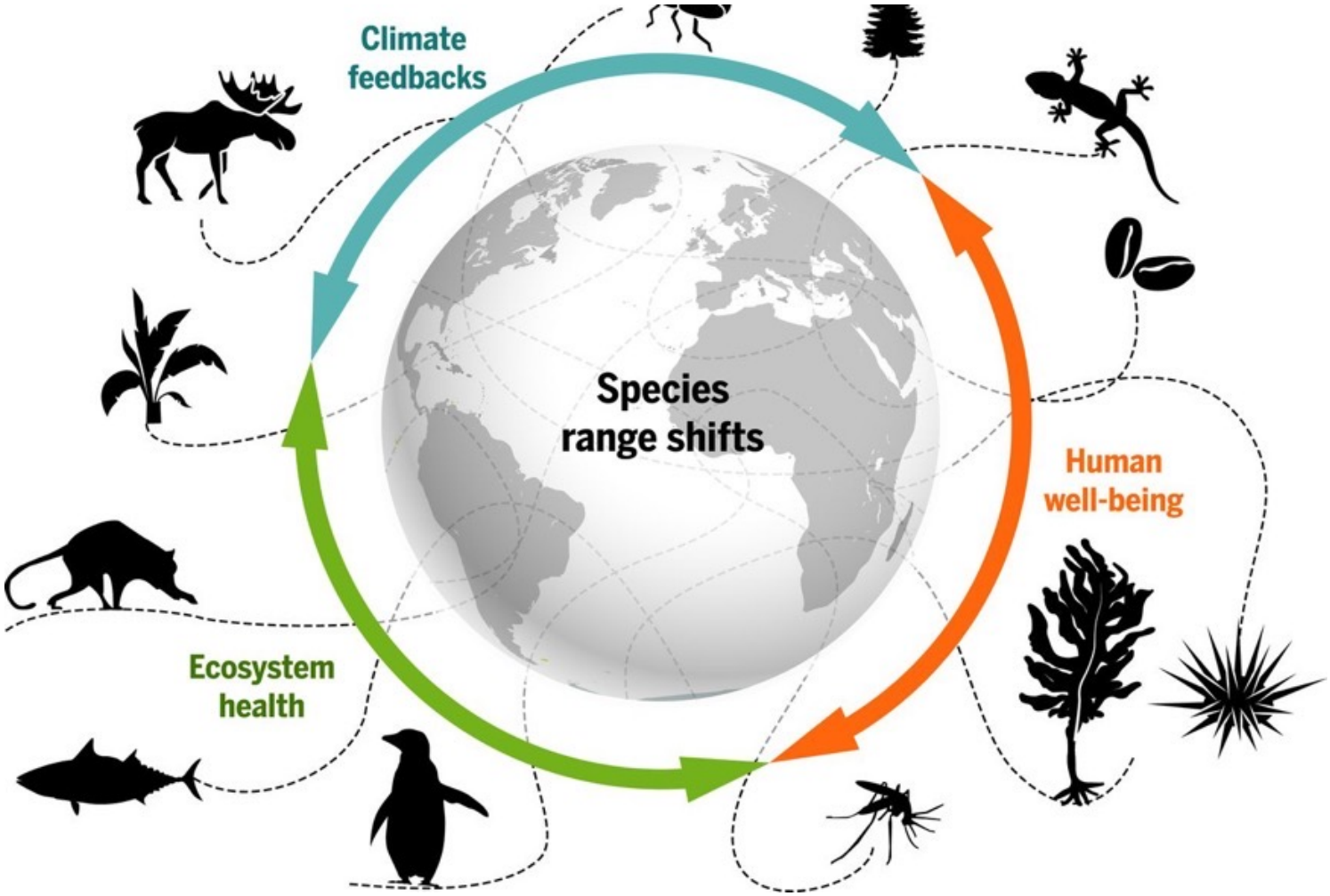

Climate Change Mitigation
CLIMATE CHANGE
Weather Events
Flood
Drought
Cyclone
Hurricane
Heat wave
El Nino/La Nina
Others
Mode of Transmission
Vector borne
Water borne
Food borne
Air borne
Rodent borne
Others
Diseases
Malaria
Dengue
Lyme disease
Hemorrhagic Fever
West Nile Fever
Yellow Fever
Others
Human Response
Education
Social response
Human adaptation
Public health
Forecast
Social development
Climate Change Mitigation

Climate change: Food security and food safety



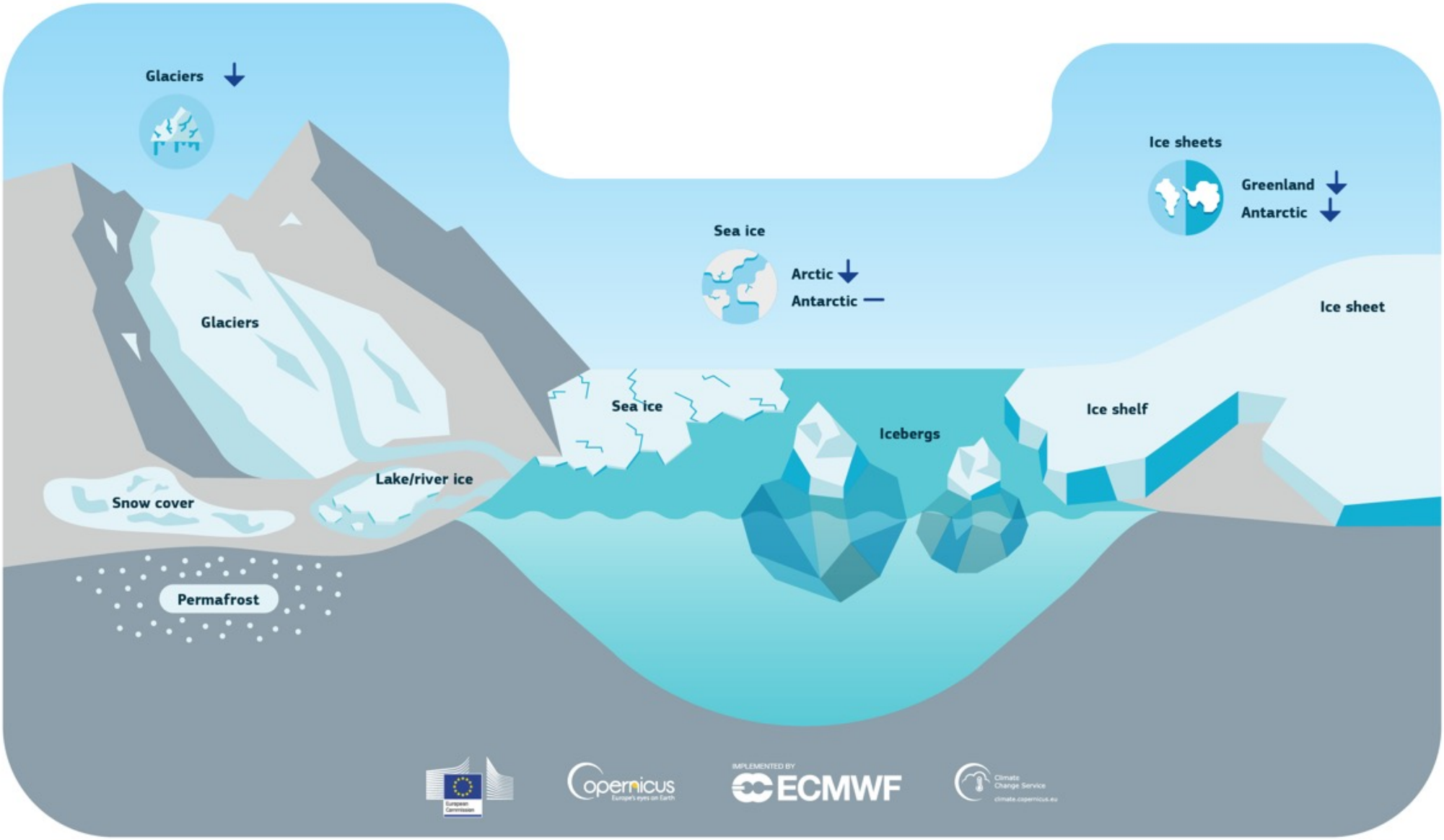
Extreme weather events: drough

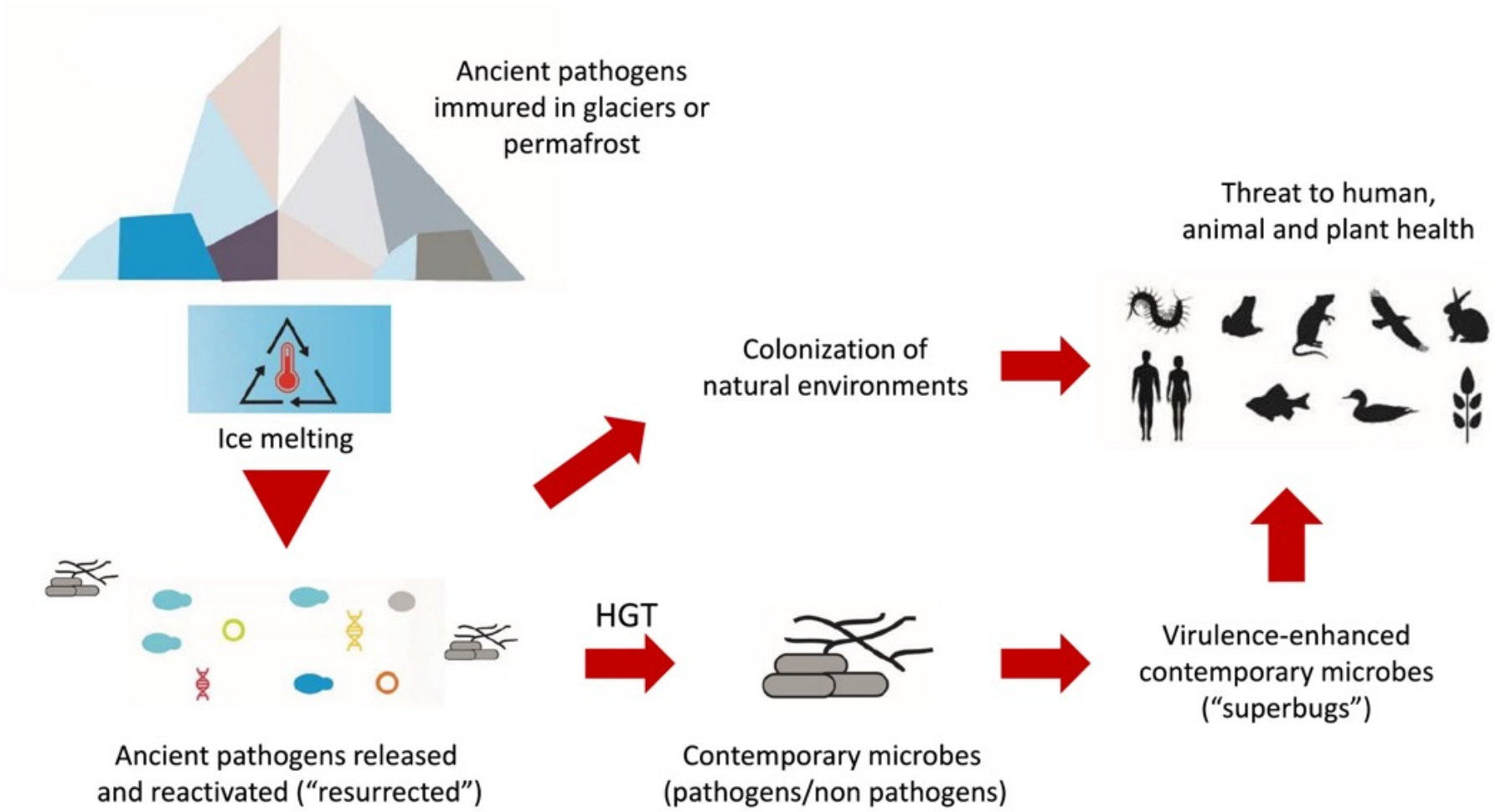

SUB-SAHARAN AFRICA
86 MILLION
SOUTH ASIA
40 MILLION
LATIN AMERICA
17 MILLION


Climate
feedbacks
Species
range shifts
Human
well-being
Ecosystem
health


Endres/AlaskaPhotoGraphics.com

Global warming and ice melting


Glaciers
Ice sheets
Greenland
Antarctic
Sea ice
Arctic
Antarctic
Ice sheet
Glaciers
Sea ice
Ice shelf
Icebergs
Lake/river ice
Snow cover
Permafrost
IMPLEMENTED BY
ECMWF


Ancient pathogens immured in glaciers or permafrost
Ice melting
Ancient pathogens released and reactivated ("resurrected")
Colonization of natural environments
HGT
Contemporary microbes (pathogens/non pathogens)
Virulence-enhanced contemporary microbes ("superbugs")
Threat to human, animal and plant health

SCIENTIFIC REPORTS

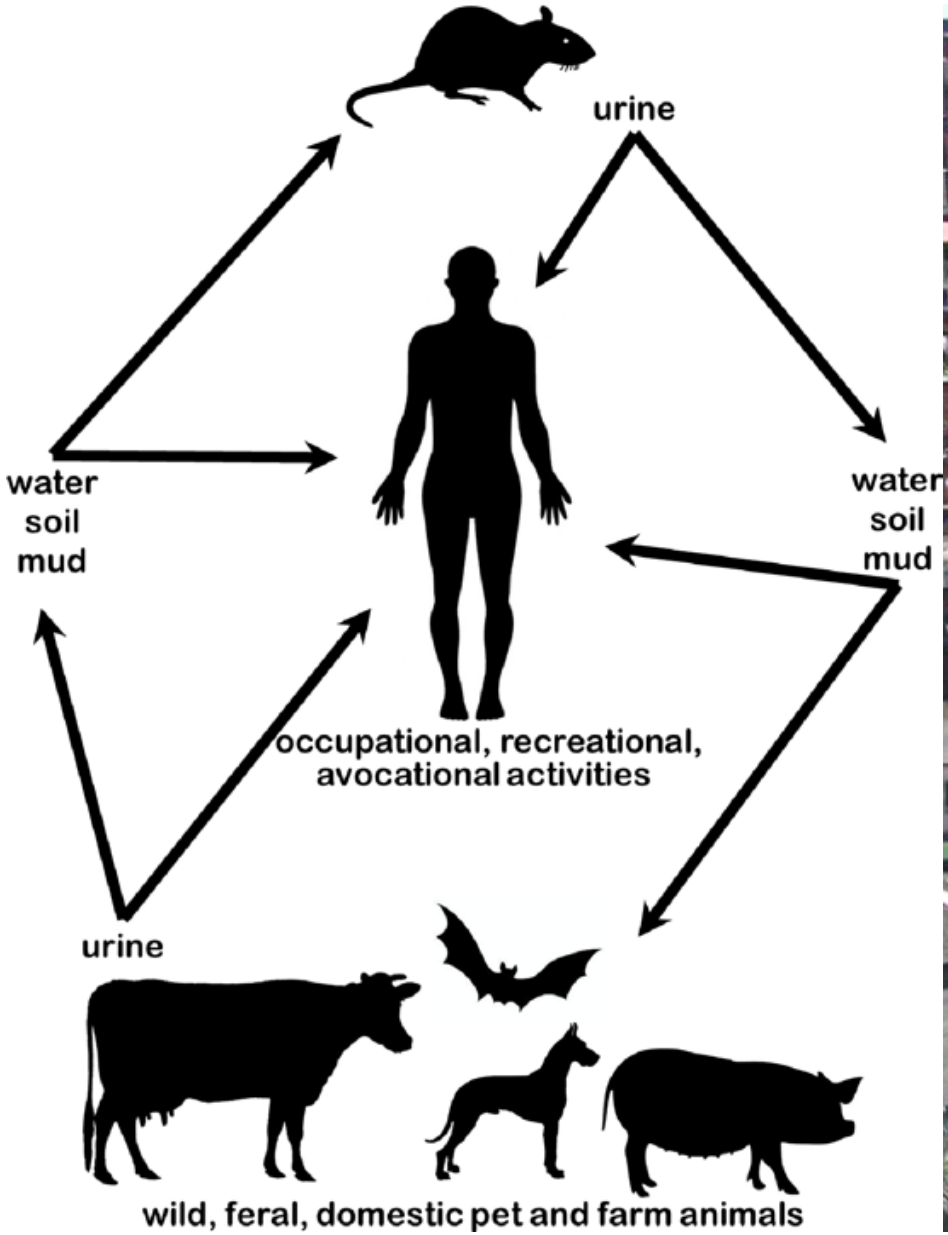
natureresearch

Permafrost dynamics and the risk of anthrax transmission: a modelling study

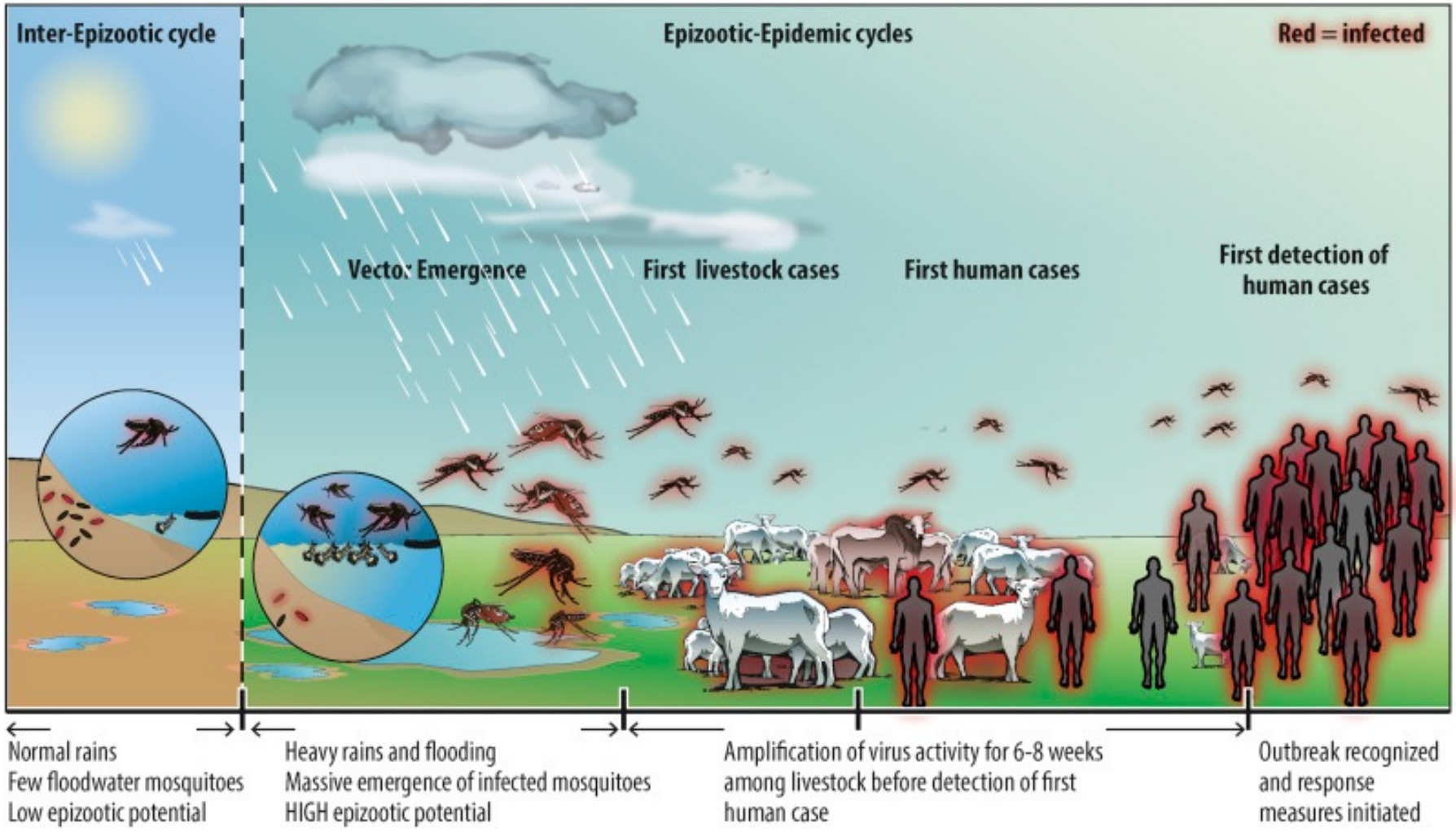
Elisa Stella[1], Lorenzo Mari[2], Jacopo Gabrieli[1], Carlo Barbante[1,3] & Enrico Bertuzzo[1,3]✉


VOLUNTEER
FIRE SERVICE

Extreme weather events: flooding


urine
water
soil
mud
water
soil
mud
occupational, recreational,
avocational activities
urine
wild, feral, domestic pet and farm animals

Rift Valley fever virus Ecology



Food and Agriculture Organization of the United Nations

العربية 中文 English Français Русский Español

Earth Observation

GIEWS

Seasonal Global Indicators | Global Indicators | Country Indicators | Data Access | FAQs | Partners | Reference | Country-level ASIS

The country level maps and graphs depict the latest 36-month period of the seasonal, vegetation and precipitation indicators. The data is presented by dekad and month. ⊞ **More**

DISCLAIMERS

The boundaries and names shown and the designations used on the maps do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries.

Ethiopia

Another country:

Seasonal Indicators | Vegetation Indicators | Precipitation Indicators

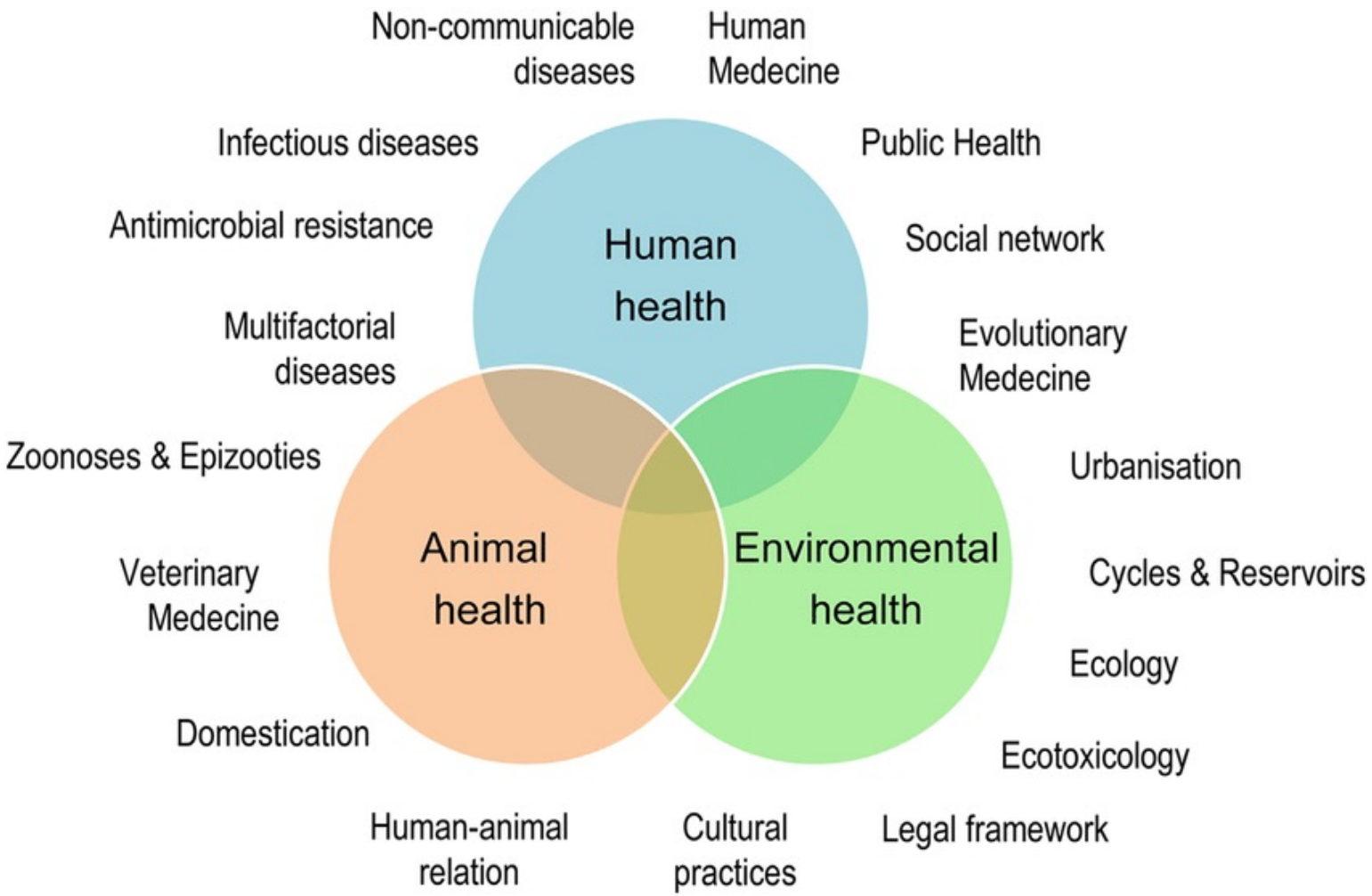
Cropland | Grassland

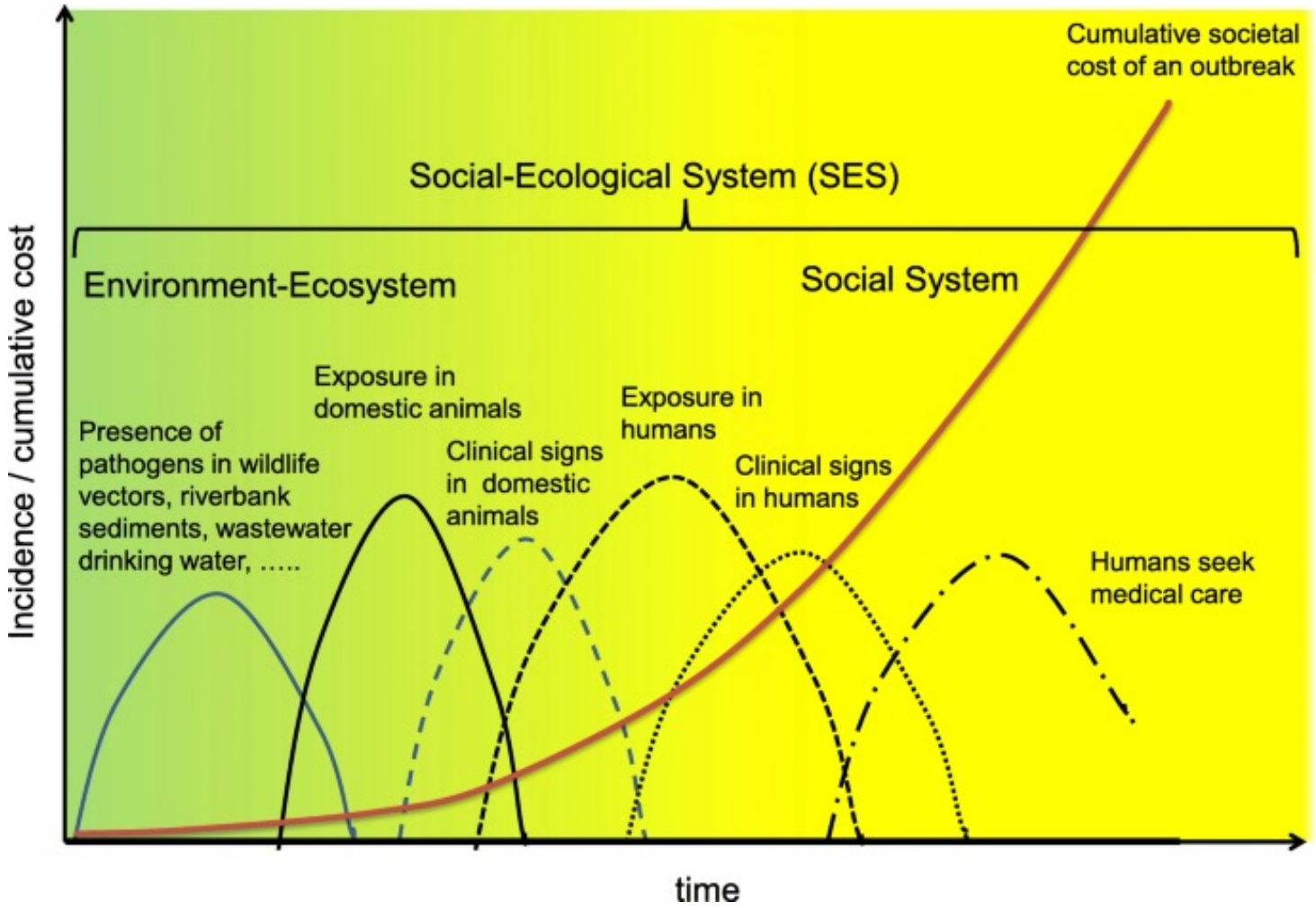
Near Real Time (10 days) | Annual Summary | Historic Drought Frequency | Crop-growing Season

Season 1 | Season 2

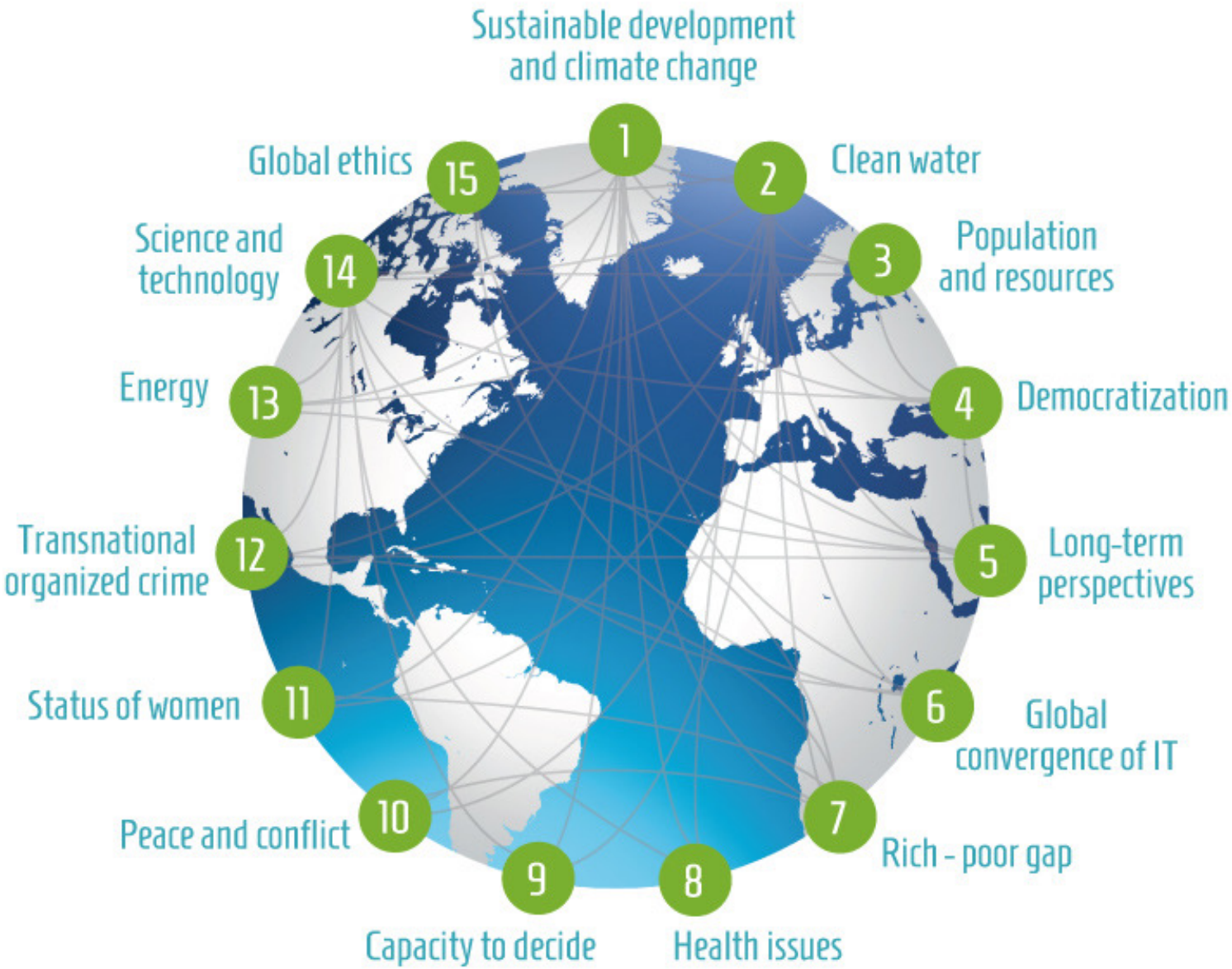
Agricultural Stress Index | Drought Intensity | Mean Vegetation Health Index

Credits: https://www.foodsource.org.uk/


Non-communicable diseases
Human Medecine
Infectious diseases
Public Health
Antimicrobial resistance
Social network
Human health
Multifactorial diseases
Evolutionary Medecine
Zoonoses & Epizooties
Urbanisation
Animal health
Environmental health
Veterinary Medecine
Cycles & Reservoirs
Ecology
Domestication
Ecotoxicology
Human-animal relation
Cultural practices
Legal framework


Cumulative societal cost of an outbreak
Social-Ecological System (SES)
Environment-Ecosystem
Social System
Exposure in domestic animals
Exposure in humans
Presence of pathogens in wildlife vectors, riverbank sediments, wastewater drinking water, ...
Clinical signs in domestic animals
Clinical signs in humans
Humans seek medical care
Incidence / cumulative cost
time

Transdisciplinary approach and participative surveillance


Sustainable development and climate change
1
Clean water
2
Population and resources
3
Democratization
4
Long-term perspectives
5
Global convergence of IT
6
Rich - poor gap
7
Health issues
8
Capacity to decide
9
Peace and conflict
10
Status of women
11
Transnational organized crime
12
Energy
13
Science and technology
14
Global ethics
15

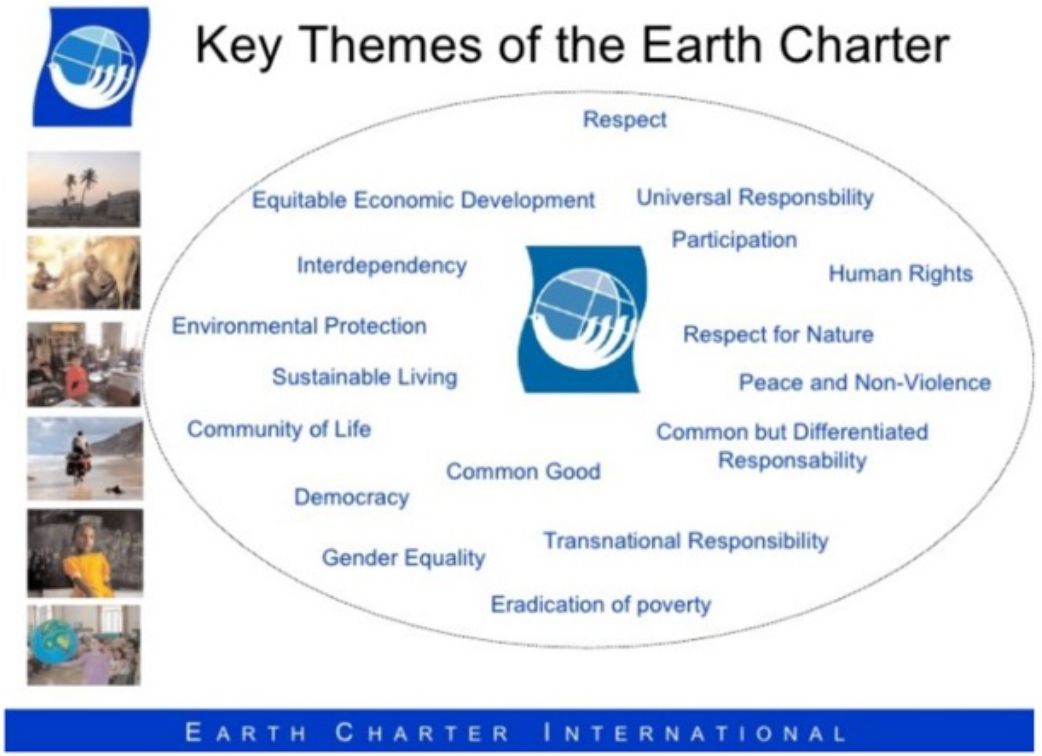
Sustainable Development Goals

WSSD 2002

Principle 1a states that we:

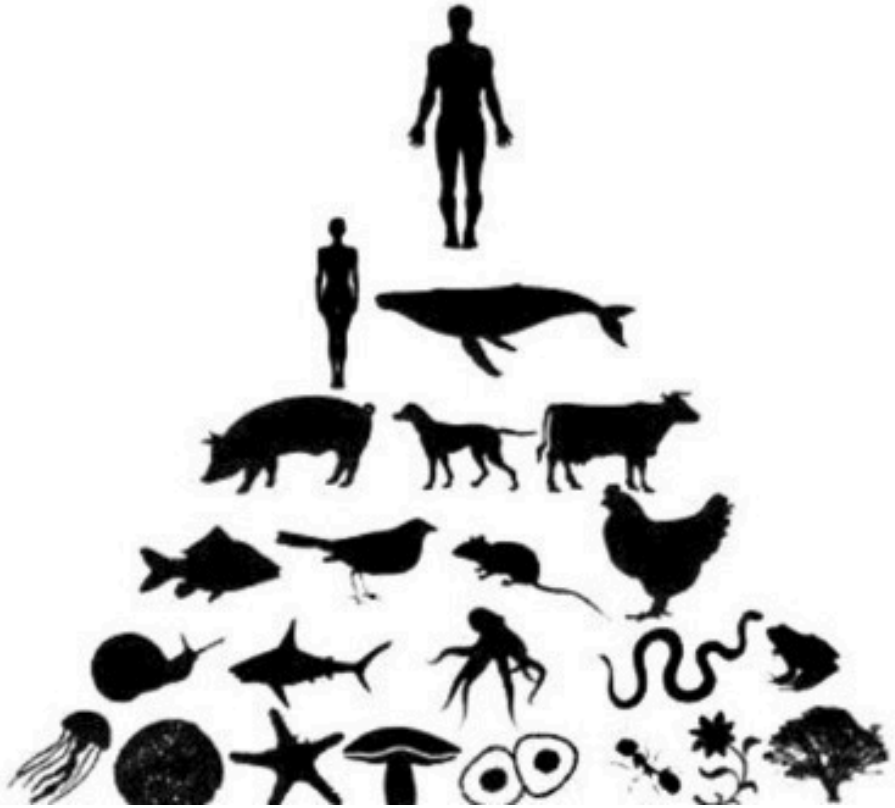
“Recognize that all beings are interdependent and every form of life has value regardless of

its worth to human beings”.




PEOPLE
End poverty and hunger in all forms and ensure dignity and equality
PROSPERITY
Ensure prosperous and fulfilling lives in harmony with nature
PEACE
Foster peaceful, just and inclusive societies
PARTNERSHIP
Implement the agenda through a solid global partnership
PLANET
Protect our planet's natural resources and climate for future generations
Sustainable development

EGO logical

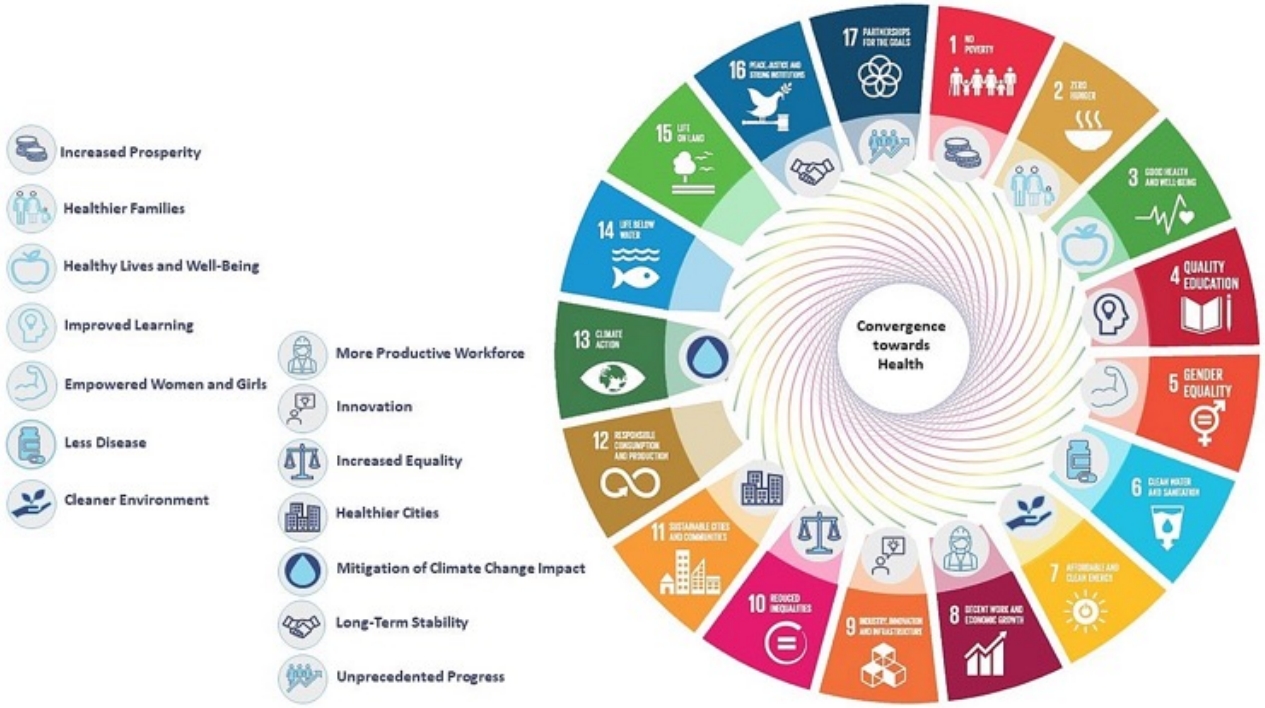


Anthropocentric Dualistic Unsustainable
Mechanistic self destructive

ECO logical

Ecocentric Holistic Sustainable
Compassionate Natural Regenerative

Introducing the Circular health concept



ONE HEALTH CENTER OF EXCELLENCE

Health in all the SDGs (Circular Health) a UF practical

- Title
  - Number of the chosen SDG and official title
- Overview description of the SDG
  - List of the main ideas the SDG deals with. These should be extracted and summarized from the targets and indicators descriptions on the official website.
  - Extra emphasis should be given to those topics that will be linked to One Health
- Key Words
  - Describing the key words of the SDG is extremely important. Especially in a multidisciplinary environment.
  - Ideally, only the key words should be on the slide with some images / graphics but not the description.
  - Different font size and special organization should be used to highlight clusters of words and more prominent words
  - In case there are many key words, extra emphasis should be given to those words that will be connected to One Health. Some unrelated key words could be omitted altogether.
- “Zipper concepts” with One Health
  - Identify specific areas where additional research / policy can help bridging the gap between the SDG and One Health. If other SDGs are involved it is even better
  - In particular, try to identify both situations where achieving a target of the SDG will improve health and those where improving health will help achieving one or more targets of the SDG
-