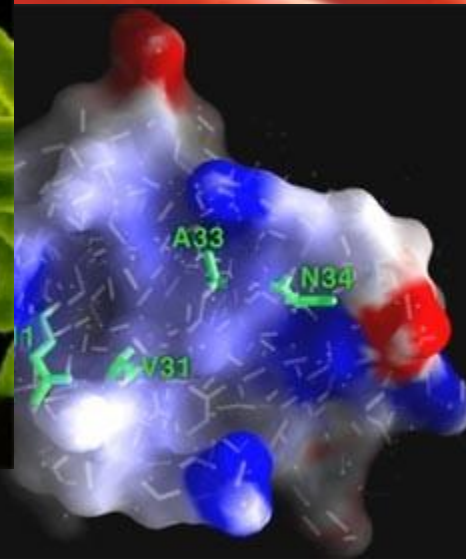
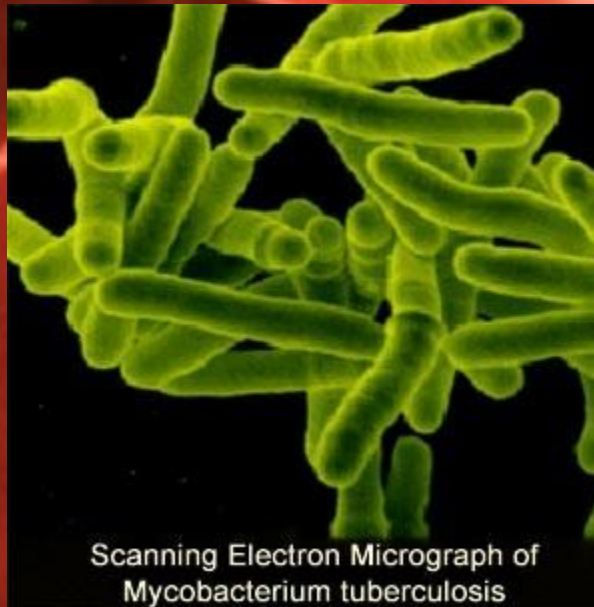


INFECTIOUS DISEASE



Cholera, malaria, tuberculosis
(TB) and AIDS

Infectious disease

- Transmissible or communicable diseases
 - Caused by pathogens (viruses, bacteria, fungi, protoctists, worms and insects) that can spread from infected people to uninfected people
 - can spread through direct contact and indirect
- Carriers – spread the pathogen even though they do not have the disease themselves
- Transmission cycle – the way in which a pathogen passes from one host to another



Endemic: a disease that exists permanently in a particular region or population. Malaria is a constant worry in parts of Africa



Epidemic: an outbreak of disease that attacks many people at about the same time and may spread through one or several communities

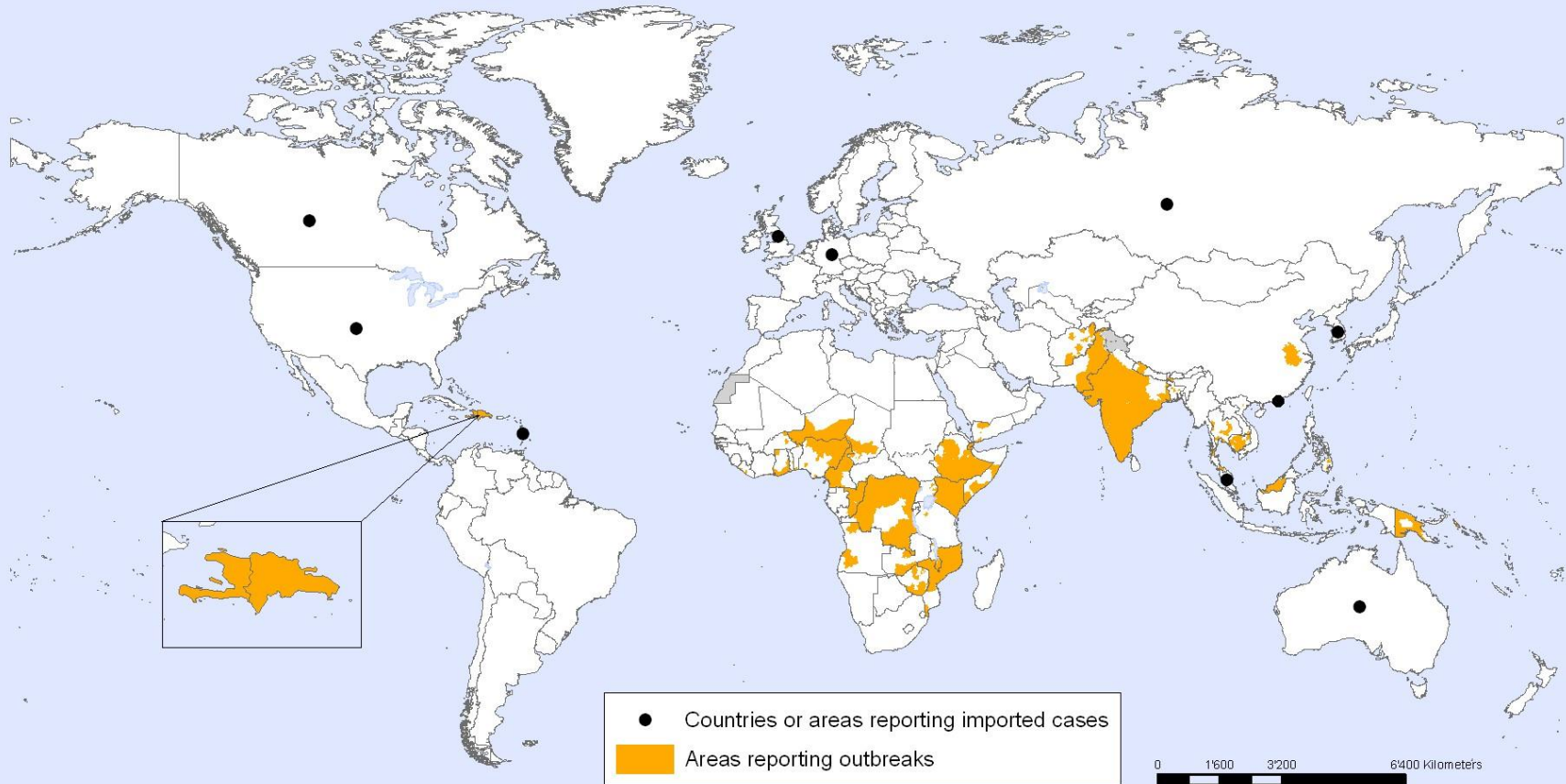


Pandemic: When an epidemic spreads throughout the world; a worldwide epidemic; an epidemic occurring over a wide geographic area and affecting a large number of people

Cholera

Pathogen	<i>Vibrio cholerae</i> (bacteria)
Methods of transmission	Food-borne, water-borne
Global distribution	Asia, Africa, Latin America
Incubation period	1-5 days
Site of action of pathogen	Wall of small intestine
Clinical features	Severe diarrhoea, loss of water and salts, dehydration, weakness
Method of diagnosis	Microscopical analysis of faeces
Annual incidence worldwide	5.5 million
Annual mortality worldwide	120 000

Cholera, areas reporting outbreaks, 2010–2011



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Transmission of cholera



Vibrio cholerae



- Cholera toxin – toxin secreted as bacteria reach the small intestine which disrupts the functions of the epithelium so that salts and water leave the blood causing severe diarrhoea
- Can be fatal if not treated within 24 hours

Treatment

- Can be controlled by giving a solution of salts and glucose **intravenously** to rehydrate the body or **oral rehydration therapy** (fluid intake is important)
- Glucose is absorbed into blood and take salts (Na^+ and K^+) with it

Factors influencing cholera outbreak

- Sewage treatment and clean water
- Human sewage used to irrigate vegetables
- Inadequate cooking or washing in contaminated water
- Vaccination
- Discharge of ship sewage into the sea, straight into shellfish beds affecting seafood (oyster and mussels)
- Over 60 different strains of *V. cholerae*

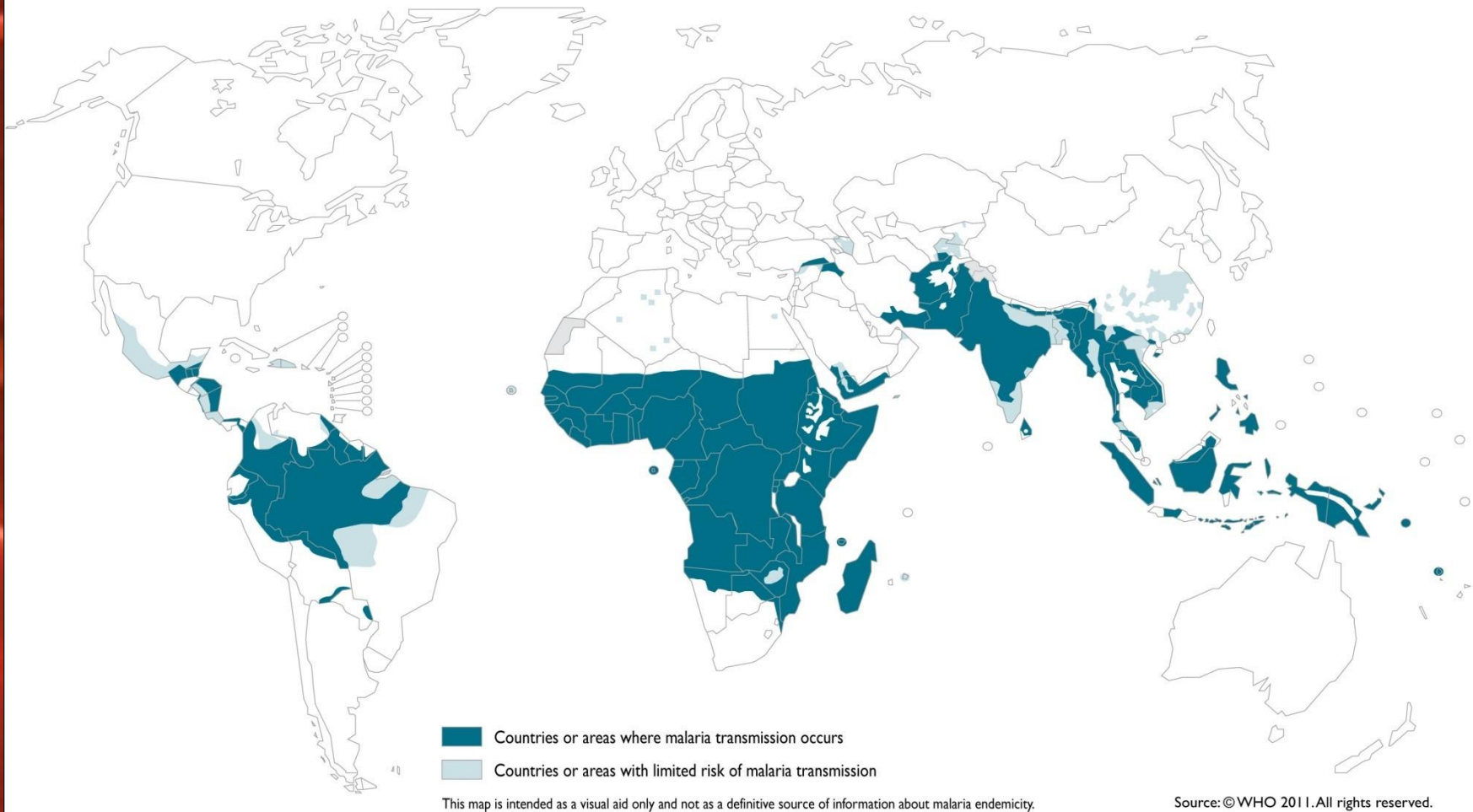


One person can excrete 10^{13} cholera bacteria a day. An infective dose is 10^6 . How many people could one person infect in one day?

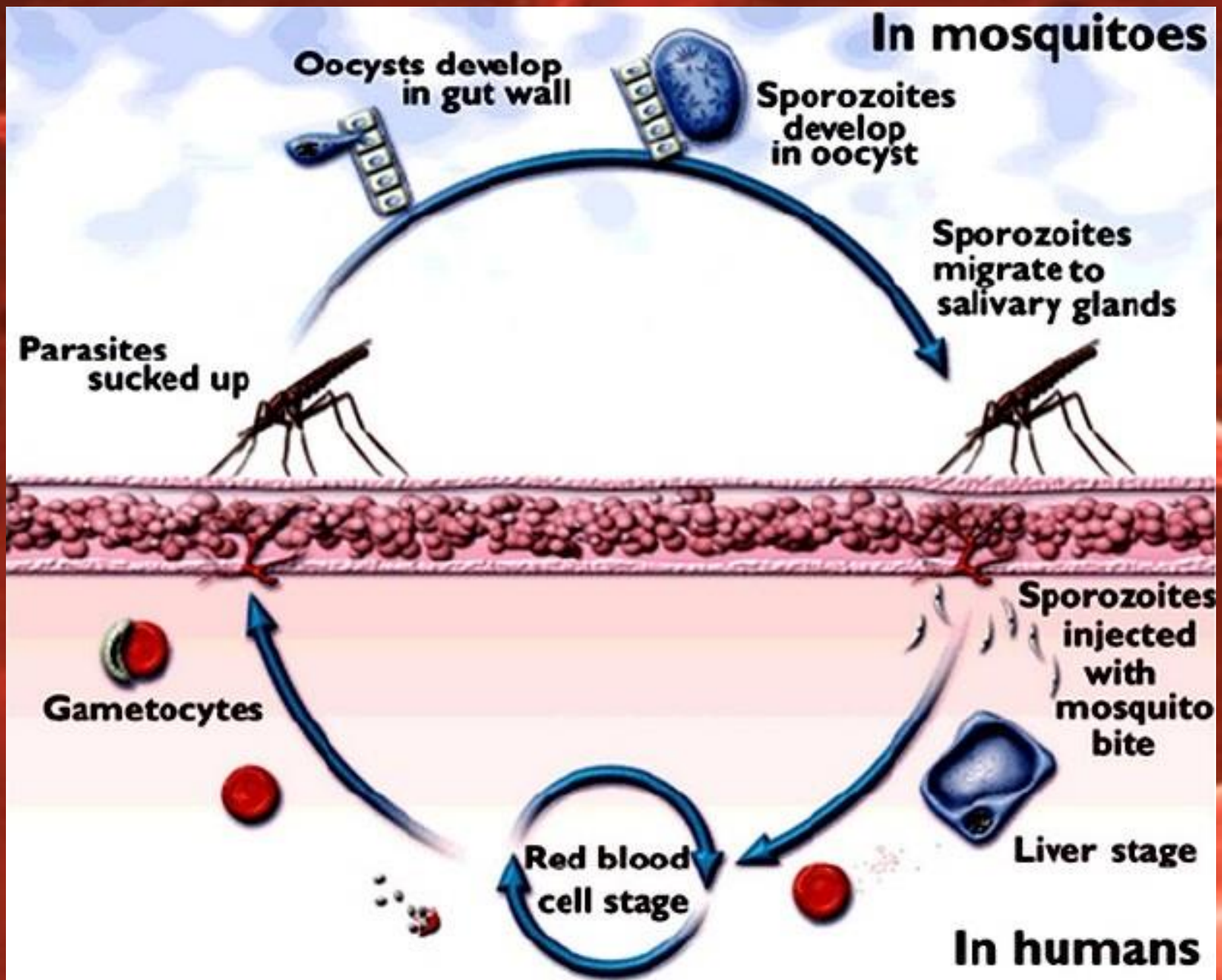
Malaria

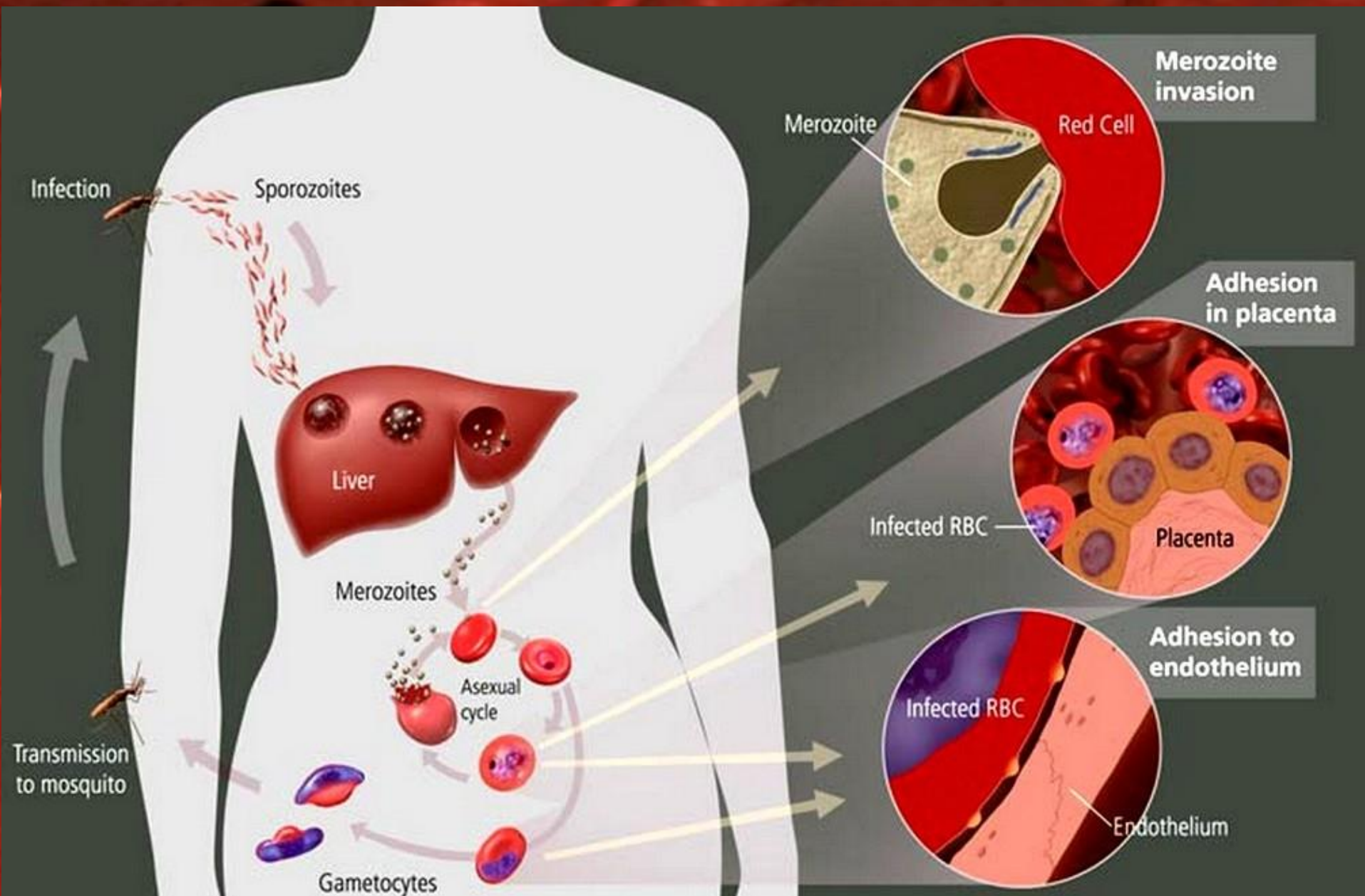
Pathogen	<i>Plasmodium falciparum</i> , <i>P. vivax</i> , <i>P. ovale</i> , <i>P. malariae</i> (protoctist)
Method of transmission	Insect vector: female <i>Anopheles</i> mosquito
Global distribution	Throughout the tropics and sub-tropics (endemic in 91 countries)
Incubation period	From a week to a year
Site of action of pathogen	Liver, red blood cells, brain
Clinical features	Fever, anaemia, nausea, headaches, muscle pain, shivering, sweating, enlarged spleen
Method of diagnosis	Microscopical examination of blood
Annual incidence worldwide	300 million (90% of cases are in Africa)
Annual mortality worldwide	1.5-2.7 million; in tropical Africa malaria kills 1 million children under the age of 5

Malaria, countries or areas at risk of transmission, 2010



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Control of malaria

- **Reduce the number of mosquitoes** (kill insect vector and break the transmission cycle)
 - Oil spread over surface of water
 - Clear mosquito breeding sites
 - Biological control:
 - Fish which feed on mosquito larvae
 - Bacterium, *Bacillus thuringiensis*
- **Avoid being bitten by mosquitoes**
 - Mosquito nets
 - Insect repellants
 - Sleeping with a dog or a pig
- **Use drugs to prevent the parasite infecting people**
 - **Prophylactic** (preventive) drugs – e.g. proguanil (inhibit sexual reproduction), quinine and chloroquine (inhibits protein synthesis), mefloquine (side effects – restlessness, dizziness, vomiting and disturbed sleep)

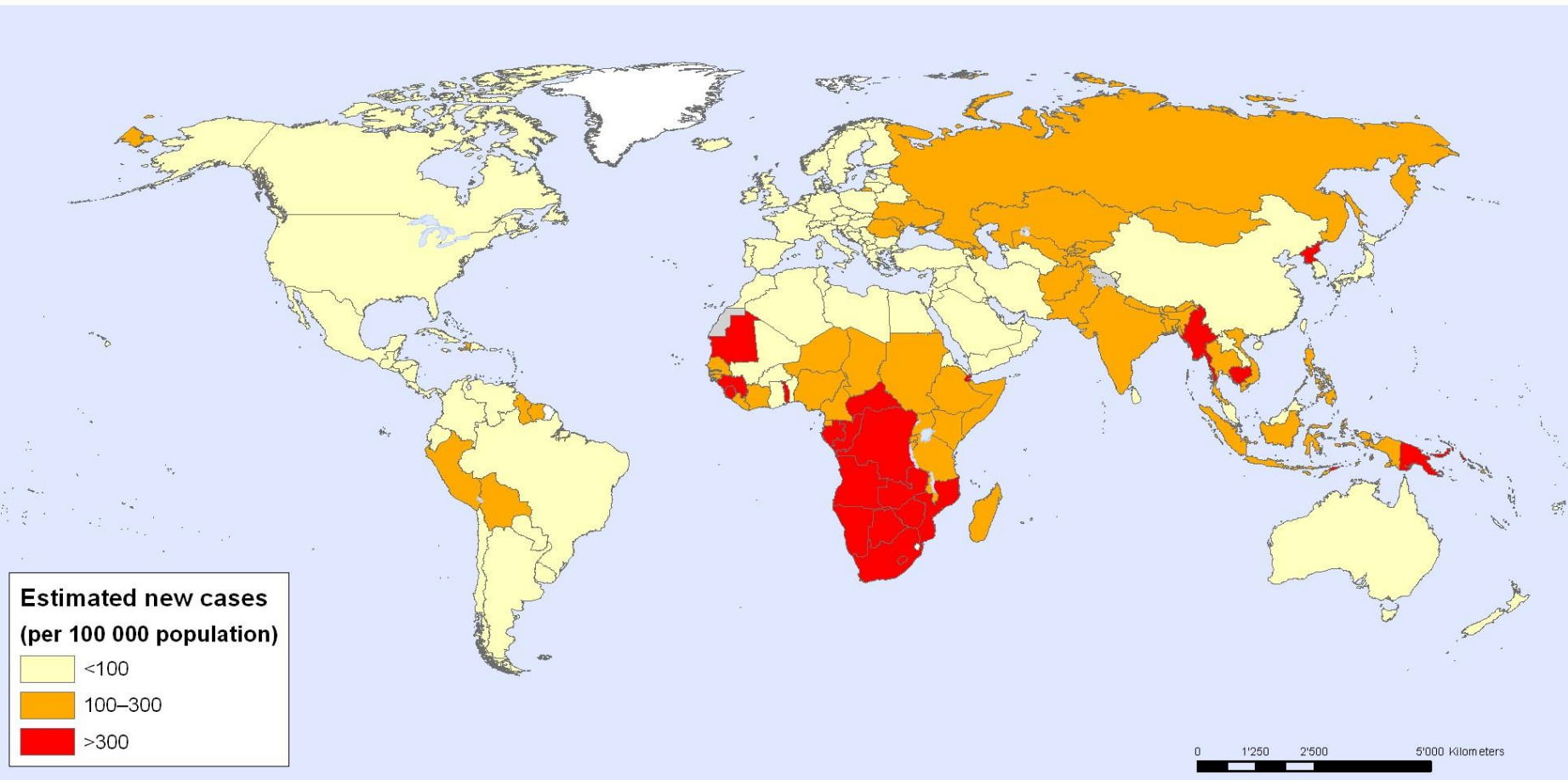
Reasons for worldwide concern over spread of malaria

- Increase in drug-resistant forms of *Plasmodium*
- Increase in the proportion of cases cause by *P. falciparum*, the form that causes severe or fatal malaria
- Difficulties in developing a vaccine
- Increase in the number of epidemics because of climactic and environmental changes that favour the spread of mosquitoes
- The migration of people as a result of civil unrest and war

Tuberculosis (TB)

Pathogen	<i>Mycobacterium tuberculosis</i> ; <i>M. bovis</i>
Methods of transmission	Airborne droplets; via unpasteurised milk
Global distribution	Worldwide
Incubation period	Few weeks or months
Site of action of pathogen	Primary infection in lungs; secondary infections in lymph nodes, bones and
Clinical features	Racking cough, coughing blood, chest pain, shortness of breath, fever, sweating, weight loss
Method of diagnosis	Microscopical examination of sputum for bacteria, chest x-ray
Annual incidence worldwide in 1998	8 million (more than 6000 cases in UK)
Annual mortality worldwide in 1998	2 million

Tuberculosis, estimated new cases, 2010



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Symptoms of Tuberculosis

Grey lines = Specific
Colored lines = Overlapping

(Established) pulmonary tuberculosis

Poor appetite

Miliary tuberculosis

Productive cough

Return of dormant tuberculosis

Night sweats

Cough with increasing mucus
Coughing up blood

Primary pulmonary tuberculosis

Weakness

Fever

Structural abnormalities

Dry cough

Weight loss

Extrapulmonary tuberculosis

Common sites:

Tuberculous pleuritis

Meninges

Lymph nodes

Chest pain

Gastrointestinal symptoms

Bone and joint sites

Genitourinary tract

Resurgence of TB due to:

- Some strains of TB bacteria which are resistant to drugs (MDR-TB: resistant to isoniazid as well)
- The AIDS pandemic
- Poor housing in inner cities in the developed world and rising homelessness
- Breakdown of TB control programmes; partial treatment for TB increases the chance of drug resistance in *Mycobacterium*
- Migration from Eastern Europe and developing countries to large cities such as London and New York

Control of TB

- Introduction of vaccine
- Improvements in housing conditions and diet
- Antibiotic (streptomycin)

Cell Wall Synthesis

Isoniazid (1952)

Inhibits cell wall synthesis



Ethambutol (1961)

Inhibits cell wall synthesis



Acyl Lipids

Mycolic Acid

Arabinogalactan

Peptidoglycan

Plasma Membrane

Mycobacterium tuberculosis

Pyrazinamide (1952)

Exact Target Unclear
Disrupts Plasma Membrane
Disrupts Energy Metabolism



ATP

Cell Wall

ATP Synthesis

DNA Coiling, Transcription, and Translation

Rifampin (1966)

Inhibits RNA synthesis



RNA Polymerase

DNA Gyrase

mRNA

DNA

Ribosome

Protein

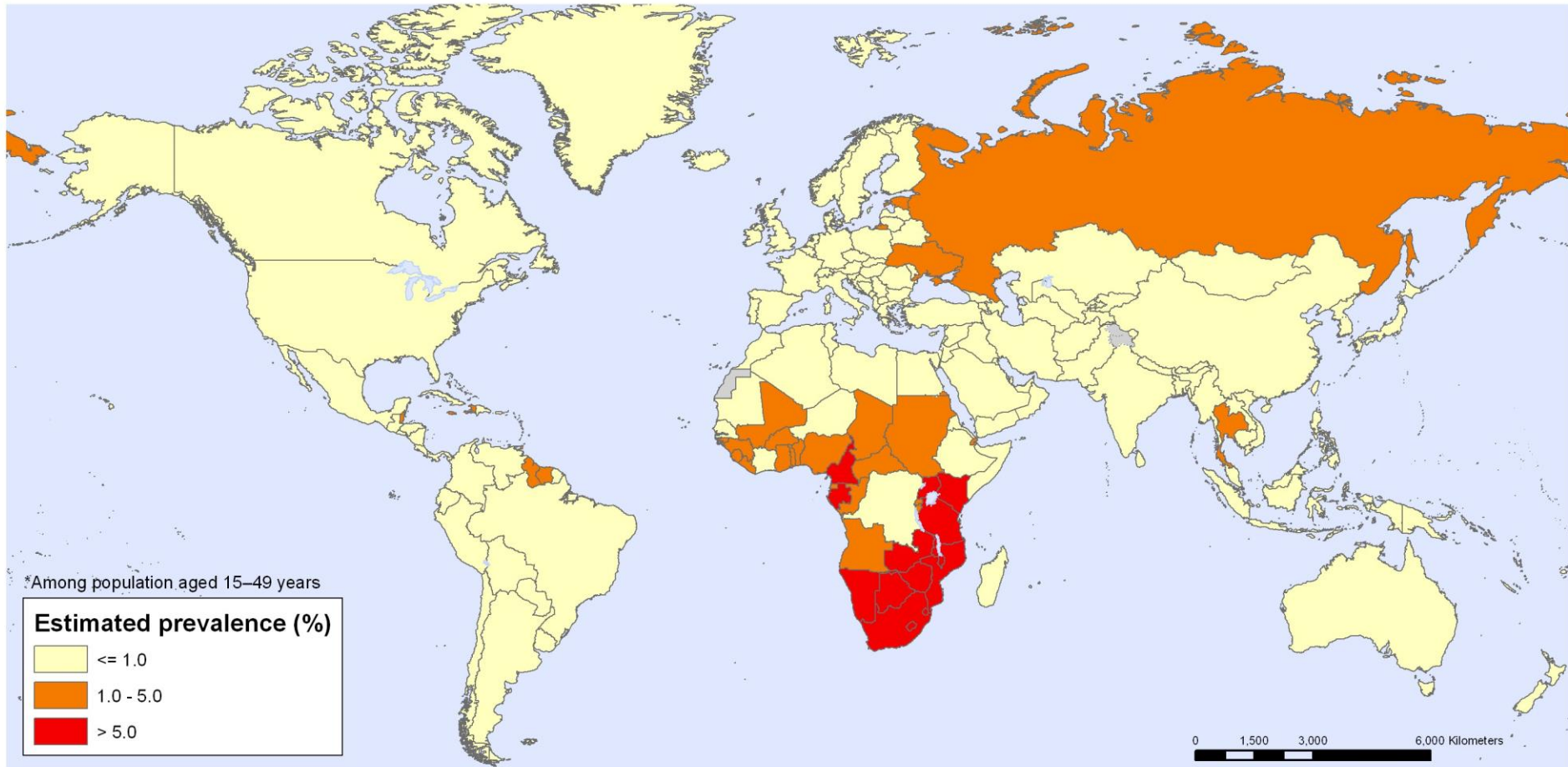
Prevention of TB

- Course of drugs which include isoniazid and rifampicin (cures 95% of patients)
- Contact tracing and subsequent testing
- Vaccination (BCG)
- Testing cattle and pasteurising milk

Acquired Immune Deficiency Syndrome (AIDS)

Pathogen	Human Immunodeficiency Virus
Method of transmission	In semen and vaginal fluids during sexual intercourse, infected blood or blood products, contaminated hypodermic syringes, mother to fetus across placenta, mother to infant in breast milk
Global distribution	Worldwide, especially in sub-Saharan Africa and South-East Asia
Incubation period	Initial incubation a few weeks, but up to ten years or more before symptoms of AIDS may develop
Site of action of pathogen	T helper lymphocytes, macrophages, brain cells
Clinical features	HIV infection – flu-like symptoms and then symptomless; AIDS – opportunistic infections including pneumonia, TB, and cancers; weight loss; diarrhoea, fever, sweating, dementia
Method of diagnosis	Blood test for antibodies to HIV
Estimated total number of people infected with HIV worldwide in 2002	42 million
Estimated number of new cases of HIV infection worldwide in 2002	5 million
Estimated number of deaths from AIDS-related diseases worldwide in 2002	3.1 million (1/3 due to TB)

HIV, estimated prevalence*, 2009

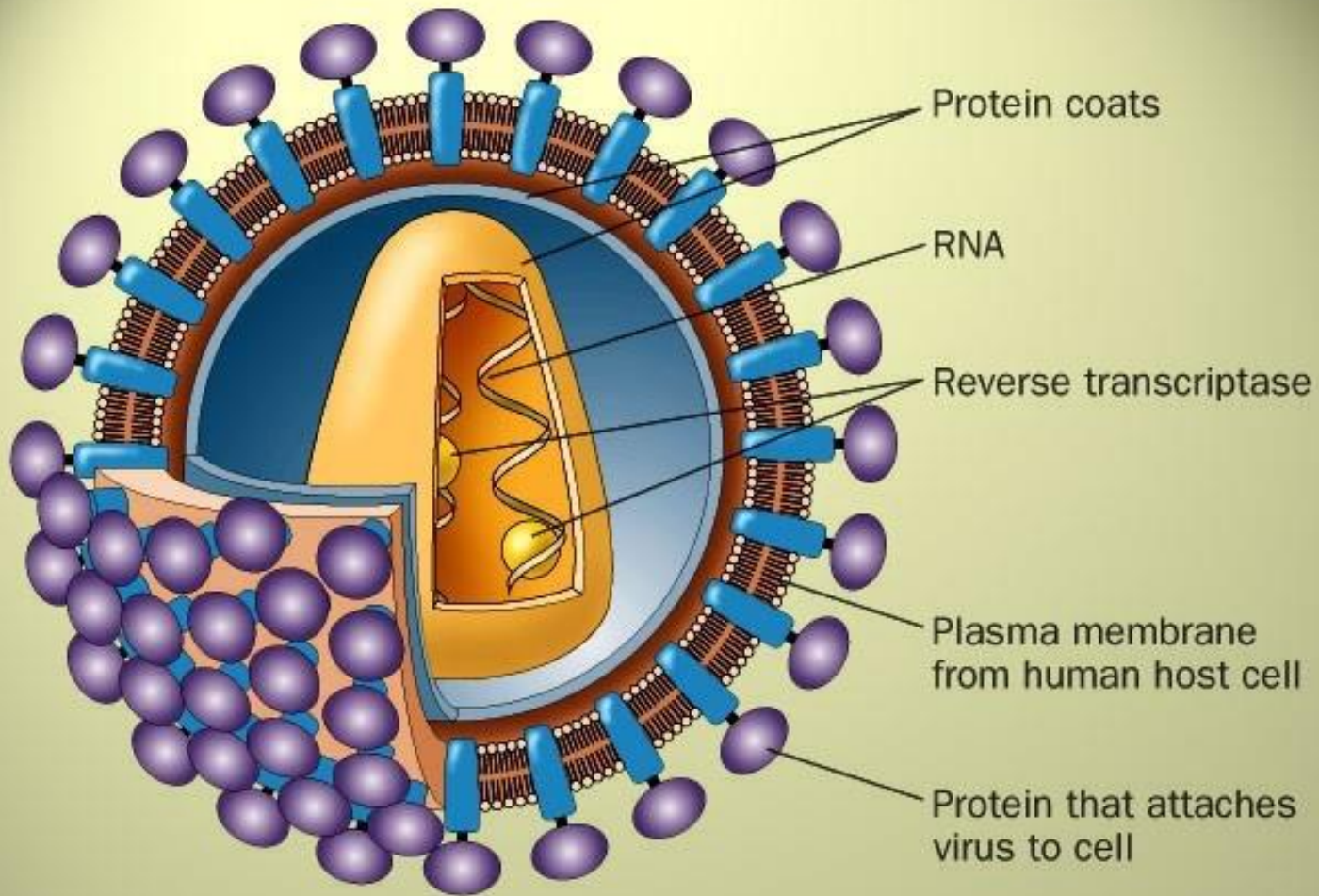


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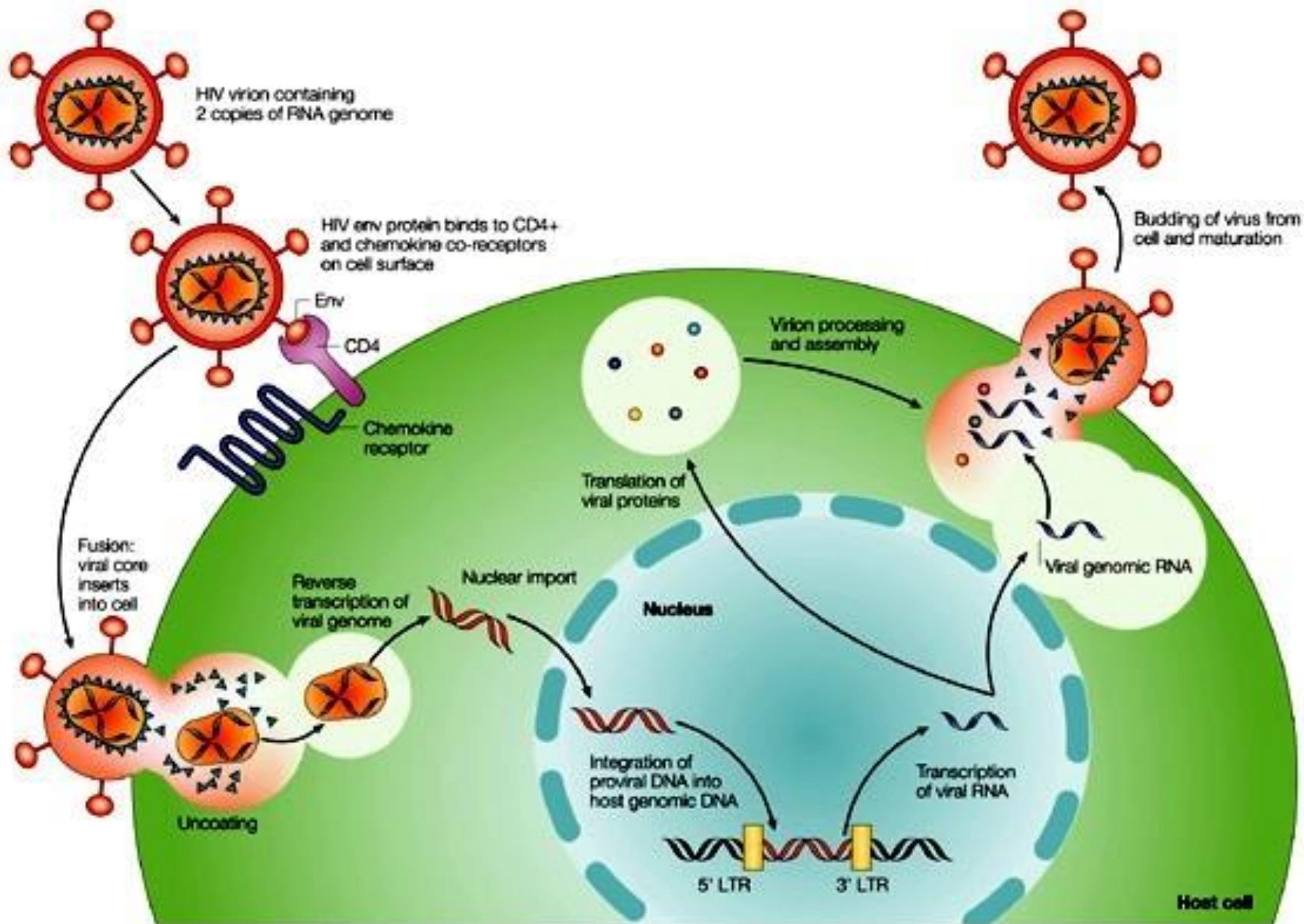
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HIV



HIV virus spread

- No vector (unlike in malaria)
- Virus unable to survive outside the human body (unlike cholera or malaria pathogens)
- Through direct exchange of body fluids (sexual intercourse, blood donation, the sharing of intravenous needles and across the placenta from mother to fetus)
- Male homosexuals practicing anal intercourse
- Having many sexual partners (homosexual and heterosexual)
- Haemophiliacs treated with factor VIII

Statistics in sub-Saharan Africa

- **80% of the world's deaths from AIDS occur in Africa**
- **34 million people are estimated to have been infected with HIV in sub-Saharan Africa since the start of the pandemic and 11.4 million are estimated to have died**
- **One-quarter of the population of Zimbabwe is infected with HIV**
- **Between 20% and 25% of people aged between 15 and 49 in Botswana and Zimbabwe are infected with HIV**
- **5.9 million children are estimated to have been orphaned by AIDS (in some places this is 25% of the population under 15)**
- **Prevalence of HIV among women attending antenatal clinics in Zimbabwe was between 20% and 50% in 1997**
- **A large proportion of women in Rwanda are HIV positive following the use of rape as a genocidal weapon in the civil war of the early 1990s**
- **The average life expectancy in South Africa dropped from 65 to 55 during 1995-1999**

Opportunistic infections that develop to create AIDS

- Oral thrush – *Candida albicans* (fungi)
- Pneumonia – *Pneumocystis carinii* (fungi)
- Skin cancer (Kaposi's sarcoma) – herpes-like virus
- Cancers of internal organs
- Degenerative diseases of the brains (Dementias)



- No cure!
- No vaccine!
- 2 or more drugs prevent the replication of virus inside host cells
- Drugs are similar to DNA nucleotides – e.g. Zidovudine
- Drug therapy slows down the onset of AIDS but have side effects:
 - Temporary (rashes, headaches, diarrhoea)
 - Severe and permanent (nerve damage, abnormal fat distribution)