

Nutrition, immunity, and poverty in the control of infectious diseases

UChicago Center in Paris

Paris, France

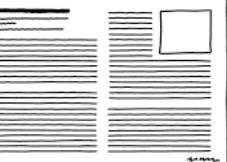
January 2024

TYPES OF SCIENTIFIC PAPER

WE PUT A CAMERA
SOMEWHERE NEW



HEY, I FOUND A TROVE
OF OLD RECORDS! THEY
DON'T TURN OUT TO BE
PARTICULARLY USEFUL,
BUT STILL, COOL!



MY COLLEAGUE IS
WRONG AND I CAN
FINALLY PROVE IT



THE IMMUNE SYSTEM
IS AT IT AGAIN



WE FIGURED OUT HOW
TO MAKE THIS EXOTIC
MATERIAL, SO EMAIL
US IF YOU NEED SOME



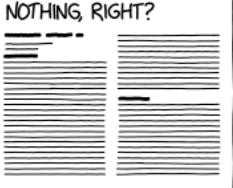
WHAT ARE FISH EVEN
DOING DOWN THERE



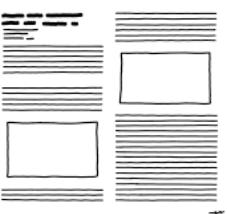
THIS TASK I HAD TO DO
ANYWAY TURNED OUT
TO BE HARD ENOUGH
FOR ITS OWN PAPER



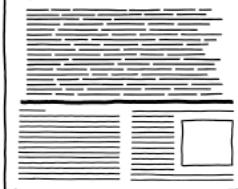
HEY, AT LEAST WE
SHOWED THAT THIS
METHOD CAN PRODUCE
RESULTS! THAT'S NOT
NOTHING, RIGHT?



CHECK OUT THIS WEIRD
THING ONE OF US SAW
WHILE OUT FOR A WALK



WE ARE 500 SCIENTISTS
AND HERE'S WHAT WE'VE
BEEN UP TO FOR THE
LAST 10 YEARS



SOME THOUGHTS ON
HOW EVERYONE ELSE
IS BAD AT RESEARCH



WE SCANNED SOME
UNDERGRADUATES

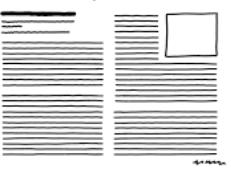


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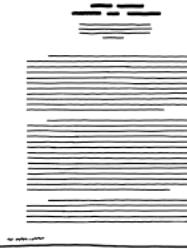
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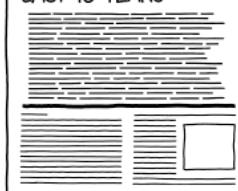
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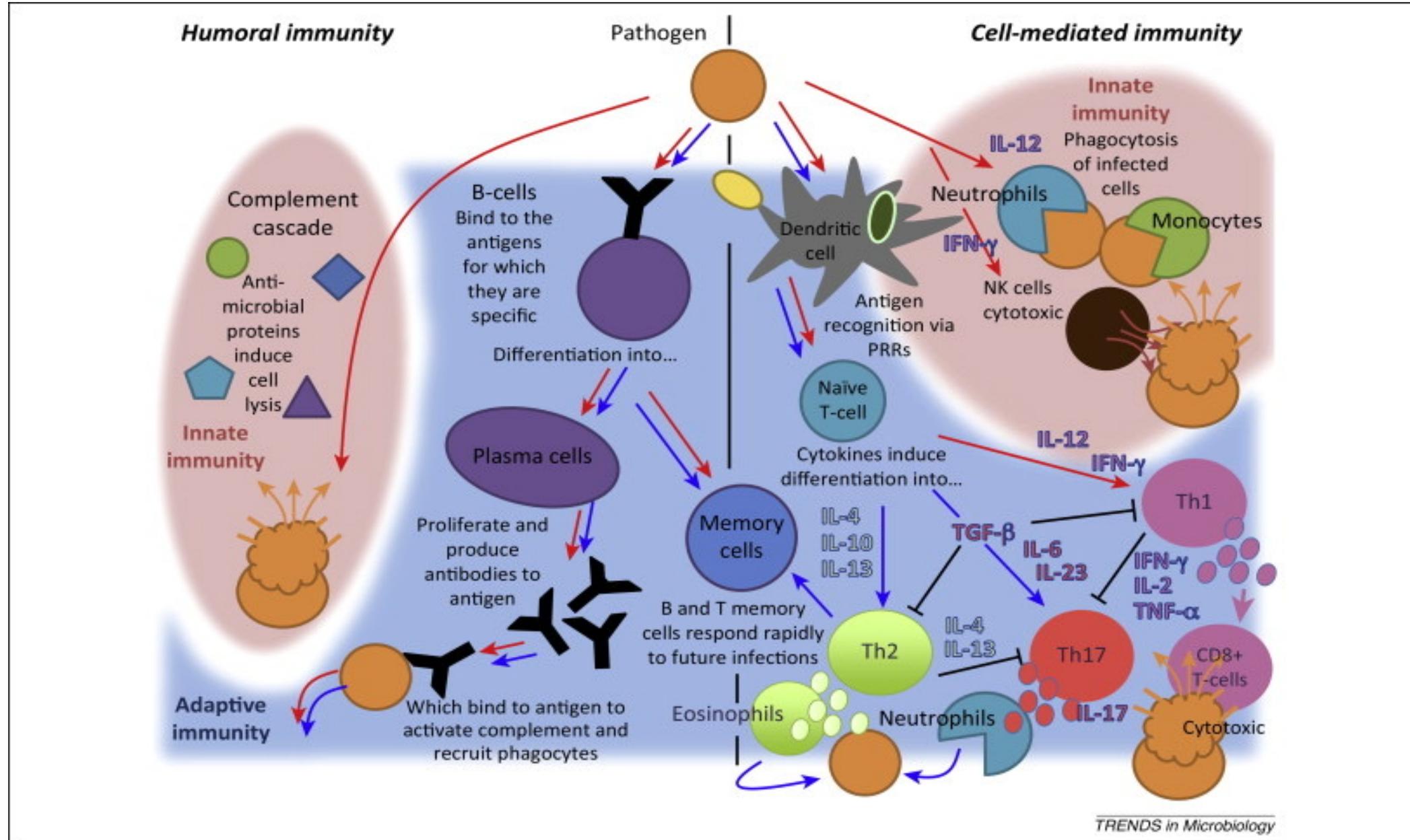
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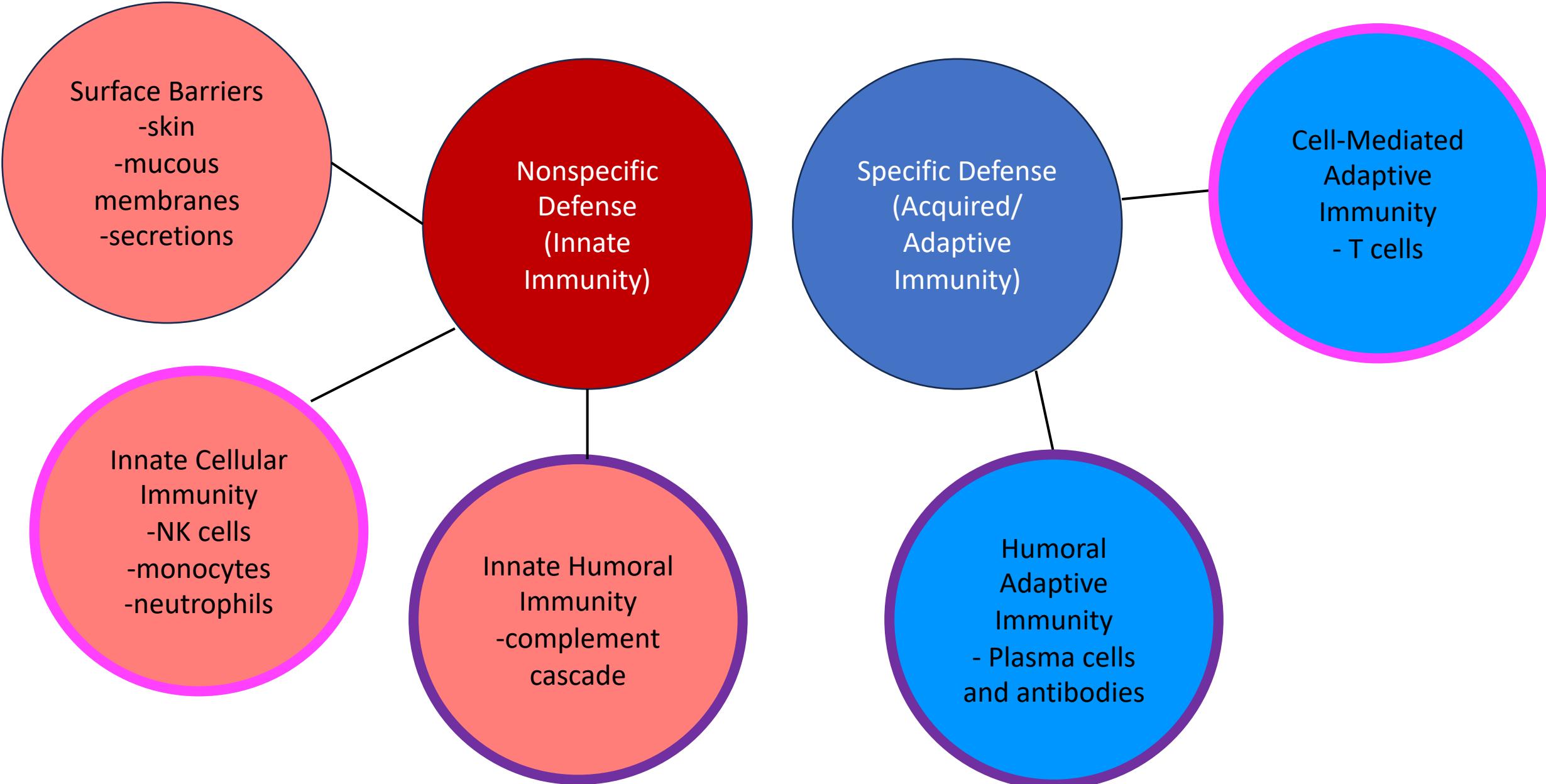
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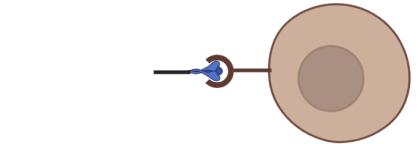
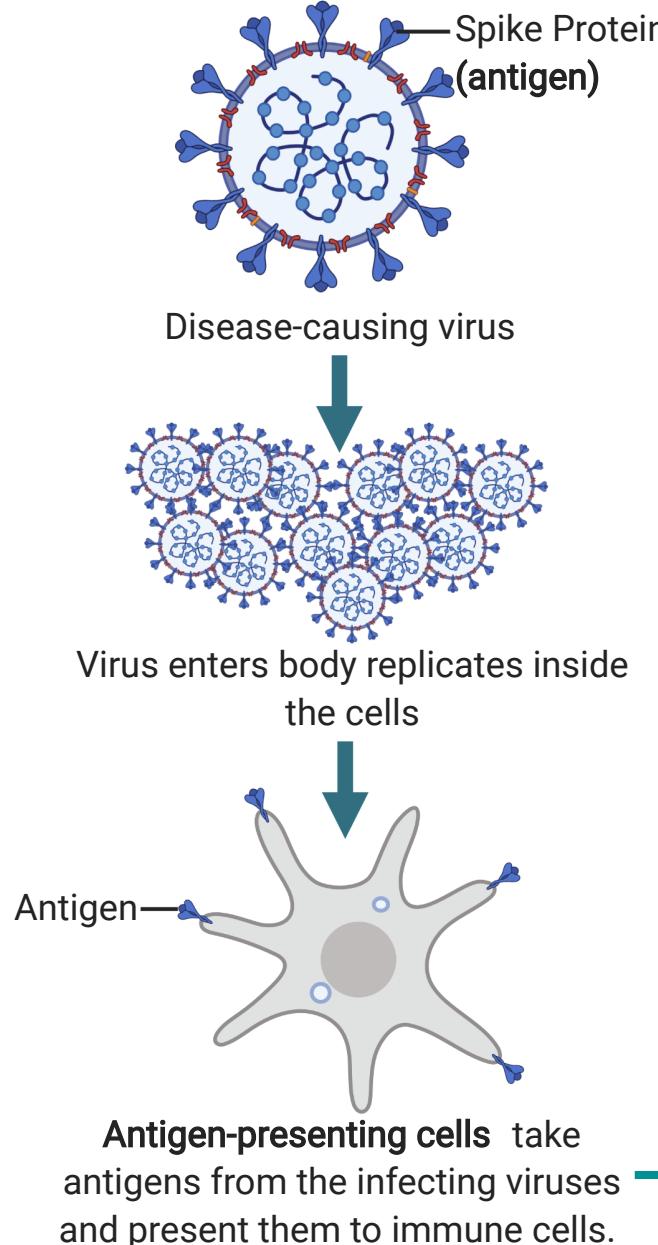
Basic Overview of the Immune System



Basic Overview of the Immune System



Basic COVID Immune Response



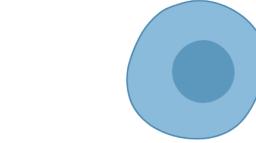
This teaches “helper” CD4+ T-cells to recognize the antigen

CELL-MEDIATED IMMUNITY



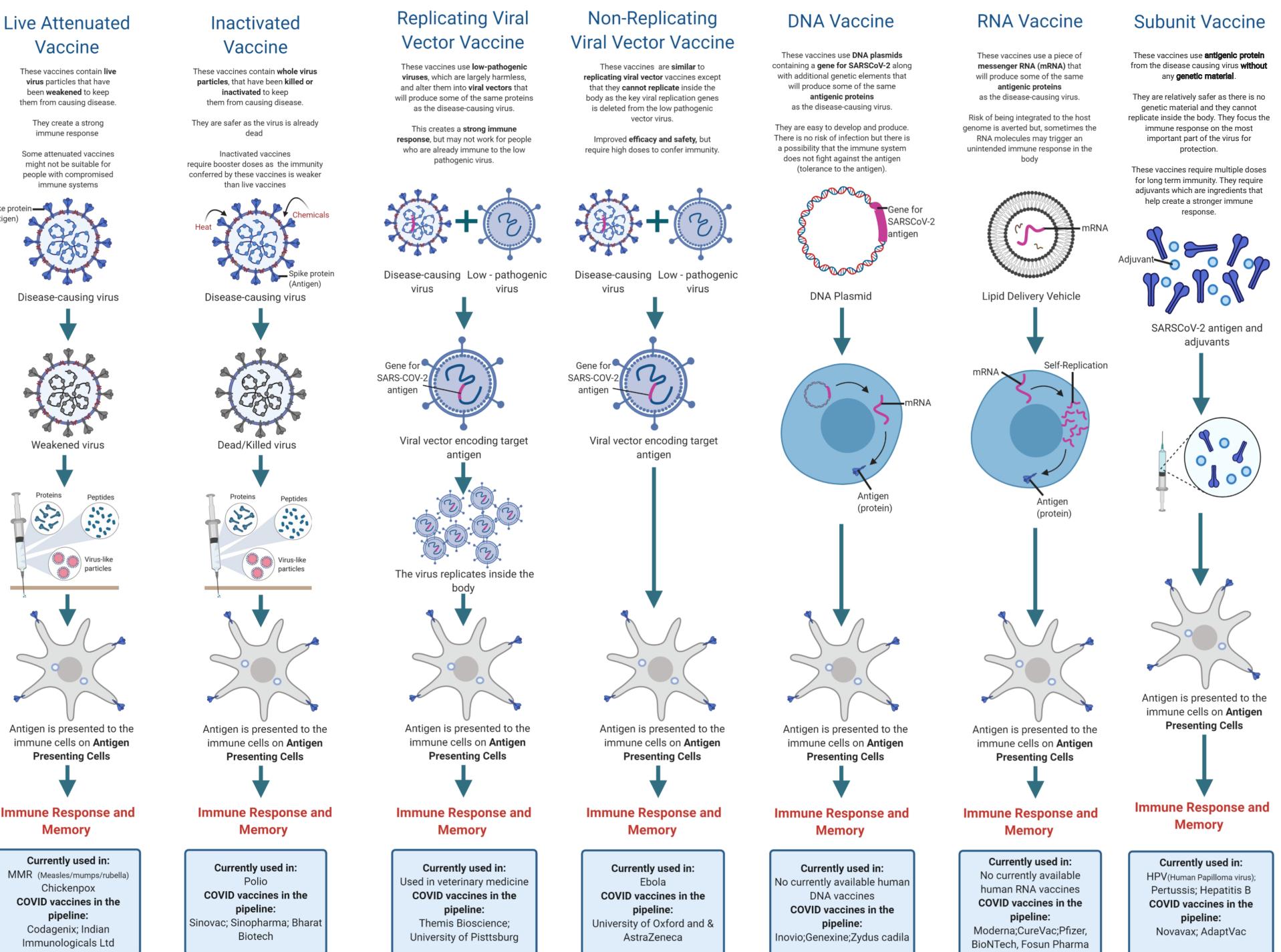
Cytotoxic or “killer” CD8+ T-cells produce and release cytotoxins, which kill infected cells.

ANTIBODY-MEDIATED IMMUNITY



B-cells produce antibodies, which can neutralize virus

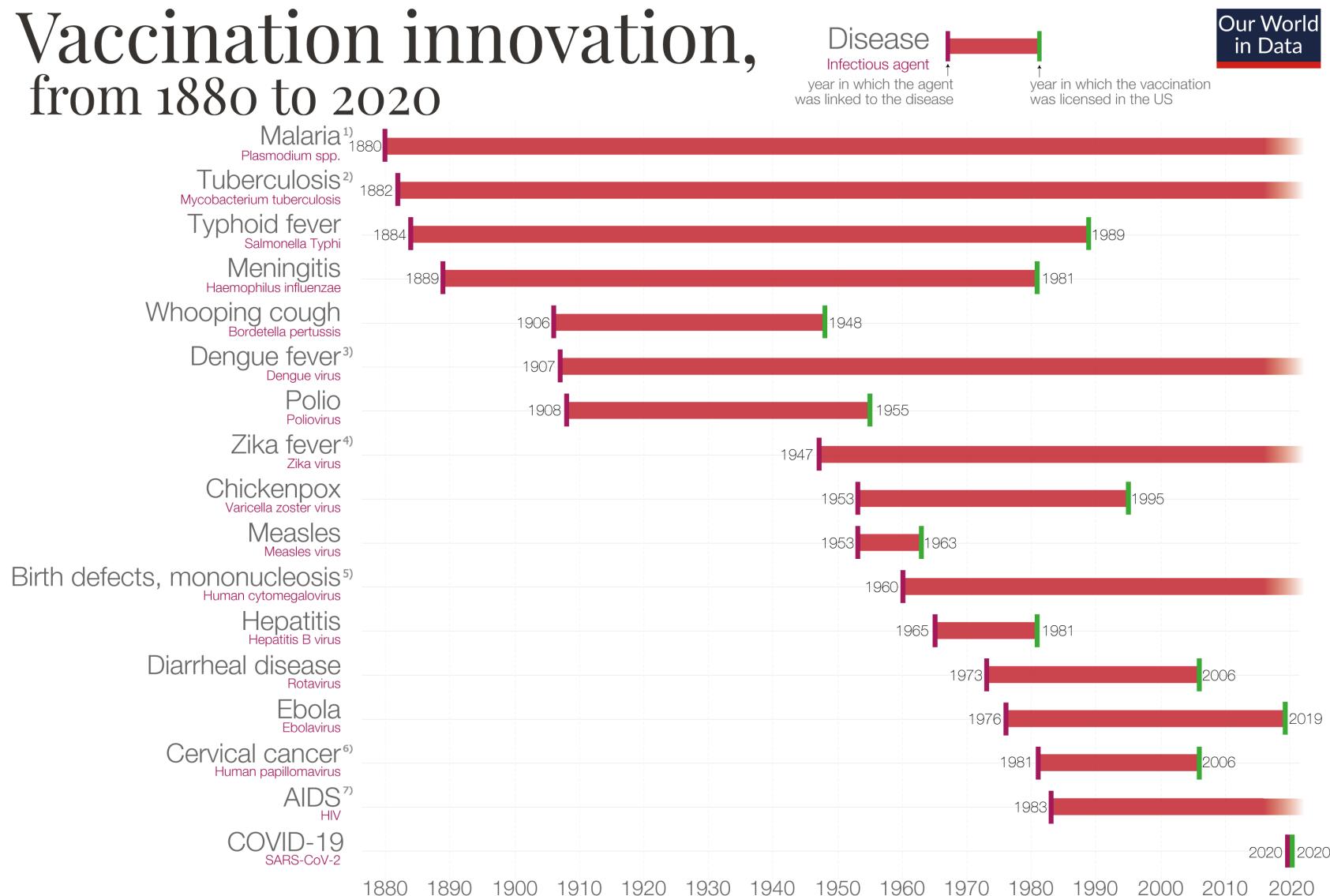
TYPES OF VACCINES



@epiCOVIDcorps

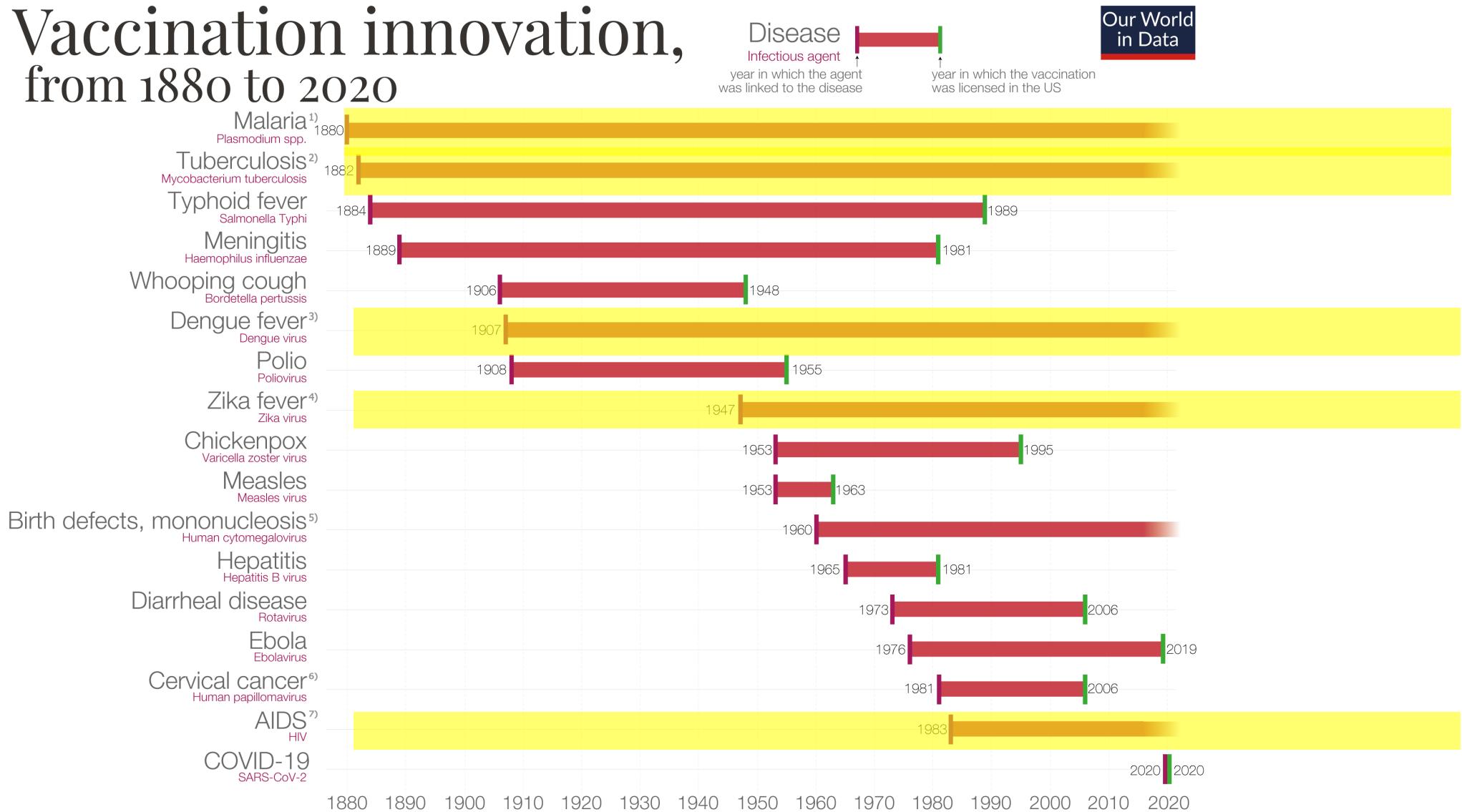
The pace of vaccine development has accelerated drastically

Vaccination innovation, from 1880 to 2020



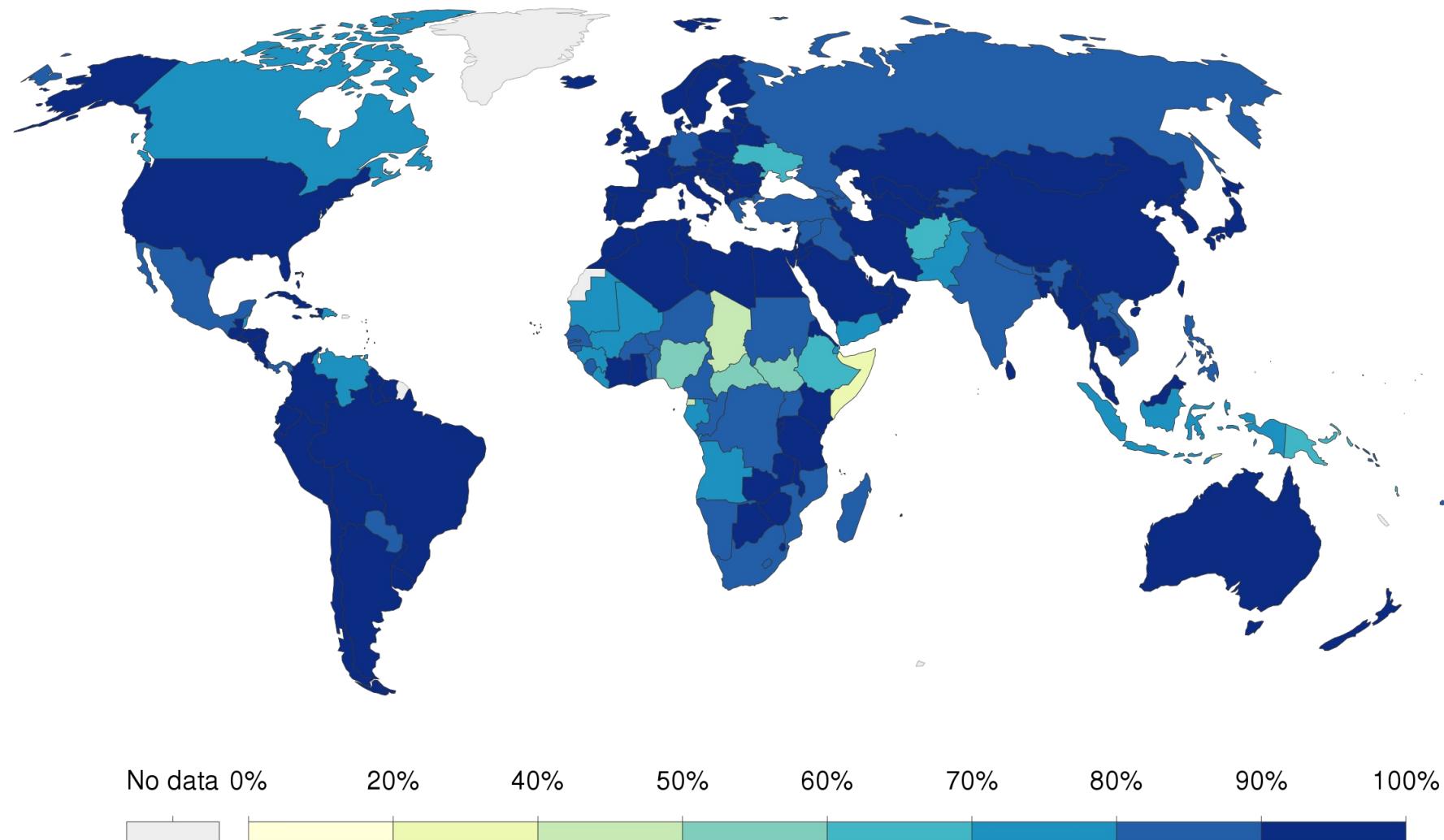
But we still lack vaccines for several important diseases.

Vaccination innovation, from 1880 to 2020



Share of children who receive key vaccines in target populations, 2016

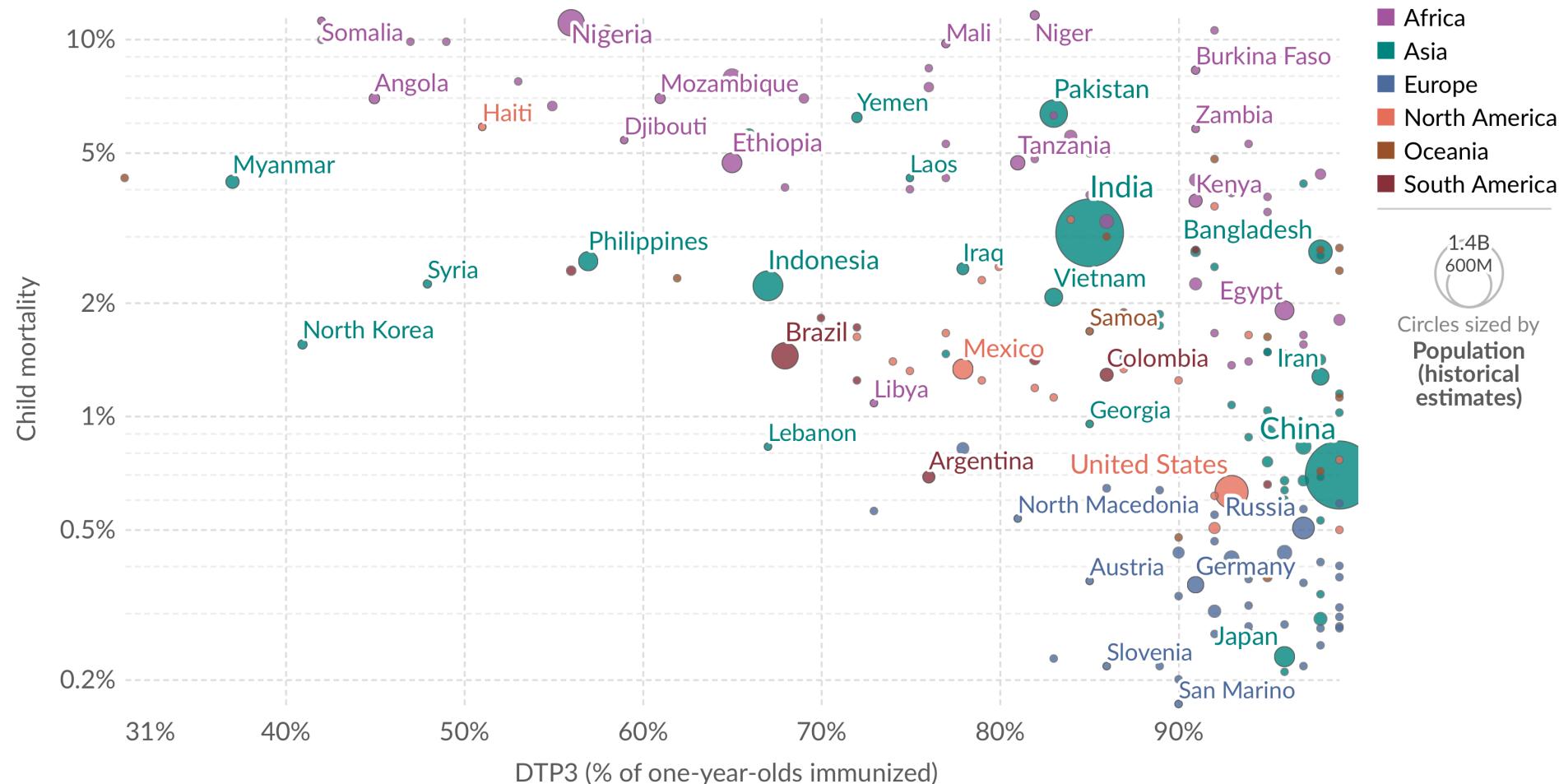
Share of children of the relevant age category who receive the seven key vaccines, conditional on inclusion in national vaccine schedules. The eight vaccines include DPT3, measles, polio, Hep3B, Haemophilus influenzae type b, pneumococcal conjugate vaccine, and rotavirus vaccine.



Child mortality vs. share of children immunized against diphtheria, pertussis, and tetanus, 2021

Our World
in Data

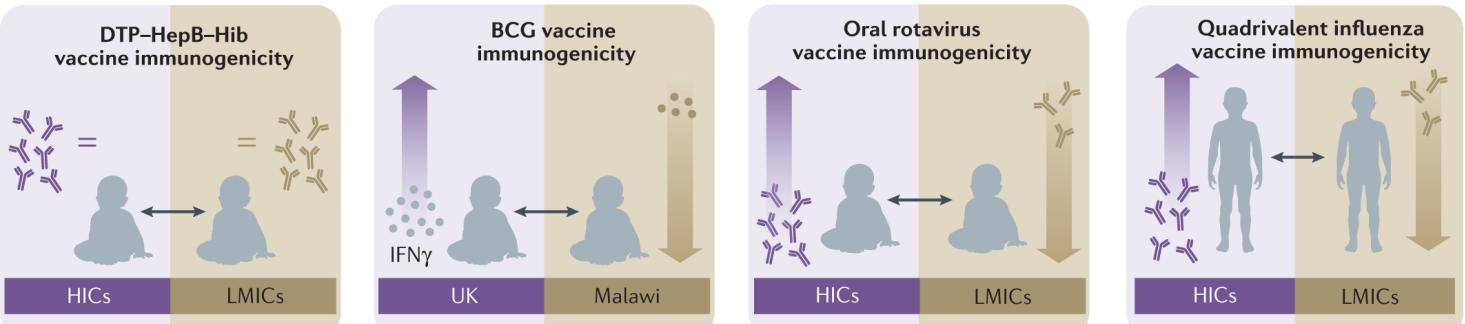
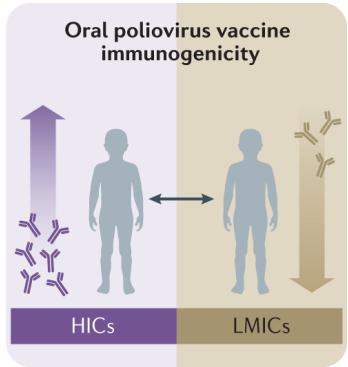
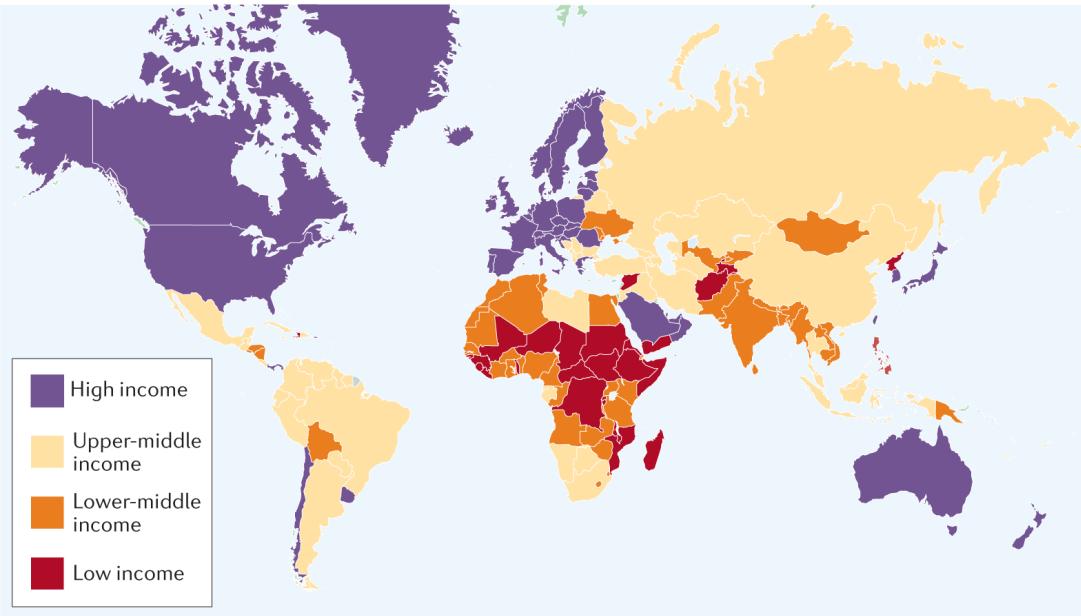
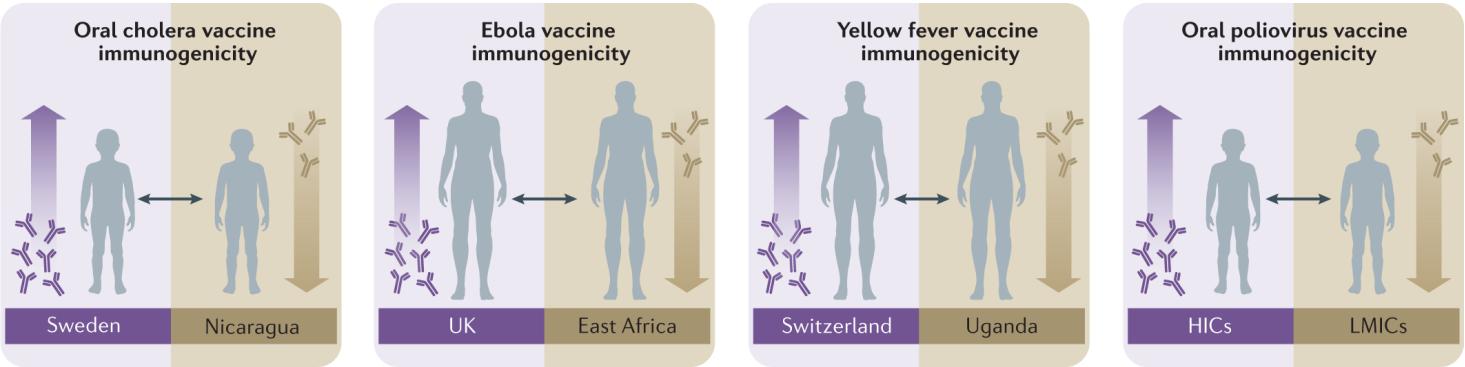
Share of children (12-23 months) that are immunized against diphtheria, pertussis, and tetanus (DPT), versus the share of newborns who die before reaching the age of 5.



Nutrition and immunity

Nutrients known to be critical for the growth and function of immune cells:

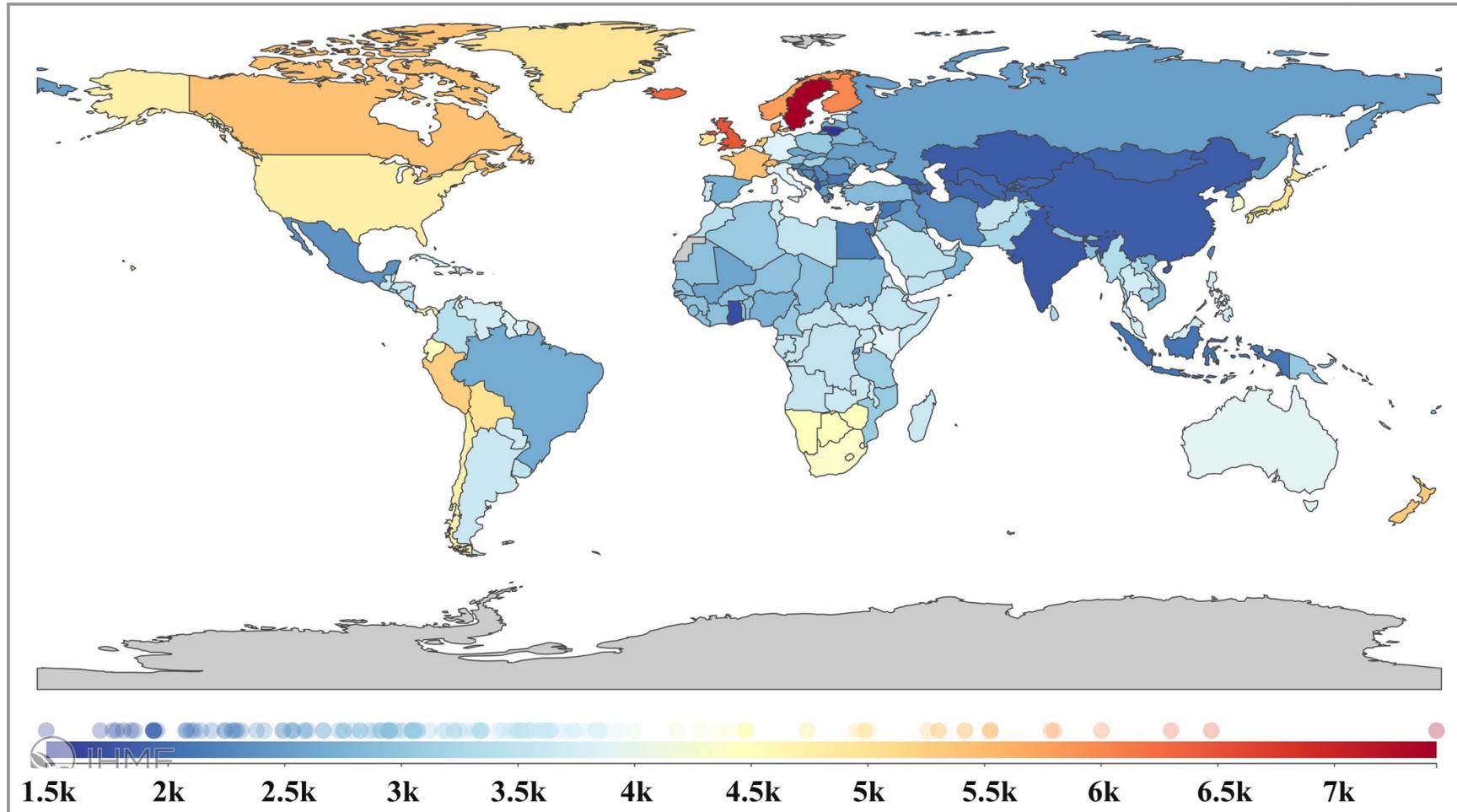
- Vitamin C
- Vitamin D
- Zinc
- Selenium
- Iron
- Protein



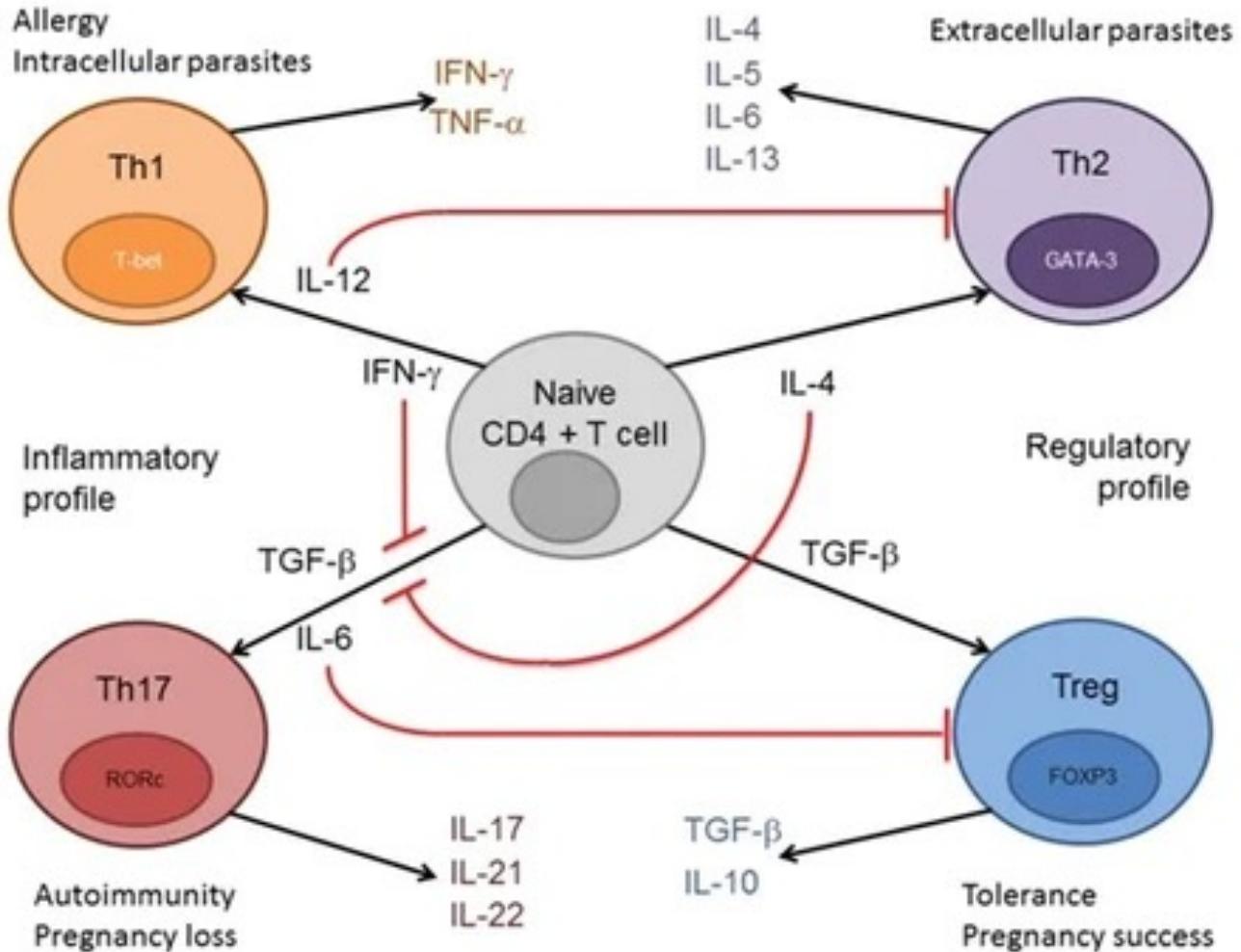
The flip side of robust immunity



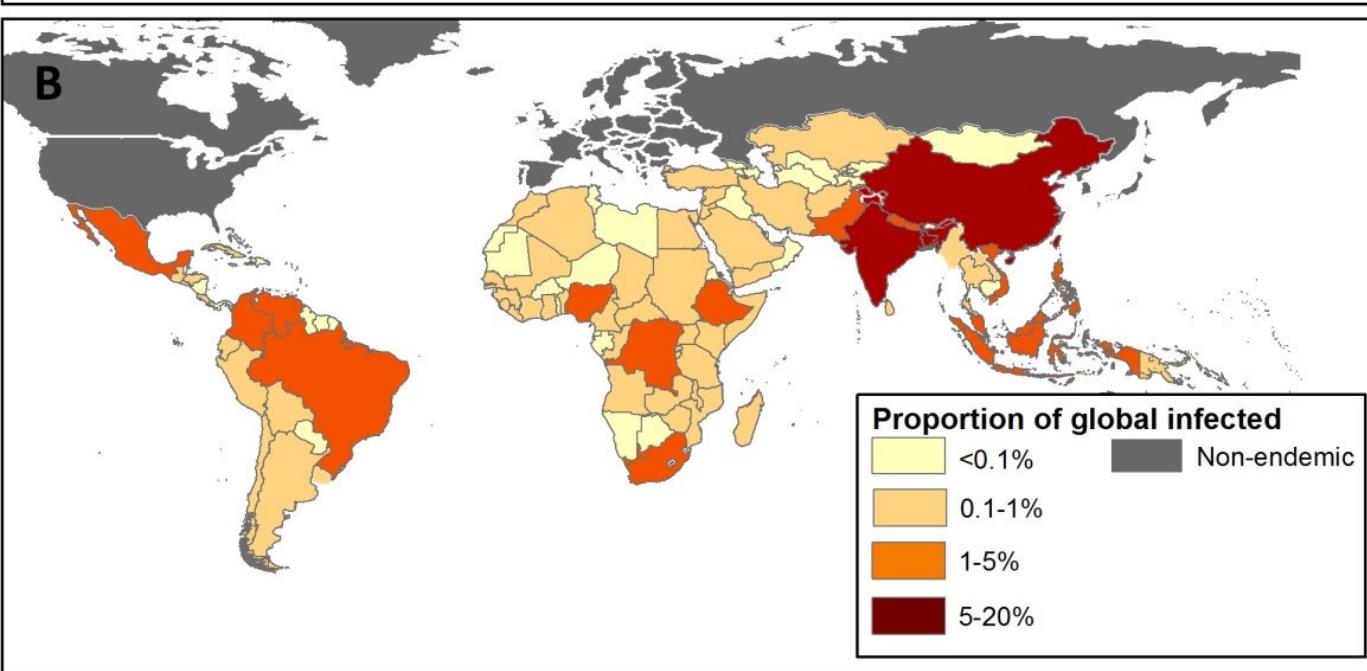
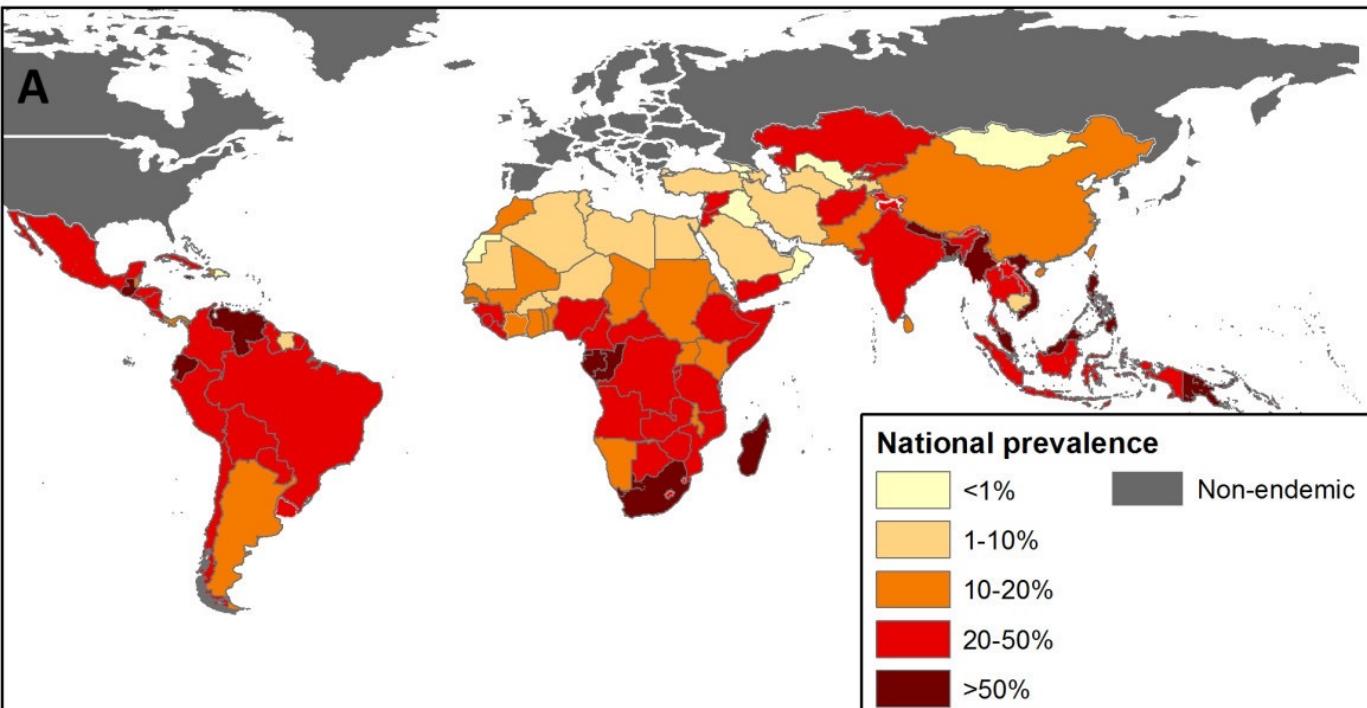
Global Burden of Atopic Dermatitis



Th1 vs Th2 Immunity

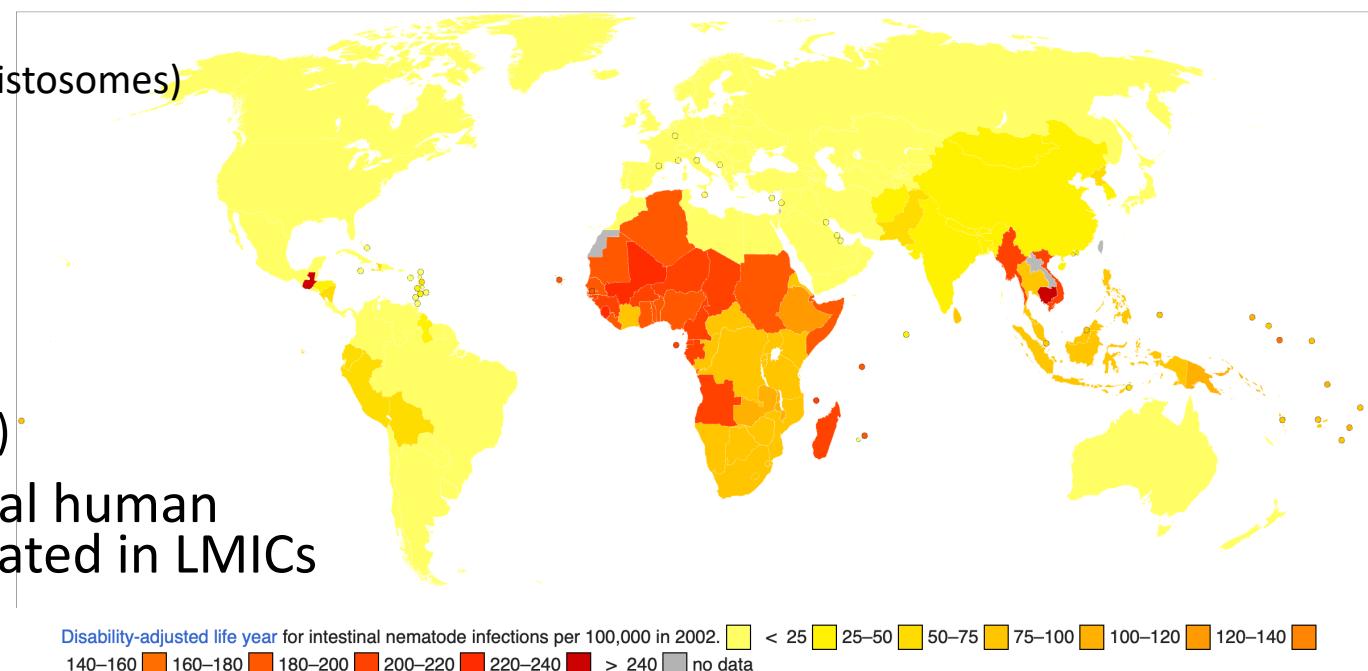
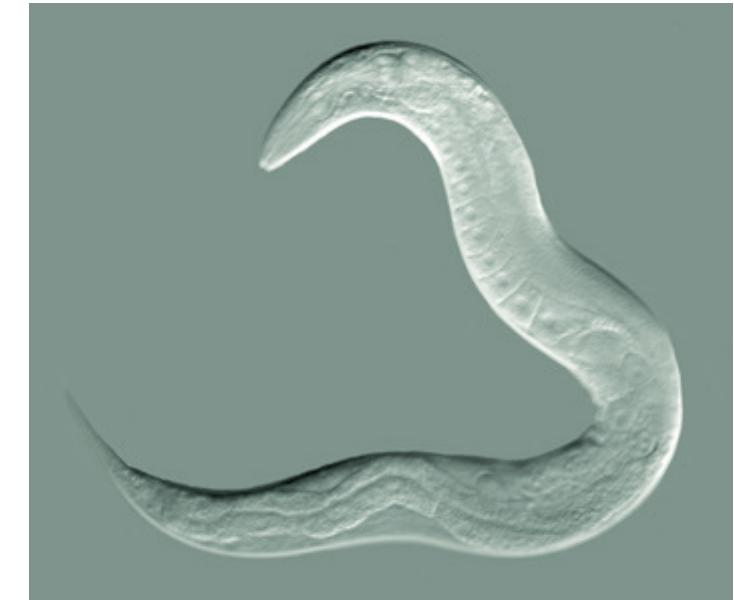


Global burden of soil transmitted helminth infections



Helminths (parasitic worms)

- Macroparasites, most soil-transmitted, infect GI tract
- Not necessarily phylogenetically related
- 4 major phyla:
 - Annelida (ringed or segmented worms)
 - Platyhelminthes (flatworms)
 - Cestodes (tapeworms)
 - Trematodes (flukes and blood flukes = schistosomes)
 - Nematoda (roundworms)
 - Ascaris (largely commensal)
 - Hookworm (pathogenic)
 - Filarias (pathogenic)
 - Pinworm(largely commensal)
 - Whipworm (pathogenic)
 - Acanthocephala (thorny-headed worms)
- Helminths infect up to 50% of the global human population, though burden is concentrated in LMICs

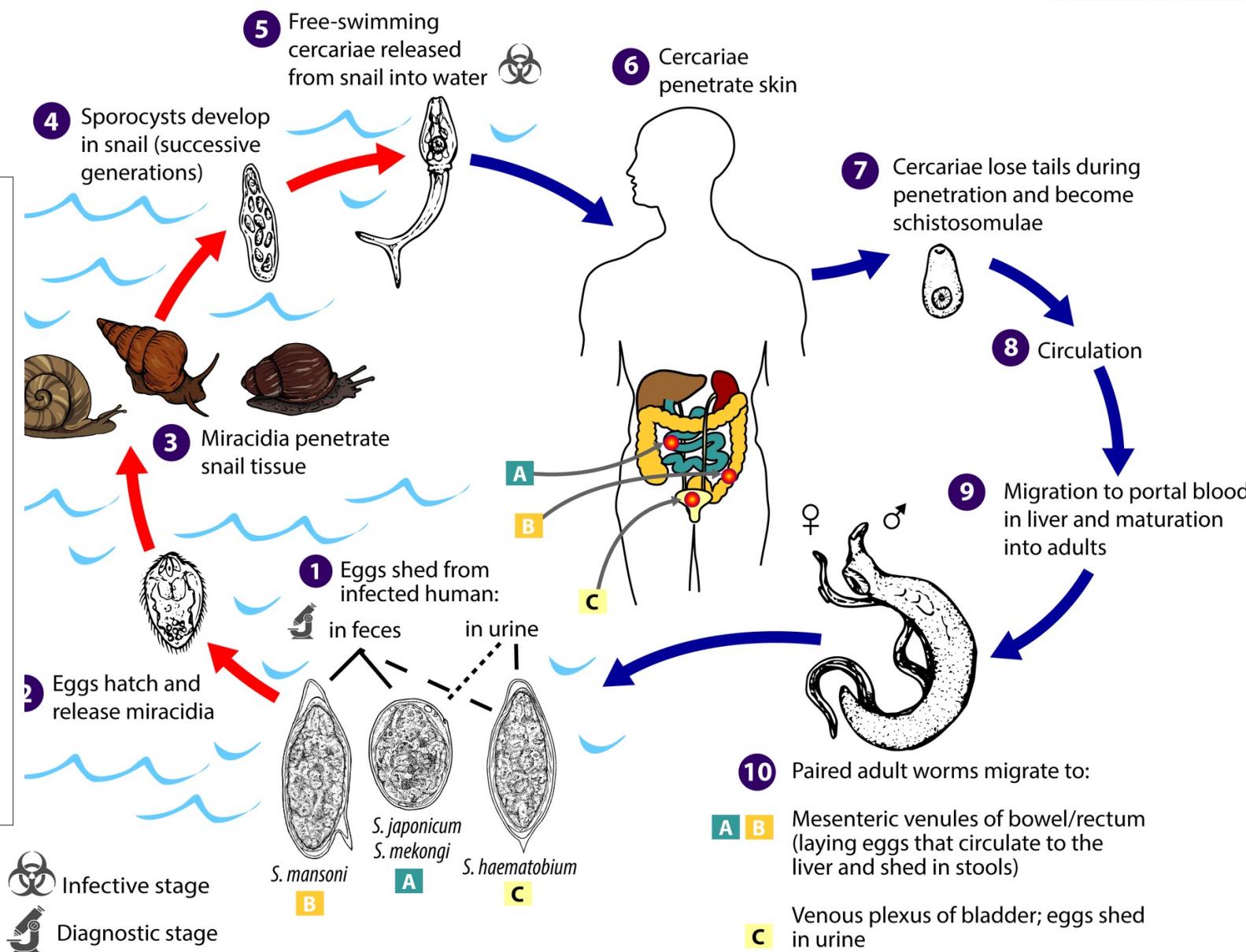
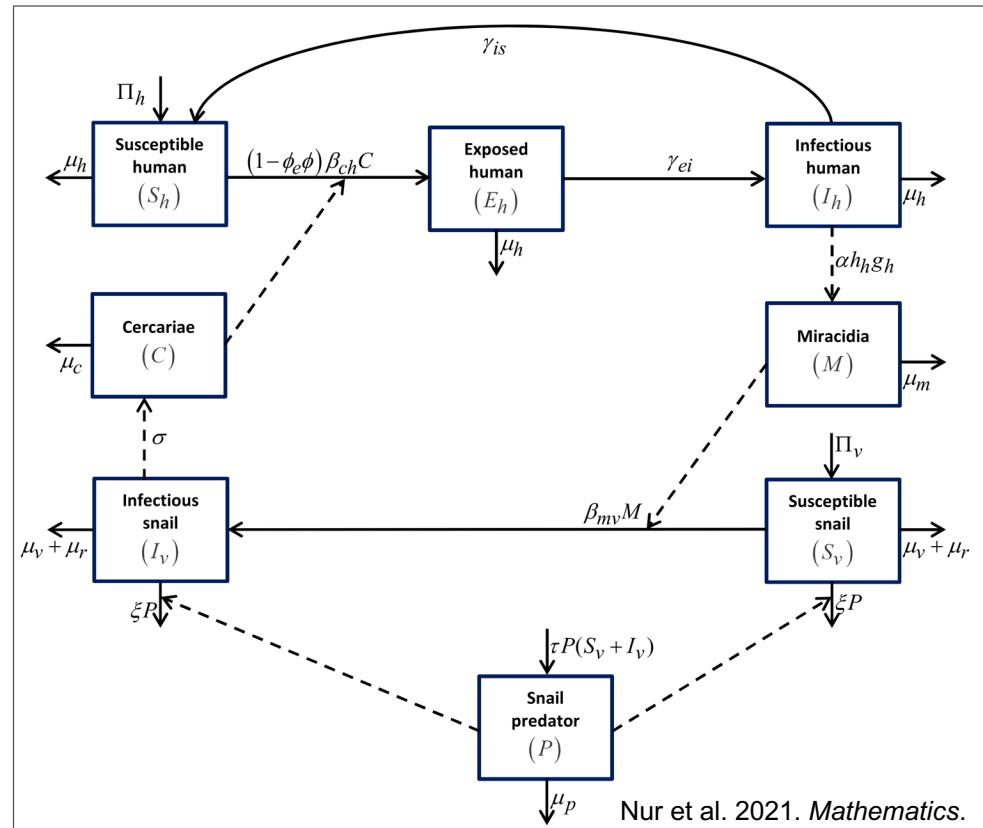


Schistosomiasis

- Snail fever, bilharzia, Katayama fever
- First infection characterized by rash as cercariae migrate into the body
- Later can be very painful as adult worms migrate through muscle tissue (can take years). Also can be inflammatory reactions as adults lay eggs. Adult schistosomes undergo sexual reproduction in the human host.
- Intestinal schistosomiasis occurs when eggs become lodged in intestinal wall, leading to blood loss, bloody stool, colon obstruction, resulting in abdominal distention
- In 2010, approximately 238 million people were infected with schistosomiasis, 85% in Africa
- Causes between 12-200,000 deaths annually, making it the most deadly of the **neglected tropical diseases** (contrast with HIV/AIDS, TB, malaria)



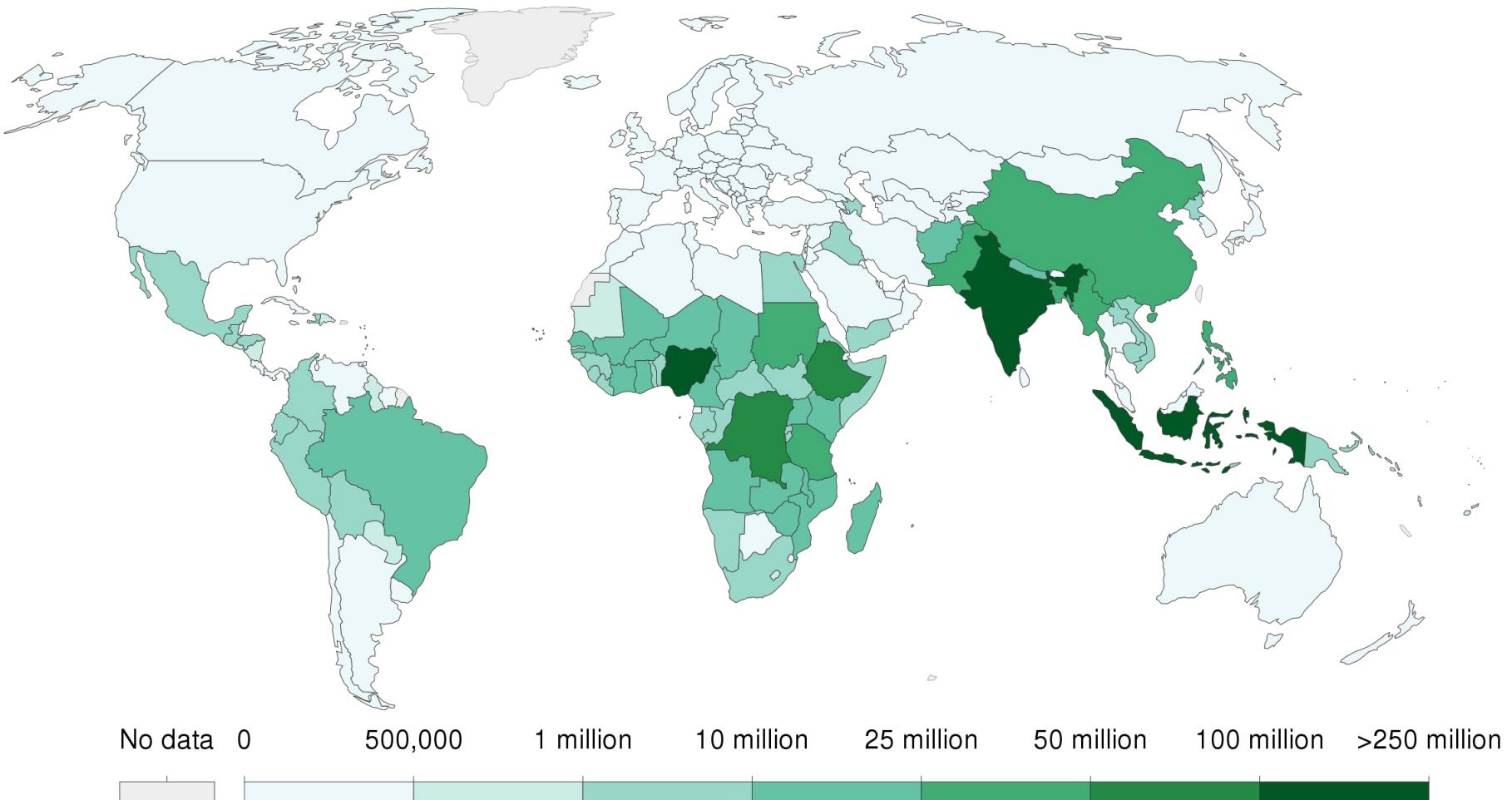
Modeling schistosomiasis



Global Burden of NTDs

Number of people requiring interventions against neglected tropical diseases (NTDs), 2015

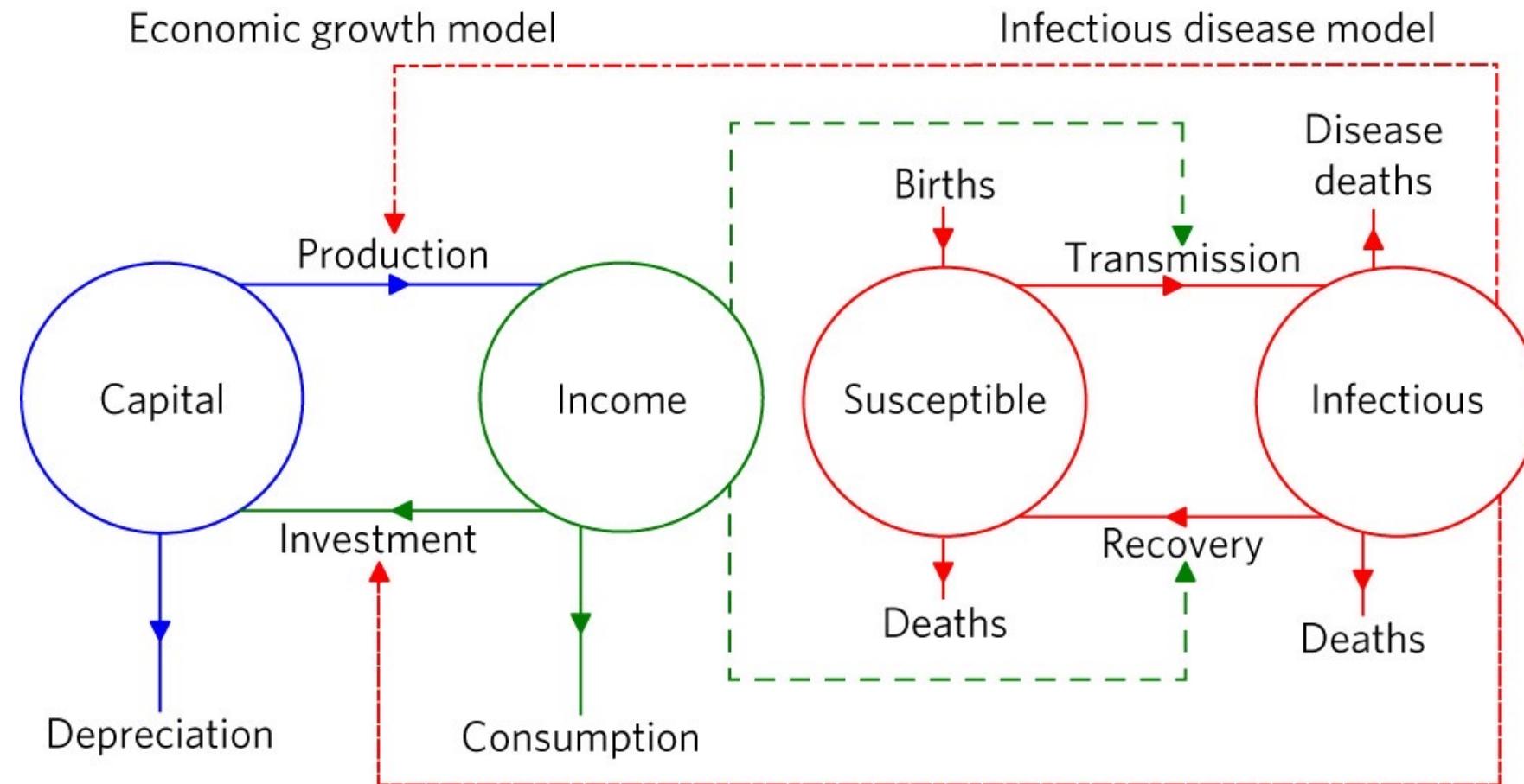
People requiring interventions against neglected tropical diseases (NTDs). SDG Target 3.3 is to end neglected tropical diseases NTDs by 2030.



Source: WHO, Global Health Observatory

Note: 15 NTDs identified by the WHO NTD Roadmap are: Buruli ulcer, Chagas disease, Dengue and Chikungunya, Dracunculiasis (guinea-worm disease), Echinococcosis, Foodborne trematodiases, Human African trypanosomiasis (sleeping sickness), Leishmaniasis, Leprosy (Hansen's disease), Lymphatic filariasis, Mycetoma, chromoblastomycosis and other deep mycoses, Onchocerciasis (river blindness), Rabies, Scabies, Schistosomiasis, Soil-transmitted helminthiases, Snakebite envenoming, Taeniasis/Cysticercosis, Trachoma, Yaws.

Poverty trap models of coupled social-ecological systems





Breaking cycles of poverty and disease

