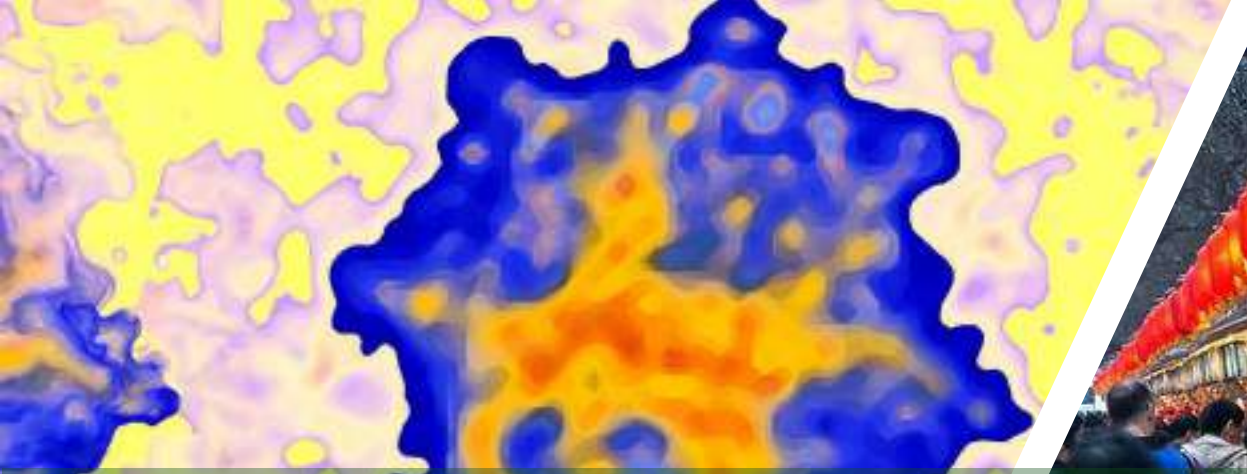
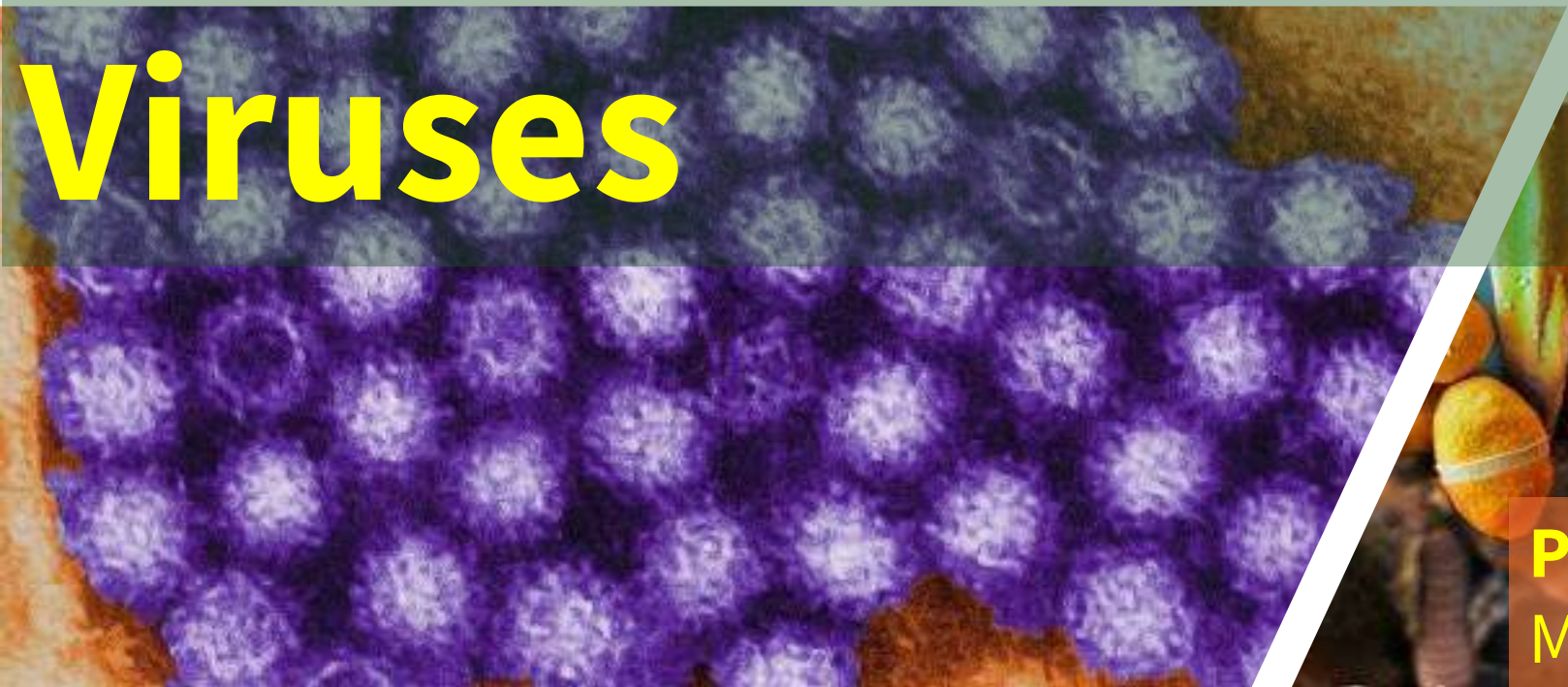


Emerging Foodborne Viruses



Prof. David Rodríguez Lázaro
Microbiology Division

- **Market of packaged foods**
  > $3 Trillons in 2020

- **Global Prod, 2020: 337 M Tm**
  (↑TOP 45%)
  Pig: 111 M Tm
  Beef: 59 M Tm
  Chicken: 118 M Tm

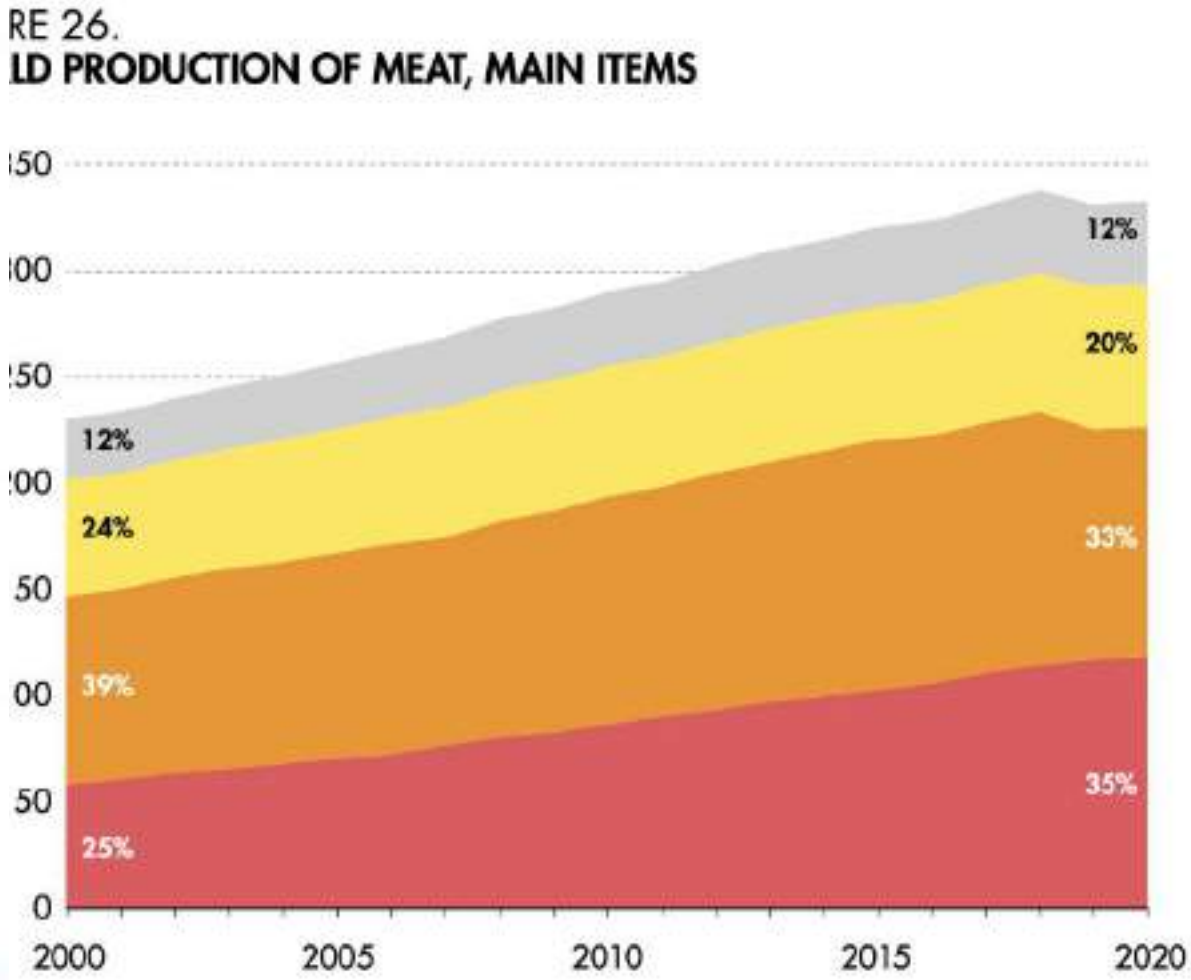
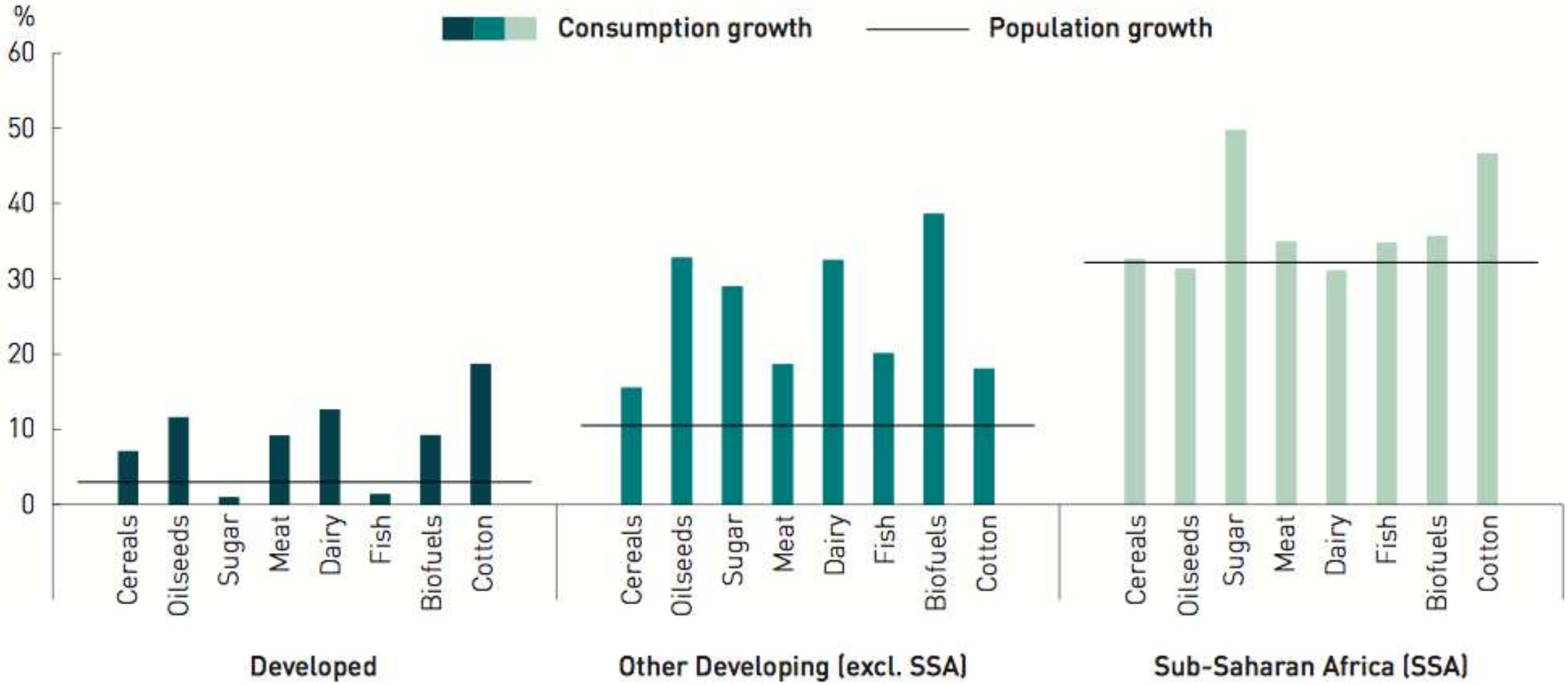


Figure 1. Consumption growth by region (2025 vs. 2013-15)

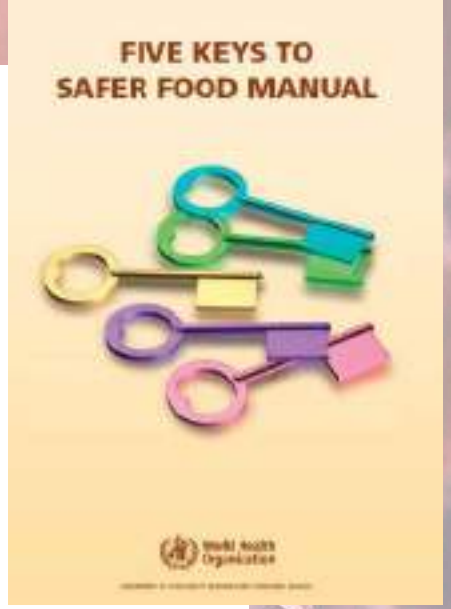


OECD

Food and Agriculture Organization of the United Nations

World Health Organization

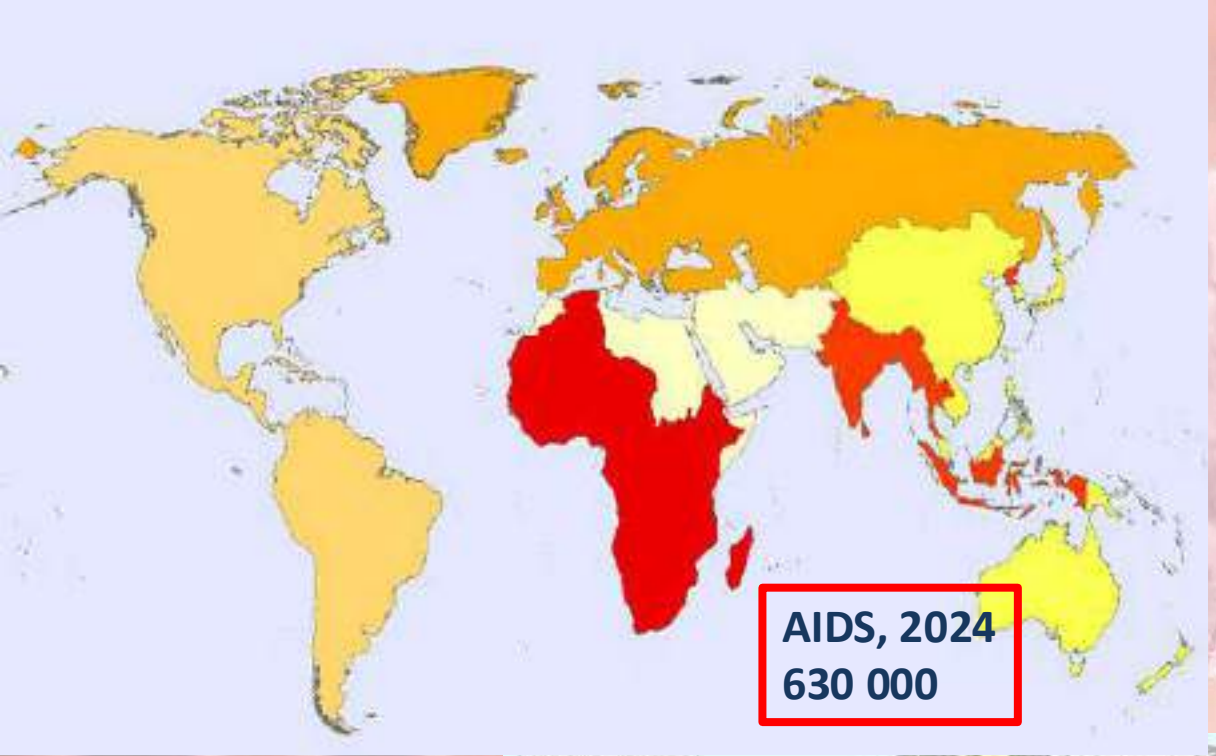
Food safety is a significant public health issue

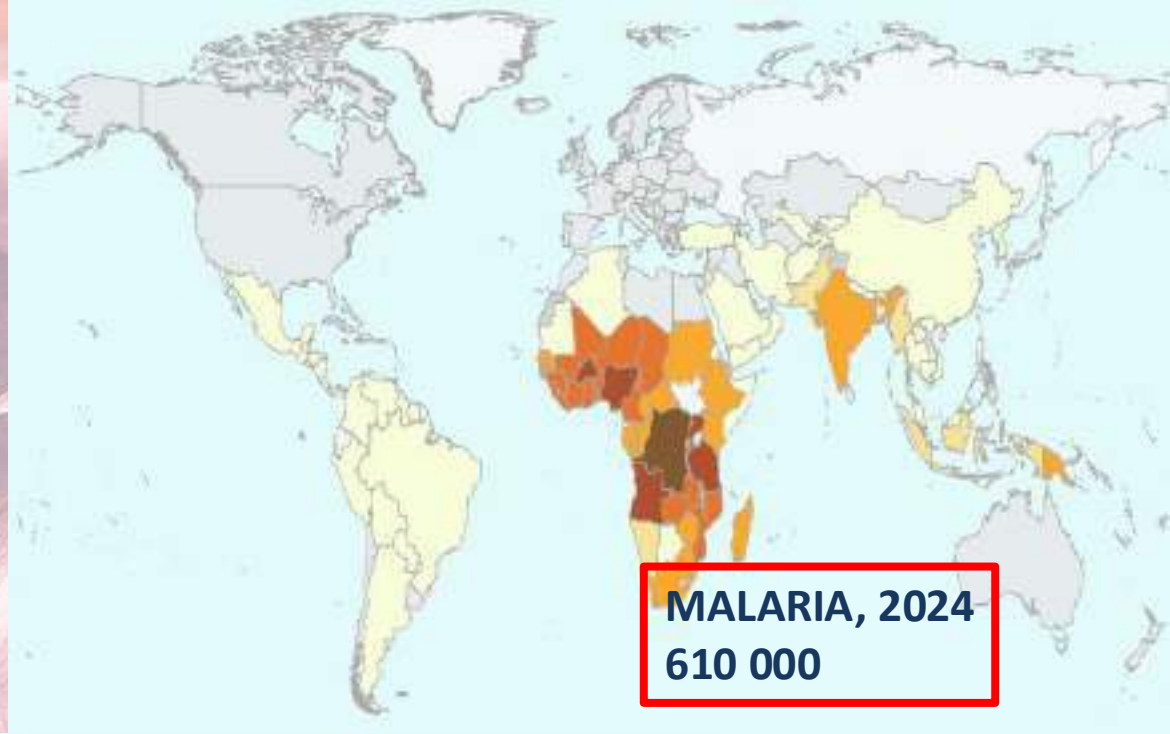


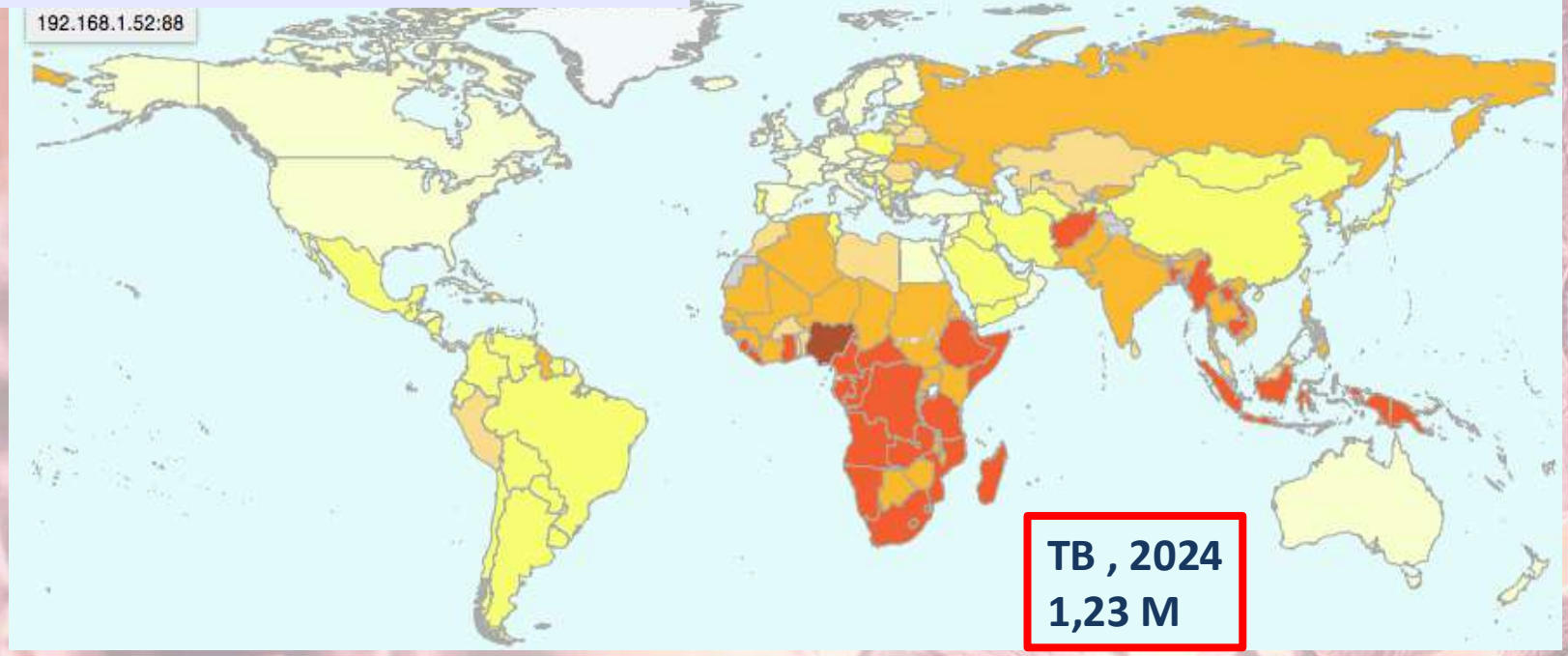
Unsafe food has been a human health problem since history was first recorded, and many food safety problems encountered today are not new. Although governments all over the world are doing their best to improve the safety of the food supply, the occurrence of foodborne disease remains a significant health issue in both developed and developing countries.

It has been estimated that each year 1.8 million people die as a result of diarrhoeal diseases and most of these cases can be attributed to contaminated food or water. Proper food preparation can prevent most foodborne diseases.

More than 200 known diseases are transmitted through food.[1]







World Health Organization

- **1.7 billion cases** of diarrhoeal disease every year (WHO)
- **200 M people** have GI disease at any point in time
- In a day, they will produce **≅ 60 000 000 litres** of diarrhoea
- Equivalent to all the water passing over Victoria Falls in 1 min

CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD

Table 2. Estimated annual number of episodes of domestically acquired foodborn

Pathogen	Multipliers: Laboratory confirmed	Multipliers: Under-reporting	Multipliers: Under-diagnosis	Trave related %	Foodborne, %†	Domestically acquired foodborne, mean (90% credible interval)
Bacteria						
Bacillus cereus, foodborne	85‡	25.5	29.3	<1	100	63,400 (15,719–147,354)
Brucella spp.	120§	1.1	15.2	16	50	839 (533–1,262)
Campylobacter spp.	43,696¶	1.0	30.3	20	80	845,024 (337,031–1,611,083)
Clostridium botulinum, foodborne	25§	1.1	2.0	<1	100	55 (34–91)
Clostridium perfringens, foodborne	1,295‡	25.5	29.3	<1	100	965,958 (192,316–2,483,309)
STEC O157	3,704¶	1.0	26.1	4	68	63,153 (17,587–149,631)
STEC non-O157	1,579¶	1.0	106.8	18	82	112,752 (11,467–287,321)
ETEC, foodborne	53‡	25.5	29.3	55	100	17,894 (24–46,212)
Diarrheagenic *E. coli* other than STEC and ETEC	53	25.5	29.3	<1	30	11,982 (16–30,913)
Listeria monocytogenes	808¶	1.0	2.1	3	99	1,591 (557–3,161)
Mycobacterium bovis	195¶	1.0	1.1	70	95	60 (46–74)
Salmonella spp., nontyphoidal	41,930¶	1.0	29.3	11	94	1,027,561 (644,786–1,679,667)
S. enterica serotype Typhi	433¶	1.0	13.3	67	96	1,821 (87–5,522)
Shigella spp.	14,864¶	1.0	33.3	15	31	131,254 (24,511–374,789)
Staphylococcus aureus, foodborne	323‡	25.5	29.3	<1	100	241,148 (72,341–529,417)
Streptococcus spp. group A, foodborne	15‡	25.5	29.3	<1	100	11,217 (15–77,875)
Vibrio cholerae, toxigenic	8§	1.1	33.1	70	100	84 (19–213)
V. vulnificus	111§	1.1	1.7	2	47	96 (60–139)
V. parahaemolyticus	287§	1.1	142.4	10	86	34,664 (18,260–58,027)
Vibrio spp., other	220§	1.1	142.7	11	57	17,564 (10,848–26,475)
Yersinia enterocolitica	950¶	1.0	122.8	7	90	97,656 (30,388–172,734)
Subtotal						3,645,773 (2,321,468–5,581,290)
Parasites						
Cryptosporidium spp.	7,594¶	1.0	98.6	9	8	57,616 (12,060–166,771)

31 known Pathogens:
9,388,075 cases

Table. Estimated annual number of episodes of domestically acquired, foodborne illness, hospitalizations, and deaths caused by 31 pathogens and unspecified agents transmitted through food, United States*

Cause	Illnesses: Mean (90% CrI)	Illnesses: %	Hospitalizations: Mean (90% CrI)	Hospitalizations: %	Deaths: Mean (90% CrI)	Deaths: %
Major known pathogens†	9,388,075 (6,641,440–12,745,709)	20	55,961 (39,534–75,741)	44	1,351 (712–2,268)	44
Unspecified agents‡	38,392,704 (19,829,069–61,196,274)	80	71,878 (9,924–157,340)	56	1,686 (369–3,338)	56
Total	47,780,779 (28,658,973–71,133,833)	100	127,839 (62,529–215,562)	100	3,037 (1,492–4,983)	100

Annual burden in USA of the acute foodborne diseases (47,780,779): **77,700 M$**

Scharff, 2012

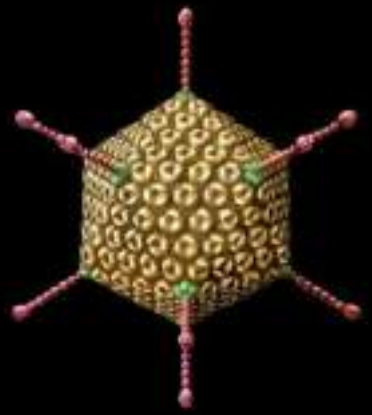
77 700 M$ ≈ **65 923M€**

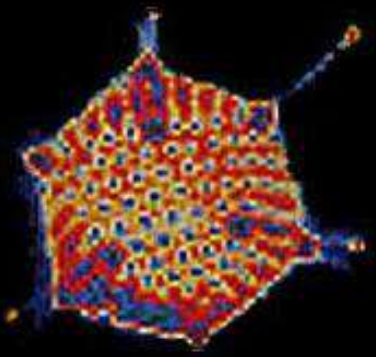
95 500 €

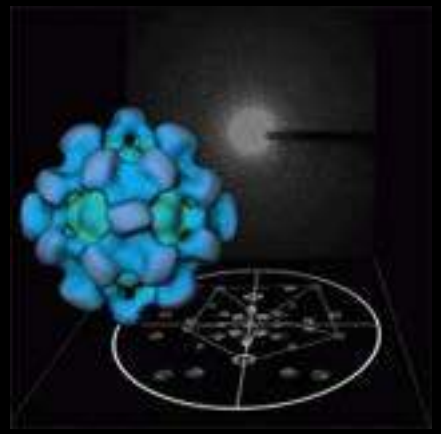
69 %

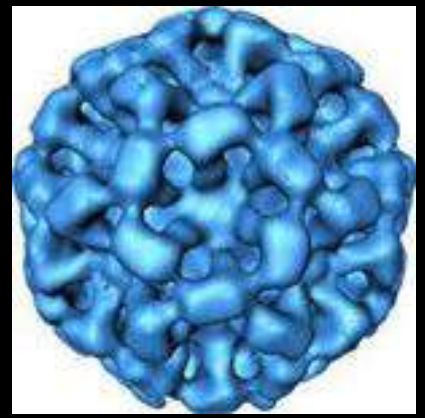
91%

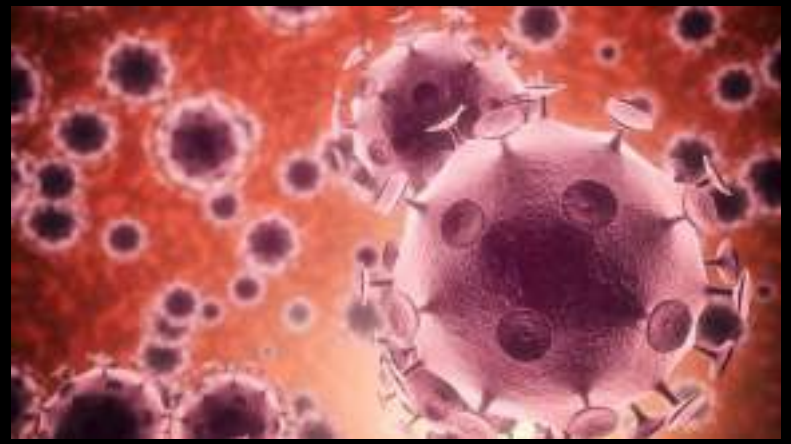
Viruses						
Astrovirus	NA	NA	NA	0	<1	15,433 (5,569–26,643)
Hepatitis A virus	3,576§	1.1	9.1	41	7	1,566 (702–3,024)
Norovirus	NA	NA	NA	<1	26	5,461,731 (3,227,078–8,309,480)
Rotavirus	NA	NA	NA	0	<1	15,433 (5,569–26,643)
Sapovirus	NA	NA	NA	0	<1	15,433 (5,569–26,643)
Subtotal						5,509,597 (3,273,623–8,355,568)









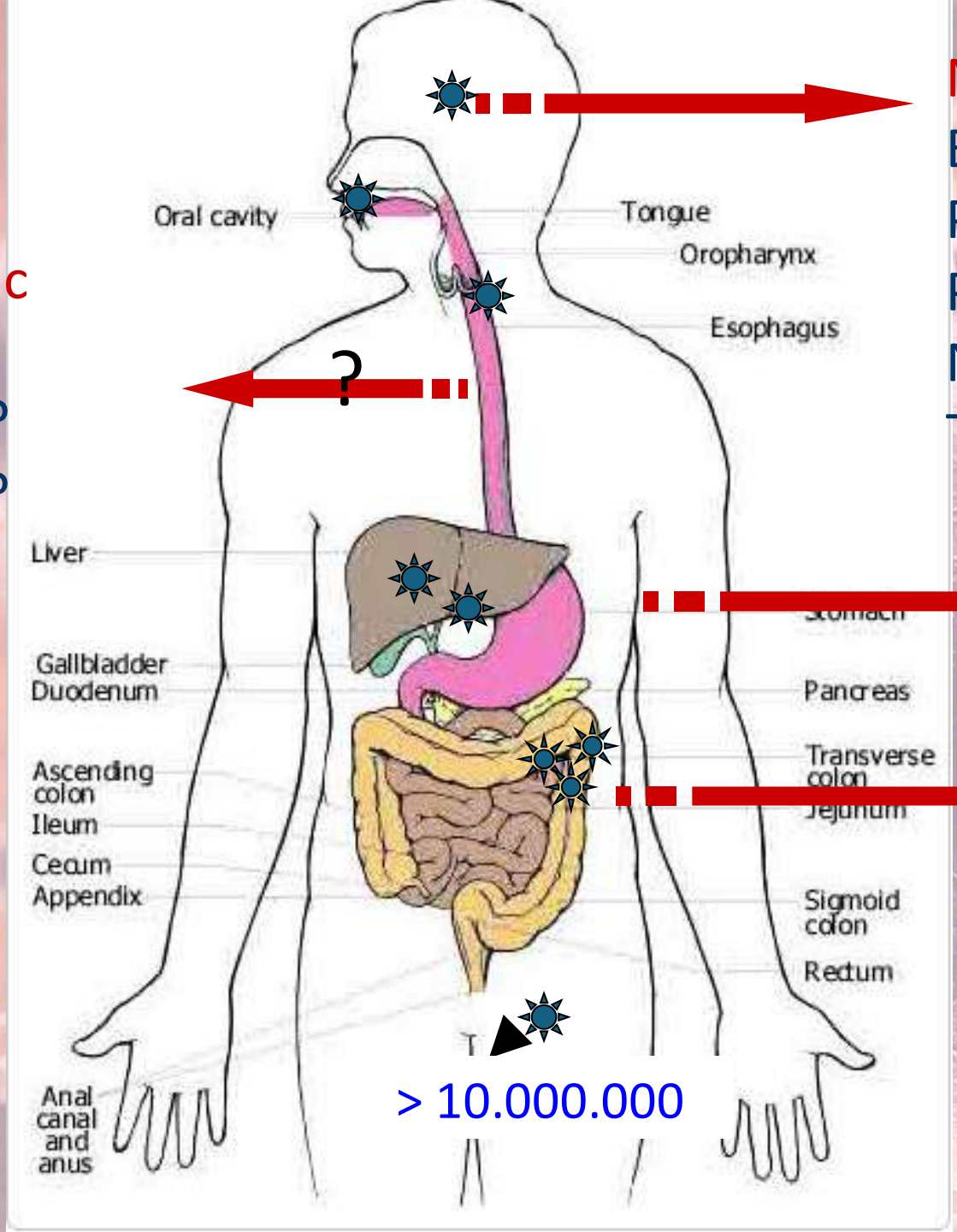


Pneumotrohic

H5N1 ?

SARS-CoV-1 ?

SARS-CoV-2 ?



Neurotrophic

Enterovirus

Poliovirus

Parechovirus

Nipah virus

TBE

Hepatotrophic

Hepatitis A

Hepatitis E

Enterotrophic

Norovirus

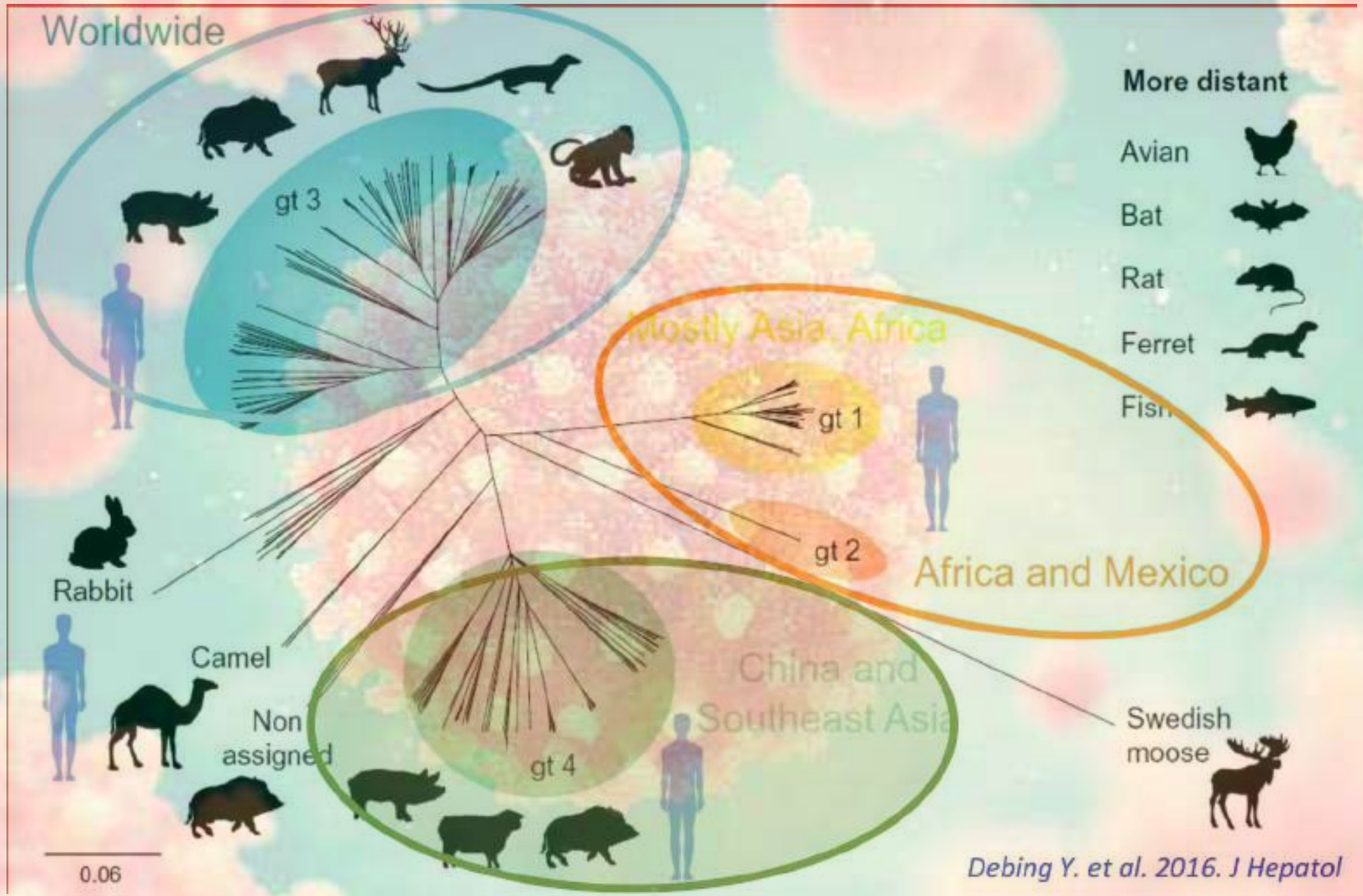
Sapovirus

Rotavirus

Astrovirus

Adenovirus

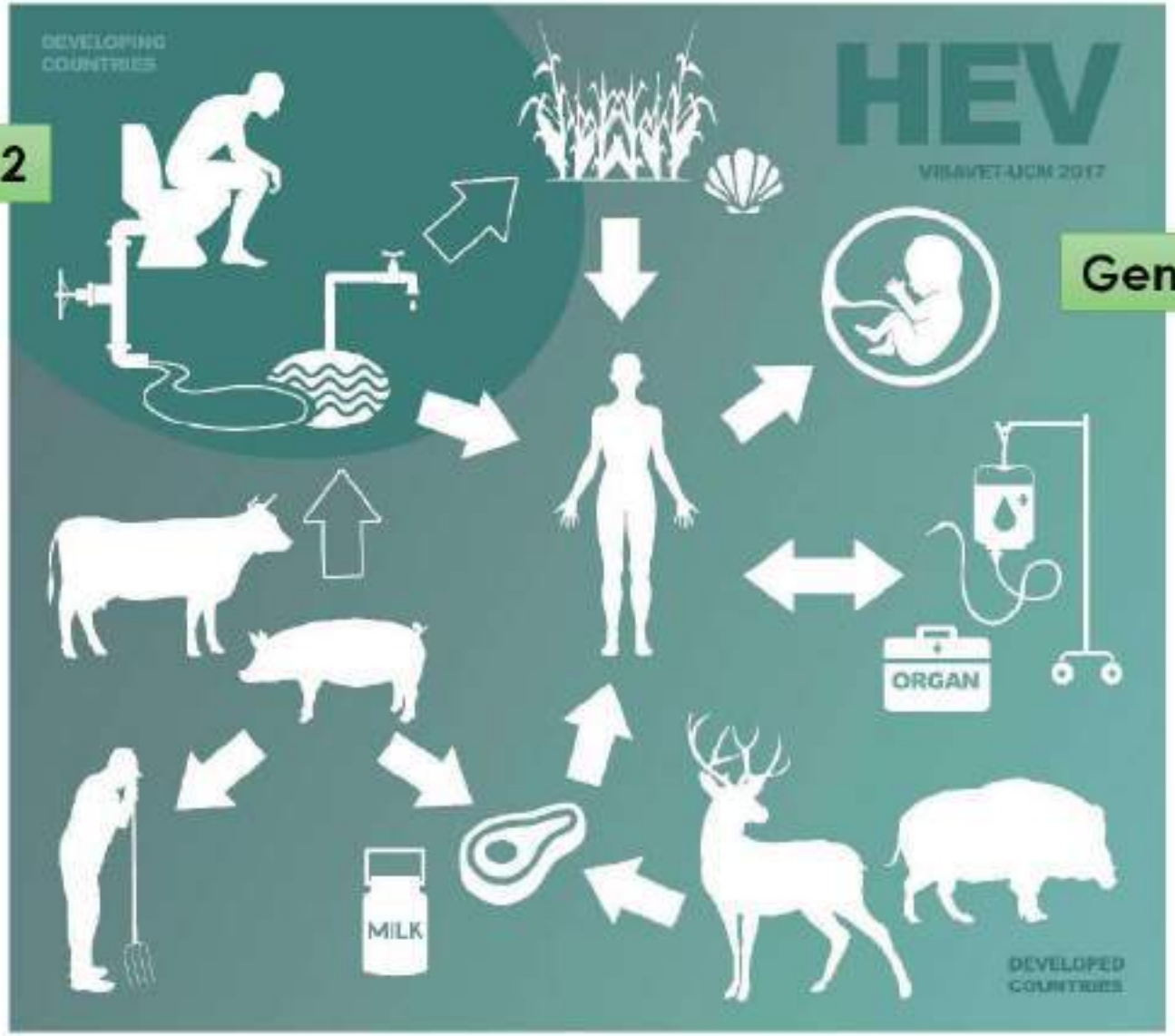
Aichivirus



Debing Y. et al. 2016. J Hepatol

TRANSMISSION

Genotypes 1 and 2



Genotypes 3 and 4

CURRENT SITUATION IN DEVELOPING COUNTRIES

La Voz de Asturias

SOCIEDAD

Una epidemia de hepatitis E amenaza a unos 250.000 desplazados en Níger

INSIDE DEVELOPMENT › HEALTH EMERGENCY

Hepatitis E outbreak sparks concern in Lake Chad Basin

Outbreak of Hepatitis E virus in Windhoek

hygiene practices in Nigeria. Photo by: Isabel Coello / ECHO /

THE health ministry this morning announced the death of one person from Hepatitis E virus while 26 others tested positive for the virus in Windhoek.

AllAfrica

Kingston

Radio Dabanga (Amsterdam) »

Sudan: Hepatitis E Outbreak in Sortony, North Darfur

Tagged: Conflict • East Africa • Health • Refugees • Sudan

ANALYSIS

Khartoum — Some 134 cases of suspected Acute Jaundice Syndrome (AJS) have been reported since May 2016 in Sortony, North Darfur, according to the state Ministry of Health. Médecins Sans Frontières-España (MSF-E), the World Health Organization (WHO) and the Sudanese organisation Anhar for Peace Development Organisation.

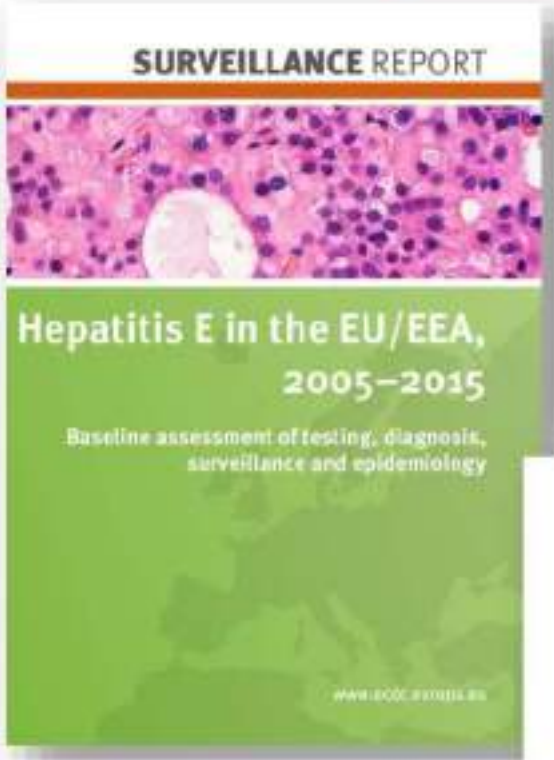
The overcrowded site near the Unamid base in Sortony hosts more than 21,000 people who were displaced from Jebel Marra following hostilities earlier this year. Seven samples sent for analysis tested positive for Hepatitis E virus.

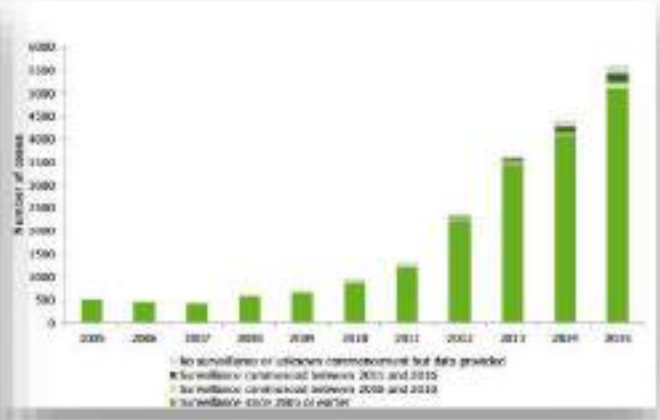
RELATED TOPICS

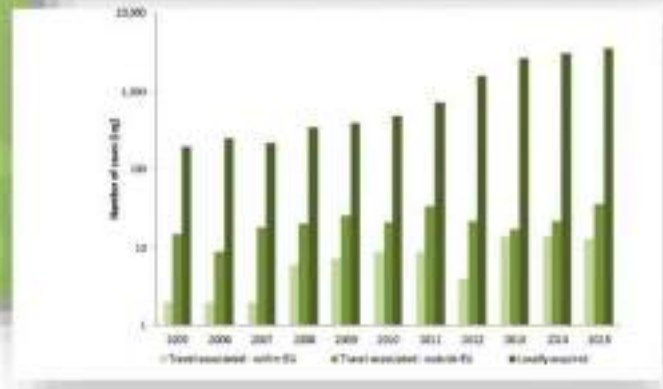
Conflict »

- Every year: 20 million HEV infections worldwide, estimated 3.3 million symptomatic cases of hepatitis E (OMS)
- Mortality rate in pregnant woman 20-25%
- Refugee camps (Niger, South Sudan, Kenya, etc.)

CURRENT SITUATION IN EUROPE





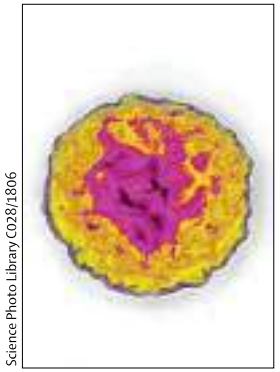


- 10 fold increase in the last ten years
- Increasing surveillance systems, detection methods and research

WHAT DO WE DON´T KNOW

- Effective cell culture methods
- Effective animal experimental models
- Inactivation treatments
- Interspecies transmission studies
- Harmonized and validated detection and characterization methods
- Research in food chain
- Real disease burden
- Development of vaccines
- ...

Growing concerns of hepatitis E in Europe



Science Photo Library C028/1806

Hepatitis E virus (HEV) infection is an important cause of acute viral hepatitis worldwide, with an increasing incidence in Europe since 2010. Although it is difficult to know the real incidence because most HEV infections are asymptomatic or self-limiting, in some people—such as immunosuppressed individuals or those with pre-existing liver disease—HEV infection can progress to chronic disease.

Ahead of World Hepatitis Day on July 28, a surveillance report on the incidence of HEV infection in Europe, published by the European Centre for Disease Prevention and Control (ECDC) on July 11, shows cause for concern. The reported incidence in Europe over 10 years has grown by ten times: from 514 cases in 2005, to 5617 cases in 2015. Another cause for concern is that testing, case definitions, diagnosis, and surveillance for HEV infection vary extensively across Europe, with only 20 member states actively monitoring HEV infection. Most reported cases were in men older than 50 years, caused by genotype 3, and reported in the UK, France, and Germany, where surveillance is in place. Incidence also increased in countries without a surveillance system, indicating that reporting of the incidence might not be the only reason for the surge in infections.

Has there been a genuine rise in the number of new cases throughout Europe, or are we seeing the benefits of greater awareness of HEV infection or better diagnostic techniques? In the context of increasing incidence, a greater understanding of risk factors and effective prevention methods is key. A report from the European Food Safety Authority provides further evidence that most HEV infections in Europe are due to the consumption of undercooked or raw pork meat and liver, highlighting the need for clearer guidance on the appropriate preparation of these foods to suppress the rise in cases.

Following on from this report, the ECDC will now undertake a wider investigation. Consistent methods must be adopted throughout Europe to provide a better understanding of the burden of this emerging, under-recognised pathogen, and of modifiable risk factors that can be targeted to prevent further infections ■ *The Lancet*

For the **ECDC report** see https://ecdc.europa.eu/en/publications-data/hepatitis-e-eueea-2005-2015

For the **European Food Safety Authority report** see http://www.efsa.europa.eu/en/efsajournal/pub/4886

Estimated Annual Numbers of Foodborne Pathogen–Associated Illnesses, Hospitalizations, and Deaths, France, 2008–2013

Dieter Van Cauteren, Yann Le Strat, Cécile Sommen, Mathias Bruyand, Mathieu Tourdjman, Nathalie Jourdan-Da Silva, Elisabeth Couturier, Nelly Fournet, Henriette de Valk, Jean-Claude Desenclos

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 23, No.i9, September 2017

Estimates of the annual numbers of foodborne illnesses and associated hospitalizations and deaths are needed to set priorities for surveillance, prevention, and control strategies. The objective of this study was to determine such estimates for 2008–2013 in France. We considered 15 major foodborne pathogens (10 bacteria, 3 viruses, and 2 parasites) and estimated that each year, the pathogens accounted for 1.28–2.23 million illnesses, 16,500–20,800 hospitalizations, and 250 deaths. *Campylobacter* spp., nontyphoidal *Salmonella* spp. and norovirus accounted for >70% of all foodborne pathogen–associated illnesses and hospitalizations; nontyphoidal *Salmonella* spp. and *Listeria monocytogenes* were the main causes of foodborne pathogen–associated deaths; and hepatitis E virus appeared to be a previously unrecognized foodborne pathogen causing 68,000 illnesses in France every year. The substantial annual numbers of foodborne illnesses and associated hospitalizations and deaths in France highlight the need for food-safety policymakers to prioritize foodborne disease prevention and control strategies.

Rabbit Hepatitis E Virus Infections in Humans, France

Florence Abravanel, Sébastien Lhomme, Richam El Costa, Betsui Schwartz, Jean-Marie Peron, Nassim Kamar, Jacques Izopet

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 23, No. 7, July 2017

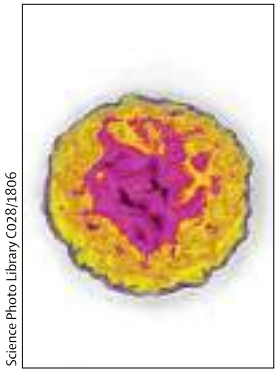
Hepatitis E virus (HEV) has been detected in rabbits, but whether rabbit HEV strains can be transmitted to humans is not known. Of 919 HEV-infected patients in France during 2015–2016, five were infected with a rabbit HEV strain. None of the patients had direct contact with rabbits, suggesting foodborne or waterborne infections.

International Journal of Food Microbiology
Volume 257, 18 September 2017, Pages 225-231

Porcine blood used as ingredient in meat productions may serve as a vehicle for hepatitis E virus transmission

Ingeborg L.A. Boxman, Claudia C.C. Jansen, Geke Hägele, Ans Zwartkruis-Nahuis, Jeroen Cremer, Harry Vennema, Aloys S.L. Tijma

Growing concerns of hepatitis E in Europe



Science Photo Library C028/1806

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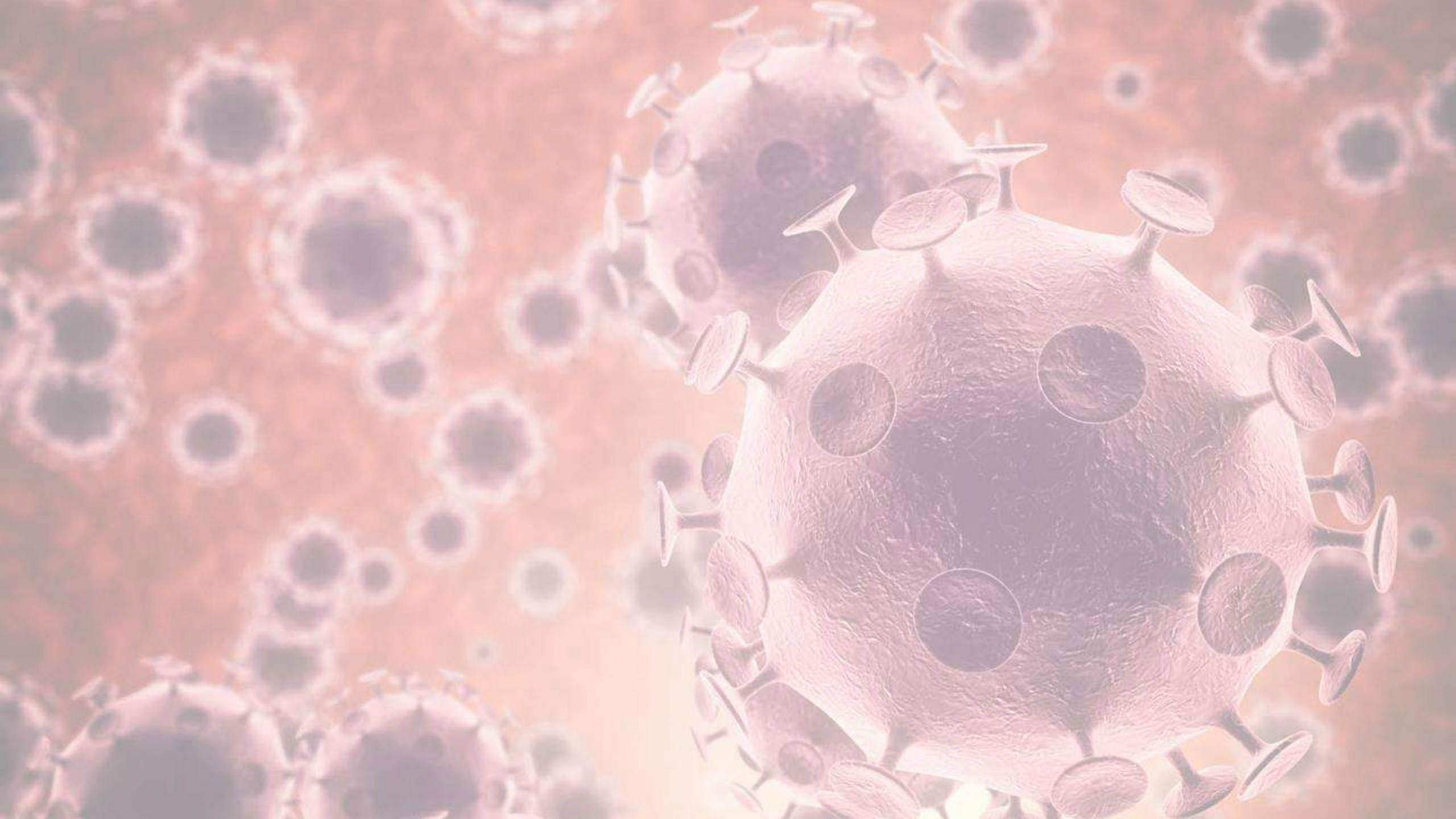
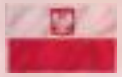


TASK 2.4 Aim and activities

Aim: - HEV detection in RTE pork and wild boar meat products as well as meat products confiscated at the border
- Detection of foodborne and zoonotic viruses in RTE meat products (pork, wild boar and confiscated food) using microarray assay

- ✓ Sampling of **RTE pork products** and virus detection using **PCR**
  -  black pudding, liverwurst
  -  black pudding, morcilla ibérica, chorizo
- ✓ Sampling of **RTE wild boar products** and virus detection using **PCR**
  -  „Chorizo" style sausage, salami, Polish white sausage
  -  wild boar „chorizo", wild boar „salchichón"
- ✓ Sampling of **meat products confiscated at the border** and HEV detection using **PCR**
- ✓ **Microarray** detection of foodborne and zoonotic viruses in: **a)** RTE pork and wild boar meat products
  b) Meat products confiscated at the border

Results on HEV detection in RTE pork and wild boar meat products

SZABO METHOD			
		+VE SAMPLES	%
PORK	Black pudding	5	13,89
	Fresh chorizo	5	13,89
	Semi cured chorizo	3	8,33
		13	12,04
WILD BOAR	chorizo	7	19,44
	salchichon	7	19,44
		14	19,44
	TOTAL	27	15,00

UBU METHOD			
		+VE SAMPLES	%
PORK	Black pudding	9	25,00
	Fresh chorizo	4	11,11
	Semi cured chorizo	10	27,78
		23	21,30
WILD BOAR	chorizo	7	19,44
	salchichon	7	19,44
		14	19,44
	TOTAL	37	20,56


THANKS
FOR YOUR ATTENTION

UNIVERSIDAD DE BURGOS

Dr. David Rodríguez Lázaro
Microbiology Division
@rodlazda