



# Gastrointestinal infections



**Pavel Drevinek**  
**Department of Medical Microbiology**



**2<sup>nd</sup> Faculty of Medicine, Charles University**  
**Motol University Hospital**



# Alimentary infections

---

contaminated food, water  
vs. infections of digestive tract

# Usual symptomatology

- diarrhea
  - watery (gastroenteritis)
  - with mucus, blood (enterocolitis)
- abdominal pain, cramps
- nausea, vomiting
- systemic, extraintestinal signs
  - fever, malaise, myalgia, dehydration

# Possible causes

Bacteria

Viruses

Parasites

Bacterial toxins

Non-infection origin:

- dietary mistake
- drugs, poison
- acute abdomen
  
- non-specific inflammation
- tumors

# Specimens collection

Rectal swab

- culture

Stool

- antigen (*C. difficile*, *H. pylori*)
- microscopy (parasites), EM (viruses)
- culture
- virus isolation
- PCR

Serum

- antibodies

## Specimens collection

- Tape – perianal region • microscopy (pinworm)
- stomach biopsy • *H. pylori* (urease test, culture)

Peritoneal liquid, pus

Blood cultures

**MIKROBIOLOGICKÁ VYŠETŘENÍ**  
(VIROLOGICKÁ VYŠETŘENÍ NA SAMOSTATNÉ ŽÁDÁNÍ)

SEROLOGICKÉ VYŠETŘENÍ	PŘÍMÁ DETEKCE ANTIGENU
Syfilis screening - RPR, TPPA	Candida spp.
<b>Salmonella sp. - Widalova r.</b>	Aspergillus sp. - krev
Bordetella pertussis	Aspergillus sp. - BAL
Bordetella parapertussis	
Lymeská borrelióza - krev	PARAZITOLOGICKÁ VYŠETŘENÍ
Lymeská borrelióza - likvor	stolice na střevní parazity
Lymeská borrelióza - kloubní punktát	průkaz roupů (Iepex)
L. borrelióza - potvrzení WB**	stolice - Cryptosporidium sp.
Brucella abortus	Giardia intes. - duod. šťáva
Francisella tularensis	Giardia intes. - stolice
<b>Yersinia enterocolitica</b>	parazit- červ, článek, ...
Listeria monocytogenes	Ektoparazit - roztoč, veš ...
Mycoplasma pneumoniae	
Chlamydia pneumoniae	PCR PŘÍMÁ DETEKCE PATOGENŮ
Chl. pneum. - potvrzení WB**	Chlamydia trachomatis (moč, stěr - lokalizace)
Chlamydia trachomatis	Burkholderia cepacia *
Chl. trachom. - potvrzení WB**	Pneumocystis jiroveci (mikroskopie je součástí vyšetření)
Chlamydia psittaci	
Chl. psittaci - potvrzení WB**	
<b>Helicobacter pylori</b>	
H. pylori - potvrzení WB** CagA	
Toxoplasma gondii	
Toxocara sp.	

\*\* Požadovaná potvrzení metodou Western Blot bude provedena u pozitivních vzorků a to pouze v případech uvedené validní klinické dg.

\* Pouze po telefonické konzultaci (mimo CF) I. S.

## Parasitology examination

stool for gut parasites  
pinworm – tape  
stool – Cryptosp. sp.  
Giardia

....

<input type="checkbox"/> kultivace b.pertussis/parapert.	<input type="checkbox"/> střední kmeny	<input type="checkbox"/> prostatický sekret
<input type="checkbox"/> antigen Str. pneumoniae (moč)	<input type="checkbox"/> likvor lumbální punkce	<input type="checkbox"/> ejakulát
<input type="checkbox"/> antigen L. pneumophilla (moč)	<input type="checkbox"/> kultivace	<input type="checkbox"/> urogenitální mykoplazmata
<input type="checkbox"/> výtěr/aspirát středouší	<input type="checkbox"/> latex. aglutinace	<input type="checkbox"/> jiné:
<input type="checkbox"/> zvukovod	<input type="checkbox"/> komorová drenáž	<b>GASTROINTESTINÁLNÍ TRAKT</b>
<input type="checkbox"/> punktát z VDN	<input type="checkbox"/> katetr arterie	<input type="checkbox"/> výtěr z rekty běžné patogeny
<input type="checkbox"/> jiné:	<input type="checkbox"/> CŽK	<input type="checkbox"/> Yersinia sp.
<b>SCREENING MRSA</b>	<input type="checkbox"/> jiný:	<input type="checkbox"/> HUS
<input type="checkbox"/> výtěr krk	<input type="checkbox"/> spojivkový vak	<input type="checkbox"/> stolice ze stomie kvantitativně
<input type="checkbox"/> nos	<input type="checkbox"/> rohovka stěr <input type="checkbox"/> seškrab	<input type="checkbox"/> stolice Ag./toxin C.difficile
<input type="checkbox"/> vlasy	<input type="checkbox"/> jiné:	<input type="checkbox"/> Ag. Helicob. pylori
<input type="checkbox"/> perineum	<input type="checkbox"/> anaerobní kultivace	<input type="checkbox"/> žaludeční sliznice Helicob.pylori
<input type="checkbox"/> jiné:		<input type="checkbox"/> mikroskopie
		<input type="checkbox"/> kultivace
		<input type="checkbox"/> žaludeční obsah

### Gastrointestinal tract

rectal swab      usual pathogens  
 Yersinia sp.  
 HUS

stool              Ag/toxin C. diif  
 Ag H. pylori

stomach biopsy





---

## Note: bowel is not sterile

### anaerobic species

*Bacteroides fragilis*

*Bifidobacterium bifidum*

*Lactobacillus*

*Clostridium perfringens*

....

### enterobacteria

*Escherichia coli*

*Enterobacter*

*Klebsiella*

*Proteus*

....

*Staphylococcus aureus*

*Enterococcus faecalis*

*Pseudomonas aeruginosa*

....

Microbiome studies: > 1,000 species

# Nosocomial intestinal infections

## Peritonitis (secondary)

- rupture of the bowel
- surgery

- Enterobacteria: *E. coli*, *Klebsiella*, *Proteus* ...
- Anaerobes! – remember for right antibiotic choice  
(+ metronidazol, clindamycin;  
piperacillin tazobactam; carbapenems)



# Enterotoxigenesis – food poisoning

## *Staphylococcus aureus*

- with production of ST enterotoxin (ca. 40% of *S. aureus*) A-E on food
- rapid onset of the disease (1 - 6 hrs after consumption), no fever
- culture can be negative

## ZÁVĚREČNÉ ZPRÁVY O EPIDEMICKÉM VÝSKYTU

FINAL REPORTS ON EPIDEMIC OUTBREAKS

### Epidemie stafylokokové enterotoxikózy v okrese Tábor

28.8.2015 2.00 am

110 affected individuals (from 120)  
diarrhoea, stomach ache, nausea

- rectal swabs neg.
- kitchen staff
  - nasopharynx *S. aureus*
  - hand wounds *S. coag. neg.*
- risotto sample *S. aureus*
- water sample neg.

dinner 27.8.2015 18.00



*S. aureus* producing enterotoxin D

# Enterotoxigenesis – food poisoning

## *Bacillus cereus*

- Two types of enterotoxin
  - ST enterotoxin causing vomiting
    - production on food (rice, pasta)
    - rapid onset
  - LT enterotoxin causing diarrhea
    - production in the gut
    - food contamination (meat, gravy)
    - symptoms 8 - 16 hrs after consumption

# Toxicosis – food poisoning

## *Clostridium botulinum*

- botulotoxin A, B, E

= neurotoxin which inhibits release of acetylcholine

- muscle paralysis (cranial nerves)
- parasympathetic nerves

→ typical signs: diplopia, mydriasis, ptosis, dysphagia, hypomimia, constipation

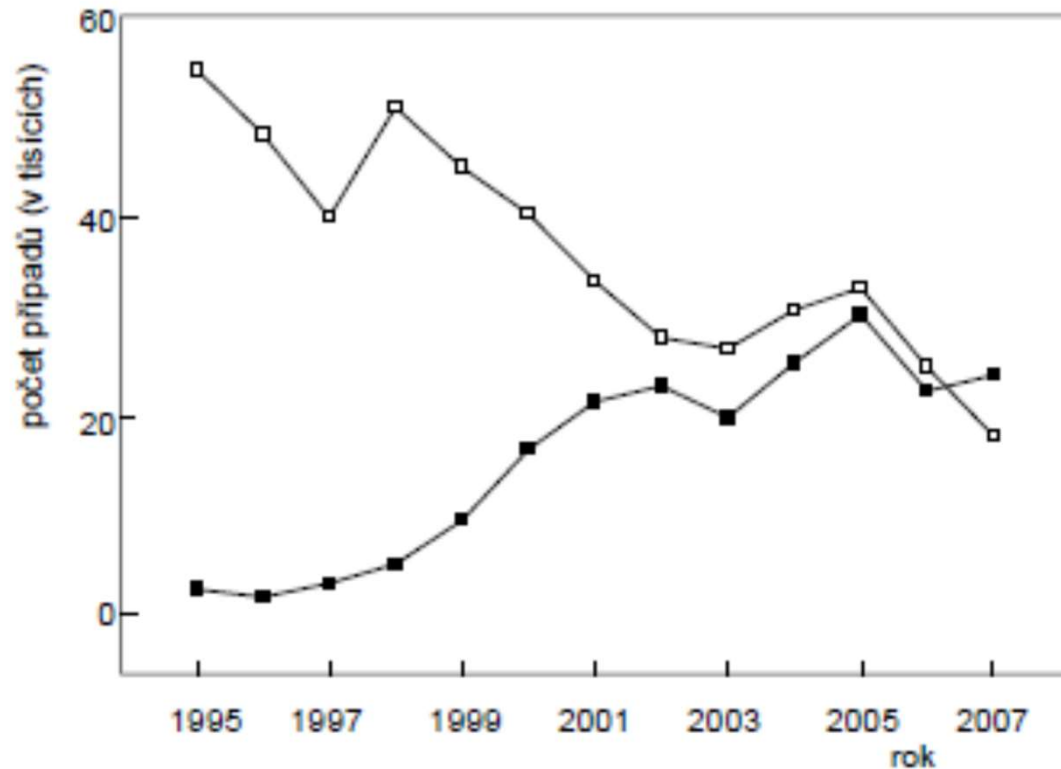


food contaminated with spores

- toxin produced in food (canned food)
- onset 6 to 72 hrs after consumption
- production in the gut rarely (infants)



# Gut infection of bacterial origin



Obr. 1. Počet případů onemocnění způsobené bakteriemi rodu *Campylobacter* a *Salmonella* v České republice v letech 1995 až 2007; ■ kampylobacteriémie, □ salmonelózy, zdroj: <http://www.szu.cz/data/infekce-v-cr>

2019:

salmonela	13 000
campylobacter	23 000

## *Salmonella enterica ssp. enterica*

- non-typhoidal salmonella (*S. Enteritidis*)
- typhoidal salmonela (*S. Typhi*, *S. Paratyphi*)

Identification which is which:  
culture and  
serotyping  
with agglutination

Kauffman – White  
classification

Group O:9 (D <sub>1</sub> )				
Type	Somatic (O) antigen	Flagellar (H) antigen		
		Phase 1	Phase 2	Other
Sendai <sup>1</sup>	<u>1</u> ,9,12	a	1,5	
Miami <sup>1</sup>	<u>1</u> ,9,12	a	1,5	
II	9,12	a	1,5	
Os	9,12	a	1,6	
Saarbruecken	<u>1</u> ,9,12	a	1,7	
Lomalinda	<u>1</u> ,9,12	a	e,n,x	
II	<u>1</u> ,9,12	a	e,n,x	
Durban	<u>1</u> ,9,12	a	e,n,z <sub>15</sub>	
II	9,12	a	z <sub>39</sub>	
Bangui	9,12	d	e,n,z <sub>15</sub>	
Zega	9,12	d	z <sub>6</sub>	
Jaffna	<u>1</u> ,9,12	d	z <sub>35</sub>	
II	9,12	d	z <sub>39</sub>	
Typhi <sup>2</sup>	9,12[Vi]	d	–	[z <sub>60</sub> ]
Boumemouth	9,12	e,h	1,2	
Eastbourne	<u>1</u> ,9,12	e,h	1,5	
Berta	1,9,12	[f] g [r]	–	
Enteritidis <sup>3</sup>	<u>1</u> ,9,12	g,m	–	

## *Salmonella enterica ssp. enterica*

- non-typhoidal salmonella (**S. Enteritidis**)
  - incubation period over 12 hrs (1 to 2 days)
  - watery diarrhea, fever, vomiting - cholera nostras
  - zoonosis, on food (eggs, mayonnaise, ice cream...or water)
  - extraintestinal complications (rarely; joint infections, cholecystitis, osteomyelitis, infectious aneurysm)

Dg.

- rectal swab and culture
- serotype determination with agglutination

# ZÁVĚREČNÉ ZPRÁVY O EPIDEMICKÉM VÝSKYTU

## FINAL REPORTS ON EPIDEMIC OUTBREAKS

### Epidemie salmonelózy v provozovně Občerstvení v okrese Strakonice

---

30.7. to 1.8.2015

60 affected (from 90), 4 hospitalized  
fever, diarrhoea, cramps, vomiting, chills

salami, mayonnaise,           neg.  
black pepper, raw eggs

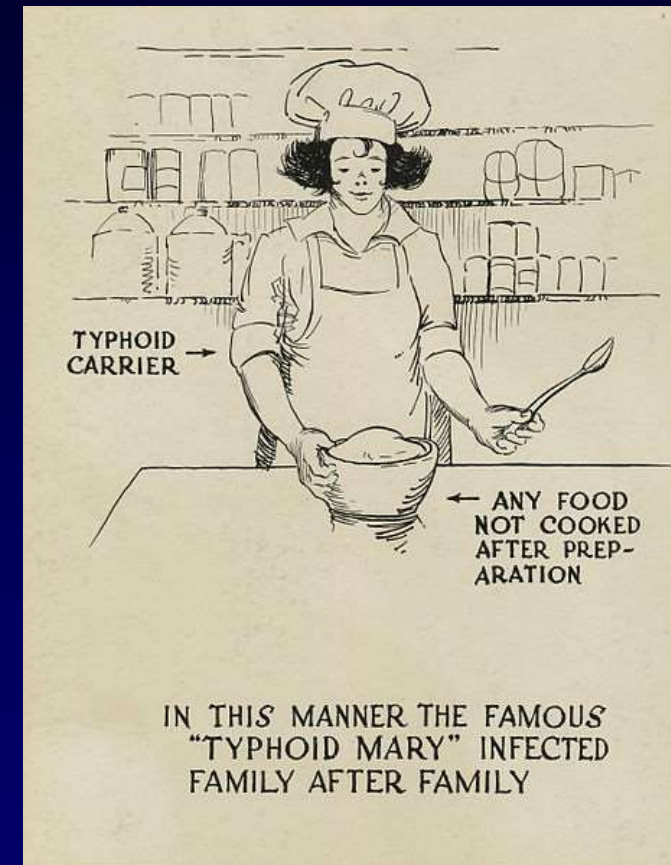
chicken droppings               neg.

rectal swabs                      S. Enteritidis  
of kitchen staff                 (but they also ate the meal)  
(with no symptoms)



## *Salmonella enterica ssp. enterica*

- typhoid fever (**S. Typhi**)
  - O 9,12, V<sub>i</sub>, d
  - systemic disease, bacteraemia
  - headache, fever (febris continua)
  - hemorrhage, bile ducts
  - contaminated water,  
or food with human faeces
  - typhoid carriers
  - vaccine: i.m. (Ag Vi)
  
  - Dg. blood culture (urine)  
indirect dg. Widal reaction
  
  - Therapy: quinolones  
cotrimoxazol  
ampicillin  
chloramphenicol



## *Campylobacter jejuni, C. coli*

- zoonosis, in food, in water (from gut of animals; chicken)
- extraintestinal infections rarely, such as parainfectious neurological complications (Guillain-Barre syndrome)



Dg.

- rectal swab + transport medium
- stool
- special culture conditions, PCR

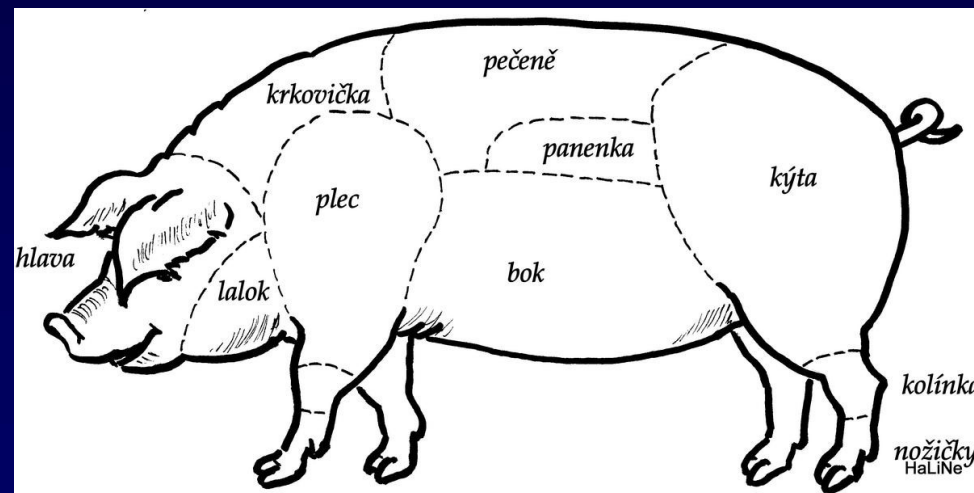
Th:

- macrolides if needed

# Gut infection of bacterial origin

## *Yersinia enterocolitica*

- enterocolitis, terminal ileum
- mesenterial lymphadenitis (lower right abdomen sympomatology)
- zoonosis, on food (pork)



Th:  
- cotrimoxazol

# Gut infection of bacterial origin

*Shigella sonnei, S. flexneri, S. dysenteriae, S. boydii*

= bacillary dysentery

- disease of „dirty hands“

- no animal reservoir

- some *S. dysenteriae* produce shiga toxin (stx)

Th:

- cotrimoxazol



# Gut infection of bacterial origin

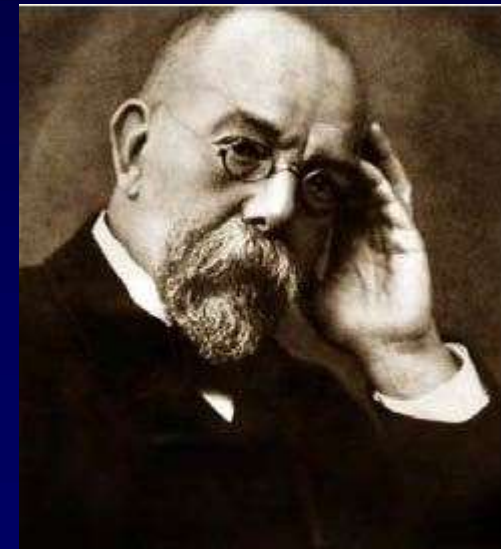
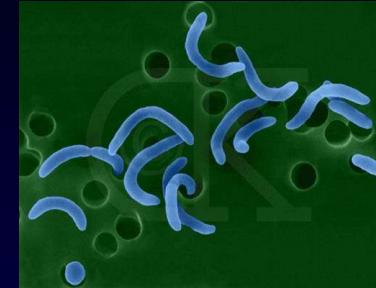
## *Escherichia coli*

- **EPEC**: newborn diarrhea (until 1 year of age)
- **ETEC**: traveller's diarrhea (toxin close to cholera toxin)  
(Delhi belly, Hong Kong dog, Casablanca crud, Montezuma's revenge)
- **EIEC**: analogy to shigellosis
- STEC (VTEC)
  - **EHEC** O157:H7; O26 etc.
    - colitis and haemolytic-uremic syndrome (children < 5 years)  
(hemolytic anaemia, thrombocytopenia, renal failure)
    - toxin stx1 or 2 (entero-, nefro-, cyto- , neuro- toxicity)
    - hamburgers, milk, farms

# Gut infection of bacterial origin

## *Vibrio cholerae*

- O1 biotype classical, biotype El Tor
- non-O1 (O139 Bengal)
  
- cholera toxin (cholera toxin), non-invasive bacterium
- watery diarrhea, with no blood
- contaminated water and food with human faeces
- no animal reservoir
  
- Robert Koch and outbreaks  
in Egypt, India, Hamburg

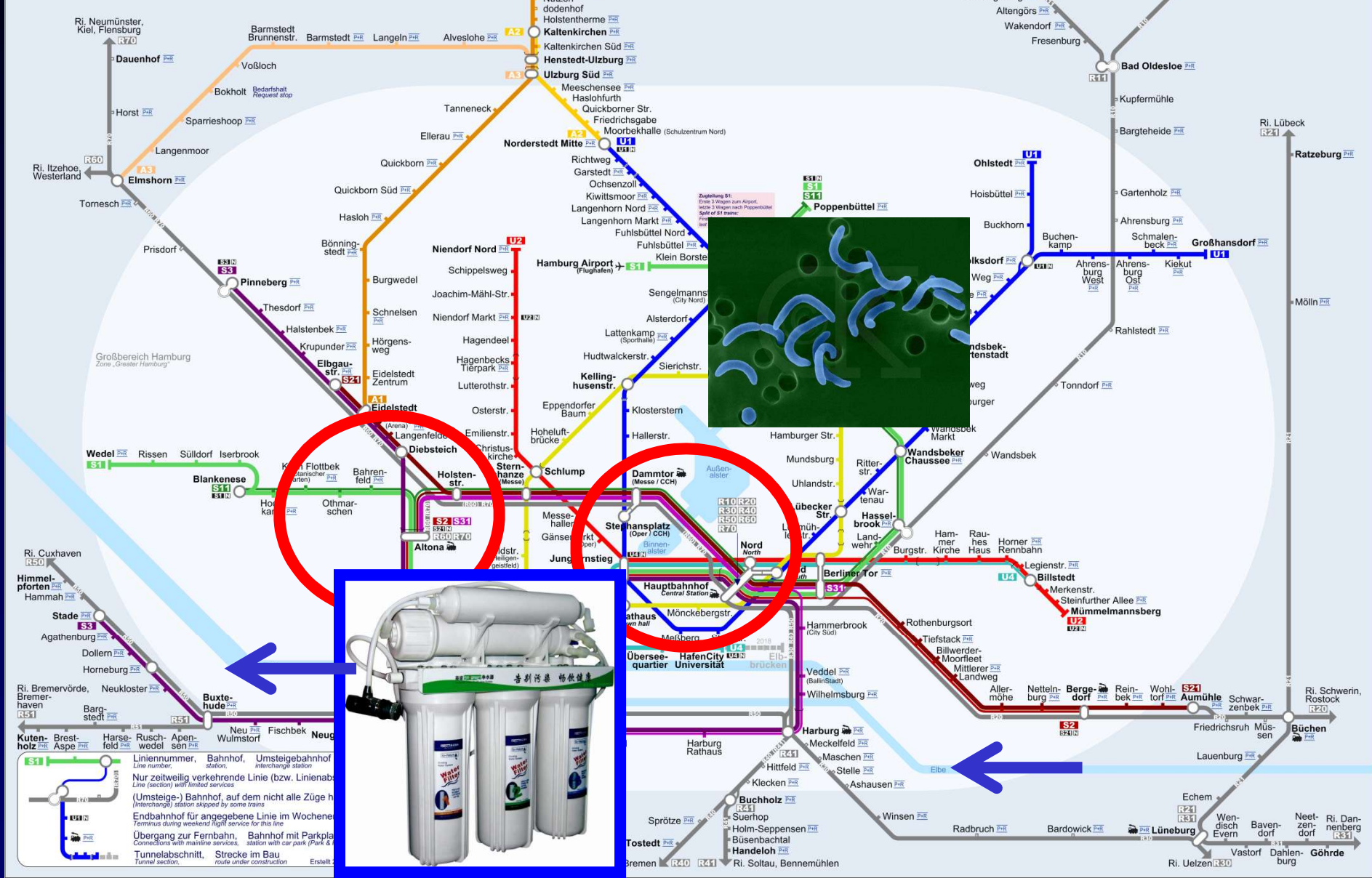


Robert Koch  
1843 - 1910

# Bahnlinien im HVV HVV Railway System Map



# year 1892



**Legend:**

- Liniennummer, Line number.
- Bahnhof, station.
- Umsteigebahnhof, interchange station.
- Nur zeitweilig verkehrende Linie (bzw. Linienabschnitt) will limited services (Umsteige-) Bahnhof, auf dem nicht alle Züge halten (Interchange) station skipped by some trains.
- Endbahnhof für angegebene Linie im Wochenende, Terminus during weekend flight service for this line.
- Übergang zur Fernbahn, Bahnhof mit Parkplätzen, Connections with mainline services, station with car park (Park & Ride).
- Tunnelabschnitt, Strecke im Bau, Tunnel section, route under construction.
- Erstellt, Created.

# Gut infection of bacterial origin - others with toxins

## *Vibrio parahaemolyticus*

- ST enterotoxin

## *Clostridium perfringens, type A*

- LT enterotoxin
- food (meat) contaminated with spores
- effect 8 - 16 hrs after consumption

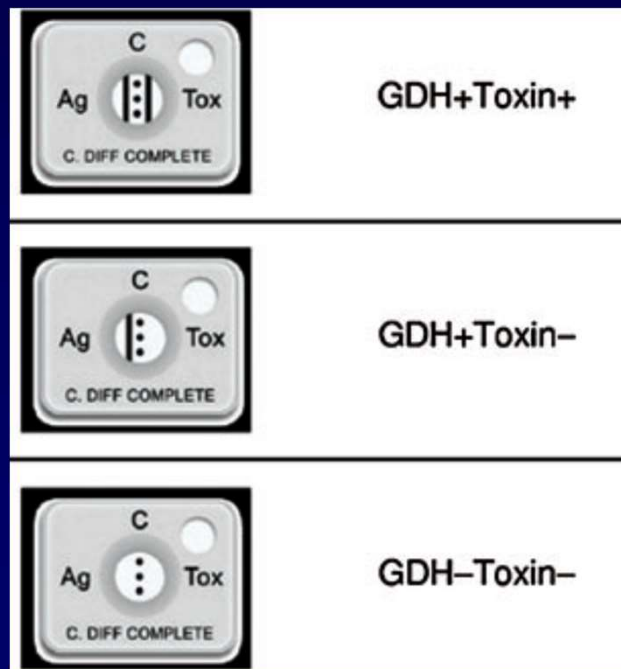
## *Bacillus cereus*

- Two types of enterotoxin
  - ST enterotoxin causing vomiting
    - production on food (rice, pasta)
    - rapid onset
  - LT enterotoxin causing diarrhea
    - production in the gut
    - food contamination (meat, gravy)
    - symptoms 8 - 16 hrs after consumption

# Nosocomial intestinal infections

## *Clostridium difficile*

- CDI: from colitis to pseudomembranous enterocolitis
- associated with ATB therapy (cephalosporins, clindamycin, quinolons...)
- pathogenic are the strains with production of toxins: toxin A and/or B
- Antigen based rapid dg.: enzyme GDH + toxins; PCR
- culture



# Nosocomial intestinal infections

## *Clostridium difficile*

- therapy: metronidazol p.o., i.v.  
or vancomycin p.o.  
or fidaxomicin p.o.

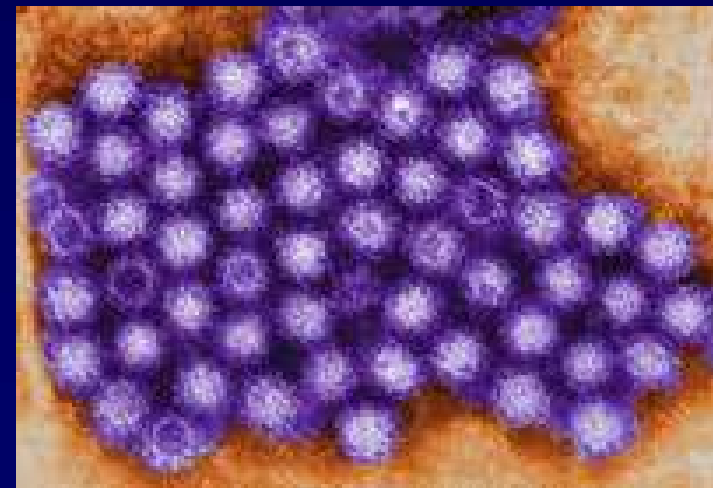
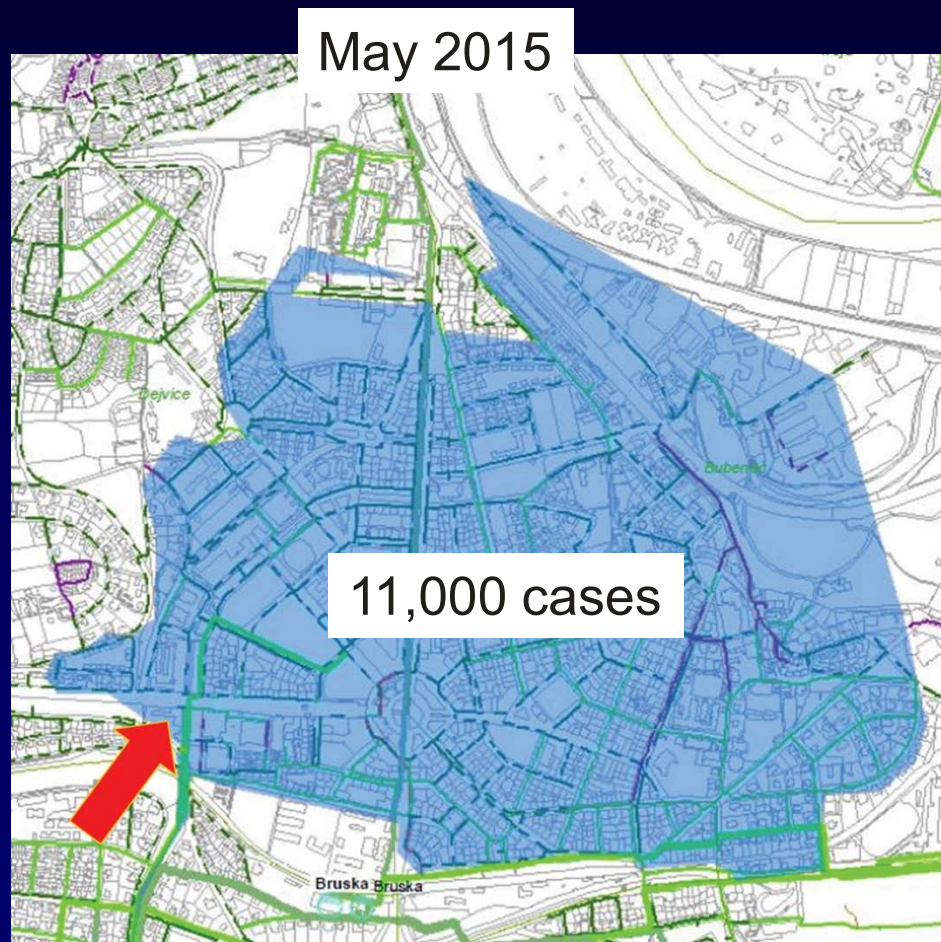
faecal microbiota transplant



# Viral gastroenteritis

## Caliciviruses: Norovirus (prototype Norwalk)

- epidemic gastroenteritis at any age



# Viral gastroenteritis

## Rotaviruses

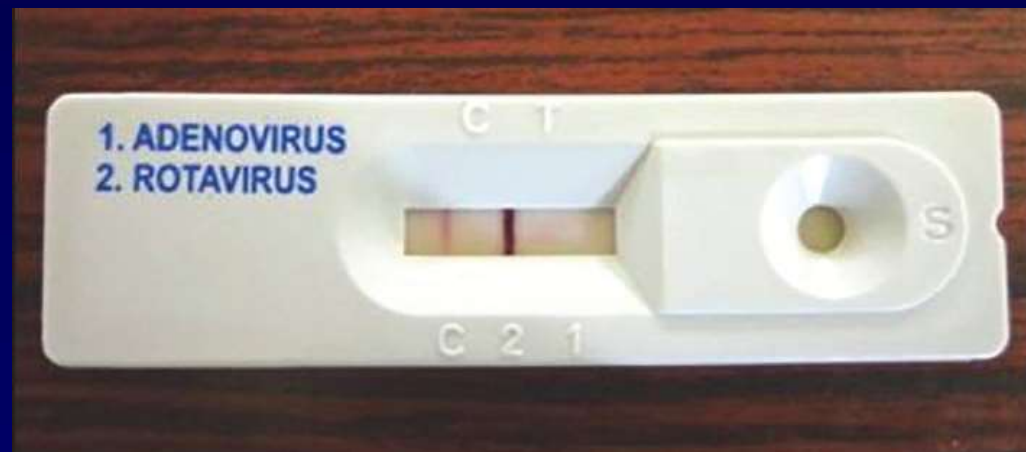
- in children, typically in winter
- dg.: Ag in stool, EM
- option for oral vaccination

## Adenoviruses

- serotypes 40, 41

## Astrovirus

another Calicivirus:  
Sapovirus





# Alternative to „classical“ diagnostics

## PCR (single agents)

*Clostridium difficile*

## PCR Panels

*Salmonella and Shigella*

*Campylobacter*

*Clostridium difficile toxin B*

*Aeromonas hydrophila*

*Yersinia spp.*

*Shiga and Shiga-like Toxin 1 and 2*

*Sapovirus*

*Rotavirus A*

*Norovirus genogroup I*

*Norovirus genogroup II*

*Human adenovirus group F and G*

*Human astrovirus*

*Giardia lamblia*

*Cryptosporidium*

## PCR Panels

*Salmonella*

*Campylobacter*

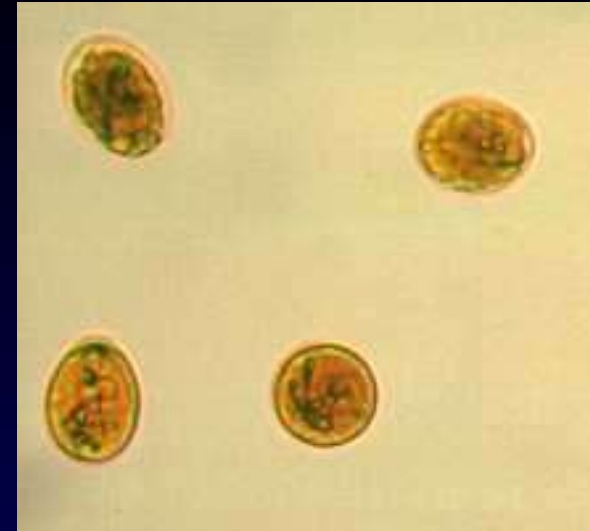
*Shigella*

*shiga toxin producing E. coli*

# Protozoa

## *Giardia intestinalis*

- dg.: cysts in stool, PCR  
trophozoits in duodenal juice
- malabsorption, steatorrhea



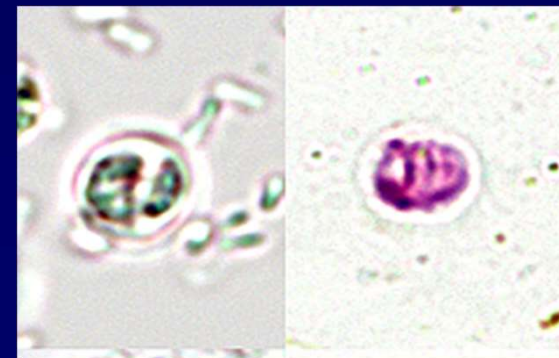
## *Entamoeba histolytica*

- dg.: cysts in stool, **PCR**
- amoebic dysentery (“walking”);  
extraintestinal complications (liver)



## *Cryptosporidium parvum*

- dg.: cysts in stool, PCR



# Helminths

## Tapeworms

- *Taenia saginata*: beef, cysticercus
- *Taenia solium*:
  1. pork, cysticercus
  2. contaminated water (food), eggs

*Enterobius vermicularis* (pinworm)

*Ascaris lumbricoides* (roundworm)

- eggs



# Gastrointestinal tract as a port of entry

## Unpasteurized milk:

- *Listeria monocytogenes* (cheese)
- *Mycobacterium bovis*

Not only through gut:

- *Coxiella burnetii*
- *Brucella spp.*

## Water:

- enteroviruses
- virus hep A (direct contact)
- virus hep E

Not only through gut:

- *Francisella tularensis*
- *Leptospira spp.*

## Meat:

- Toxoplasmosis (or oocysts)
- Toxocariasis
- Trichinellosis