



Gastrointestinal infections



Pavel Drevinek
Department of Medical Microbiology



2nd 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

- ! children (< 5 years of age)

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

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

Serum

- antibodies

Specimens collection

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

Peritoneal liquid, pus

Blood cultures

<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	GASTROINTESTINÁLNÍ TRAKT
<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.
SCREENING MRSA	<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

MIKROBIOLOGICKÁ VYŠETŘENÍ

(VIROLOGICKÁ VYŠETŘENÍ NA SAMOSTATNÉ ŽÁDÁNÍ)

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



Ústav lékařské mikrobiologie 2. LF UK a FN Motol

V Úvalu 84, 150 06, Praha 5 – Motol, Tel.: 224 435 350, Fax: 224 435 352

Přednosta: doc. MUDr. Pavel Dřevínek, Ph.D.



Vyplní žadatel			Datum odběru:	Čas odběru:
Rodné číslo:			Typ odebraného materiálu (zaškrtněte):	
Příjmení, titul:			Srážlivá krev pro sérologickou (protilátkovou) detekci	
Jméno:			Krev EDTA	Likvor
U cizince:	F	Samoplátce	Stolice	Moč
Datum narození:	M		BAL	Stěr (odkud):
Adresa:			Jiný:	
Město:	PSC:		Vyplní laboratoř	
Pojišťovna:	Dg.:		Datum přijetí:	Čas přijetí:
Infekční dg.:			Přijal:	Zapsal:
Jméno lékaře:	Telefon:	Zkratka oddělení:	Laboratorní číslo:	
Razítko oddělení a podpis indikujícího lékaře:			Poznámka	

VIROLOGICKÁ VYŠETŘENÍ

Požadované zaškrtněte (kurzívou uveden typ vhodného materiálu pro jednotlivá vyšetření):

SÉROLOGICKÁ DETEKCE	PCR PŘÍMÁ DETEKCE DNA VIRŮ	PCR PŘÍMÁ DETEKCE RNA VIRŮ
Detekce ve vzorku séra, případně likvoru ¹	Krev EDTA, likvor, stolice, moč, tkáň... ¹	Detekce ve vzorku séra
<input type="checkbox"/> EBV ¹	<input type="checkbox"/> HSV 1 a HSV 2	<input type="checkbox"/> HCV (kvalitativní detekce)
<input type="checkbox"/> Paul-Bunellova reakce	<input type="checkbox"/> VZV	<input type="checkbox"/> HCV (kvantitativní detekce)
<input type="checkbox"/> CMV	<input type="checkbox"/> CMV	Detekce ve výtěrech a vzorcích DC
<input type="checkbox"/> HHV-6 ¹	<input type="checkbox"/> HHV-6 A a HHV-6 B	<input type="checkbox"/> Influenza A/B*
<input type="checkbox"/> HSV ¹	<input type="checkbox"/> HHV-7	<input type="checkbox"/> RS virus/lid. Metapneumovirus*
<input type="checkbox"/> VZV ¹	<input type="checkbox"/> EBV	Detekce ve vzorcích likvoru, příp. stolice
	<input type="checkbox"/> HHV-8*	<input type="checkbox"/> Enterovirus*
<input type="checkbox"/> Zarděnky		
<input type="checkbox"/> Parvovirus B19	<input type="checkbox"/> Adenoviry skupin A-C	
<input type="checkbox"/> Klíšťová encefalitida ¹	<input type="checkbox"/> Parvovirus B19	
<input type="checkbox"/> Influenza A a B (KFR)	<input type="checkbox"/> BKV	
<input type="checkbox"/> RS virus (KFR)	<input type="checkbox"/> JCV*	
<input type="checkbox"/> Adenovirus (KFR)	<input type="checkbox"/> WUV*	
	<input type="checkbox"/> KIV*	
PŘÍMÁ DETEKCE ANTIGENU	<input type="checkbox"/> ganciklovir rezist. CMV kmeny (L595S, A594V)*	<input type="checkbox"/> STATIM
Detekce ve vzorku z dýchacích cest:		STATIM vyšetření a detekce označené * budou provedeny POUZE po výše zapsané konzultaci na lince 5380
<input type="checkbox"/> Influenza A/B		Konzultováno s kým a kdy:
<input type="checkbox"/> Adenovirus/RS virus		
Detekce ve vzorku stolice:		
<input type="checkbox"/> Rotavirus/Adenovirus		
<input type="checkbox"/> Norovirus		

Direct detection of Ag from stool: Rotavirus/Adenovirus Norovirus

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 the 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

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

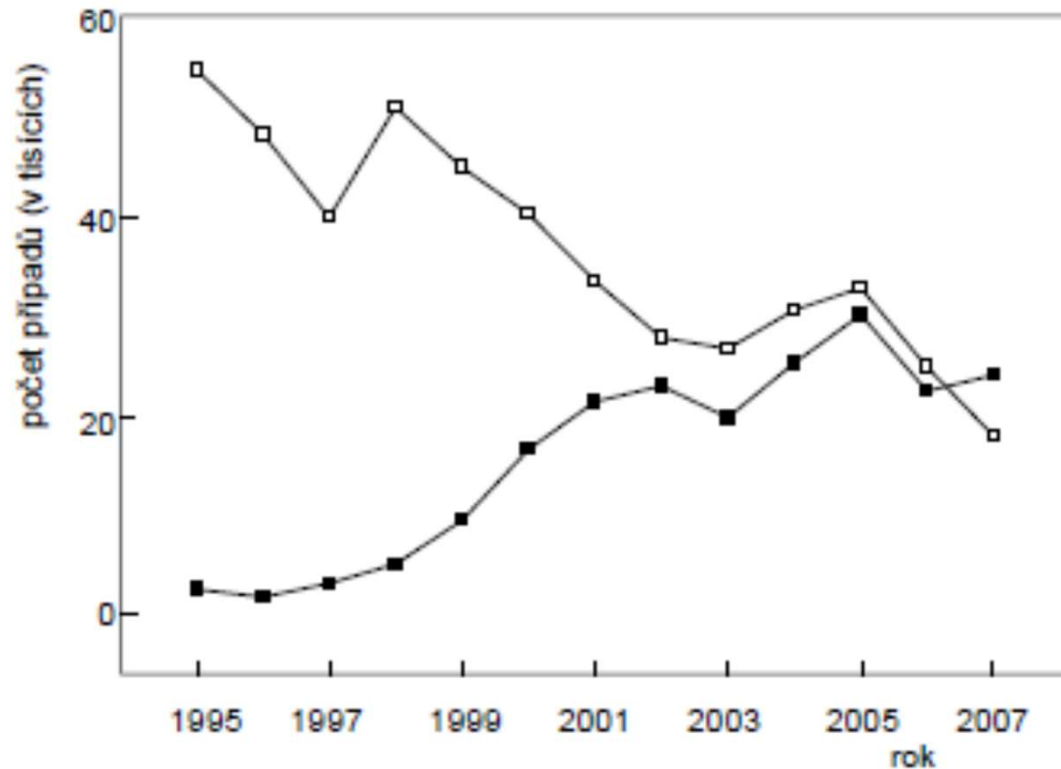
→ typical signs: diplopia, mydriasis, ptosis, dysphagia, hypomimia, constipation



food contaminated with spores

- toxin produced on 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; ■ kampylobacteriόzy, □ salmonelόzy, zdroj: <http://www.szu.cz/data/infekce-v-cr>

2020:

salmonela	10 000
campylobacter	18 000

Salmonella enterica ssp. enterica

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

Identification which is which:
culture + serotyping
(agglutination)

Kauffman – White
classification
(today, over 2000 serotypes)

Group O:9 (D ₁)				
Type	Somatic (O) antigen	Flagellar (H) antigen		
		Phase 1	Phase 2	Other
Sendai ¹	<u>1</u> ,9,12	a	1,5	
Miami ¹	<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 ₁₅	
II	9,12	a	z ₃₉	
Bangui	9,12	d	e,n,z ₁₅	
Zega	9,12	d	z ₆	
Jaffna	<u>1</u> ,9,12	d	z ₃₅	
II	9,12	d	z ₃₉	
Typhi ²	9,12[Vi]	d	–	[z ₆₀]
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 ³	<u>1</u> ,9,12	g,m	–	

Salmonella enterica ssp. enterica

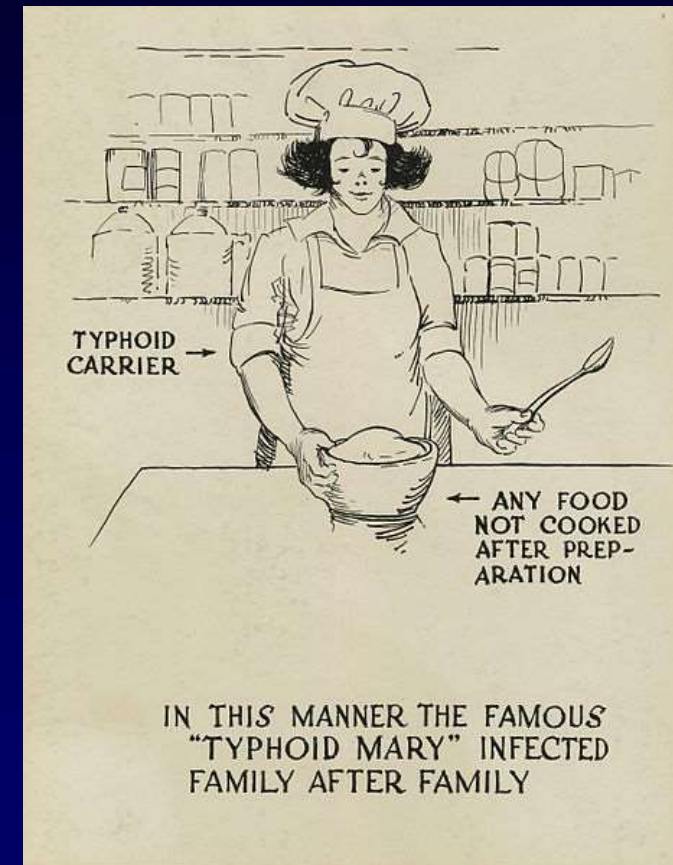
- non-typhoidal salmonella (**S. Enteritidis**)
 - incubation period over 12 hrs (1 to 2 days)
 - watery diarrhea, fever, vomiting - cholera nostras
 - zoonosis, on food (eggs, mayonnaise, ice cream...or water)
 - extraintestinal complications (rarely; joint infections, cholecystitis, osteomyelitis,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

Salmonella enterica ssp. enterica

- typhoid fever (**S. Typhi**)
 - O 9,12, V_i, 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, on food, in water (from gut of animals; chicken)
- diarrhoea (with blood), fever
- extraintestinal infections rarely, such as
reactive arthritis
parainfectious neurological complications (Guillain-Barre syndrome)



Dg.

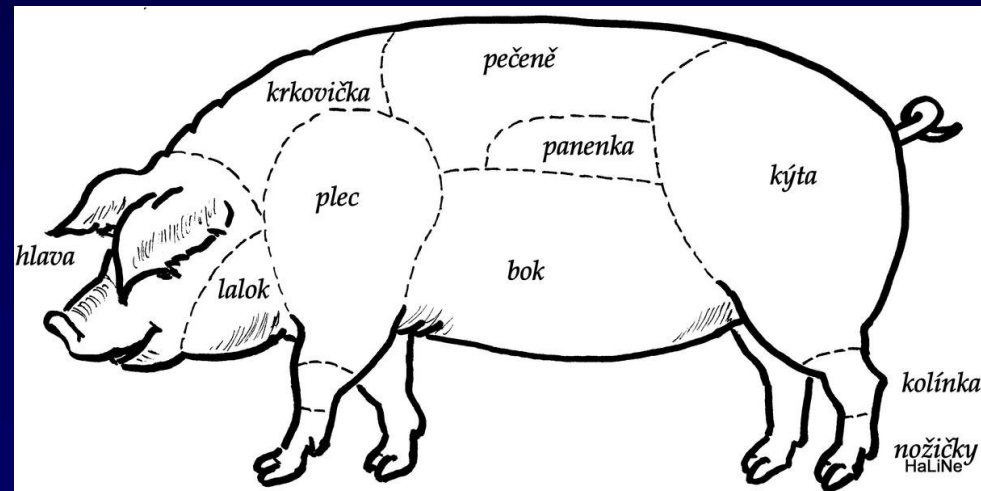
- rectal swab + transport medium
- stool
- special culture conditions, PCR

Th:

- macrolides if therapy is needed

Yersinia enterocolitica

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



Th:
- cotrimoxazol

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

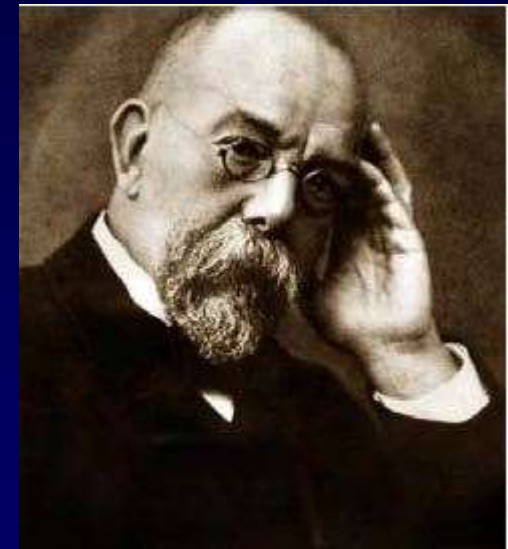
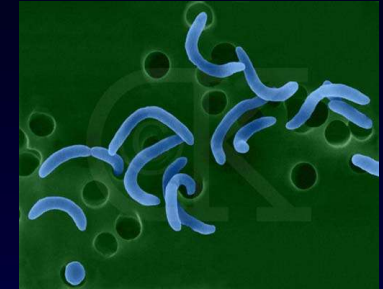
- **EPEC**: newborn diarrhea (until 1 year of age)
- **ETEC**: traveller's diarrhea (toxin close to cholera toxin)
(Delhi belly, Hong Kong dog, Casablanca crud, Montezuma's revenge)
- **EIEC**: analogy to shigellosis
- STEC (VTEC)
 - **EHEC** O157:H7; O26 etc.
 - colitis and haemolytic-uremic syndrome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

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

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

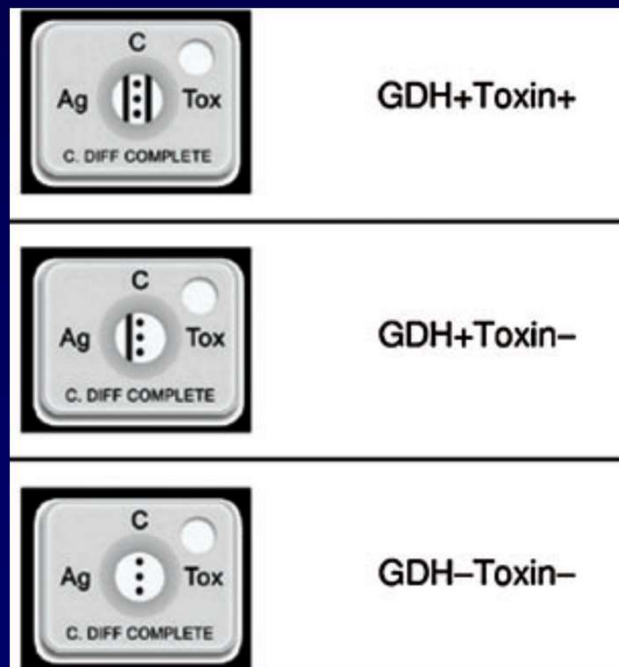
Clostridium difficile

- *Clostridoides difficile*
- the source: environment, symptomatic patient, carriers, animals
- up to 70% children colonized (by the age of 3, testing not recommended)

Nosocomial intestinal infections

Clostridium difficile

- CDI: from colitis to pseudomembranous enterocolitis
- associated with AB therapy (cephalosporins, clindamycin, quinolons...)
- pathogenic are the strains with production of toxins: toxin A a/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.
or tigecyclin i.v.

risk of CDI recurrence

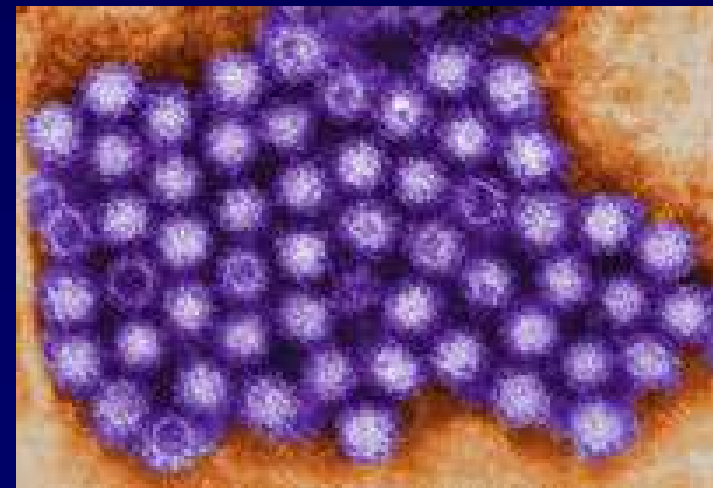
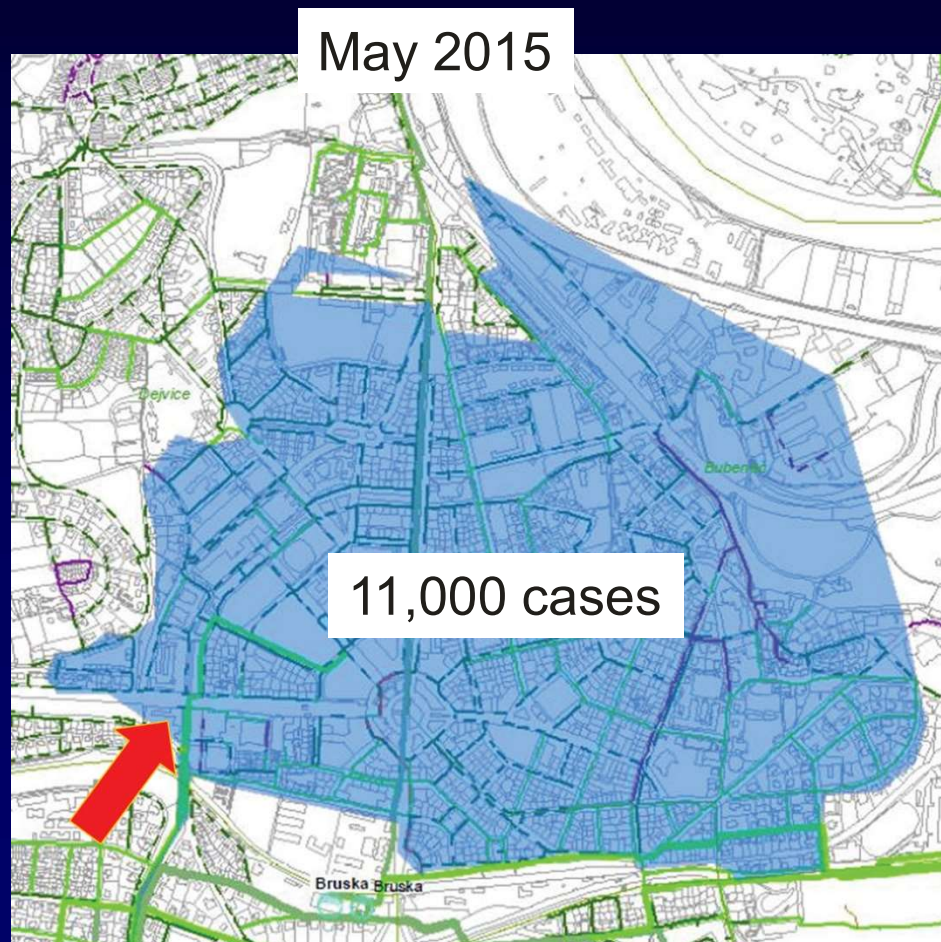
faecal microbiota transplant



Viral gastroenteritis

Caliciviruses: Norovirus (prototype Norwalk)

- epidemic gastroenteritis at any age



Viral gastroenteritis

Rotaviruses

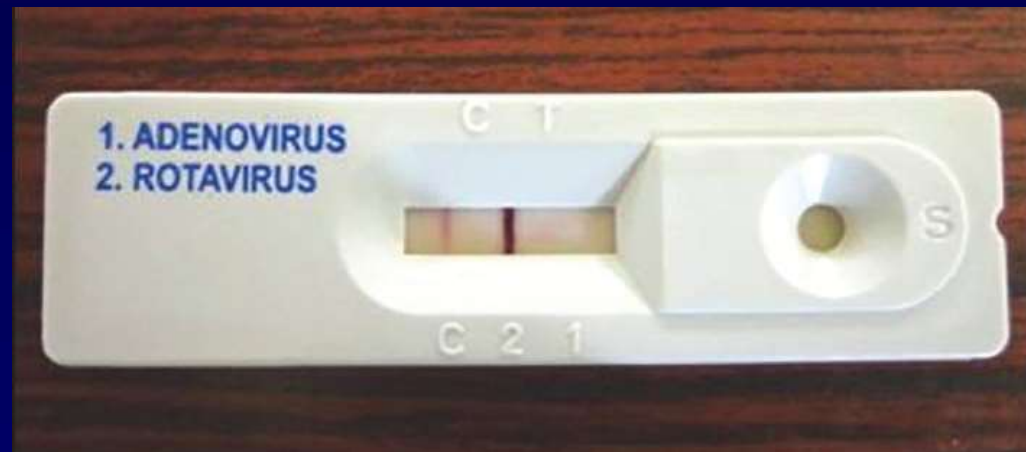
- in children, typically in winter
- dg.: Ag in stool, EM
- option for oral vaccination

Adenoviruses

- traditional 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



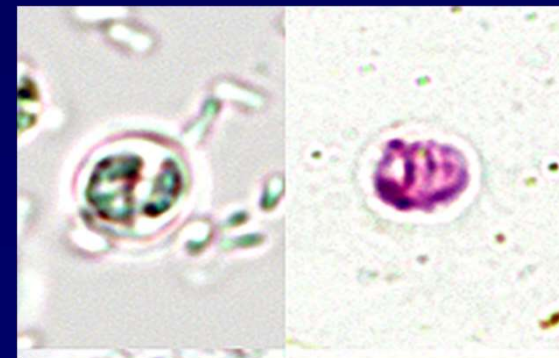
Entamoeba histolytica

- 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 = alimentary infections

Unpasteurized milk:

- *Listeria monocytogenes* (cheese)
- *Coxiella burnetii*
- *Mycobacterium bovis*
- *Brucella* spp.

Water:

- enteroviruses
- virus HAV (direct contact)
- virus HEV
- *Francisella tularensis*
- *Leptospira* spp.

Meat:

- Toxoplasmosis
- Toxocariasis
- Trichinellosis