# Gastrointestinal infections

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# 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 | • culture<br>• antigen (*C. difficile, H. pylori)*<br>• microscopy (parasites), EM (viruses)<br>• virus isolation<br>• PCR |
| Serum | • antibodies |

# Specimens collection

Tape – perianal region • microscopy (pinworm)

stomach biopsy • *H. pylori* (urease test, culture)

Peritoneal liquid, pus

Blood cultures

| | | |
|---|---|---|
| | antigen Str. pneumoniae (moč) | |
| | antigen L. pneumophilla (moč) | |
| | výtěr/aspirát | středouší |
| | | zvukovod |
| | punktát z VDN | |
| | jiné: | |

| | | |
|---|---|---|
| | likvor | lumbální punkce |
| | | kultivace |
| | | latex. aglutinace |
| | | komorová drenáž |
| | katetr | arterie |
| | | CŽK |
| | | jiný: |
| | spojivkový vak | |
| | rohovka stěr | seškrab |
| | jiné: | |
| | anaerobní kultivace | |

| | |
|---|---|
| | ejakulát |
| | urogenitální mykoplazmata |
| | jiné: |

| SCREENING MRSA | | |
|---|---|---|
| | výtěr | krk |
| | | nos |
| | | vlasy |
| | | perineum |
| | jiné: | |

| GASTROINTESTINÁLNÍ TRAKT | | |
|---|---|---|
| | výtěr z rekta | běžné patogeny |
| | | Yersinia sp. |
| | | HUS |
| | stolice ze stomie | kvantitativně |
| | stolice | Ag./toxin Cl.difficile |
| | | Ag. Helicob. pylori |
| | žaludeční sliznice | Helicob.pylori |
| | | mikroskopie |
| | | kultivace |
| | žaludeční obsah | |

**Gatrointestinal tract**

rectal swab — usual pathogens
Yersinia sp.
HUS

stool — Ag/toxin C. diif
Ag H. pylori

stomach biopsy

**MIKROBIOLOGICKÁ VYŠETŘ**

*(VIROLOGICKÁ VYŠETŘENÍ NA SAMOSTATNÉ Ž*

| SEROLOGICKÉ VYŠETŘENÍ | |
|---|---|
| | Syfilis screening - RPR, TPPA |
| | Salmonella sp. - Widalova r. |
| | Bordetella pertussis |
| | Bordetella parapertussis |
| | Lymská borrelióza - krev |
| | Lymská borrelióza - likvor |
| | Lymská borrelióza - kloubní punktát |
| | L. borrelióza - konfirmace WB** |
| | Brucella abortus |
| | Francisella tularensis |
| | Yersinia enterocolitica |
| | Listeria monocytogenes |
| | Mycoplasma pneumoniae |
| | Chlamydophilla pneumoniae |
| | Chl. pneum. - konfirmace WB** |
| | Chlamydia trachomatis |
| | Chl. trachom.- konfirmace WB** |
| | Chlamydophilla psittaci |
| | Chl. psittaci - konfirmace WB** |
| | Helicobacter pylori |
| | H. pylori - konfirmace WB** CagA |
| | Toxoplasma gondii |
| | Toxocara sp. |

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

| PŘÍMÁ DETEKCE ANTIGENU | |
|---|---|
| | Candida spp. |
| | Aspergillus sp. - krev |
| | Aspergillus sp. - BAL |

| PARAZITOLOGICKÁ VYŠETŘENÍ | |
|---|---|
| | stolice na střevní parazity |
| | průkaz roupů (lepex) |
| | stolice - Cryptosporidium sp. |
| | Giardia intes. - duod. šťáva |
| | Giardia intes. - stolice |
| | parazit- červ, článek,... |
| | Ektoparazit - roztoč, veš,... |

| PCR PŘÍMÁ DETEKCE PATOGENŮ | |
|---|---|
| | Chlamydia trachomatis *(moč, stěr - lokaliz* |
| | Burkholderia cepacia * |
| | Pneumocystis jiroveci *(mikroskopie je součástv* |

*Konzultováno s kým a kdy:*

** Pouze po telefonické konzultaci (mimo CF) l. 5*

## Parasitology examination

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

FN MOTOL

**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 | | | |
|---|---|---|---|
| Rodné číslo: | | Datum odběru: | Čas odběru: |
| Příjmení, titul: | | Typ odebraného materiálu (zaškrtněte): | |
| Jméno: | | Srážlivá krev pro sérologickou (protilátkovou) detekci | |
| U cizince: Datum narození: | F / M / Samoplátce | Krev EDTA | Likvor |
| | | Stolice | Moč |
| | | BAL | Stěr (odkud): |
| Adresa: | | Jiný: | |
| Město: | PSČ: | | |
| Pojišťovna: | Dg.: | | |
| Infekční dg.: | | | |
| Jméno lékaře: | Telefon: | Zkratka oddělení: | |
| Razítko oddělení a podpis indikujícího lékaře: | | | |

| Vyplní laboratoř | |
|---|---|
| Datum přijetí: | Čas přijetí: |
| Přijal: | Zapsal: |
| Laboratorní číslo: | |
| Poznámka | |

## VIROLOGICKÁ VYŠETŘENÍ

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

| SÉROLOGICKÁ DETEKCE |
|---|
| *Detekce ve vzorku séra, případně likvoru[L]* |
| EBV[L] |
| Paul-Bunellova reakce |
| CMV |
| HHV-6[L] |
| HSV[L] |
| VZV[L] |
| |
| Zarděnky |
| Parvovirus B19 |
| Klíštová encefalitida[L] |
| Influenza A a B (KFR) |
| RS virus (KFR) |
| Adenovirus (KFR) |

| PCR PŘÍMÁ DETEKCE DNA VIRŮ |
|---|
| *Krev EDTA, likvor, stolice, moč, tkáně…* |
| HSV 1 a HSV 2 |
| VZV |
| CMV |
| HHV-6 A a HHV-6 B |
| HHV-7 |
| EBV |
| HHV-8* |
| |
| Adenoviry skupin A-C |
| Parvovirus B19 |
| BKV |
| JCV* |
| WUV* |
| KIV* |
| |
| ganciklovir rezist. CMV kmeny (L595S, A594V)* |

| PCR PŘÍMÁ DETEKCE RNA VIRŮ |
|---|
| *Detekce ve vzorku séra* |
| HCV (kvalitativní dekekce) |
| HCV (kvantitativní detekce) |
| *Detekce ve výtěrech a vzorcích DC* |
| Influenza A/B* |
| RS virus/lid. Metapneumovirus* |
| *Detekce ve vzorcích likvoru, příp. stolice* |
| Enterovirus* |

| PŘÍMÁ DETEKCE ANTIGENU |
|---|
| *Detekce ve vzorku z dýchacích cest:* |
| Influenza A/B |
| Adenovirus/RS virus |
| *Detekce ve vzorku stolice:* |
| Rotavirus/Adenovirus |
| Norovirus |

STATIM

*STATIM vyšetření a detekce označené * budou provedeny POUZE po výše zapsané konzultaci na lince 5380*

Konzultováno s kým a kdy:

**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 for right antibiotic choice
(+ metronidazol, clindamycin;
piperacillin tazobactam; carbapenems)

# Enterotoxicosis – 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
- cuture 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

dinner 27.8.2015 18.00

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

*S. aureus* producing enterotoxin D

# Enterotoxicosis – 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

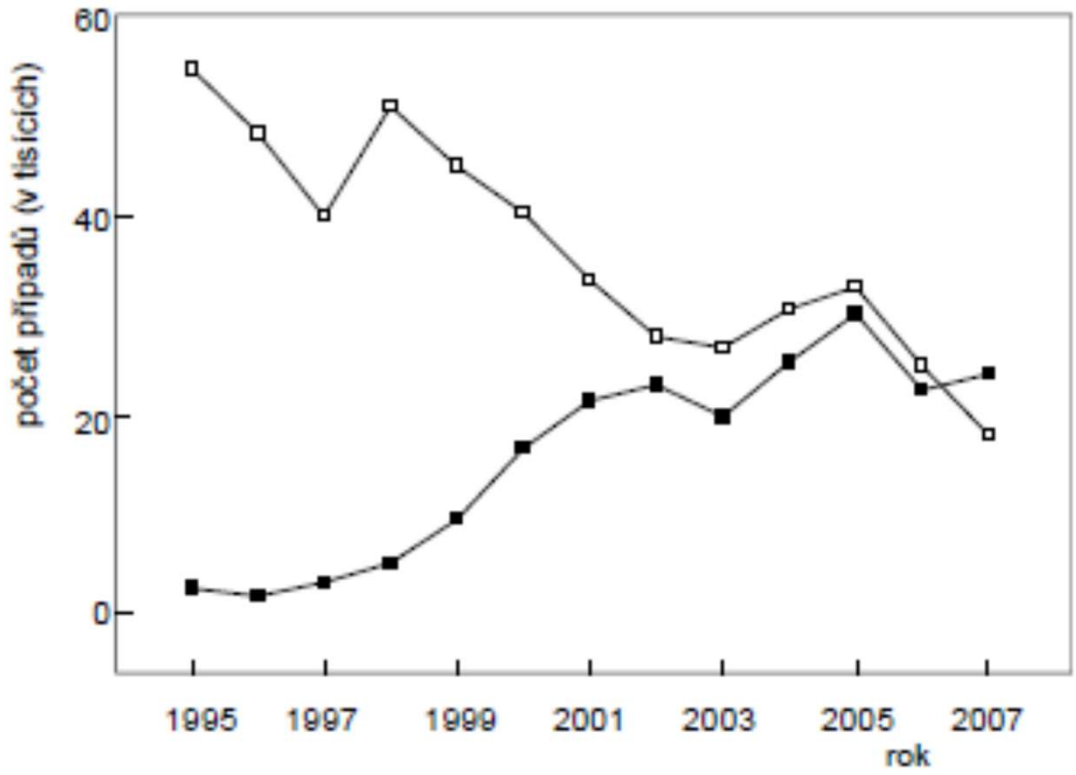
→ typical signs: diplopia, mydriasis, ptosis, dysphagia, hypomimia, constipation

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;** ■ kampylobacteriózy, □ salmonelózy, 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 salmonela (*S.* Typhi, *S.* Paratyphi)

Identification which is which: culture and serotyping
with agglutination

Kauffman – White classification

**Group O:9 ($D_1$)**

| Type | Somatic (O) antigen | Flagellar (H) antigen | | |
|---|---|---|---|---|
| | | Phase 1 | Phase 2 | Other |
| Sendai[1] | 1,9,12 | a | 1,5 | |
| Miami[1] | 1,9,12 | a | 1,5 | |
| II | 9,12 | a | 1,5 | |
| Os | 9,12 | a | 1,6 | |
| Saarbruecken | 1,9,12 | a | 1,7 | |
| Lomalinda | 1,9,12 | a | e,n,x | |
| II | 1,9,12 | a | e,n,x | |
| Durban | 1,9,12 | 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 | 1,9,12 | d | $z_{35}$ | |
| II | 9,12 | d | $z_{39}$ | |
| Typhi[2] | 9,12[Vi] | d | – | [$z_{66}$] |
| Bournemouth | 9,12 | e,h | 1,2 | |
| Eastbourne | 1,9,12 | e,h | 1,5 | |
| Berta | 1,9,12 | [f] g [t] | – | |
| Enteritidis[3] | 1,9,12 | 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, ostemyelitis, infectious aneurysm)

**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, black pepper, raw eggs | neg. |
| chicken droppings | neg. |
| rectal swabs of kitchen staff (with no symptoms) | S. Enteritidis (but they also ate the meal) |

## *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, in 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

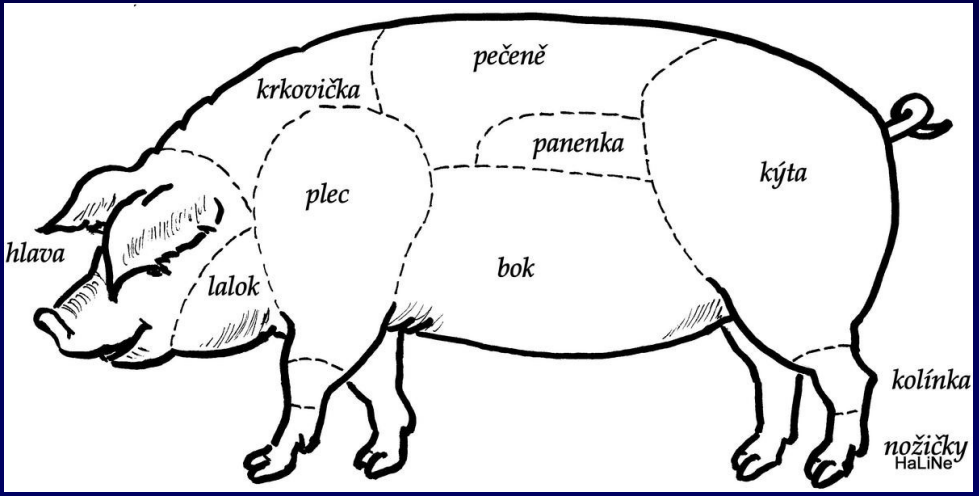
Th:
- macrolides if needed

# Gut infection of bacterial origin

*Yersinia enterocolitica*

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

" It's a pity you're not having an appendix operation - I'm rather good at that !! "




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

# Case report

girl, 8 years old

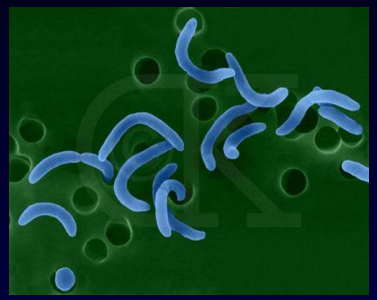
PC: summer camp, day 9: diarrhoea with blood
hospitalized in regional hospital, diarrhoea 12x a day, anuria, thrombotic microangiopathy.

Motol: dg. D+ HUS confirmed, ICU Paediatrics --> ICM
brain oedema
exitus day 7

DG z.: D593 Hemolyticko-uremický syndrom upř+lok:
DG o.: odděl: AROA KAR resuscitace děti

| Kult | Dat | Operace | |
|---|---|---|---|
| | | Enterický panel | - vyšetření metodou PCR - U |
| | 13.07-07:41 | Salmonella spp.: | negativní |
| | 13.07-07:41 | Campylobacter spp.: | negativní |
| | 13.07-07:41 | Shigella spp./Enteroinvazivní E. coli (EIEC): | negativní |
| | 13.07-07:41 | Shiga-toxin produkující E. coli (STEC/EHEC): | POZITIVNÍ |

# Gut infection of bacterial origin

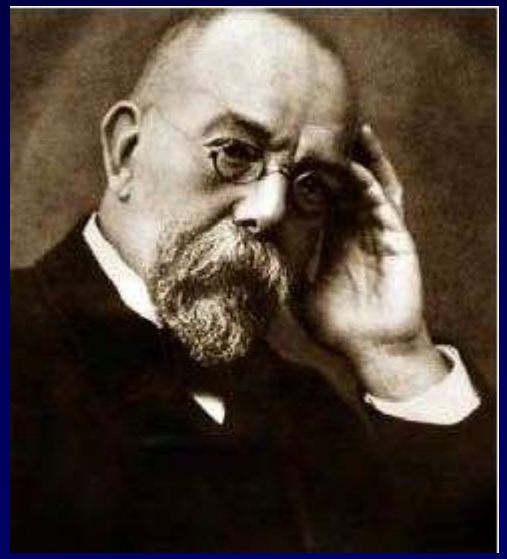


*Vibrio cholerae*

- O1 biotype classical, biotype El Tor
- non-O1 (O139 Bengal)

- cholera toxin (choleragen), 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*

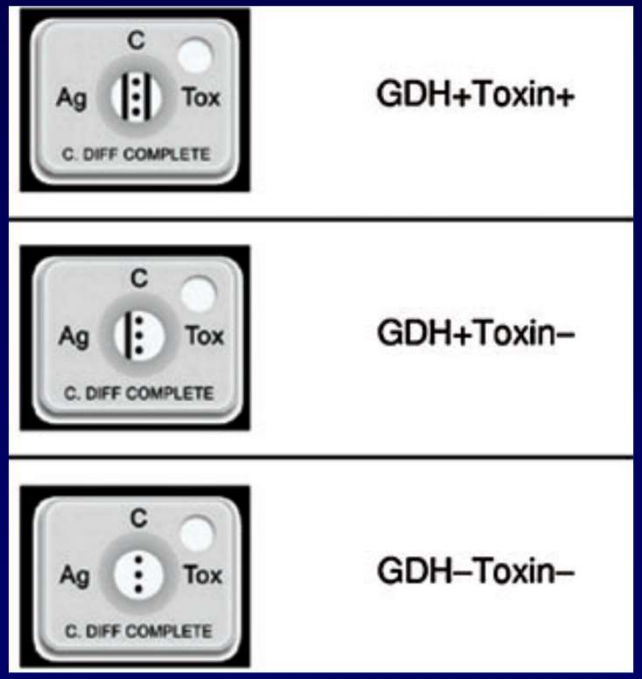
- *Clostridoides difficile*
- the source: environment, symptomatic patient, carriers, animals
- up to 70% children colonized (by the age of 3, testing not recommended)

# Nosocomial intestinal infections

## *Clostridium difficile*

- CDI: from colitis to pseudomembranous enterocolitis
- associated with ATB 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*

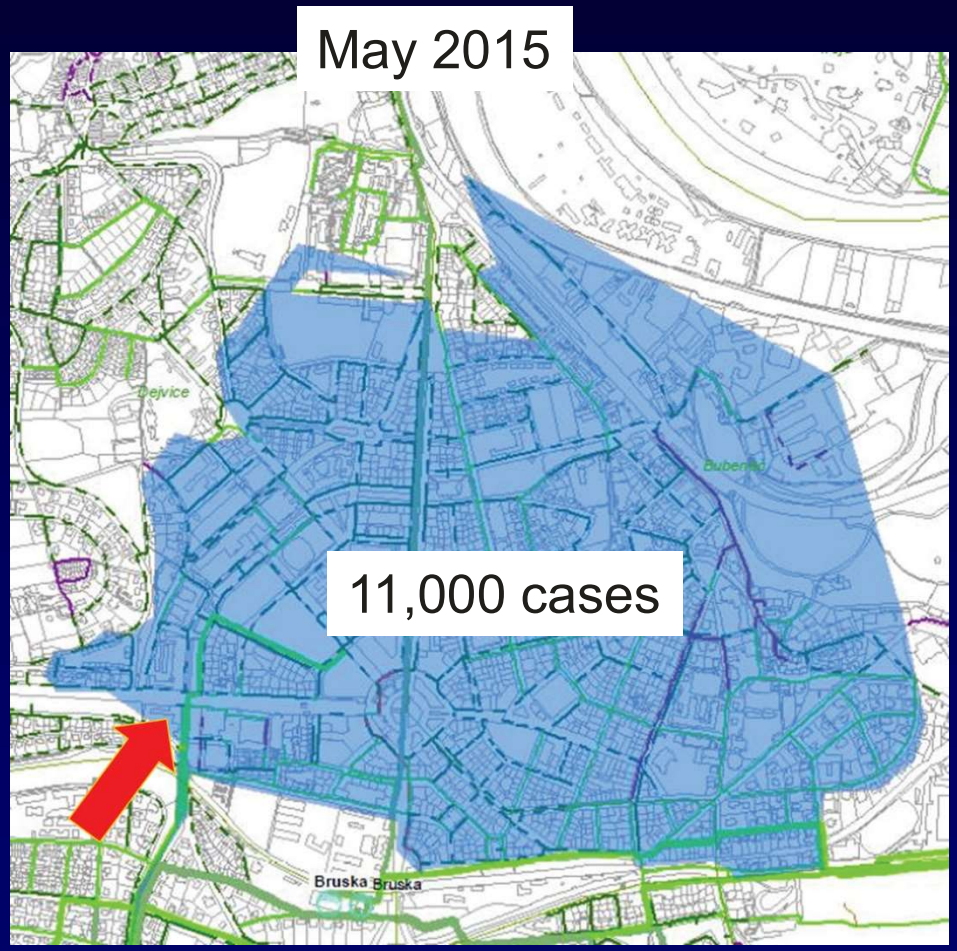
- therapy: metronidazol p.o., i.v.
  or vancomycin p.o.
  or fidaxomicin p.o.

faecal microbiota transplant

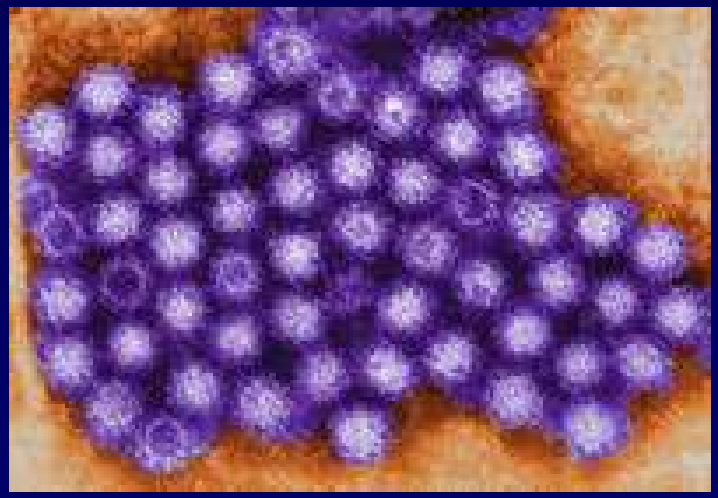
# Viral gastroenteritis

Caliciviruses: Norovirus (prototype Norwalk)

- epidemic gastroenteritis at any age







# Viral gastroenteritis

## Rotaviruses

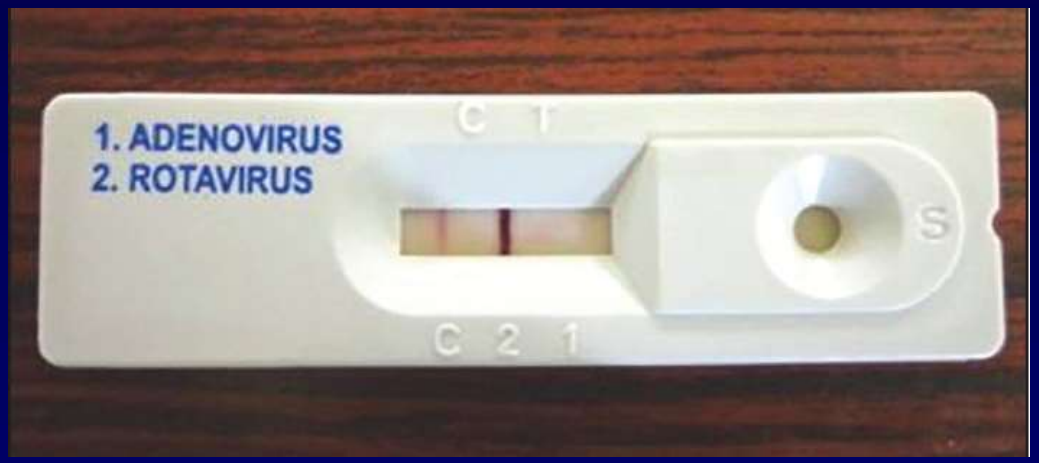
- in children, typically in winter
- dg.: Ag in stool, EM
- option for oral vaccination

## 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 produkující E. coli* |

# Protozoa

*Giardia intestinalis*

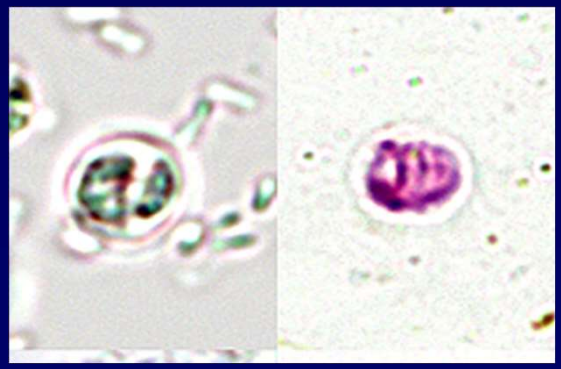
- dg.: cysts in stool, PCR
  trophozoits in duodenal juice
- malabsorption, steatorhea

*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