

# Gastrointestinal infections



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## Global significance of GI infections

- Estimates are that over 1.8 million children still die each year ( more than 6000/day)
- The second most common infections in developed countries (after respiratory infections)



# Gastrointestinal infections in CR 2006-2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
<b>Campylobacter</b>	22 713	24 254	20 175	20 371	21 164	18 811	18 412	18 389	20 903	21 085
<b>Salmonella</b>	25 102	18 204	11 009	10 805	8 622	8 752	10 507	10 280	13 633	12 727
<b>Shigella</b>	289	349	229	178	450	164	266	257	92	88
<b>Bacterial other</b>	2 471	2 831	3 305	3 178	3 343	4 607	5 168	5 797	6 762	8 138
<b>Viral</b>	5 597	6 025	6 639	6 066	8 517	9 955	6 877	7 778	9 438	18 817
<b>Food poisoning</b>	48	70	84	106	100	381	14	203	177	793

# Gastrointestinal infections

- bacterial
- viral
- parasitic



# Bacterial GI infections

- transmission of pathogenic microbes
  - zoonosis
  - human
- food-poisoning (toxins in food)

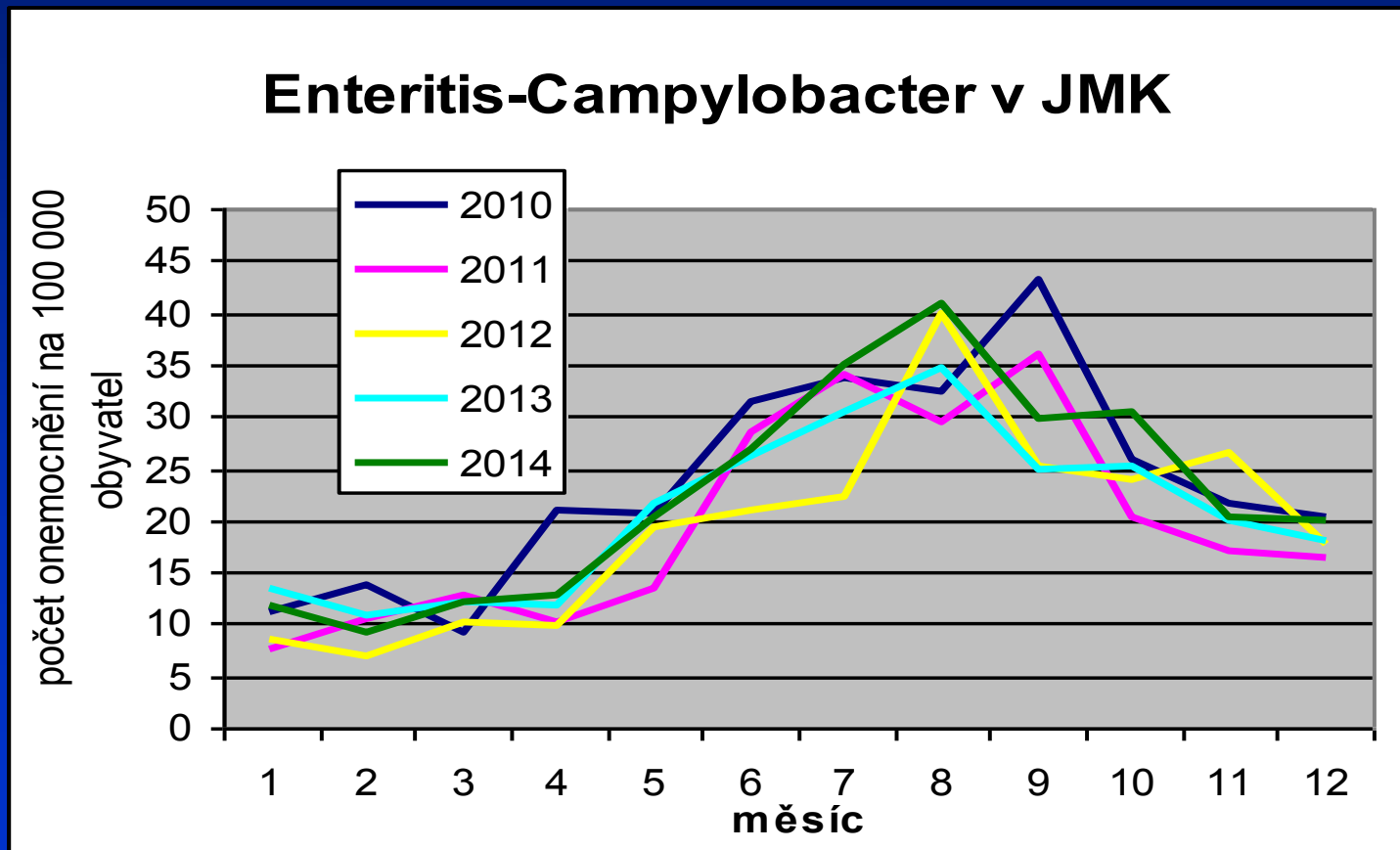
# Zoonosis

- salmonellosis (*S. Enteritidis*)
- campylobacteriosis (*C. jejuni*)
- yersiniosis (*Y. enterocolitica*)
- EHEC (*E. coli*)

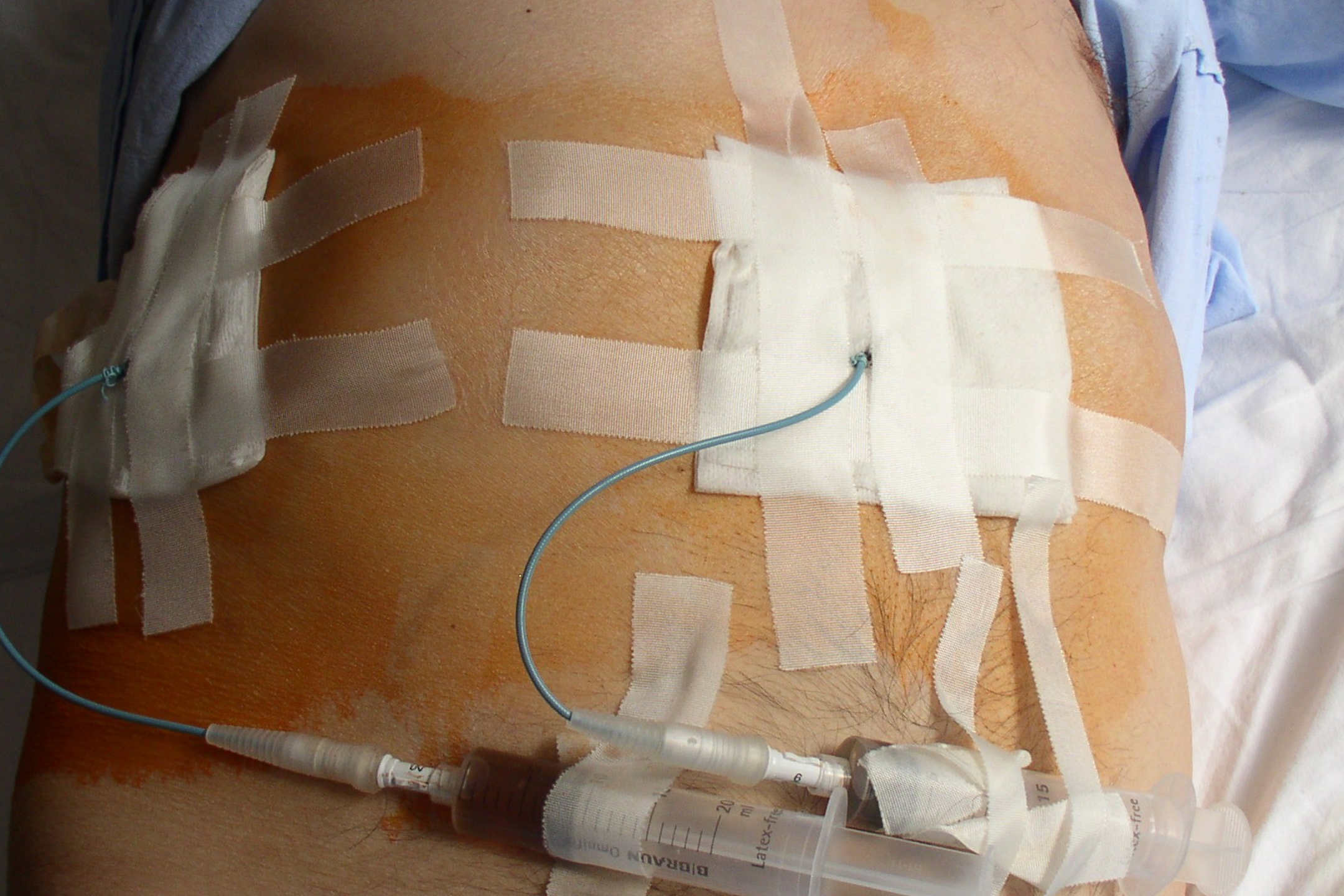
# Campylobacteriosis

- now the most common zoonosis in CR a many other European countries (especially undercooked poultry)
- *Campylobacter jejuni*
- clinical course – from inaparent to serious acute enterocolitis with right lower abdominal quadrant pain, fever, and bloody diarrhoea
- sepsis is possible in IS patients
- reactive arthritis, erythema nodosum – possible immune-mediated complications
- rehydration, diet, complicated forms: macrolides

# Campylobacteriosis in Southern Moravia 2010-2014











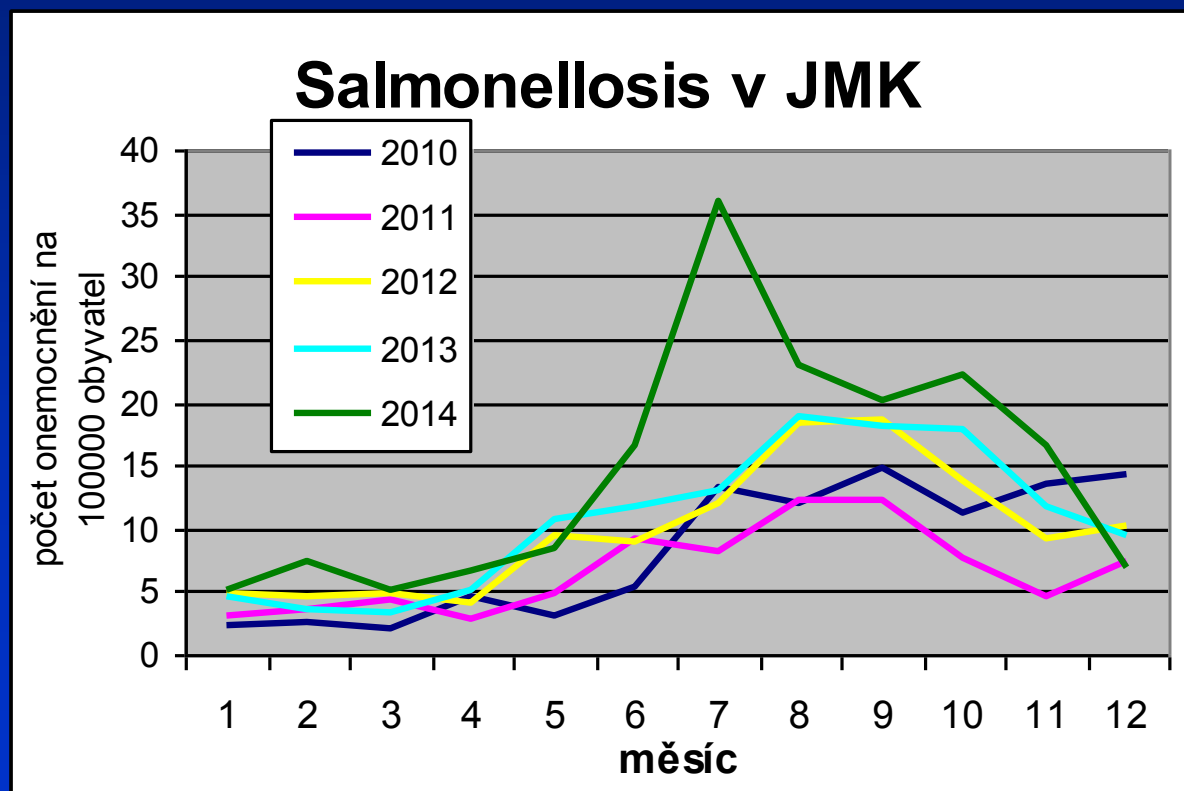
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# Salmonellosis

- the second most common zoonosis in CR and most European countries
- at present in CR minimally 90 % cases caused by *S. Enteritidis*, rarely *S. Typhimurium*
- gastroenteritidis
- enterotoxin production and active penetration into intestinal epithel
- septic form (extraintestinal abscesses) in IS patients
- reactive arthritis, erythema nodosum – possible immune-mediated complications
- rehydration, diet, complicated forms: fluoroquinolones, co-trimoxazol, ampicilin, chloramphenicol

# Salmonellosis in Southern Moravia 2010-2014





# Yersiniosis

- worldwide zoonosis, relatively more common in Northern Europe
- *Yersinia enterocolitica*
- more often in winter
- fever, diarrhea, often bloody, syndrome of the lower right quadrant (mesenteric lymphadenitis)
- complication: sepsis, metastatic abscesses (esp. liver)
- reactive arthritis, erythema nodosum - possible immune-mediated complications
- rehydration, diet, complicated forms: fluoroquinolones, co-trimoxazol, ampicillin, chloramphenicol

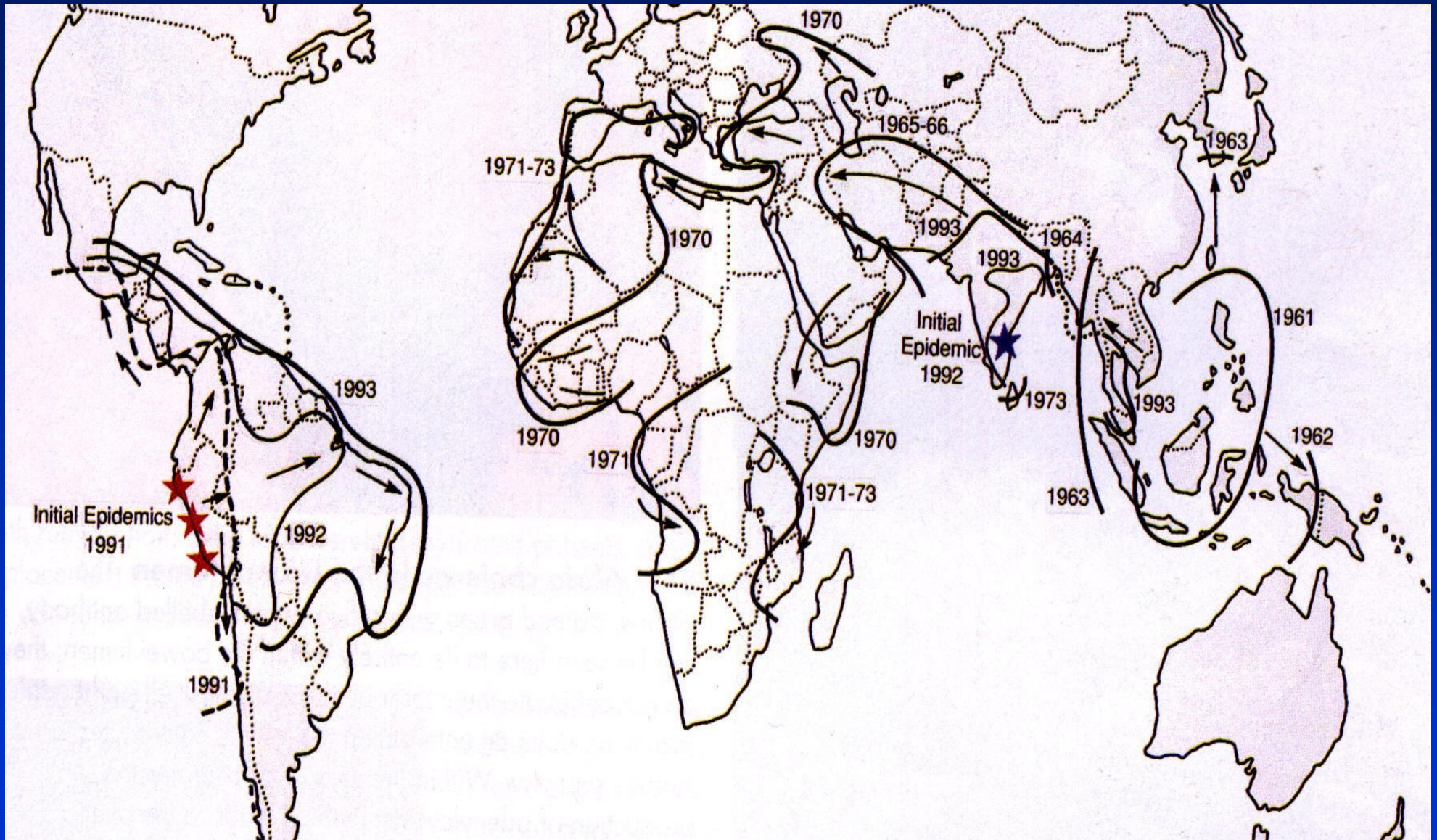
# Human bacterial infections

- cholera
- shigellosis
- *E.coli* enterocolitis (except for EHEC – zoonosis)
- *Clostridium difficile* infection

# Cholera

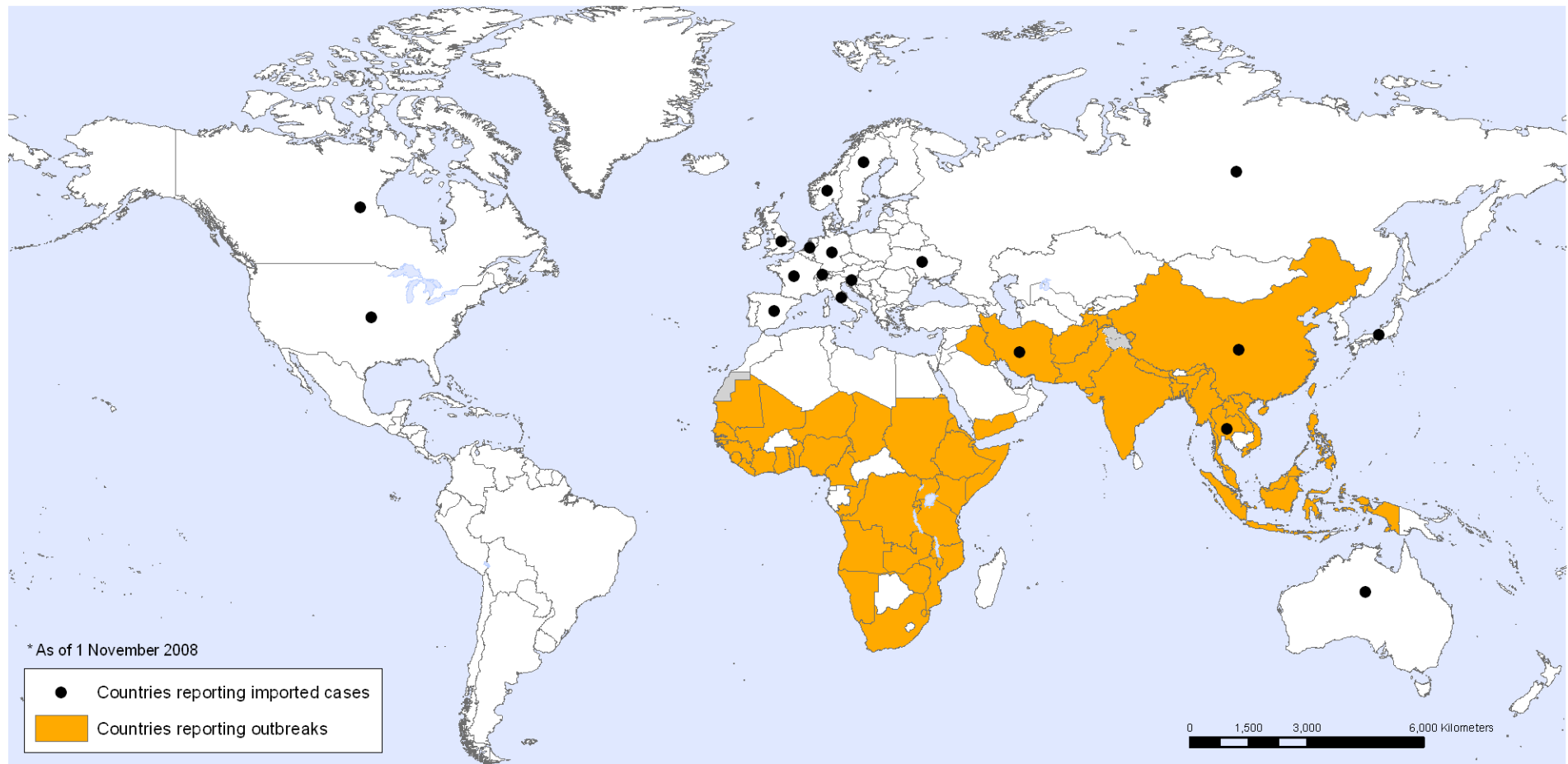
- endemic in South and South-East India
- *Vibrio cholerae* faecally contaminated water – drinking water, undercooked animals from this water
- boiling destroys this bacteria
- at least 7 cholera pandemics worldwide during last 200 years
- 1st-6th pandemics - classic type (1817-1923)
- 7th pandemic - biotyp El Tor (since 1960s)
- 8th pandemic - O139 Bengal (since 1992)

# Cholera – 7th and 8th pandemics





## Cholera, countries reporting outbreaks and imported cases, 2006–2008\*



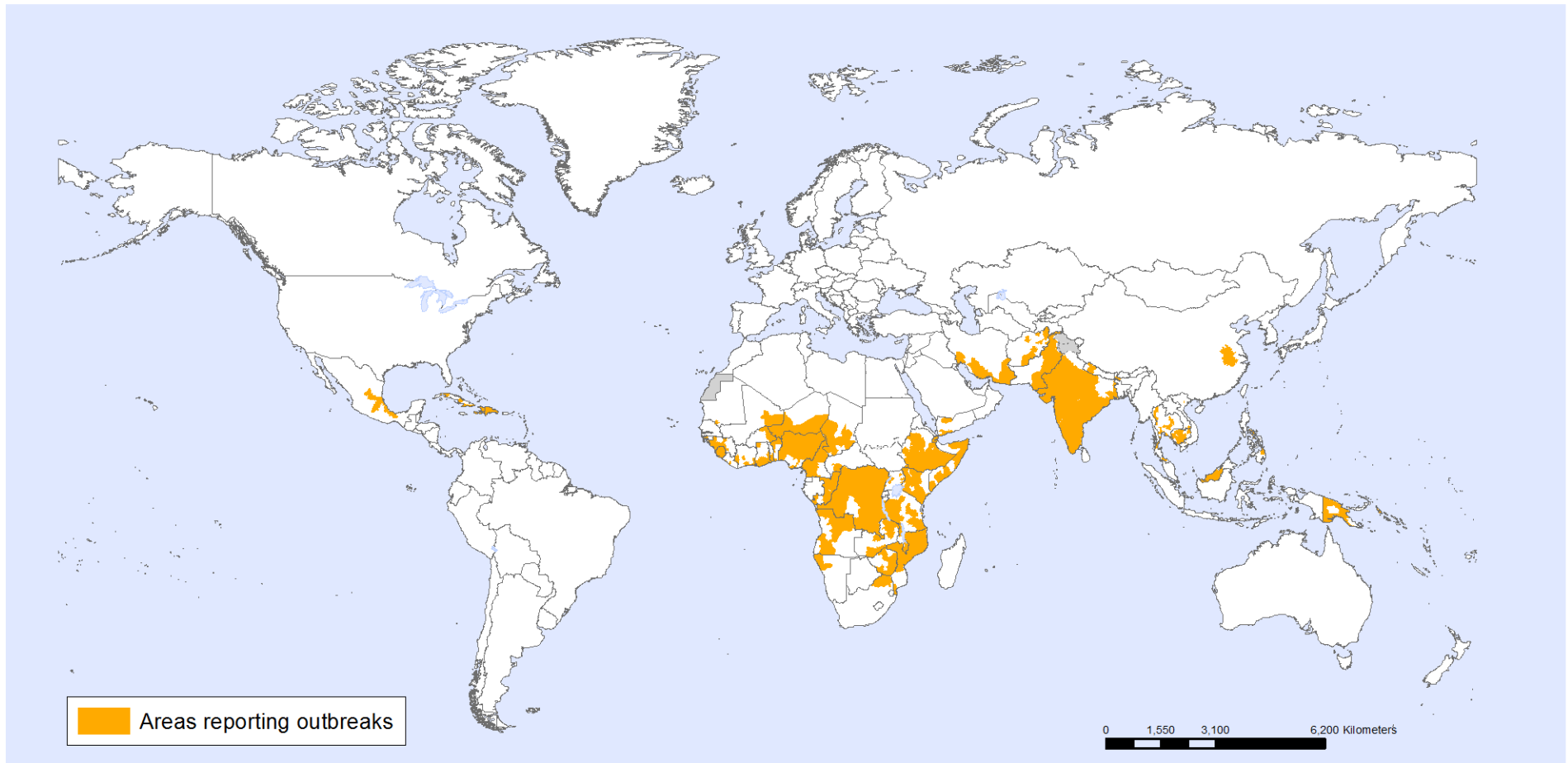
The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization  
Map Production: Public Health Information  
and Geographic Information Systems (GIS)  
World Health Organization



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## Cholera, areas reporting outbreaks, 2010–2013



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization  
Map Production: Health Statistics and  
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World Health Organization

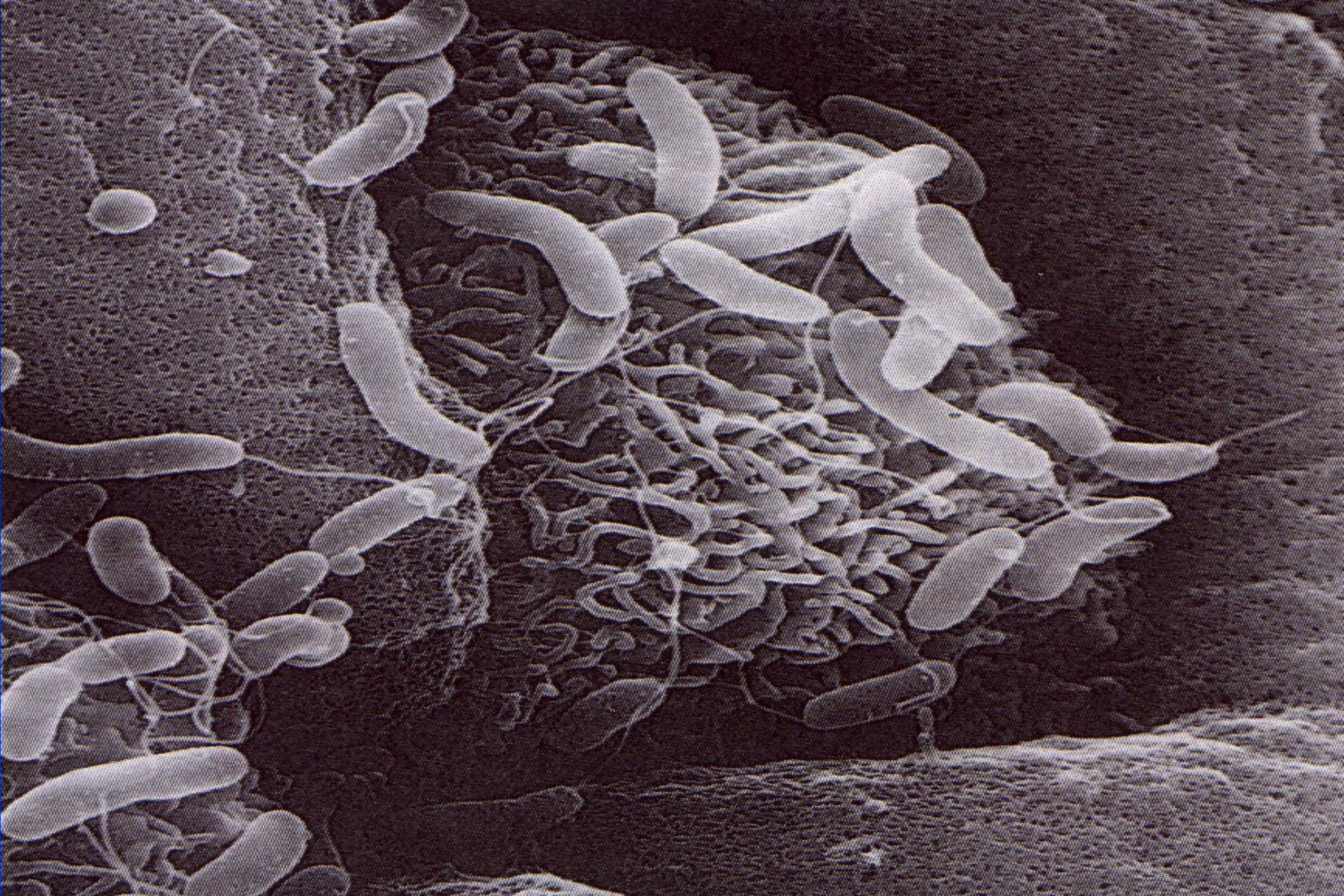


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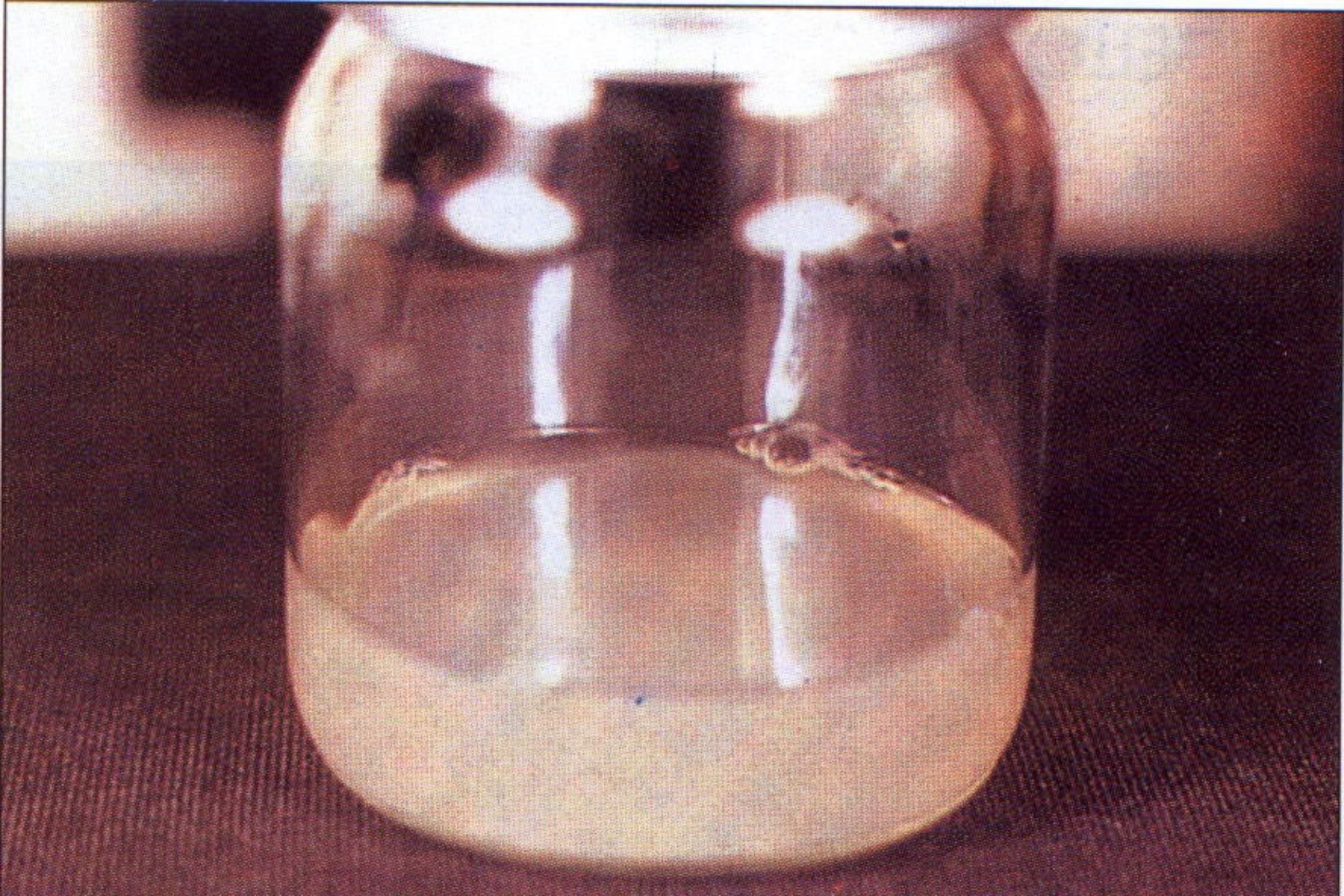
# Cholera

- enterotoxin production - profuse diarrhea, vomiting and rapid dehydration (especially when is the infection caused by classic type)
- the collection of stool by special swabs and culture
- the necessity of quick rehydration
- antibiotics – above all epidemiological significance (fluroquinolones, co-trimoxazol, doxycycline, chloramphenicol)
- vaccination available (combined vaccine with ETEC), not generally recommended – low efficacy, short duration of protection











# Shigellosis

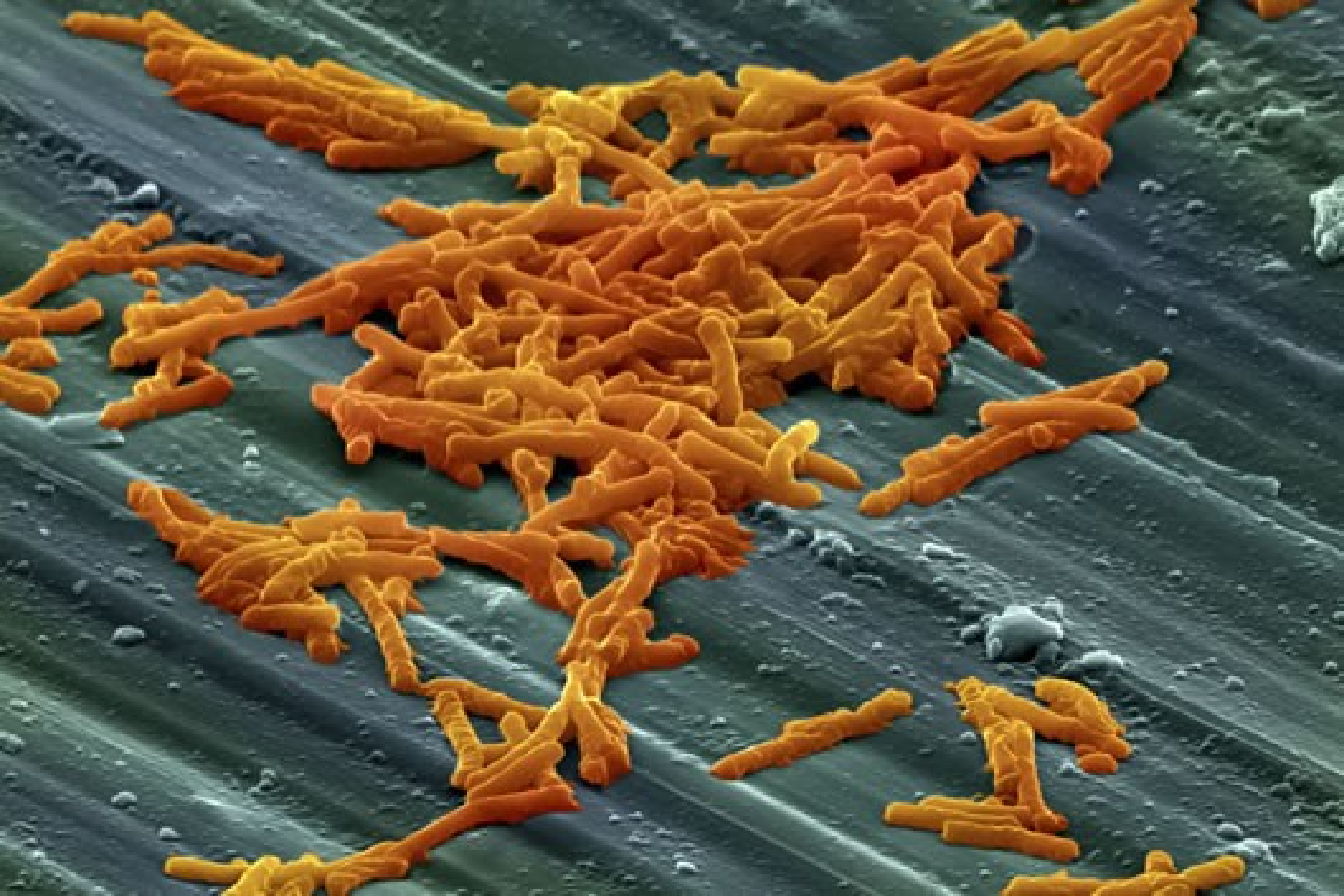
- one of the most contagious intestinal infections
- associated with poor hygiene conditions – war conflicts, natural catastrophes
- *Shigella sonnei*, *S. flexneri*
- colitis (tenesmus, often mucus, pus, and blood in stool)
- rehydration, diet, complicated forms: fluoroquinolones, co-trimoxazol, ampicilin, chloramphenicol

# *E. coli* enterocolitis

- Enterotoxigenic - ETEC
- Enteroinvasive - EIEC
- Enteropathogenic - EPEC
- Enterohemorrhagic - EHEC
- Enteroagregative - EAEC
- Difuse adherent

# *Clostridium difficile* infection (CDI)

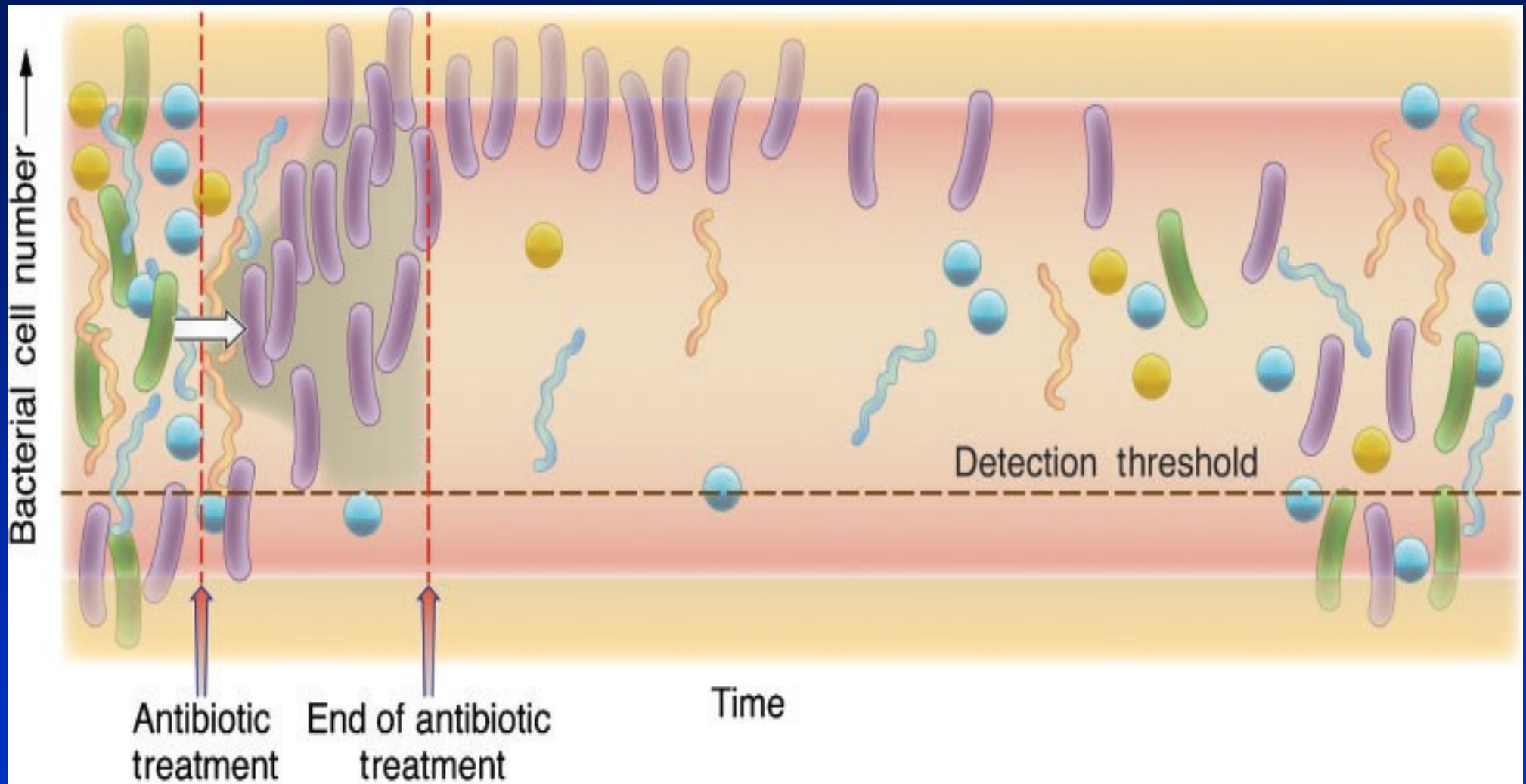
- *C. difficile* - G<sup>+</sup> anaerobic spore-forming bacteria
- spores survive for many months outside an organism – extremely resistant
- common nosocomial infections in developed countries
- development of vegetative forms in the colon
- production of exotoxins (usually both at once)
  - toxin A (enterotoxin – necrotic)
  - toxin B (cytotoxin)
  - binary toxin (unknown mechanism)





# Important factors for CDI

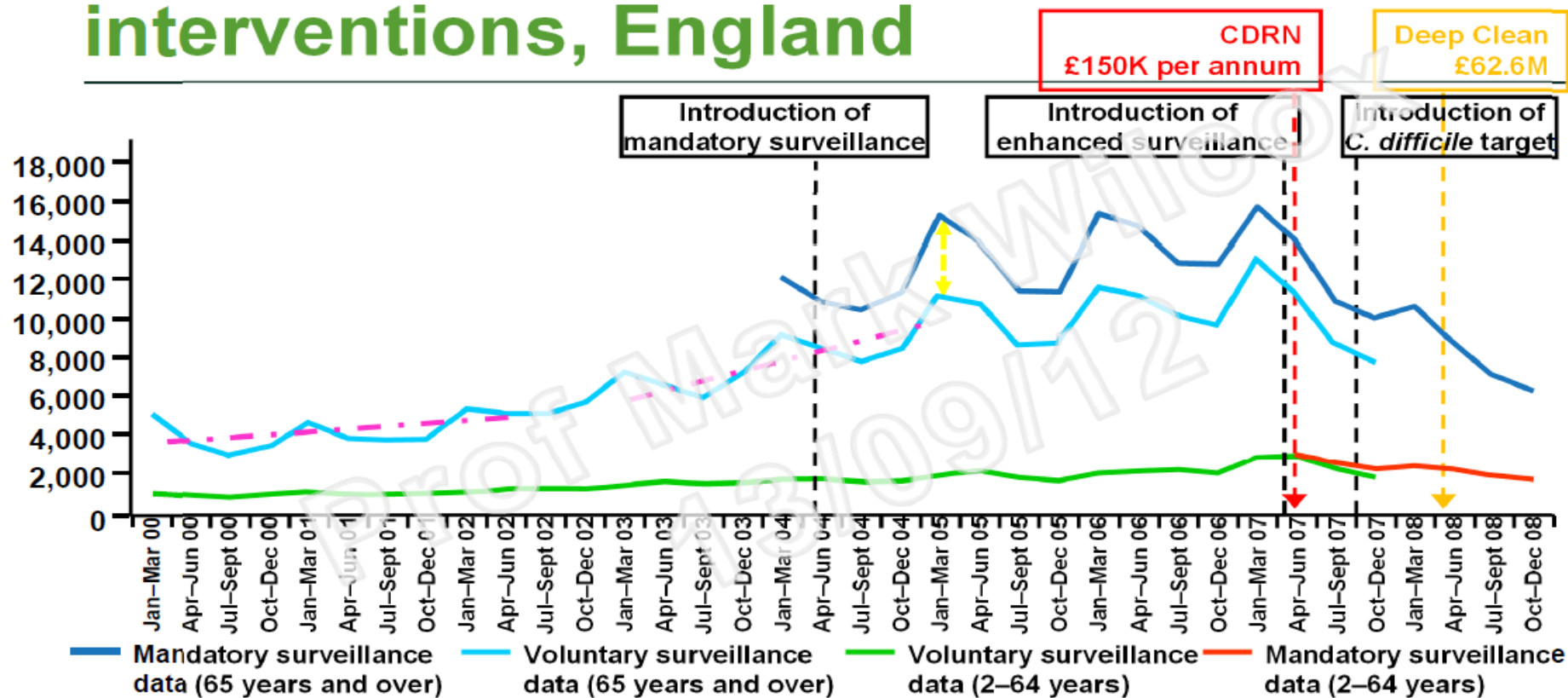
- presence of toxigenic strain of *C.difficile*
- antibiotic treatment – aminopenicilins, cephalosporins, lincosamides...
- less frequently without antibiotic treatment – oncologic patients
- age  $\geq$  65 years, comorbidities, IS
- function of GI tract – peristalsis, only perenteral nutrition, disturbances of mucous immunity



*Long-term impacts of antibiotic exposure on the human intestinal microbiota.*  
Jernberg C., Löfmark S, Edlund Ch. et al. *Microbiology* (2010), 156, 3216–3223



# C. difficile reports and key interventions, England



National Audit Office. Reducing Healthcare Associated Infections in Hospitals in England. London, England: National Audit Office; 2009. Copyright © National Audit Office. Table data from the Health Protection Agency.

Date of preparation: August 2012 DIF12045UKI



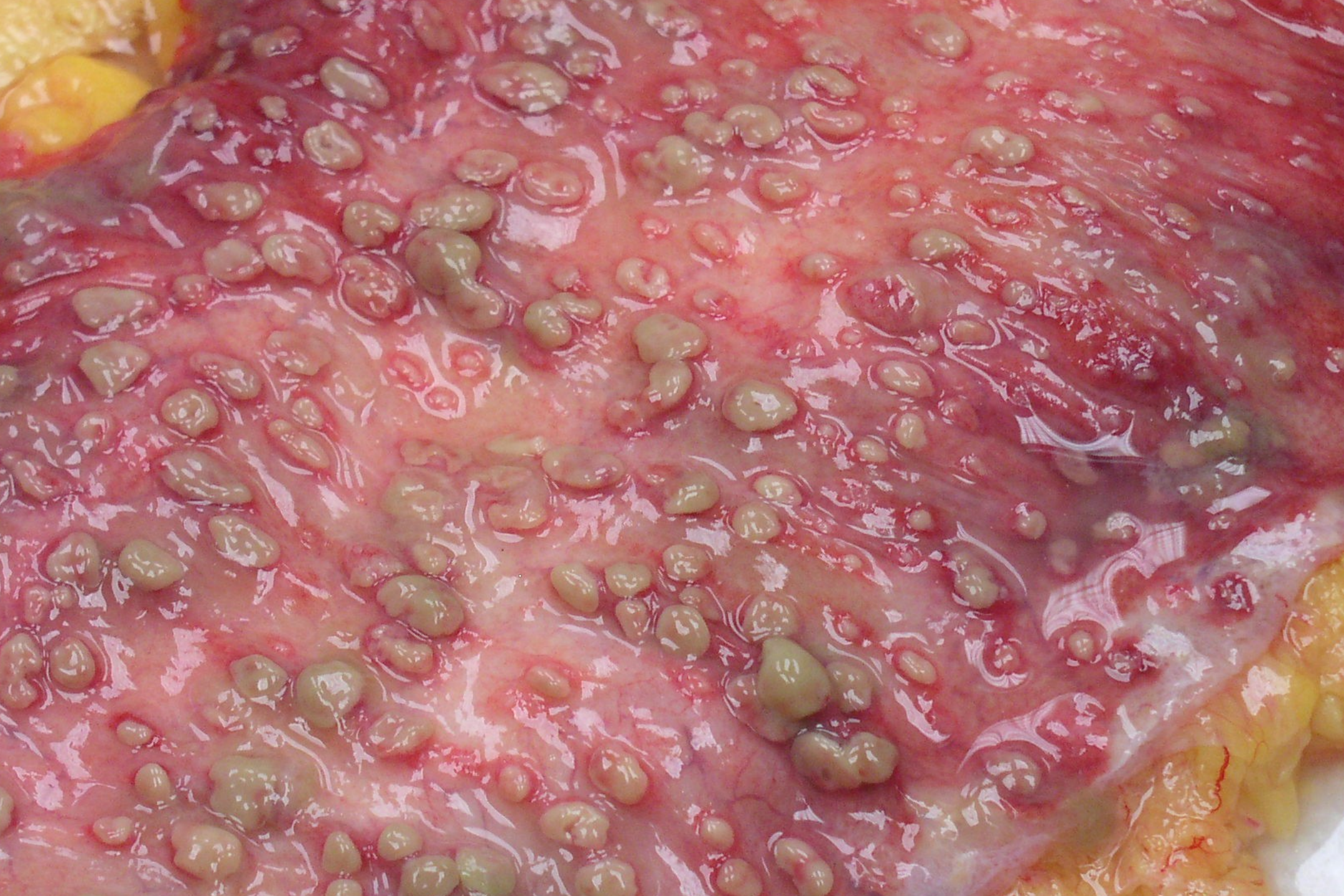
# CDI – clinical forms

- a) asymptomatic carriers (2-3 % of adults, in children much more, prevalence is increasing with the length of hospitalization - 10-25 % or more)
- b) uncomplicated colitis (diarrhea, fever, no pseudomembranes)
- c) pseudomembranous colitis - PMC (sepsis, leucocytosis, abdominal pain, and bloody stool)
- d) toxic megacolon (paresis and necrosis of the gut, possible perforation, infectious shock)





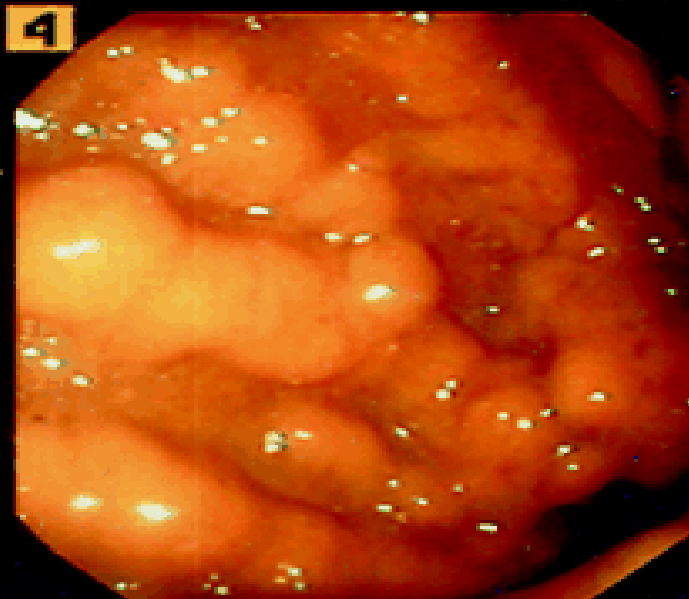
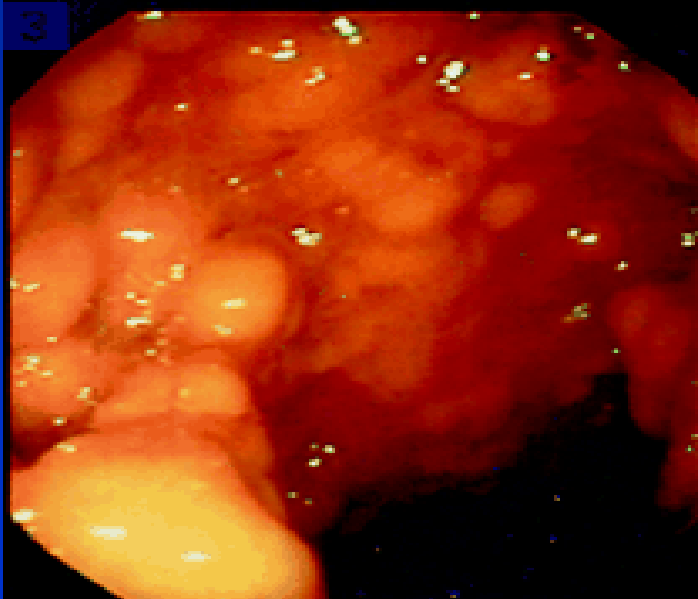
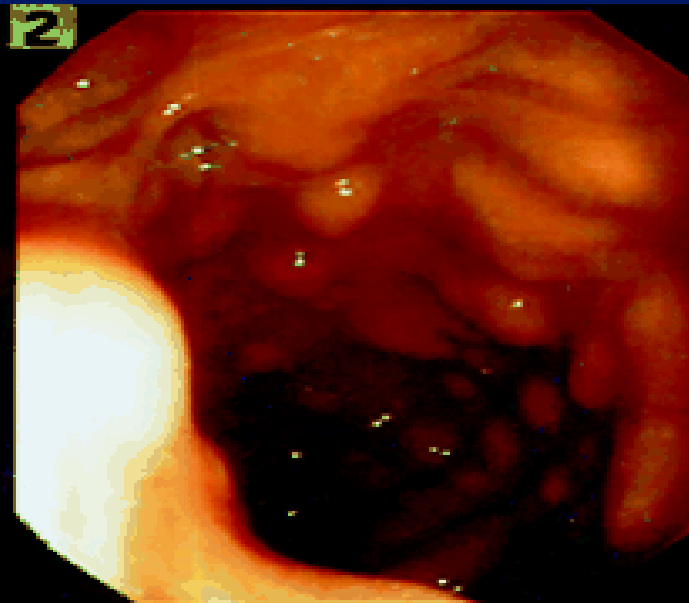




# Diagnosis of CDI

- antibiotics in history
- clinical findings
- microbiological testing – detection of toxins (ELISA), specific antigen (GDH), culture, cytotoxic test, PCR
- coloscopy (pseudomembranes)
- ultrasound, CT – auxilliary methods





# CDI therapy

- termination of ATB therapy
- colitic diet, rehydration, rehabilitation
- do not use antimotility drugs - danger of toxic megacolon
- pharmacotherapy – 10-14 days
  - metronidazol 3 × 500 mg oral or intravenous
  - vancomycin 4 × 125 mg oral
  - fidaxomicin 2 × 200 mg oral
- faecal bacteriotherapy – faecal transplant
- colectomy



# Food poisoning

- **with short incubation period** (1-6 hours)-thermostable toxins –  
nausea, vomiting

*Staphylococcus aureus*

*Bacillus cereus*

- **with long incubation period** (6-18 hours)- termolabile toxins -  
diarrhea

*Bacillus cereus*

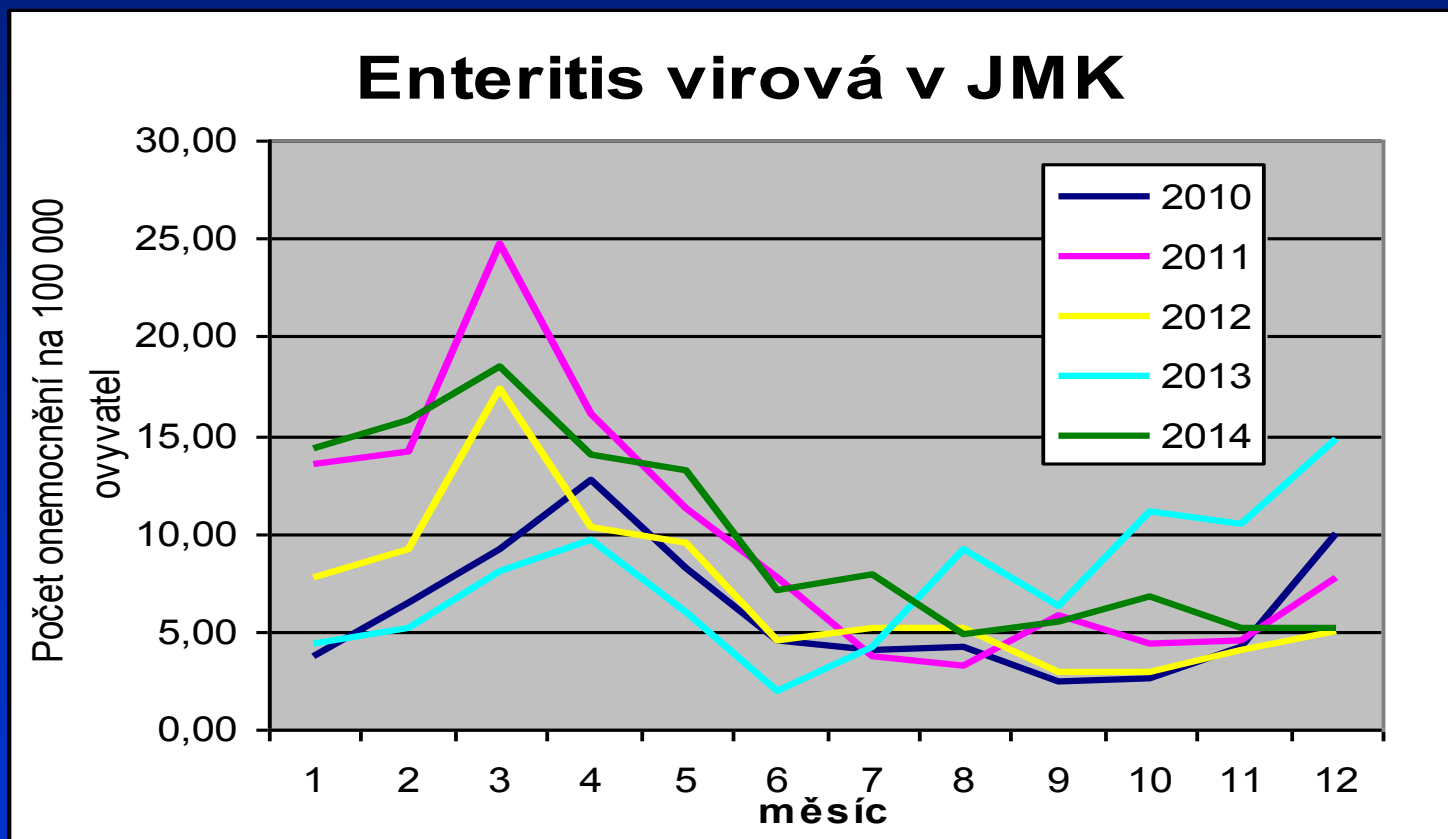
*Clostridium perfringens A*

- absence of fever, outbreaks
- rehydration, diet

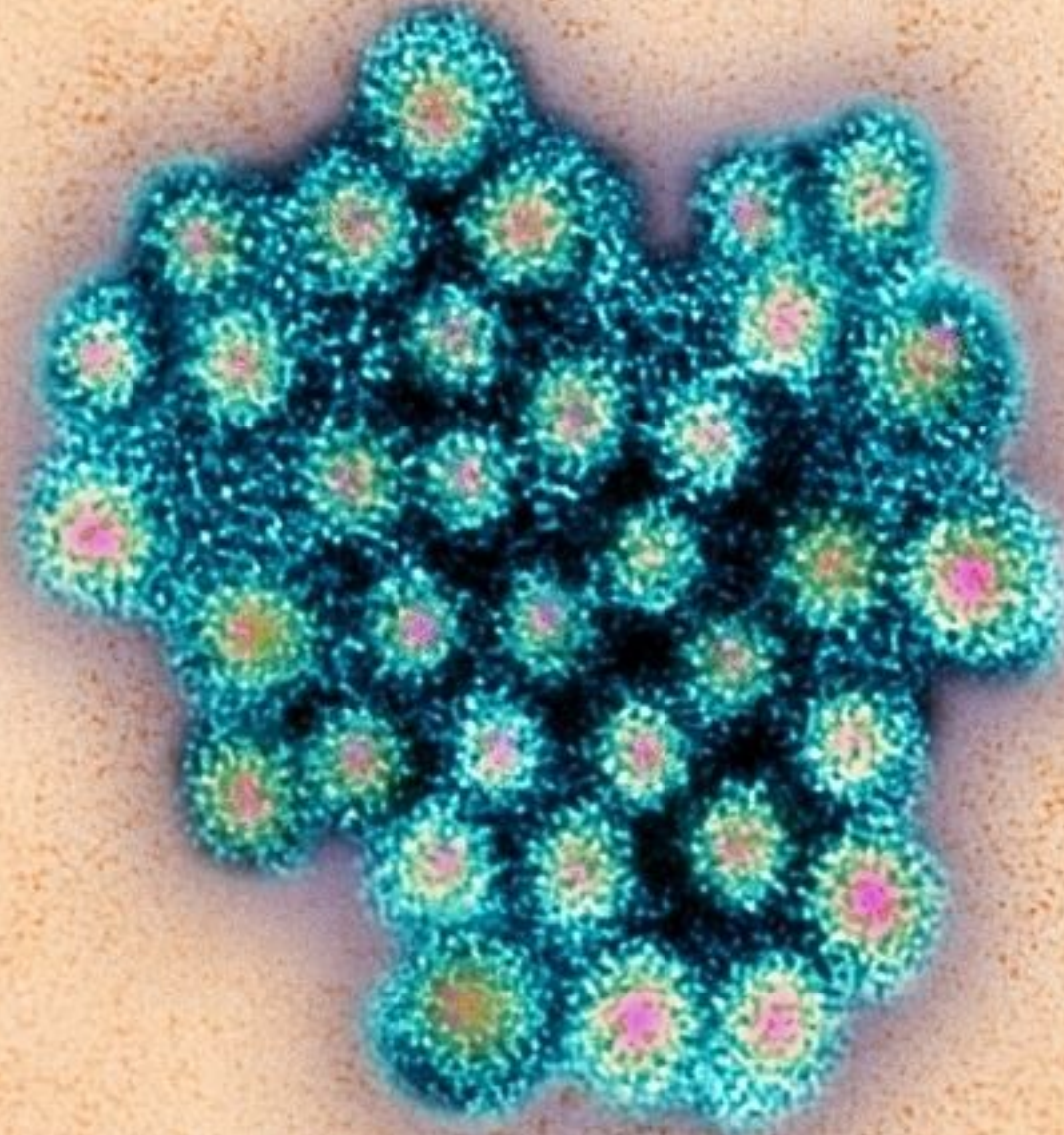
# Viral gastroenteritis

- noroviruses (Norwalk, Norwalk-like virus) – older children, adults
  - rotaviruses (small children- 6-24 months, seniors) – fecal-oral, airborne infection, vaccine available
  - adenoviruses
  - astroviruses
  - coronaviruses
- 
- symptomatic therapy

# Viral GI infections in Southern Moravia 2010-2014



# Norovirus





# Incubation periods of GI infections

<b>Patogen</b>	<b>Inkubační doba</b>
kampylobakter	1–7 dnů
salmonela	6–48 hodin
yersinie	4–10 dnů
shigela	1–5 dnů
<i>Clostridium difficile</i>	3–30 dnů
<i>Staphylococcus aureus</i>	1–6 hodin
<i>Bacillus cereus</i> (dle toxinu)	1–6 hodin či 8–16 hodin
<i>Clostridium perfringens</i> typu A	8–16 hodin
rotavirus	1–2 dny
adenovirus	1–2 dny
norovirus	18–72 hodin

# Parasitic infection of GI tract

- protozoal
- helminthic
- fungal



# Protozoal infections

## Human

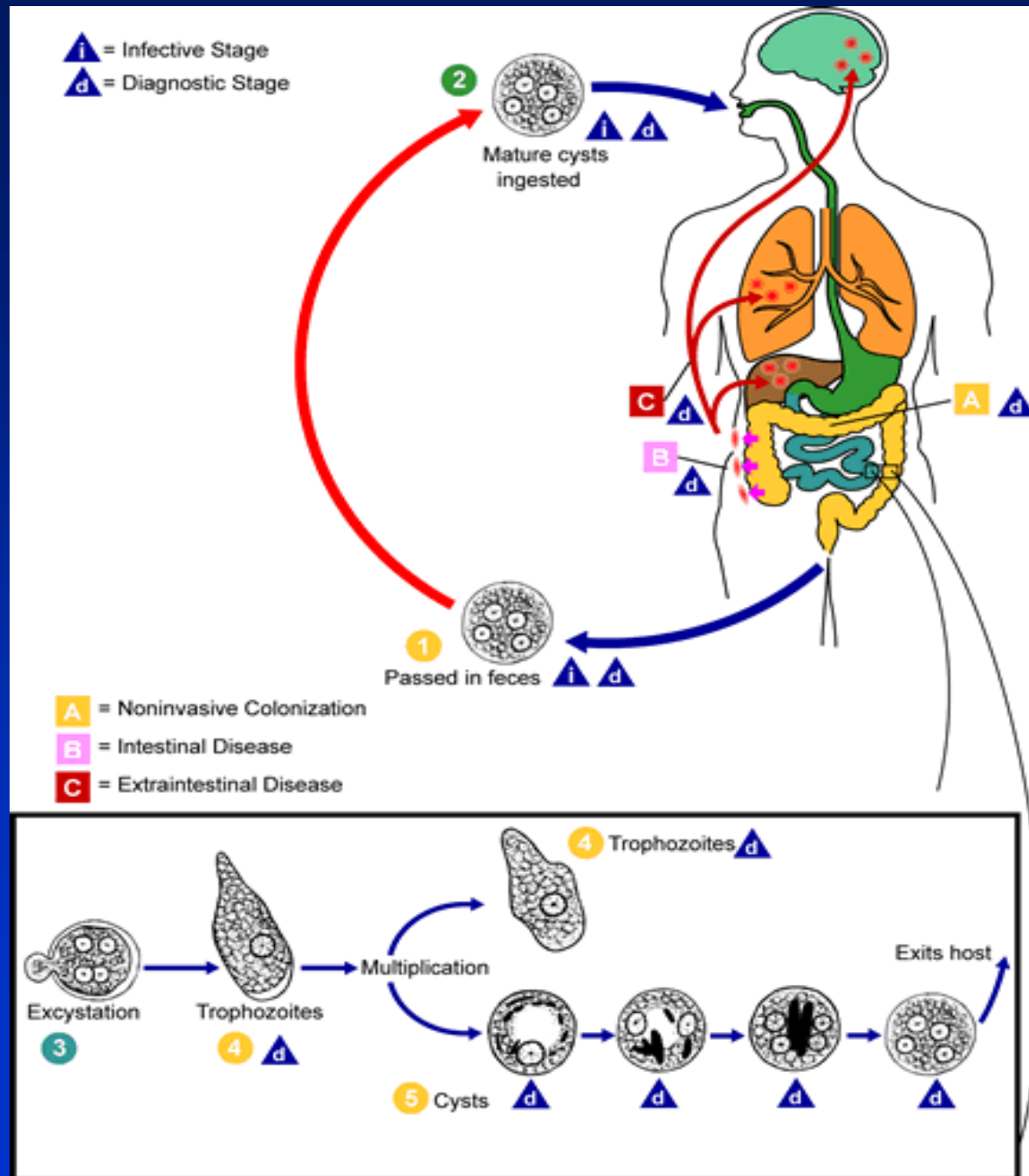
- Amebiasis (*Entamoeba histolytica*)
- Lambliasis = giardiasis (*L.*, *G. intestinalis*)

## Zoonotic

- cryptosporidiosis (*Cryptosporidium parvum*)
- isosporosis (*Isospora belli*)
- microsporidiosis (*Enterocytozoon bineusi*)
- cyclosporiasis (*Cyclospora cayetanensis*)

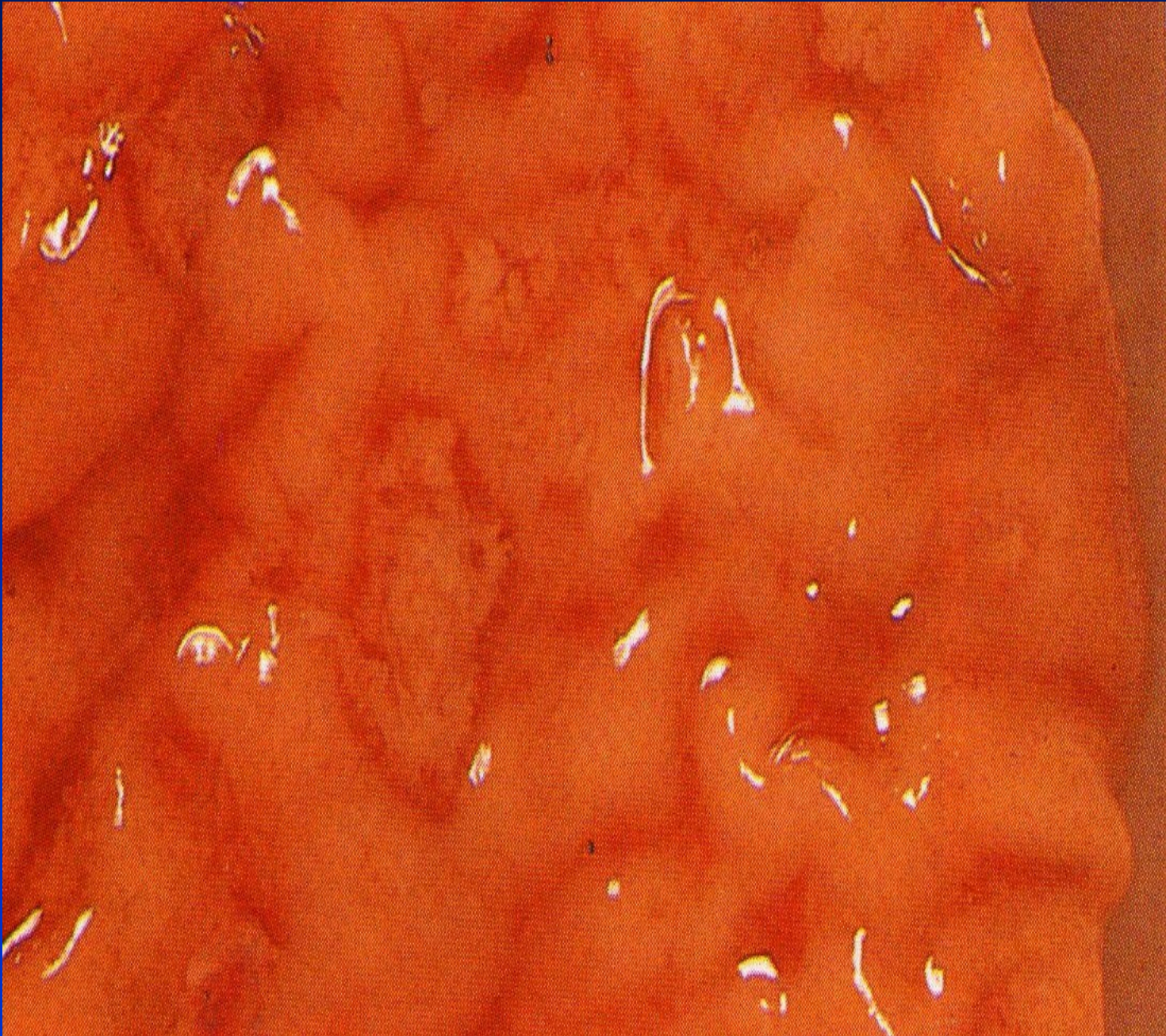
# Amebiasis

*Entamoeba histolytica*





Amebic colitis





Amebic abscess



CT – day 0

Amebic abscess



CT – drainage of 2 abscesses – day 2



Map 3  
150dB/C3  
Persist Med  
Fr Rate Med  
2D Opt:Gen

ATL

D X

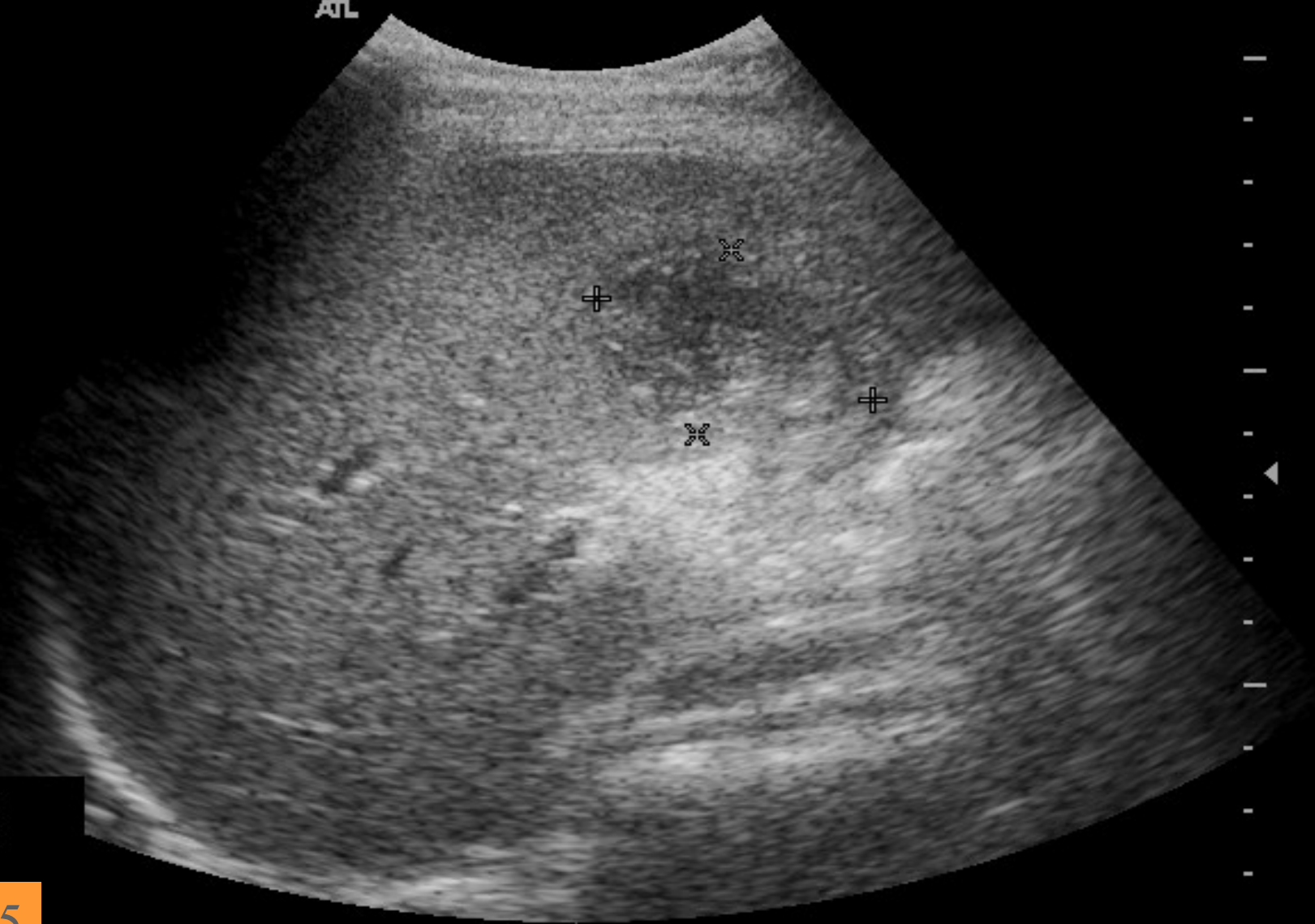
5.76cm

US - day 0



Map 3  
150dB/C3  
Persist Med  
Fr Rate Med  
2D Opt:Gen

ATL



+  
\*

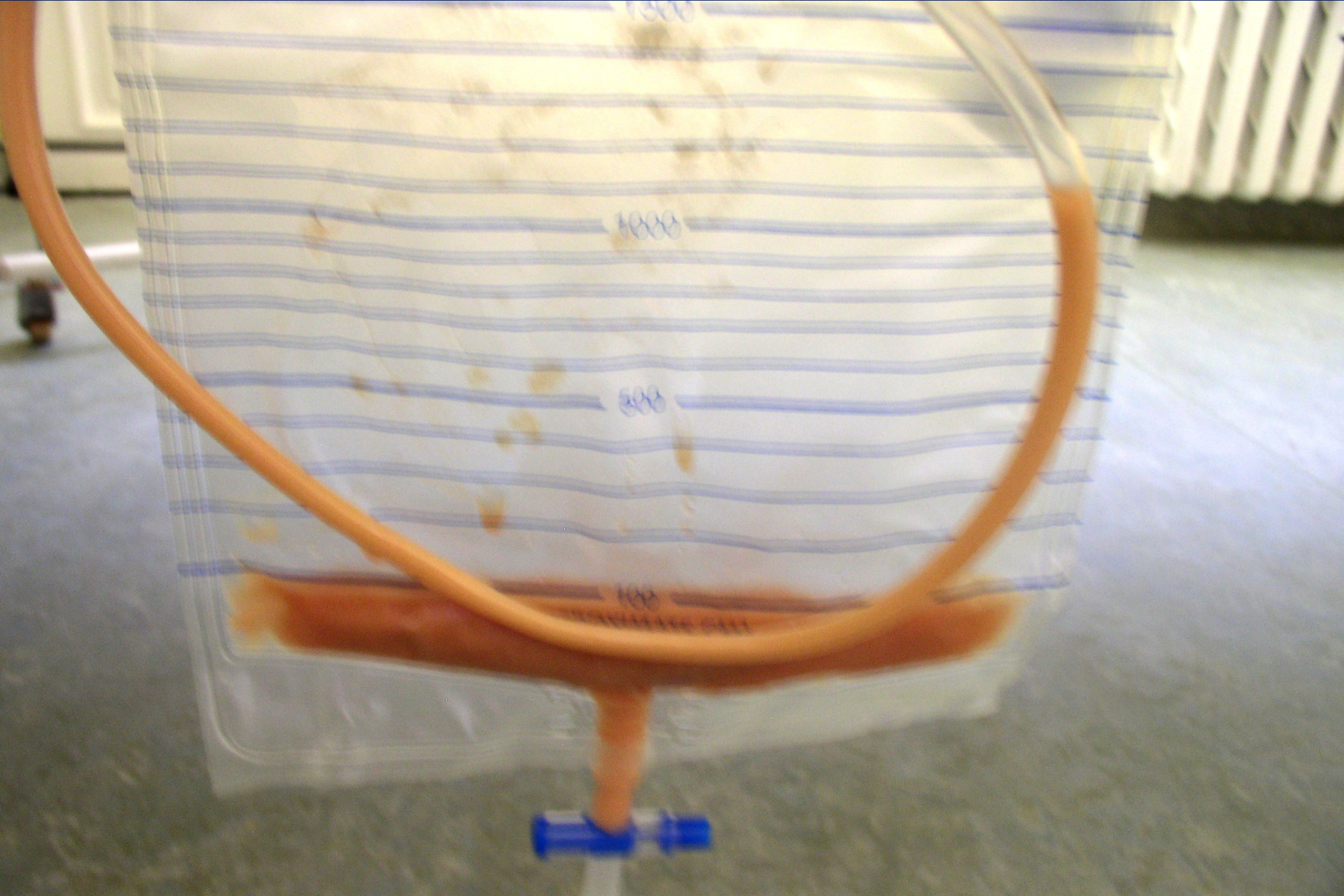
4.23cm  
2.98cm

US – day 5







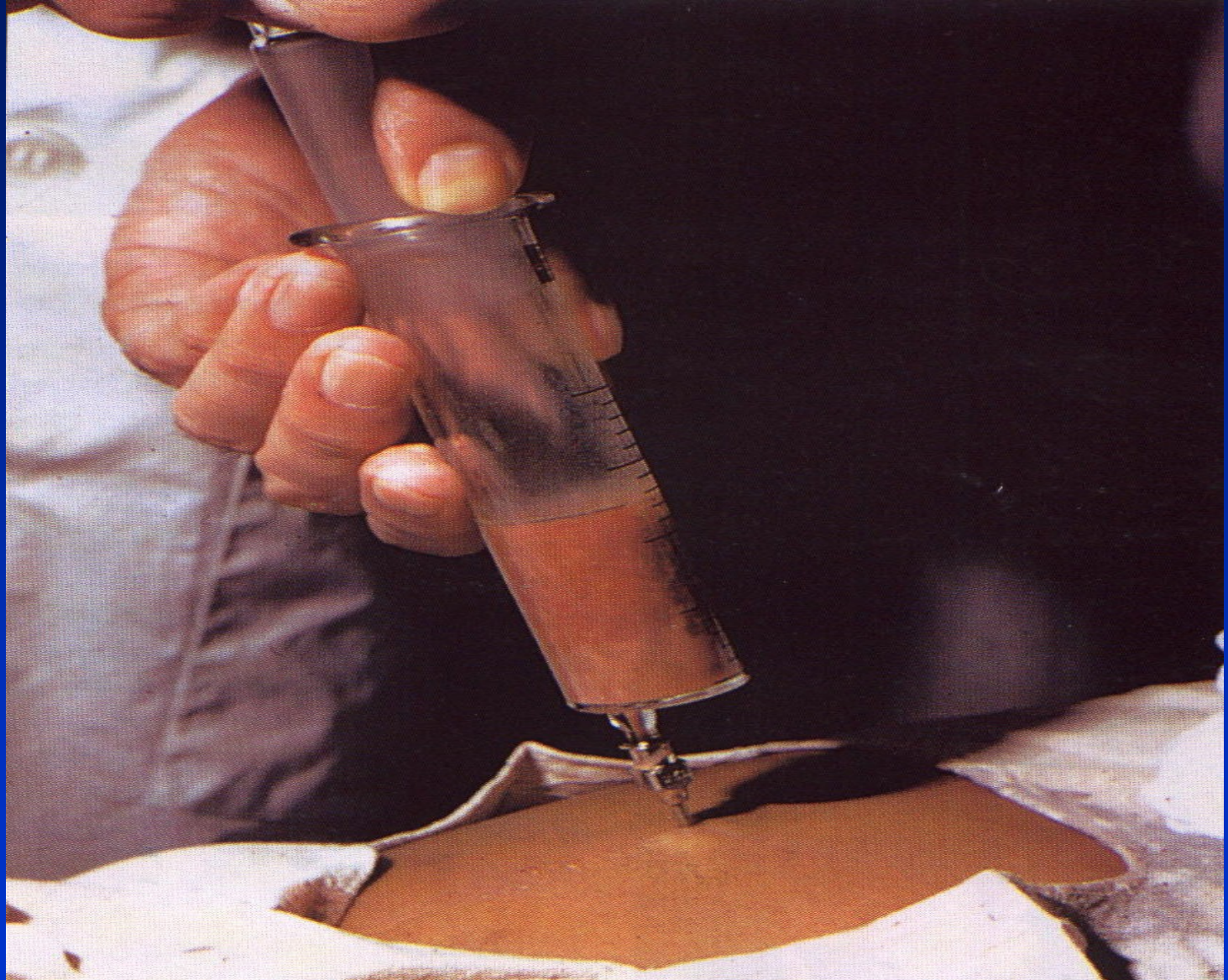






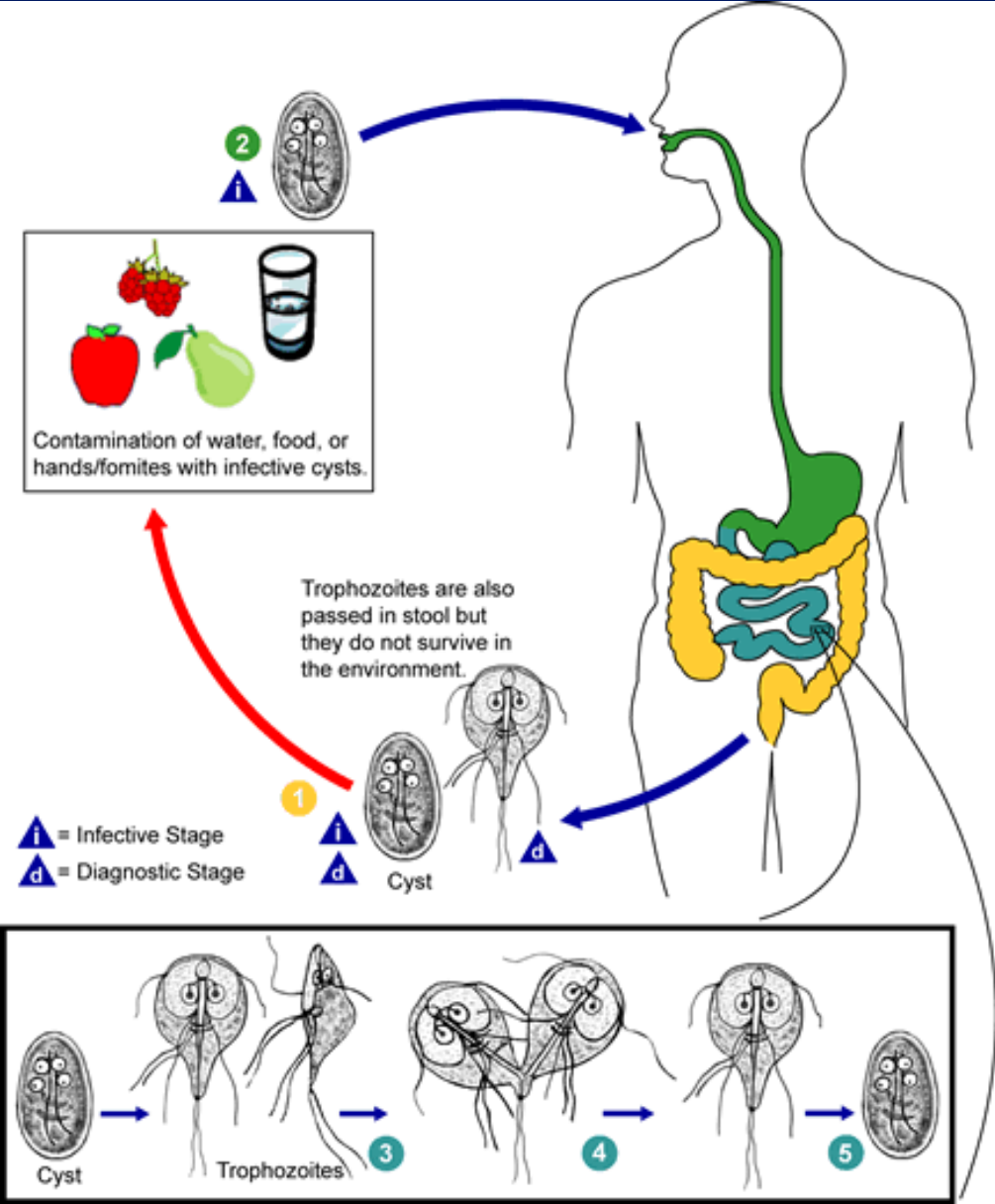


Amebic abscess –  
transcutaneous puncture



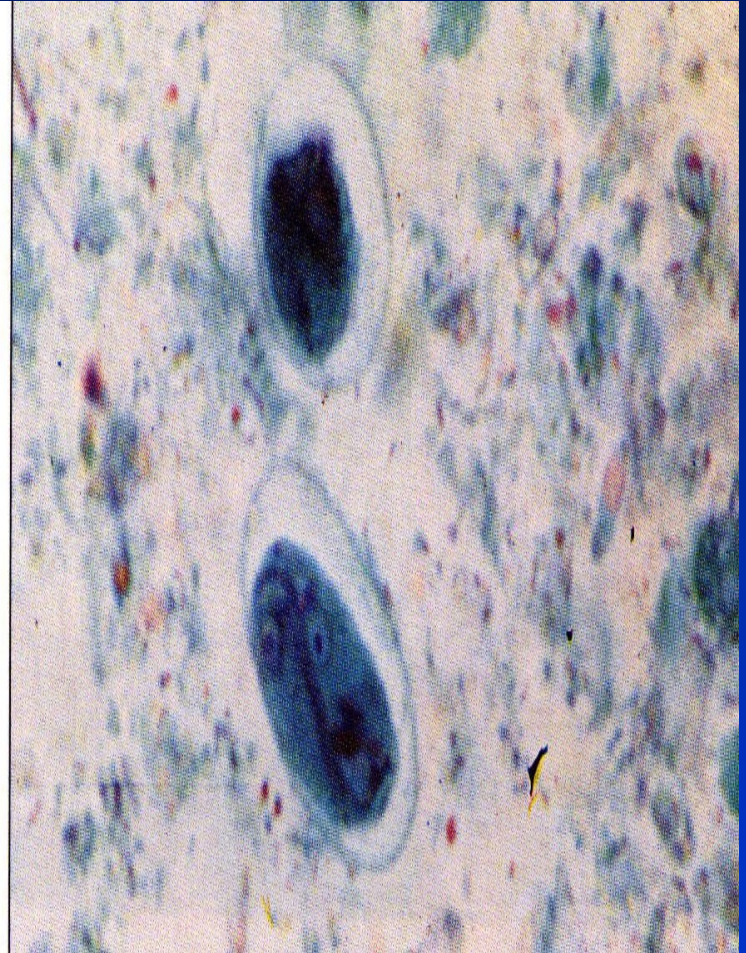
# Lambliasis, girardiasis

*Lamblia, Giardia  
intestinalis*





Lamblasis  
microskopy





Lambliasis  
scan



# Helmintic GI infections

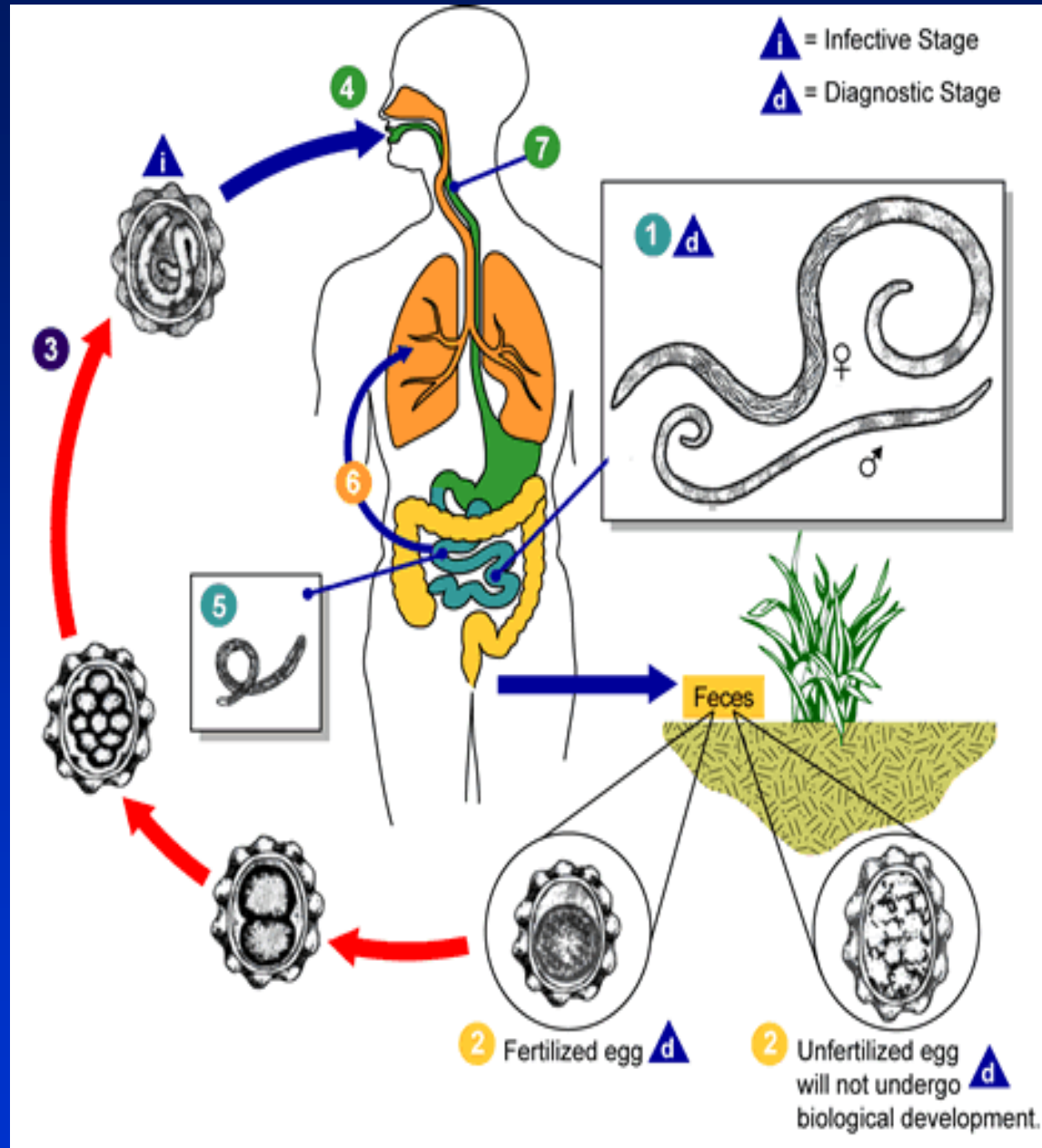
- **Roundworms (Nematodes)** - ascariasis, enterobiosis=oxyuriasis, trichuriasis
- **Tapeworms (Cestodes)** - teniosis, diphylobotriosis, hymenolepsiosis, echinococcosis, alveococcosis
- **Flukes (Trematodes)** - schistosomosis

# Roundworms (Nematodes)

- *Ascaris lumbricoides*
- *Enterobius, Oxyuris vermicularis*
- *Trichuris trichiura*

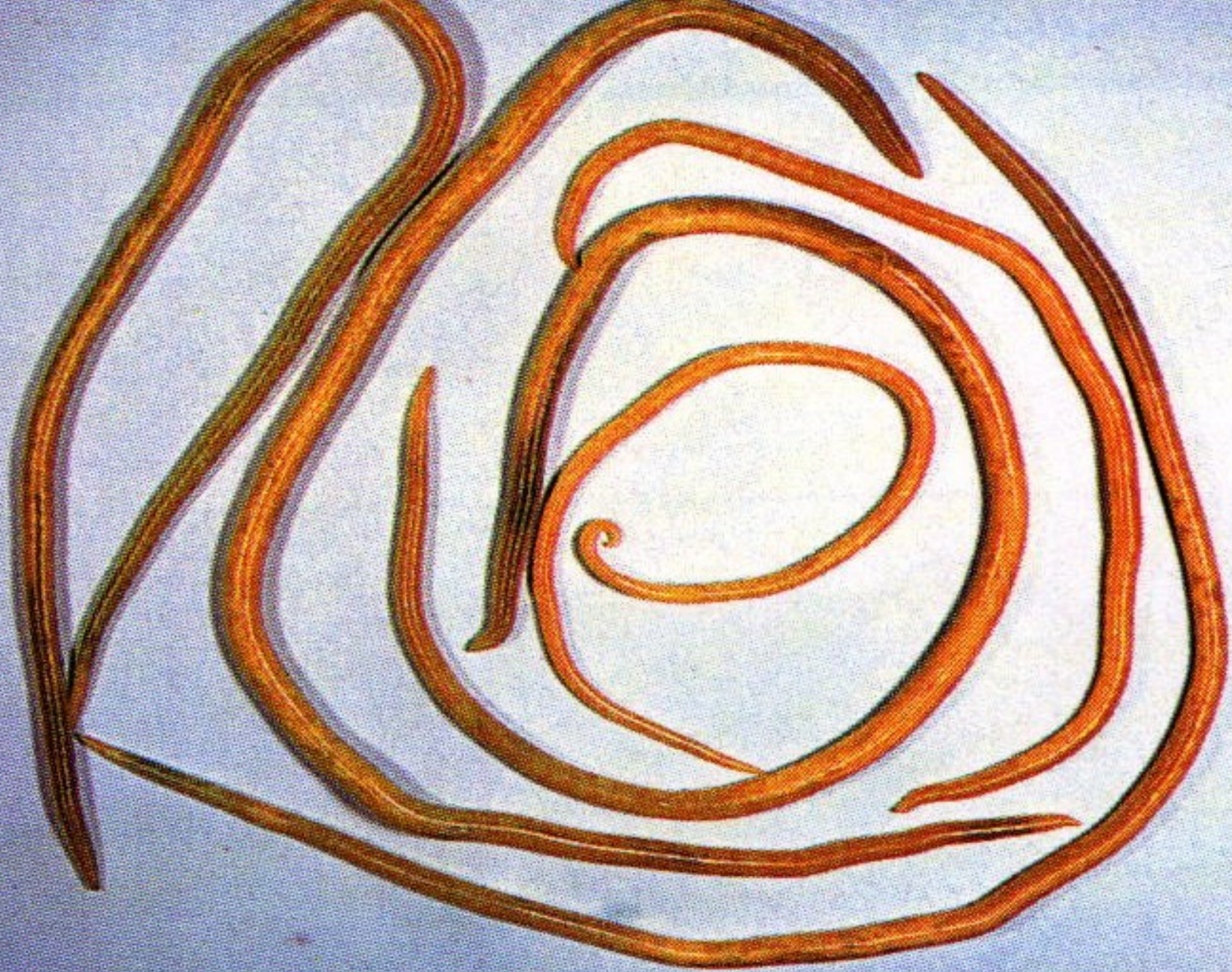


# Ascariasis



*Ascaris lumbricoides*

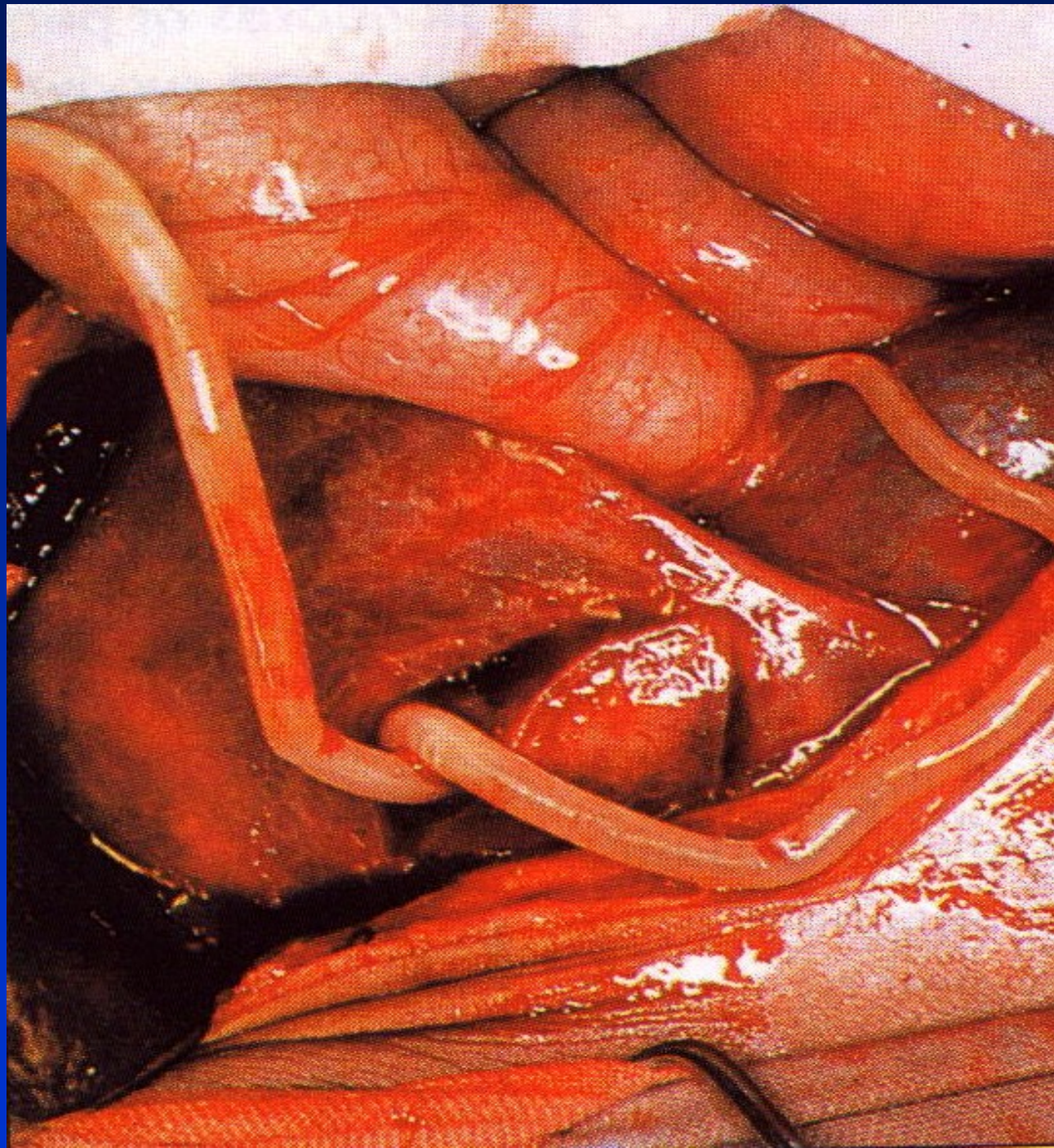










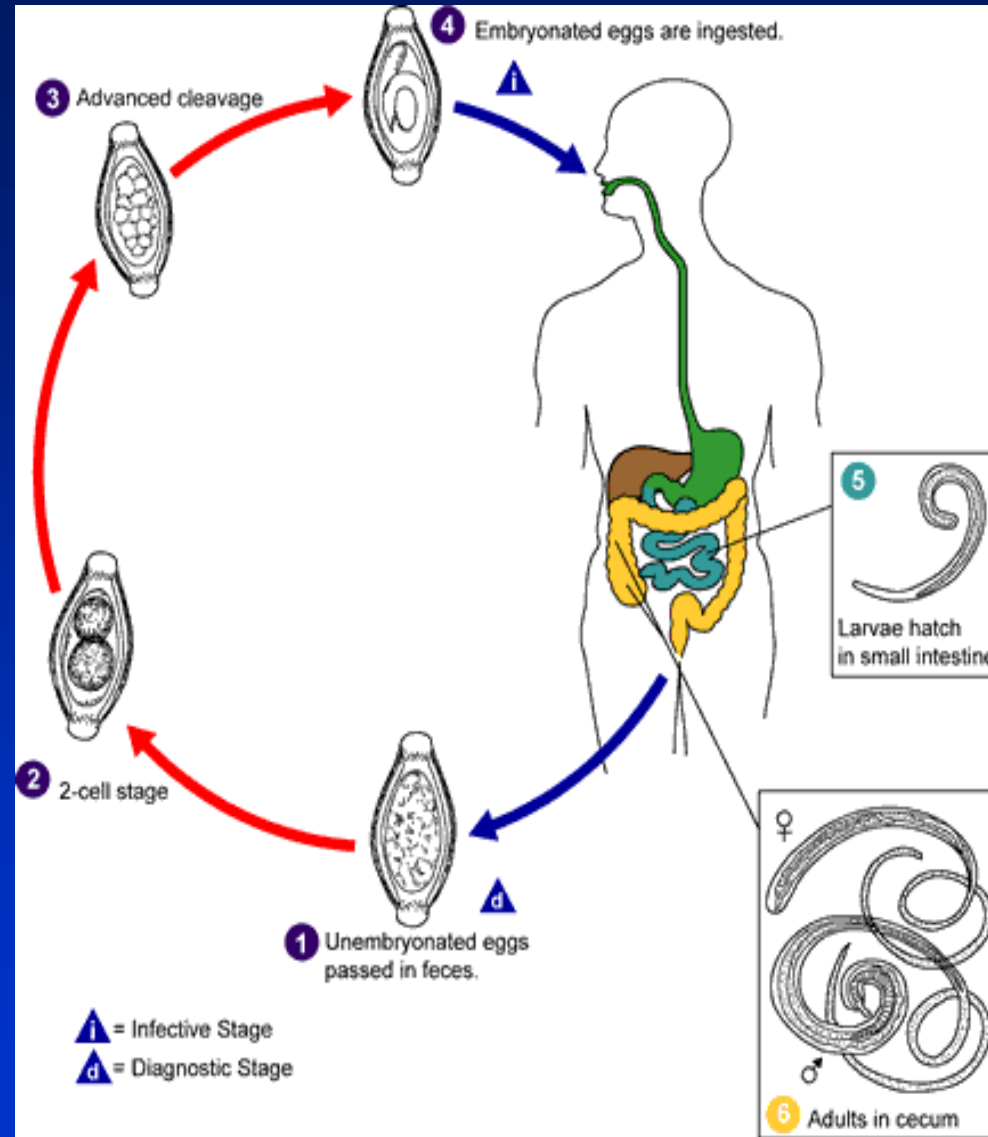




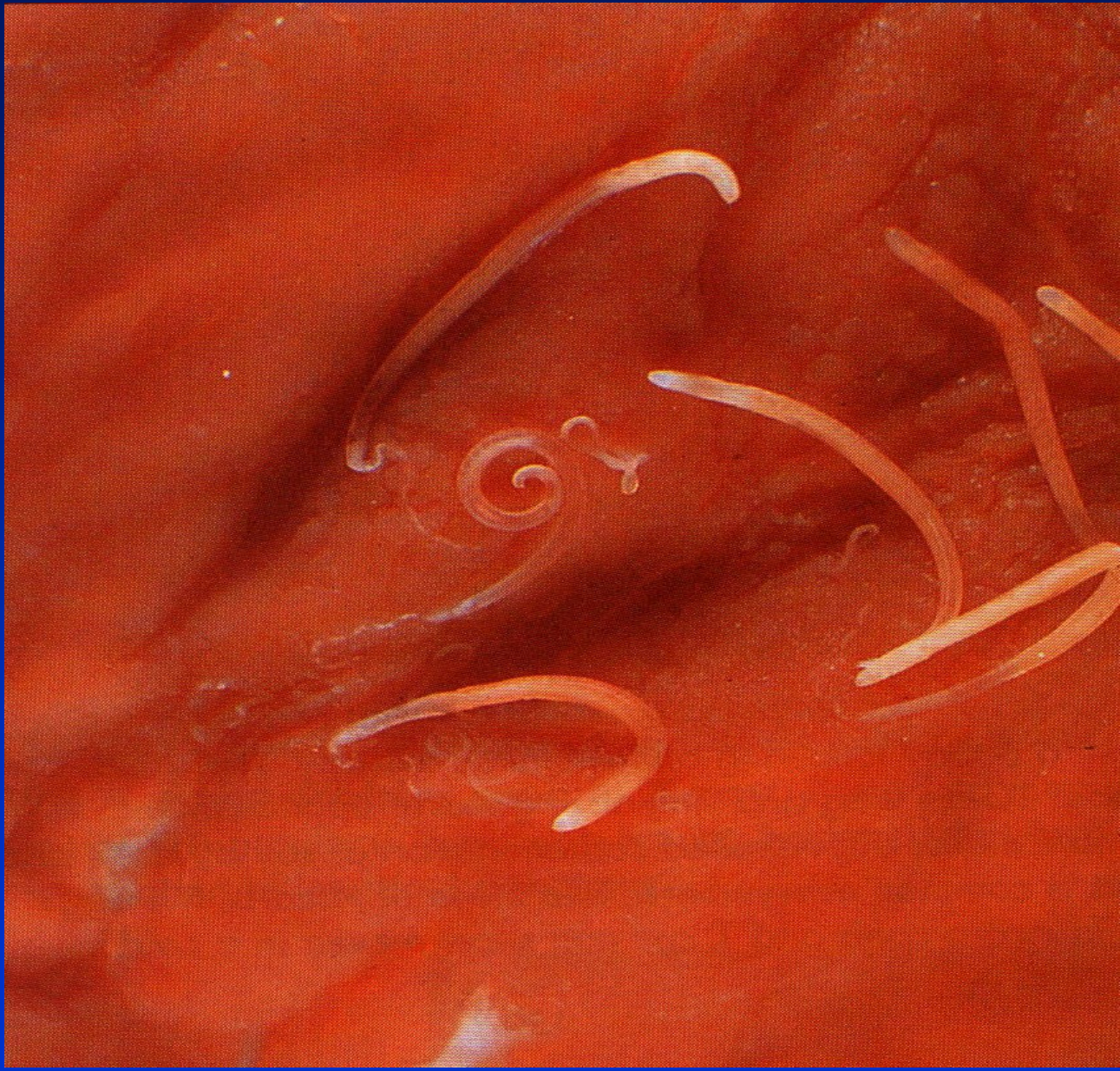




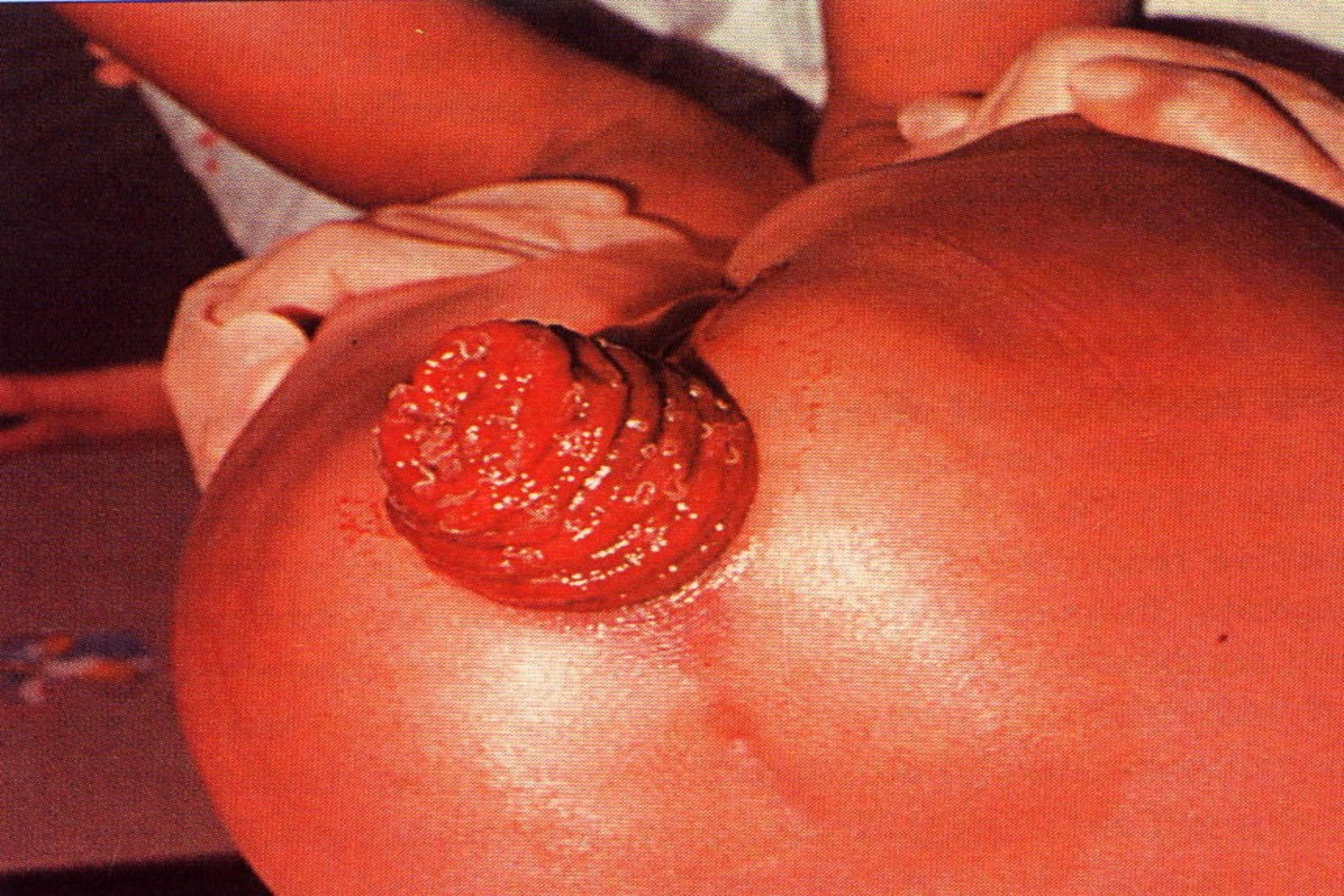
# Trichuriasis



*Trichuris trichiura*

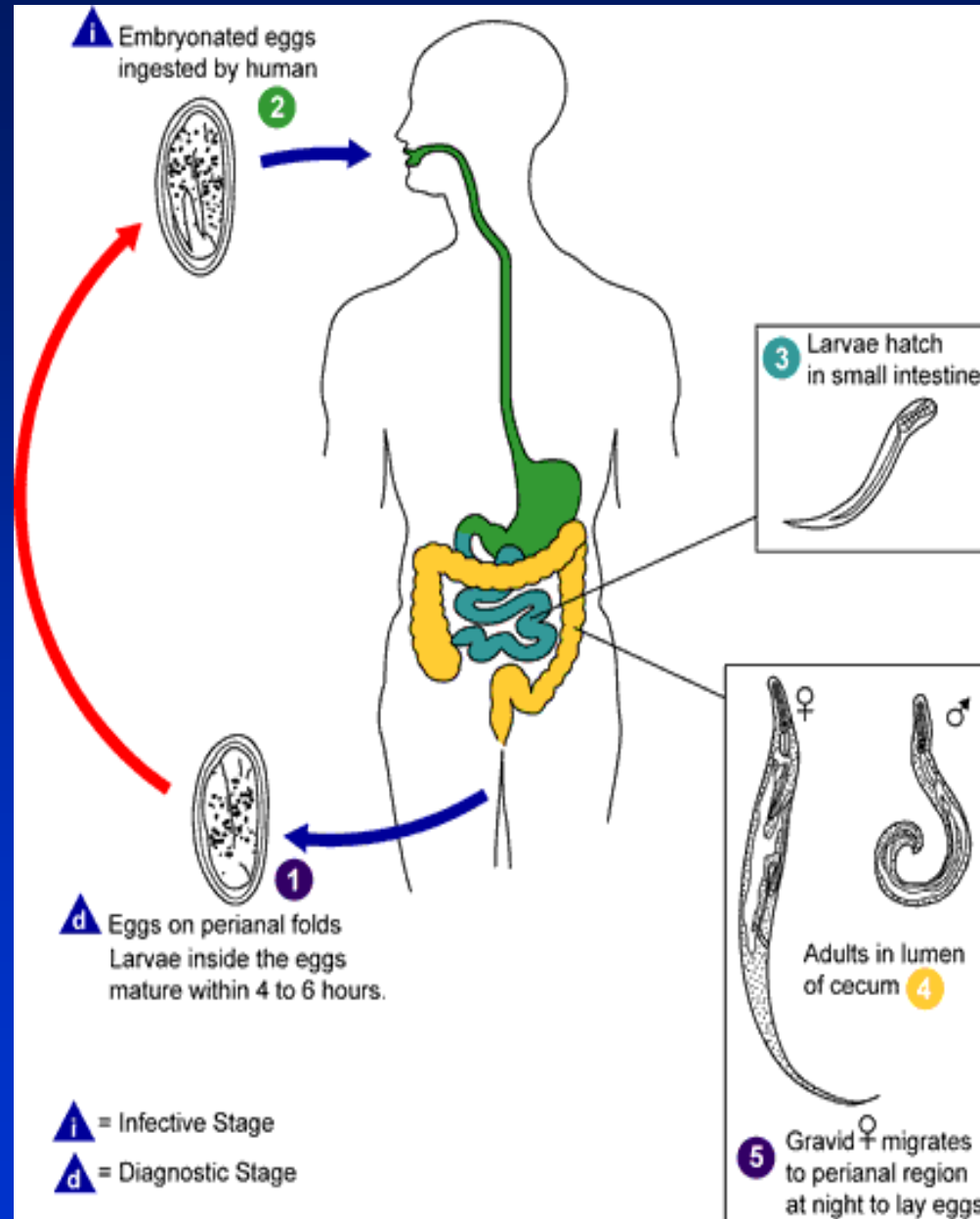






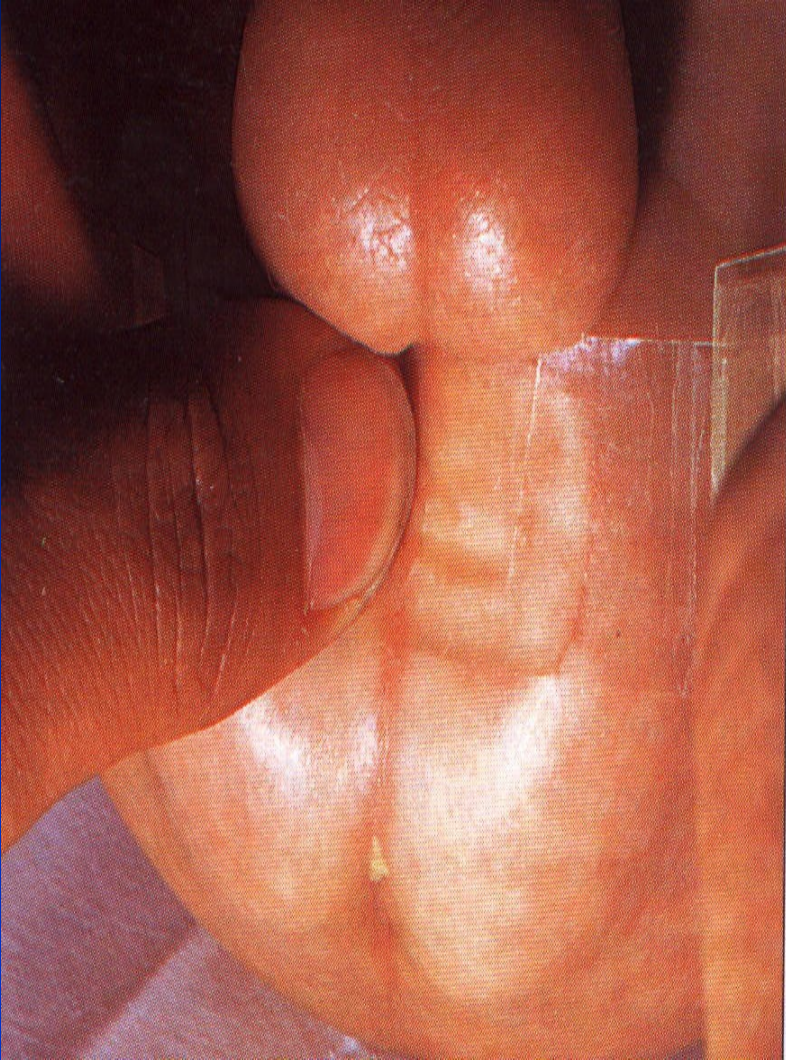


# Enterobiosis, oxyuriasis



*Enterobius, Oxyuris  
vermicularis*

**Enterobiosis,  
oxyuriasis**





# Tapeworms (Cestodes)

## Man as final host

- *Taenia saginata*
- *Taenia solium*
- *Diphyllobotrium latum* , *D. pacificum*
- *Hymenolepsis nana*

## Animal as final host

- *Echinococcus granulosus*
- *Echinococcus (Alveococcus) multilocularis*

**i** Oncospheres develop into cysticerci in muscle

**4** Humans infected by ingesting raw or undercooked infected meat

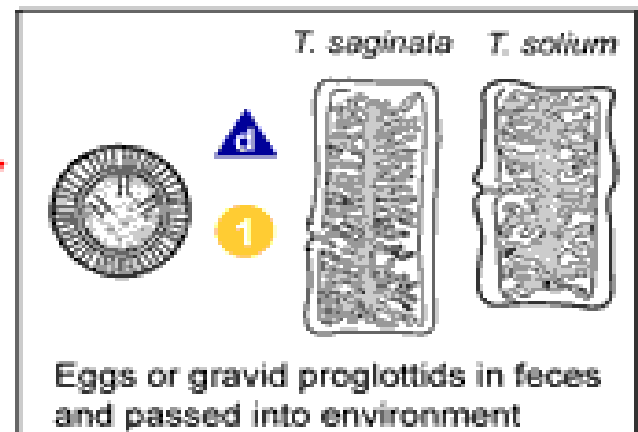
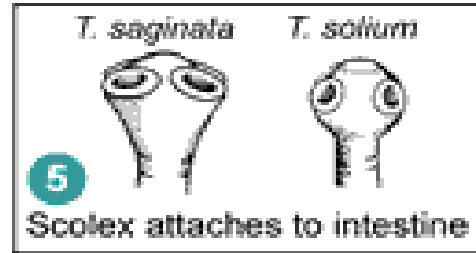
Oncospheres hatch, penetrate intestinal wall, and circulate to musculature

**3**

**2**

Cattle (*T. saginata*) and pigs (*T. solium*) become infected by ingesting vegetation contaminated by eggs or gravid proglottids

*Taenia saginata*  
*Taenia solium*

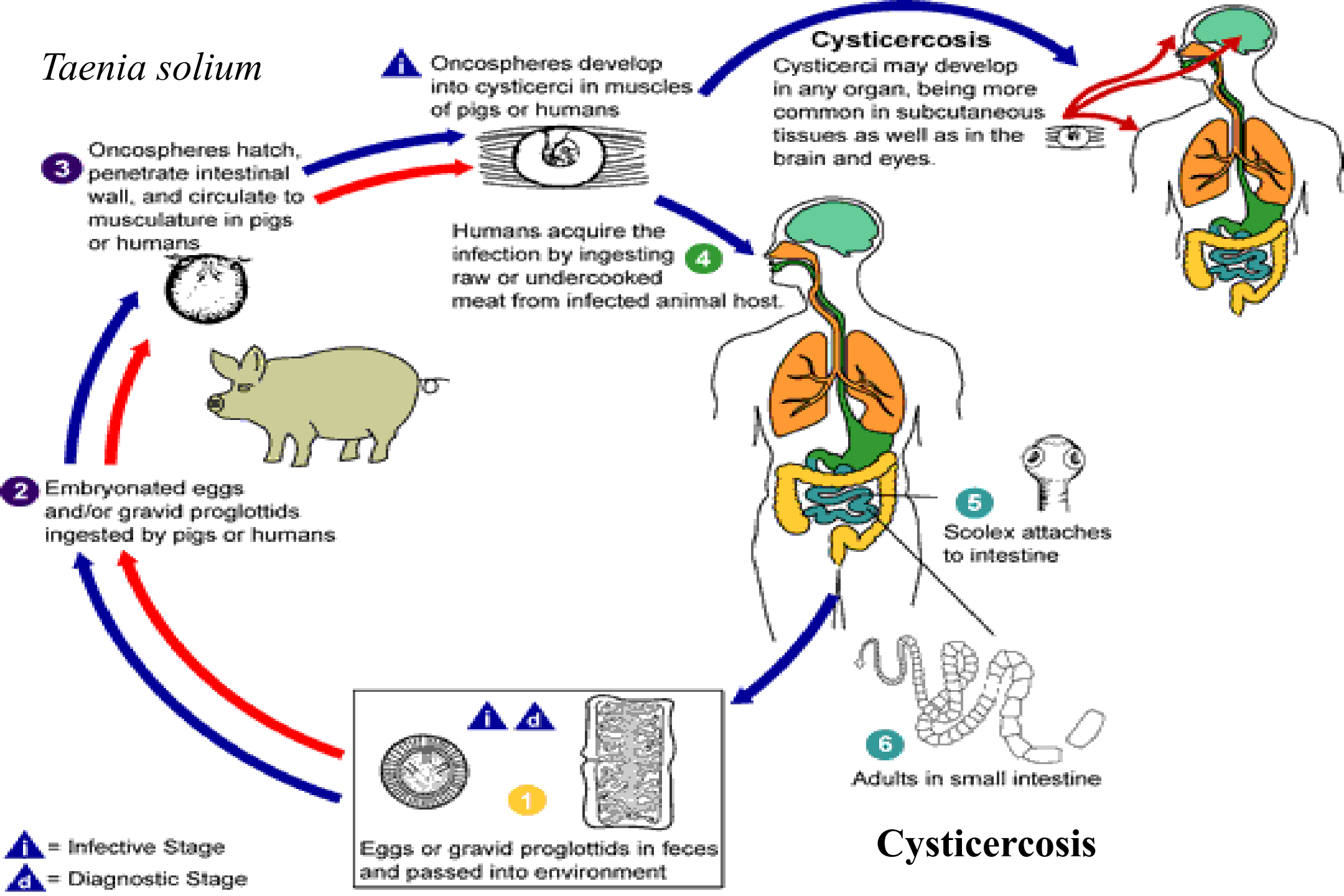


**i** = Infective Stage  
**d** = Diagnostic Stage

# Taeniosis



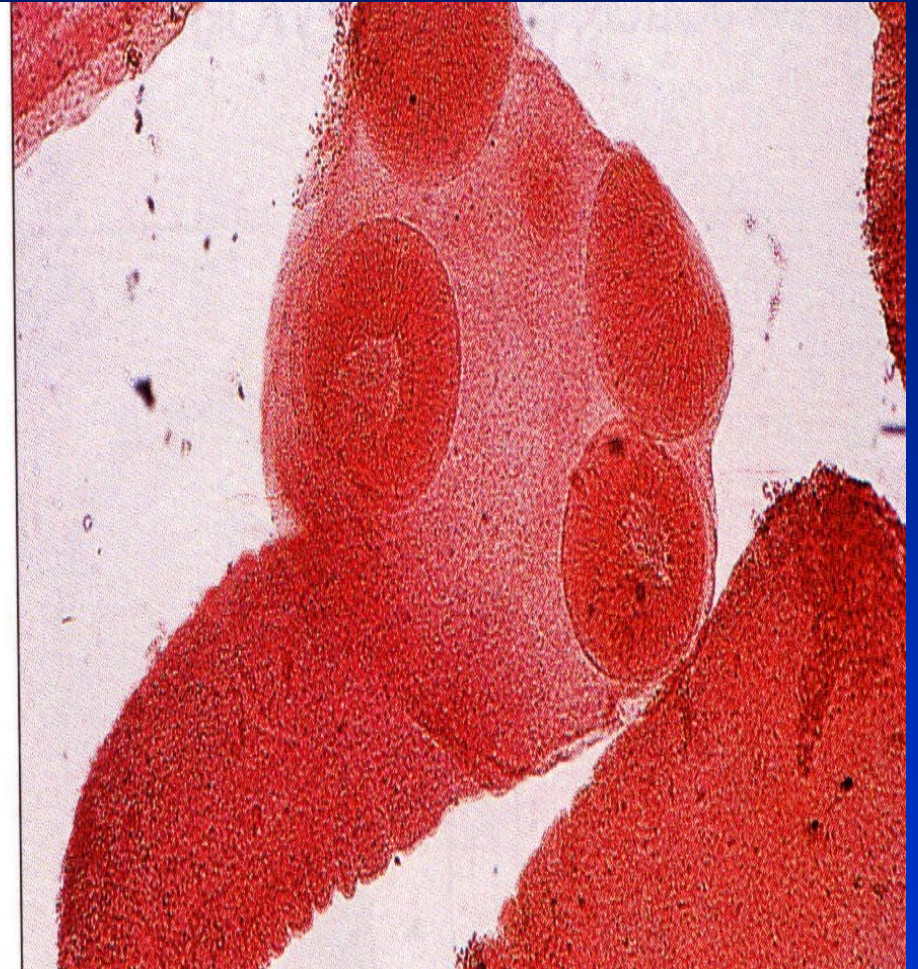
# Taenia solium



*Taenia solium*



*Taenia saginata*



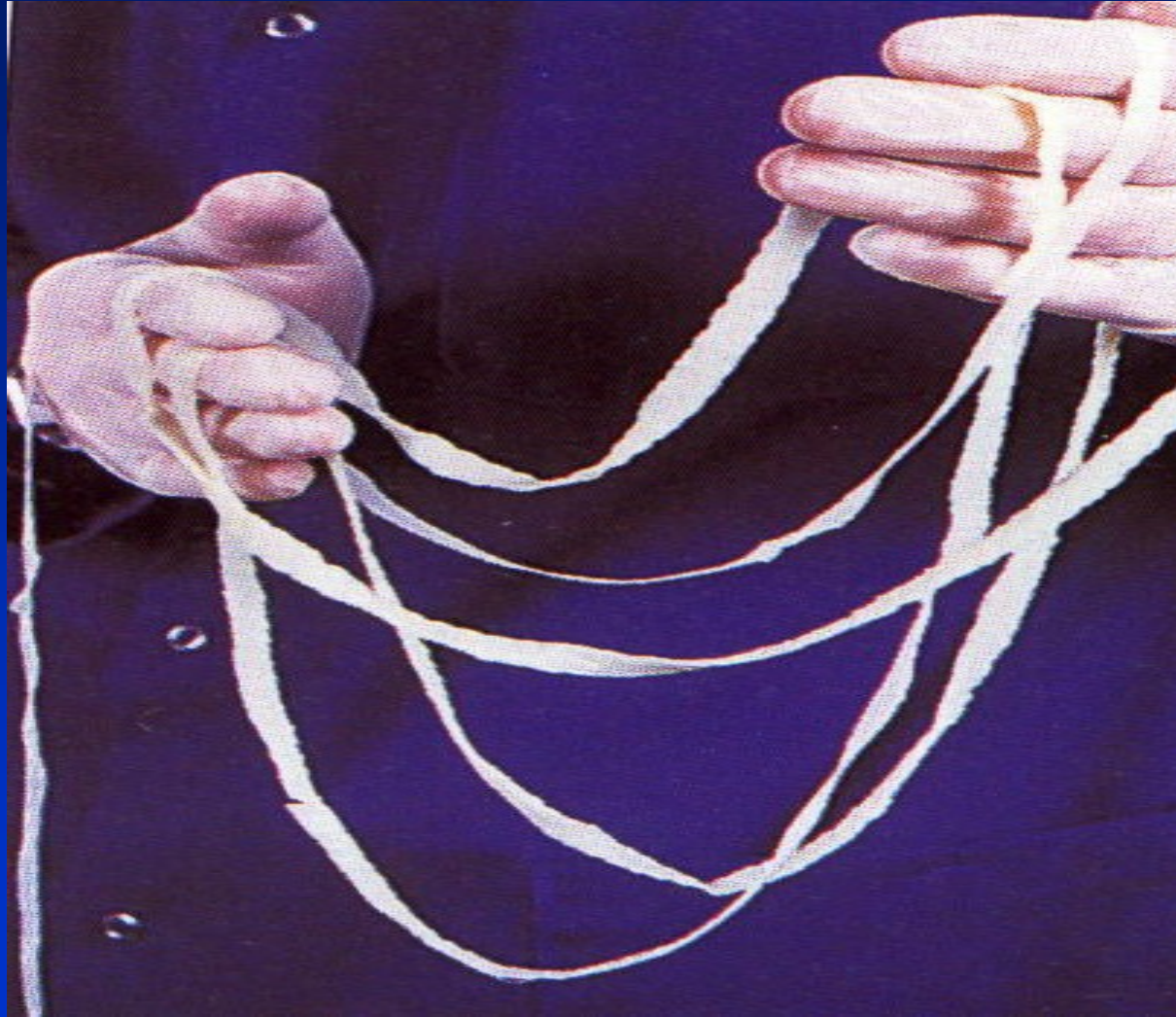


*Taenia solium*





*Taenia saginata*



# Cysticercosis (pig)





# Cysticercosis (man)

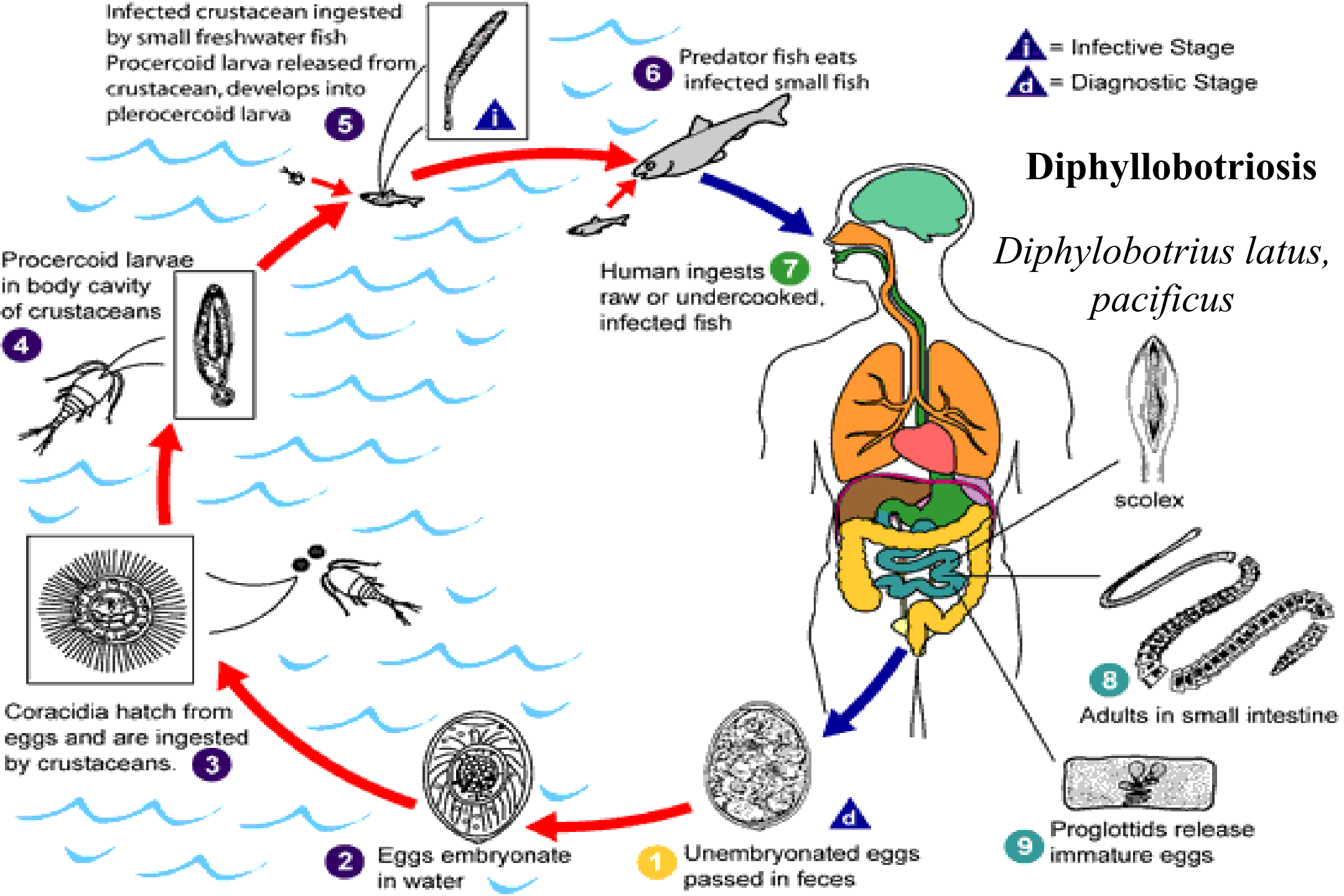




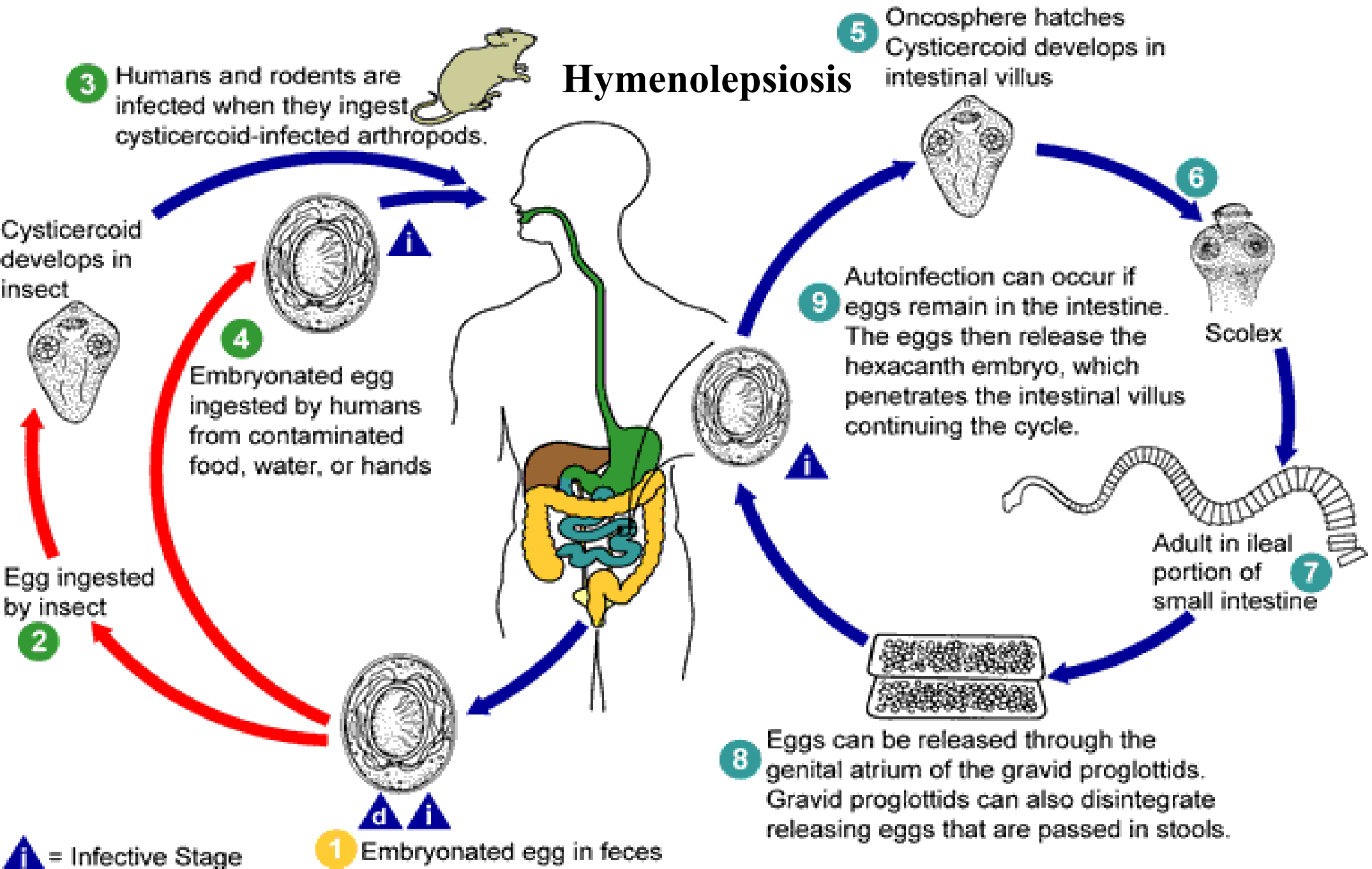
# Cysticercosis (cow)







# Hymenolepsis

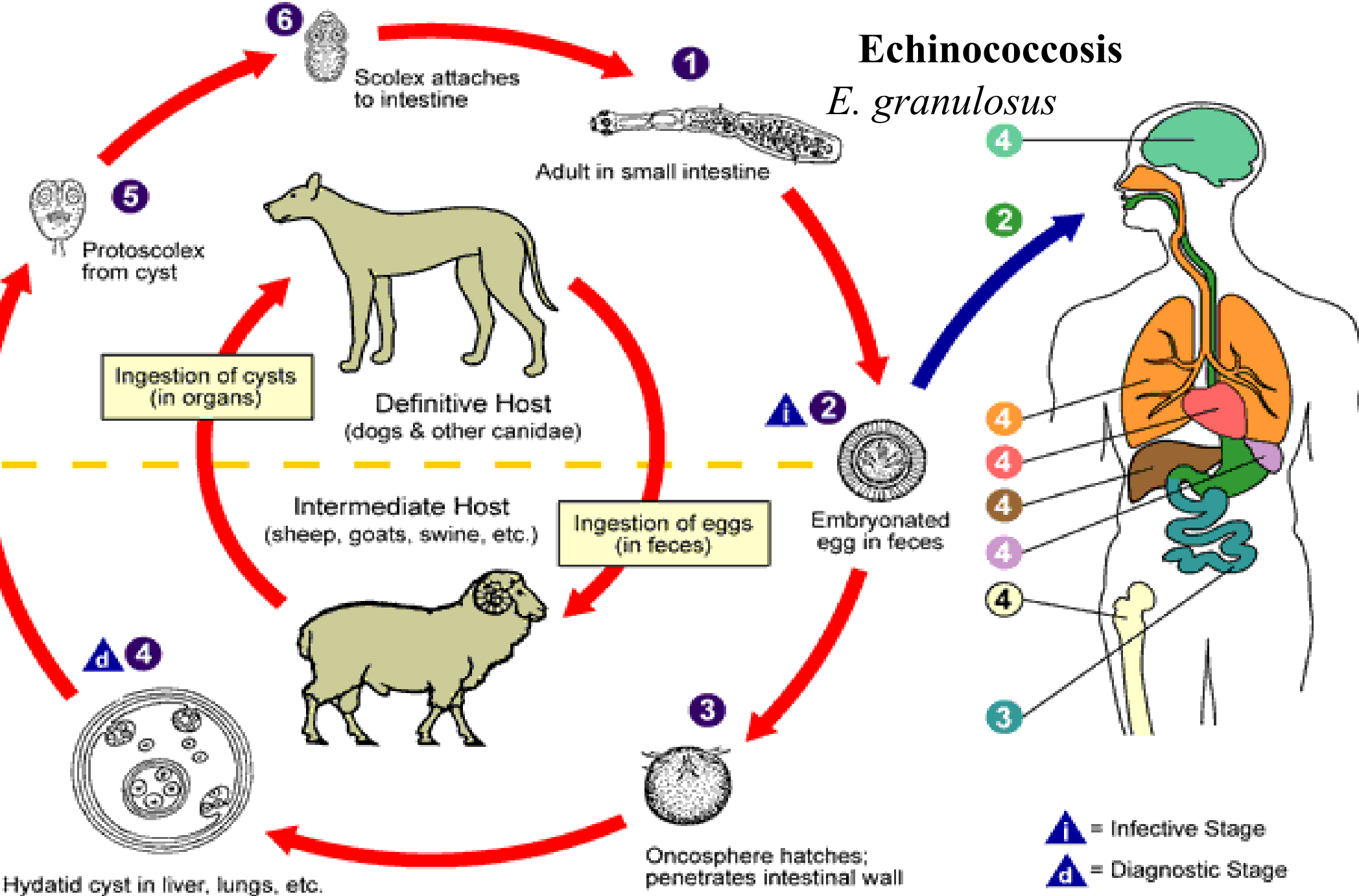


*Hymenolepsis nana*



# Echinococcosis

*E. granulosus*

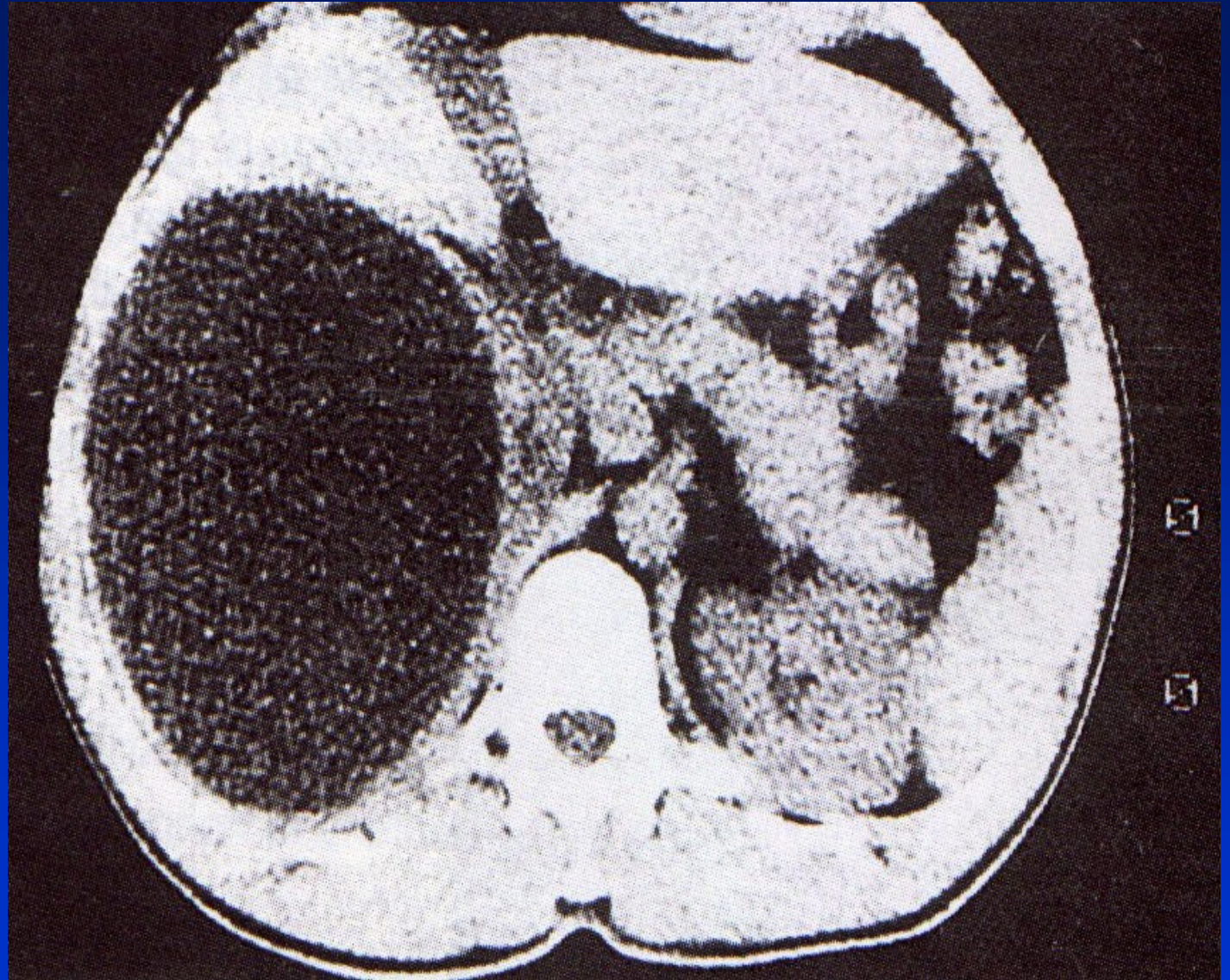


*Echinococcus*  
*granulosus*  
(dog)





*Echinococcus granulosus* – liver cysts  
(man)





*Echinococcus  
granulosus* – liver cysts  
(man)



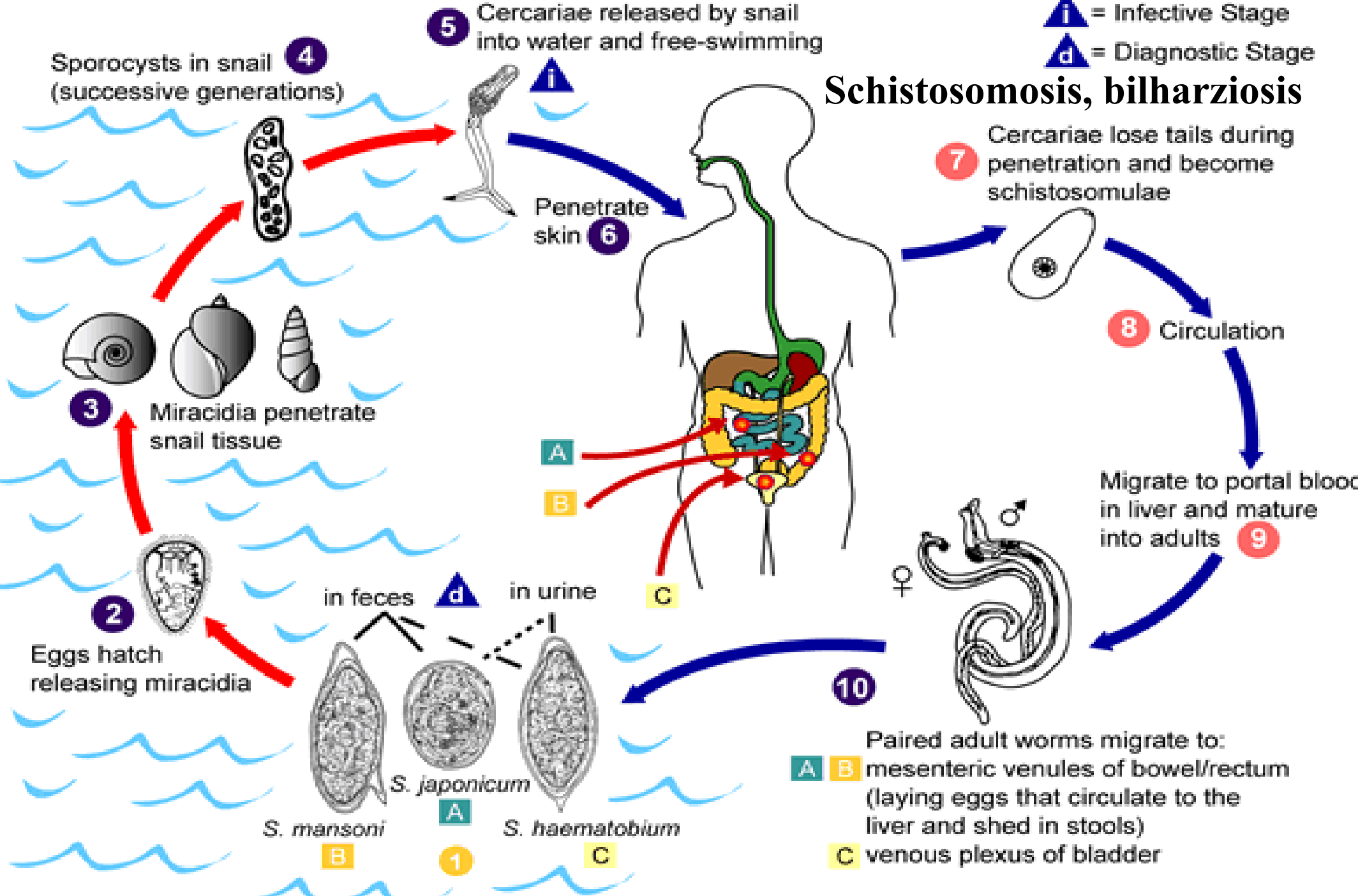


# Flukes (Trematodes)

- schistosomiasis (bilharsiasis)
  - ✓ *S. hematobium*
  - ✓ *S. intestinalis (mansoni)*
  - ✓ *S. japonicum*
  - ✓ *S. mekongi*

**i** = Infective Stage  
**d** = Diagnostic Stage

# Schistosomosis, bilharziosis



Sporocysts in snail (successive generations) **4**

Cercariae released by snail into water and free-swimming **5**

Penetrate skin **6**

Cercariae lose tails during penetration and become schistosomulae **7**

Circulation **8**

Migrate to portal blood in liver and mature into adults **9**

Paired adult worms migrate to:  
**A** mesenteric venules of bowel/rectum (laying eggs that circulate to the liver and shed in stools)  
**C** venous plexus of bladder

Eggs hatch releasing miracidia **2**

Miracidia penetrate snail tissue **3**

in feces **d**

in urine **d**

*S. mansoni*

*S. japonicum*

*S. haematobium*

**B**

**A**

**C**

**10**







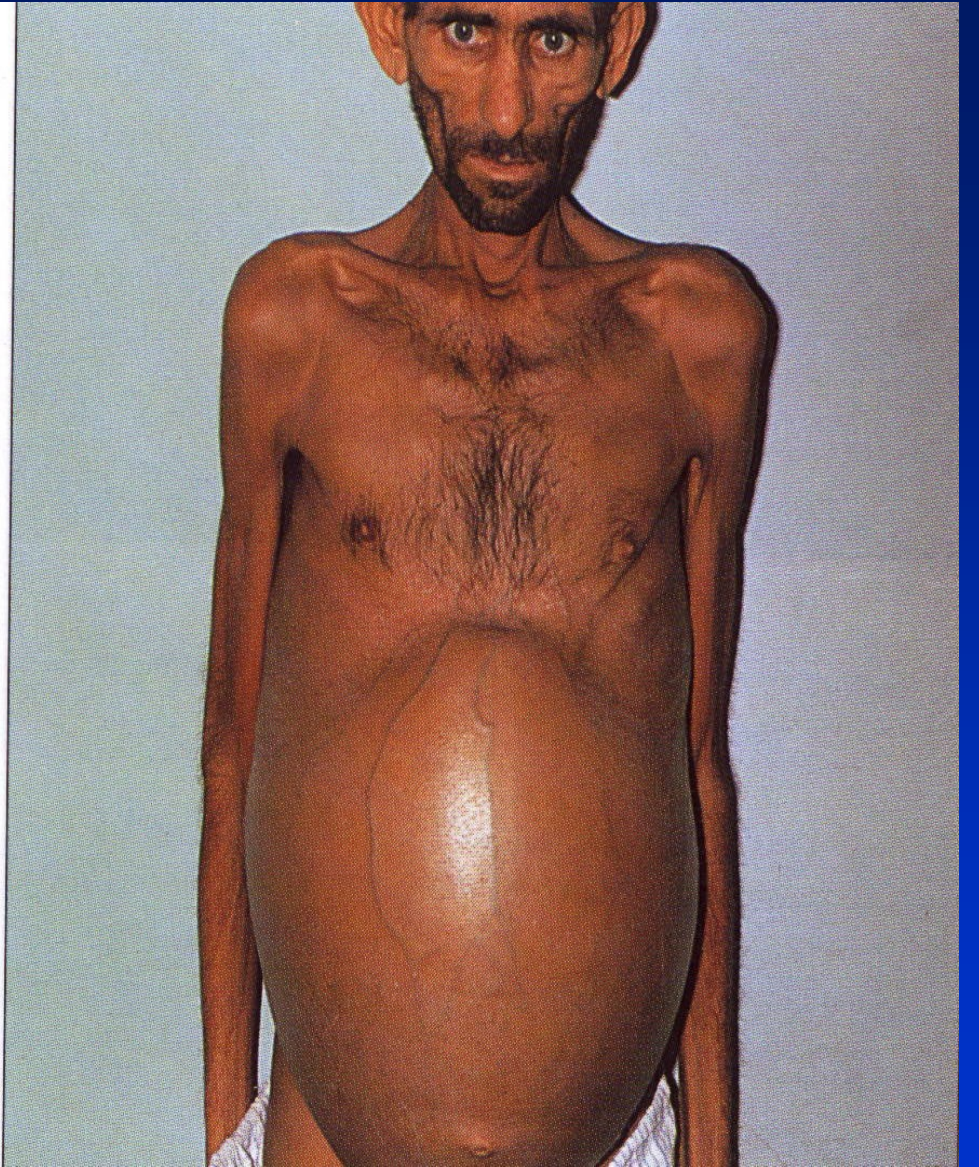
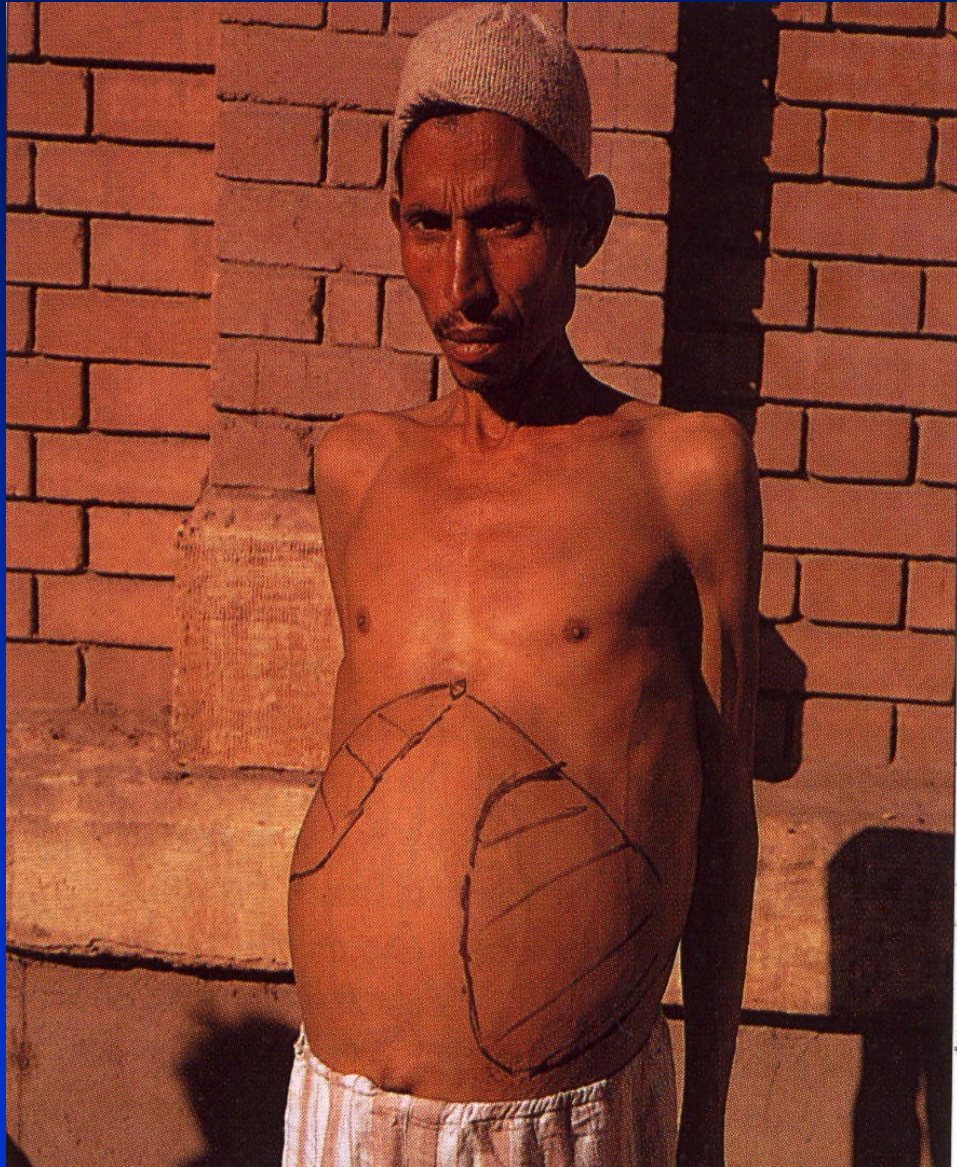


















# Fungal GI infections

- about all candidiasis
- different members of *Candida* sp. (mostly *C.albicans*)
- mouth cavity, oesophagus, anorectal
- mostly IS patients
- fluconazol, itraconazol, ketoconazol, amphotericin B



***Thank you for your attention!***

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