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13 – 16 June 2018

Cryptosporidium in water and food

Prof. Panagiotis Karanis
Medical School, University of Cologne, Germany
UNIKLINIK KÖLN

Contents of this presentation

Short self – introduction

***Cryptosporidium* - What are the facts:**

- Importance of *Crypto*
- Prevalence & outbreaks
- What is Cryptosporidium?
- Transmission & life cycle
- Crypto in food
- Diagnosis
- Treatment & prevention
- Water treatment & pathogen removal

What are the problems ?

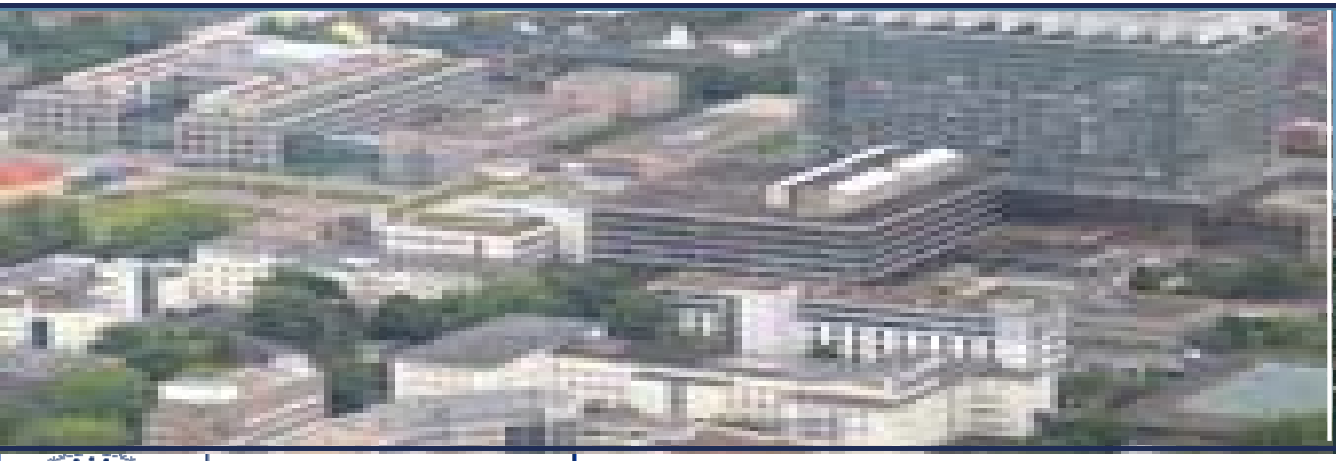
- Inter alia tourism in danger

What are the solutions ?

Take home message

PANAGIOTIS KARANIS
Professor & Director of The Centre of Biomedicine and Infectious Diseases, Qinghai University in Xining, China

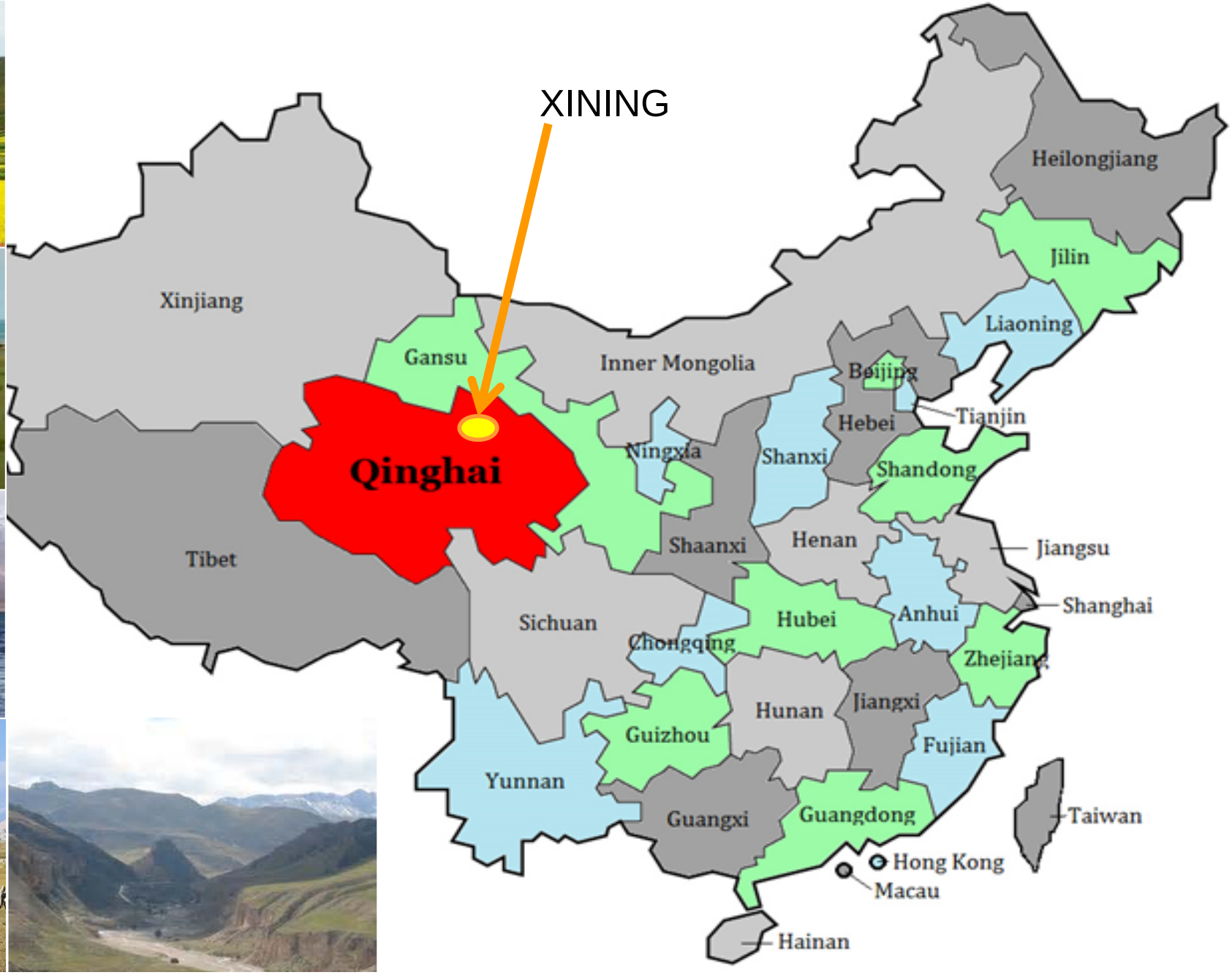
青海大学
Qinghai University



UNIKLINIK KÖLN

PANAGIOTIS KARANIS
Professor at The Medical School, University of Cologne, Germany

CHINA Qinghai Province



1000 Talent Plan of the Chinese Government

青海大学

Qinghai University

Upgraded to Key State Laboratory for Plateau Ecology and Agriculture 1000 TP of the Chinese Government

Chinese scientist Tu Youyou wins Nobel Prize for breakthrough malaria treatment developed under Chairman Mao

Chinese scientist Tu Youyou won a share of the Nobel Prize in Physiology or Medicine yesterday for her work in developing an effective herbal therapy that fights against malaria, work that first started when studying ancient Chinese texts in a secret project ordered by Chairman Mao Zedong during the Cultural Revolution.

Tu becomes the first Chinese scientist to win a Nobel Prize in the sciences who has spent the majority of his or her career in China. She also becomes China's first Nobel Prize winner in medicine and just the 12th woman overall to win in that field.

The 85-year-old is famous as the inventor of artemisinin, a highly effective treatment against malaria with unbelievable origins.

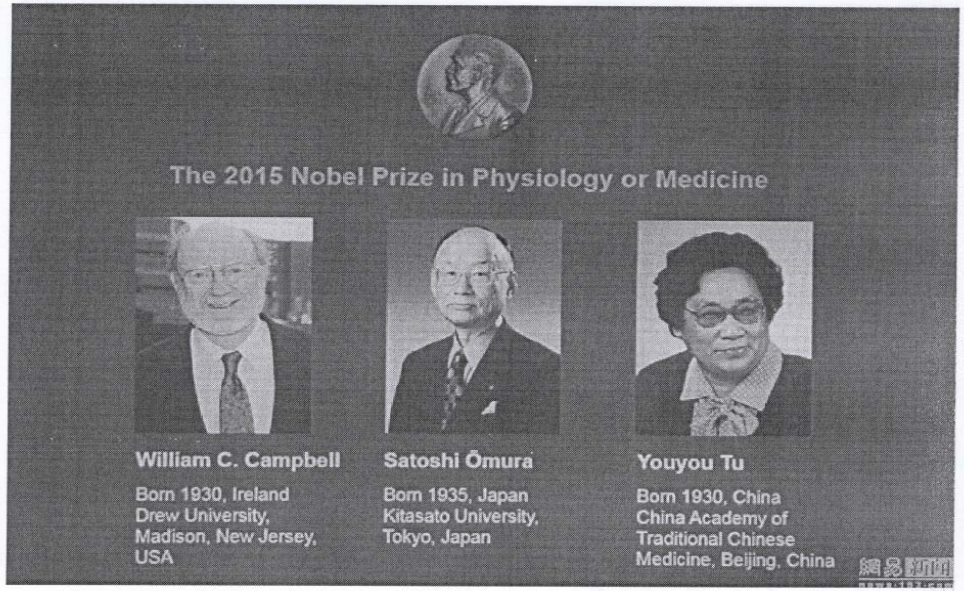
Tu's work on artemisinin dates back to a secret military project known only as "523" directly ordered by Mao during the Cultural Revolution. Its purpose was to develop an efficient anti-malaria drug as the the disease had been wiping out North Vietnamese troops fighting in the jungles of southeast Asia. The project cycled through hundreds of scientists and researchers, many of whom were purged after less than a year from political vendettas.

Tu turned out to be the most successful of these researchers and found the answers that the Chairman wanted in ancient Chinese texts. She found mention of sweet wormwood being used to treat malaria. Through further refinement, the team developed a compound that attacked malaria-causing parasites in the blood. Not content with tests done on animals, Tu tested the new drug on herself first.

"The work was the top priority so I was certainly willing to sacrifice my personal life," the scientist later recalled.

Today, this drug called artemisinin is a key ingredient in frontline treatment for malaria in Africa and Asia. Experts say that it has saved millions of lives. Here's what the WHO had to say about Tu being honored with the Nobel Prize:

"It is a great tribute to the contribution of the Chinese scientific community in the fight against # malaria ... Since 2000, more than 1 billion # artemisinin -based treatment courses have been administered to malaria patients."



The 85-year-old scientist is still continuing her work in artemisinin at a lab in China Academy of Traditional Chinese Medicine in Beijing. She has been jokingly called a "Three-Without Scientist." Tu has no doctorate degree, has not studied abroad and hasn't received membership in the China's Academy of Sciences.

She does have a Nobel Prize though. That's something.

Contact the author of this article or email tips@shanghaiist.com with further questions, comments or tip

Prof. Dr. Panagiotis Karanis – Short CV

1959: Born in Chrysso / Evritania / Greece

1979: Germany / Studies of Biology & Medicine

1992: PhD in Parasitology / Bonn University / Germany

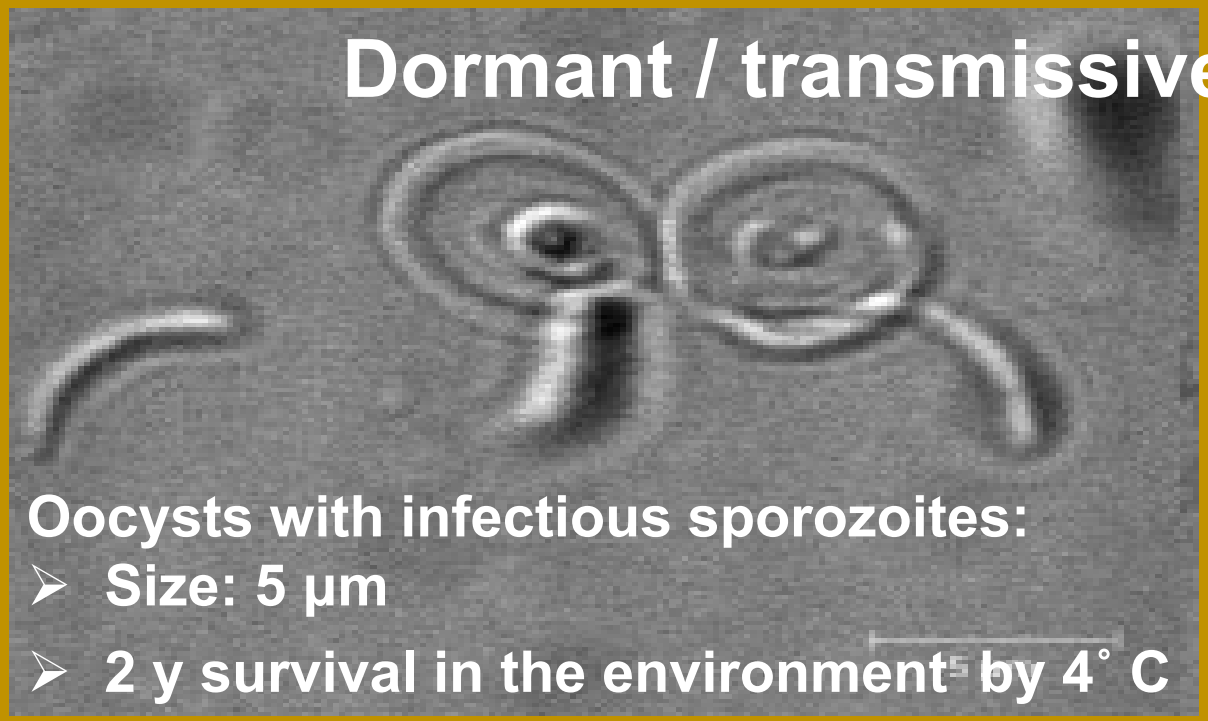
1999: **Habilitation** (*Venia legendi*) in Parasitology, Medical School / Bonn University / Germany

2000 - today: Professor at Cologne Medical School / Germany

1999, 2003, 2004: Visiting Professor at the National Research Center for Protozoan Diseases (NRCPD) / Japan

2005 - 2009: Professor, NRCPD / Japan

2014 - 2017: Professor, Center for Biomedicine and Infectious Diseases, Qinghai University / China



What is *Cryptosporidium* ?

- Parasite (Protozoon), cause disease called Cryptosporidiosis in humans
- Most common species *Cryptosporidium hominis* & *C. parvum*, other species
- There are 34 different *Cryptosporidium* – species and 62 genotypes

THE IMPORTANCE OF *CRYPTOSPORIDIUM*

Clinical importance of *Cryptosporidium*

Food- and waterborne gastroenteritis

Cryptosporidium is responsible for:

- **1 Mio children's deaths / year**
- **Human colon cancer**
- **Transplant rejection**

Cryptosporidium: a first step toward tractability

Lizbeth Hedstrom

Departments of Biology and Chemistry, Brandeis University, MS009, 415 South

The child-killer and famously recalcit
***Cryptosporidium* is the latest o**
magic of CRISPR/Cas9
and introdu

lexingly,
e many
e avail-
mpro-

d by
ate
um
infect
dergo just a few
ng. This severely constrains
ing experiments to small numbers of
and a fraction of the life cycle. Parasites can be
propagated in immunodeficient animals, though these
experiments are largely limited to *C. parvum* rather than
the primary human pathogen *C. hominis*. As a result,
Cryptosporidium drug discovery efforts have been largely
futile, with few compounds showing efficacy in animals,
much less in humans. Since no truly effective drug exists,
we do not even know what pharmacokinetic properties are
required to eradicate infections [6].

The genomic sequences of both *C. hominis* and *C.*

Enteric
Cryptosporidium
diarrheal mortality in small
avirus [2]. Every year, diarrhea causes
the deaths of 800 000 children under five, which is more
than that well-recognized child-killer malaria. Alone
among the top four diarrheal pathogens, which also include

Every year, diarrhea causes the deaths of 800 000 children under five, which is more than that well-recognized child-killer malaria.

Hedstrom L (2015): Trends Parasitology

Occurrence & worldwide outbreaks of *Cryptosporidium*

WORLDWIDE & UBIQUITOUS

Cryptosporidium Prevalence

- Immunosuppressed, HIV-infected and organ transplants.
- Children, in particular 0-2; 2-4 years.
- In industrialized countries: '*Crypto*.'- detection in 2-4% patients with diarrhea.
  '*Crypto*'.- detection by 1-4% healthy, asymptomatic humans.
- In developing countries the prevalence is higher compared to industrialized countries.
- In Germany: since 2001 registered by RKI: 800 - 1.500 cases with increasing number from July to the end of November.

Global burden of food-borne / water-borne (diarrheal) diseases currently unknown

- **1.8 million people died from diarrheal diseases (WHO 2005) due to contaminated food and drinking water.**
- This is not just a problem of the underdeveloped world.
- About 76 million cases of food-borne diseases, resulting in 325.000 hospitalizations and 5.000 deaths, are estimated to occur each year only in the U.S.A. (Mead et al., 1999).
- Over 200 known microbial, chemical or physical agents can cause illness when ingested.
- Over the last 20 years, at least in the industrialized world, water- and food-borne diseases caused by bacteria, parasites, viruses and prions have significantly moved up the political agenda and generated substantial media attention.

Cryptosporidium: diarrhea

Cryptosporidium **is the number 2 cause (after Rota-virus) of diarrhea-associated mortality in children under 5 years of age, worldwide**

Kotlof et al. (2013)

Cryptosporidium: waterborne transmission and worldwide outbreaks

From the begin of the last century until 2016, *Cryptosporidium* was responsible for ~ 60% (524/913) of all reported waterborne outbreaks caused by protozoan parasites

Karanis et al (2007); Baldursson & Karanis (2011); Efstratiou et al (2017)

Cryptosporidium: outbreaks

Largest waterborne Cryptosporidium outbreak:

- Milwaukee, **USA** in **1993** (1)
- ~ 403,000 individuals with cryptosporidiosis
- via contaminated drinking water
- ~ illness-associated cost of US $96.2 million
- ~ 100 deaths (2)

Second largest waterborne outbreak occurred in:

- Östersund, **Sweden** in **2010**
- ~ 27,000 individuals infected (3)

Another waterborne outbreak:

- Skellefteå, **Sweden** in **2011**
- ~ 18,500 individuals (4)

(1) MacKenzie et al (1995); (2) Corso et al (2003); (3) Widerström et al (2014); (4) Bjelkmar et al (2017)

INCREASE OF:

- Waterborne diseases
- Foodborne diseases
- Vectorborne diseases

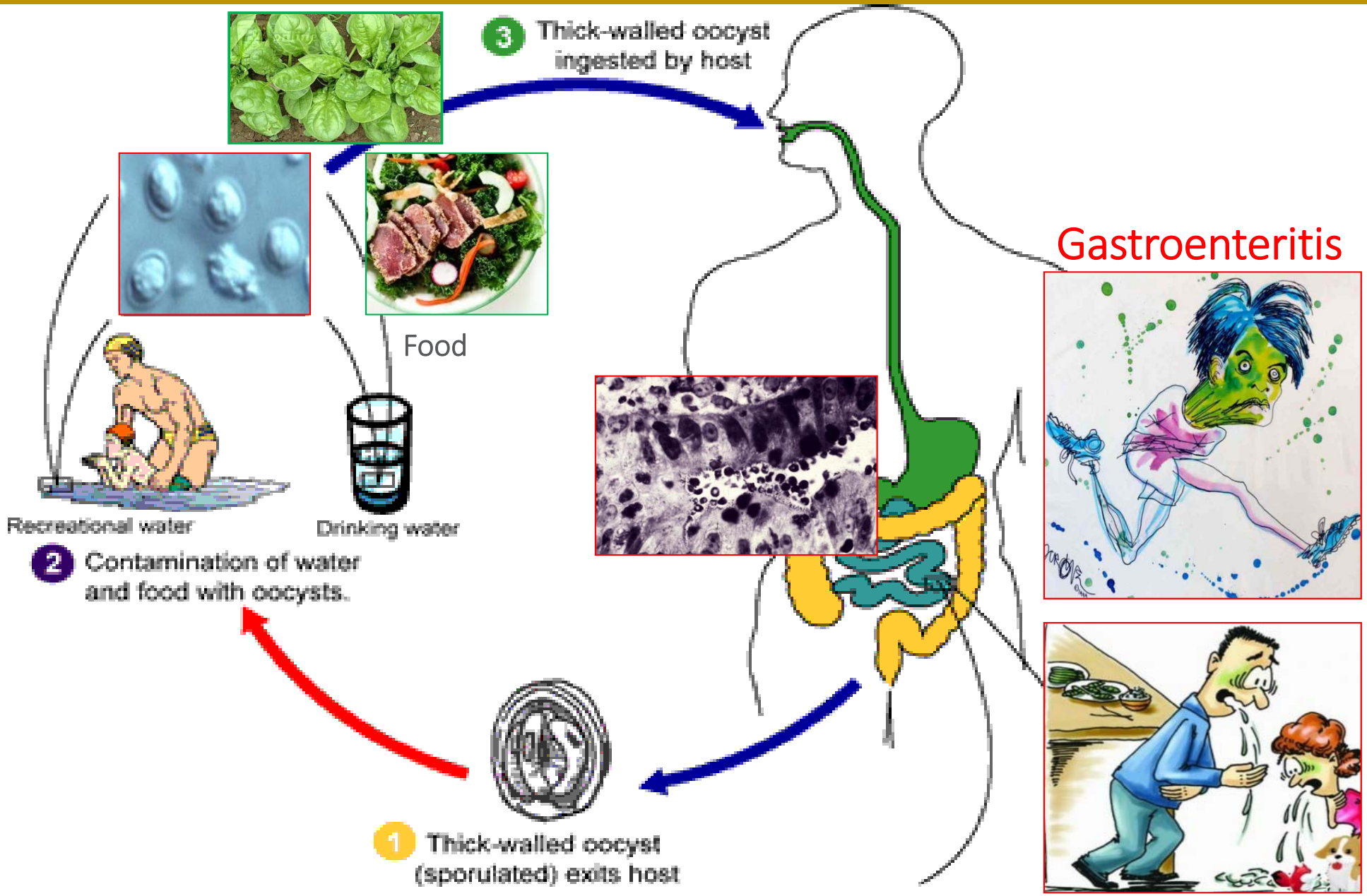
Unlimited Mobility

MIGRANTS & REFUGEES

Transmission of *Cryptosporidium*

- Human - to - Human
- Animal - Human - Animal
- Water
- Food
- Air

Cryptosporidium Life Cycle



Identify the contamination sources!

CRYPTOSPORIDIUM IN WATER & FOOD

Cryptosporidium: foodborne transmission

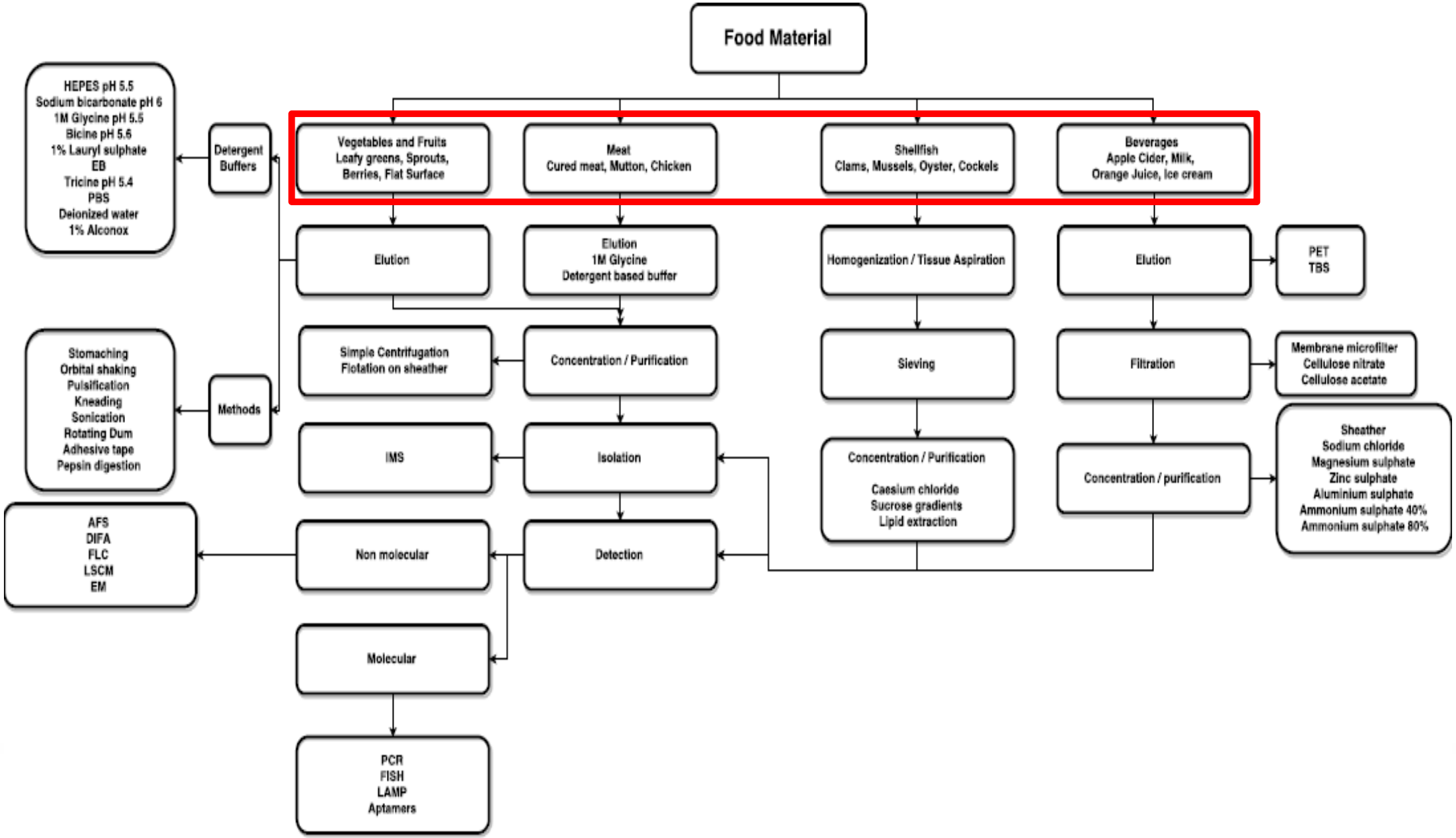
Main causes of foodborne *Cryptosporidium* outbreaks usually associated with food service and catering industries:

- Cold pressed non-alcoholic apple cider
- Ozonated apple cider
- Milk
- Béarnaise sauce
- Raw meat, raw liver
- Chicken salad
- Pre-cut mixed salad leaves (bagged salad)
- Frisée salad
- Fruit juice
- Molluscs
- Sprouted seeds

Highly expected of being vehicles for transmission of *Cryptosporidium:* freshly produced, and when consumed with minimal preparation.

Ahmed & Karanis (2017). An overview of methods / techniques for the detection of *Cryptosporidium* in food samples. Parasitol Res 117, 629-653.

33 years review (Ahmed & Karanis, 2017, in press): *Cryptosporidium* detection in food material



Cryptosporidium: foodborne transmission and worldwide outbreaks

***Cryptosporidium* was ranked**

5th out of 24 potentially foodborne parasites

in terms of importance as a foodborne pathogen

FAO/WHO 2014

Cryptosporidium: foodborne transmission

***Cryptosporidium* is**

among the 10 foodborne pathogens

monitored by the FoodNet surveillance system

in the United States

Crim et al. (2014)

Cryptosporidium: foodborne transmission and worldwide outbreaks

Cryptosporidium **is particularly suited to foodborne transmission and is responsible for**

> 8 million cases of foodborne illness annually

33 years review (Ahmed & Karanis, 2017): Documented outbreaks of cryptosporidiosis associated with different food materials 1984-2017

Infected food material	Causative species /subtype of *Cryptosporidium**	Location of outbreak	No. of people affected	Year of outbreak occurrence	Reference/s
Sausage	NP	UK (North Wales)	19	1984	Casemore et al., 1986
Milk	NP	Mexico	22	1984	Elsser et al., 1986
Kefir prepared in the nursery milk kitchen	NP	Russia	13	1990	Romanova et al., 1992
Fresh pressed apple cidar	*C. parvum*	France (central Maine)	160	1993	Millard et al., 1994
Chicken salad	*C. parvum*	US (Minnesota)	15	1995	CDC, 1996
Unpasteurized apple cidar	NP	Connecticut and New York	31	1995	CDC, 1997
School Milk (cow milk)	NP	UK	50	1995	
Uncooked green onions (suspected)	*C. parvum*	US (Spokane)	54		
Fruit/vegetables related to food handler	*C. parvum*	US (Washing			
Unpasteurized milk	N				
					Yoshida et al. , 2007
				2008	Insulander et al., 2008
	parvum / 4 subtypes (IIaA16G1R1, IIaA15G2R1, IIdA22G1 , IId19G1)	Sweden (Stockholm)	18	2008	Insulander et al., 2013
Salad mixture was suspected from same canteen	*C. parvum*	Finland	72	2008	Pönka et al., 2009
Ham from a sandwich bar	*C. parvum* / IIaA17G2R1	USA (North Carolina)	46	2009	CDC, 2011
No identified food item. suspected (Peeled carrots left in water)	*C. parvum*	Norway	74	2009	Rimseliene et al., 2011
Pre-cut mixed salad leaves	*C. parvum* / IIaA15G2R1	England and Scotland	Over 300	2012	McKerr et al., 2015
Frisée salad	*C. parvum* /	Finland	Over 250	2012	Åberg et al., 2015

25 documented outbreaks of cryptosporidiosis associated with food 1984 – 2017.

Review: Ahmed & Karanis (2017) - in press

Cryptosporidium: foodborne transmission and worldwide outbreaks

Foodborne outbreaks of cryptosporidiosis have been increasingly reported, however most foodborne outbreaks are **never recognized**, and those that are recognized, frequently are **poorly investigated** - if at all, and **often** go **unreported**

Robertson (2014)

Investigation

DIAGNOSIS

Recognition

40 years - Overview (Efstratiou, Ongerth, Karanis 2017): Detection methods for *Crypto* & *Giardia* monitoring

Table 3
Overview of the literature relating to detection/identification methods used during Phase 3 of the *Cryptosporidium* and *Giardia* monitoring procedure. The table refers to the original research articles for further information.

Microscopy Procedures	Conventional staining	Lugol's Iodine	Ajeagah et al., 2007
		Auramine O	Rodriguez-Hernandez et al., 1994
		Modified acid-fast	Smith et al., 1989
		Wright-Giemsa	Smith et al., 1989
	Immunofluorescence assay	Direct	Sorenson et al., 1986, Musial et al., 1987
		Indirect	Sauch, 1985, Ongerth and Stibbs, 1987
	Microscopy tools	Bright-field	Shaw et al., 1977, Holman et al., 1983
		Phase contrast	Sauch, 1985, Payment et al., 1989
		DIC	deRegnier et al., 1989, Smith et al., 1991
	Others	Lens-free holographic microscopy	Mudanyali et al., 2010
		Digital Holographic Microscopy	El Mallahi et al., 2013
	Spectroscopy	Rapid Surface-enhanced Resonance Raman Spectroscopy	Rule Wigginton and Vikesland, 2010
		Electrochemical Impedance Spectroscopy	Houssin et al., 2010
Molecular Procedures	PCR	PCR	Sluter et al., 1997, Rochelle et al., 1997a,b, Chung et al., 1998, Hallier-Soulier and Guillot, 1999
		Nested PCR	Monis and Saint, 2001
		PCR-RFLP	Sturbaum et al., 2001, Xiao et al., 2001, Nichols et al., 2003
		RT-PCR	Stinear et al., 1996, Kaucner and Stinear, 1998, Hallier-Soulier and Guillot, 2003, Kishida et al., 2012
		Real time PCR	Guy et al., 2003, Foulds et al., 2002, Fontaine and Guillot, 2003, Yu et al., 2010, Staggs et al., 2013
	LAMP	Karanis et al., 2013, Plutzer and Karanis 2009, Plutzer et al., 2010, Koloren et al., 2011	
	RT-LAMP	Inomata et al., 2009	
	DNA-based procedure	DNA microarray-based detection	Lee et al., 2010, Brinkman et al., 2013
	RNA-based procedure	Nucleic acid sequence-based amplification	Baeumner et al., 2001
	Integrated cell culture procedures	Cell culture with PCR	Di Giovanni et al., 1999, LeChevallier et al., 2000, 2003
		Cell culture with RT-PCR	Rochelle et al., 1997a,b, Johnson et al., 2012
Cytometry	Flow cytometry	Instrument development	Veal et al., 2000, Vesey et al., 1993b
		Antibodies and alternative labeling	Ferrari et al., 2000, Ferrari and Bergquist, 2007, Chung et al., 2004
		Processing procedure and variations	Lepesteur et al., 2003, Keserue et al., 2011, Keserue et al., 2012
		Time-gated Flow Cytometry	Jin et al., 2009
		FACS	Vesey et al., 1994
	Laser Scanning Cytometry	Reynolds et al., 1999, Rushton et al., 2000, deRoubin et al., 2002	
Optical Procedures	Electro-chemiluminescence immune-assay	Lee et al., 2001, Call et al., 2001	
	Enzyme immunoassay	Siddons et al., 1992	
	FISH	Taguchi et al., 2006	
	Microfluidic Device With the SUS Micromesh	Taguchi et al., 2007	
Developing/automated technology	Surface plasmon resonance biosensor	Kang et al., 2006	
	Piezoelectric-excited cantilever biosensor	Campbell and Mutharasan, 2008, Xu and Mutharasan, 2010	
	Near-real-time optical microfluidic biosensors	Angus et al., 2012	
	Automated fiber optic-based biosensor	Kramer et al., 2007	
	Immuno-dot blot assay	Thiruppathiraja et al., 2011	
	Gas chromatography mass spectrometry	Beale et al., 2013	
	Electrode-based potentiometric assay	Laczka et al., 2013	

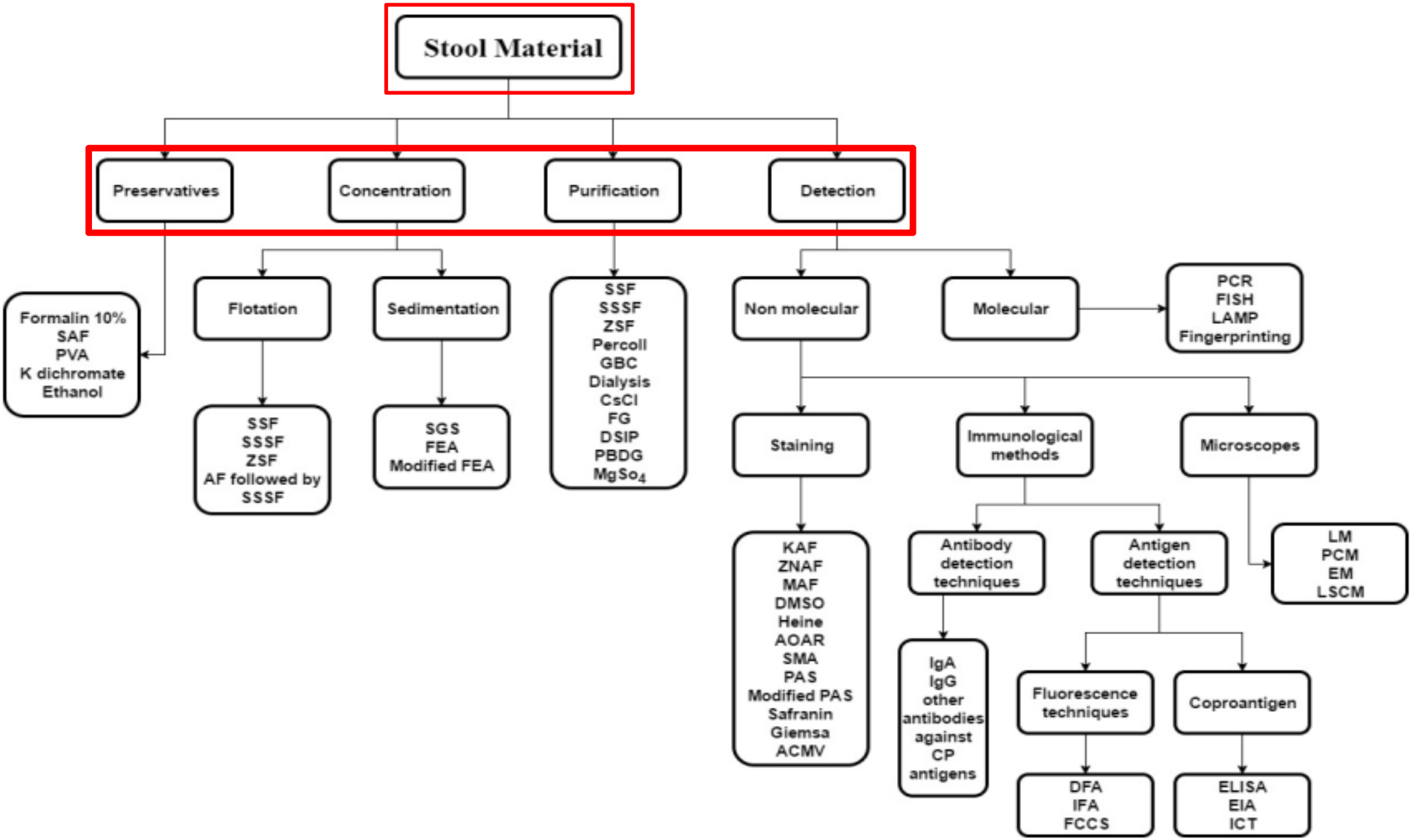
A. Efstratiou et al. / Water Research 123 (2017) 96–112

Detection of *Cryptosporidium* oocysts

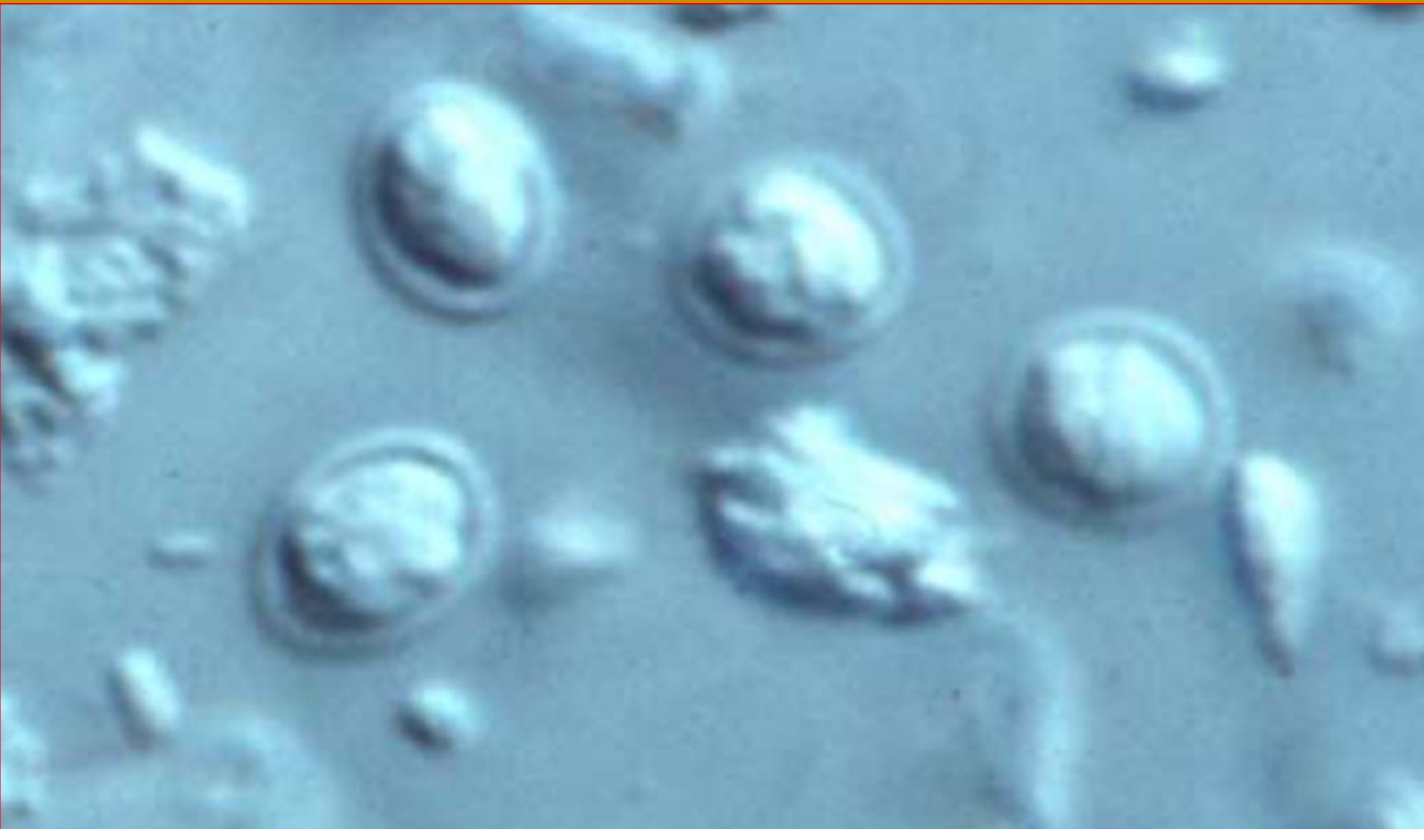
- by staining
  - e.g. Giemsa
  - Eosine
  - modified Ziehl-Neelsen-Staining = mZNS
  - **in stool smears**

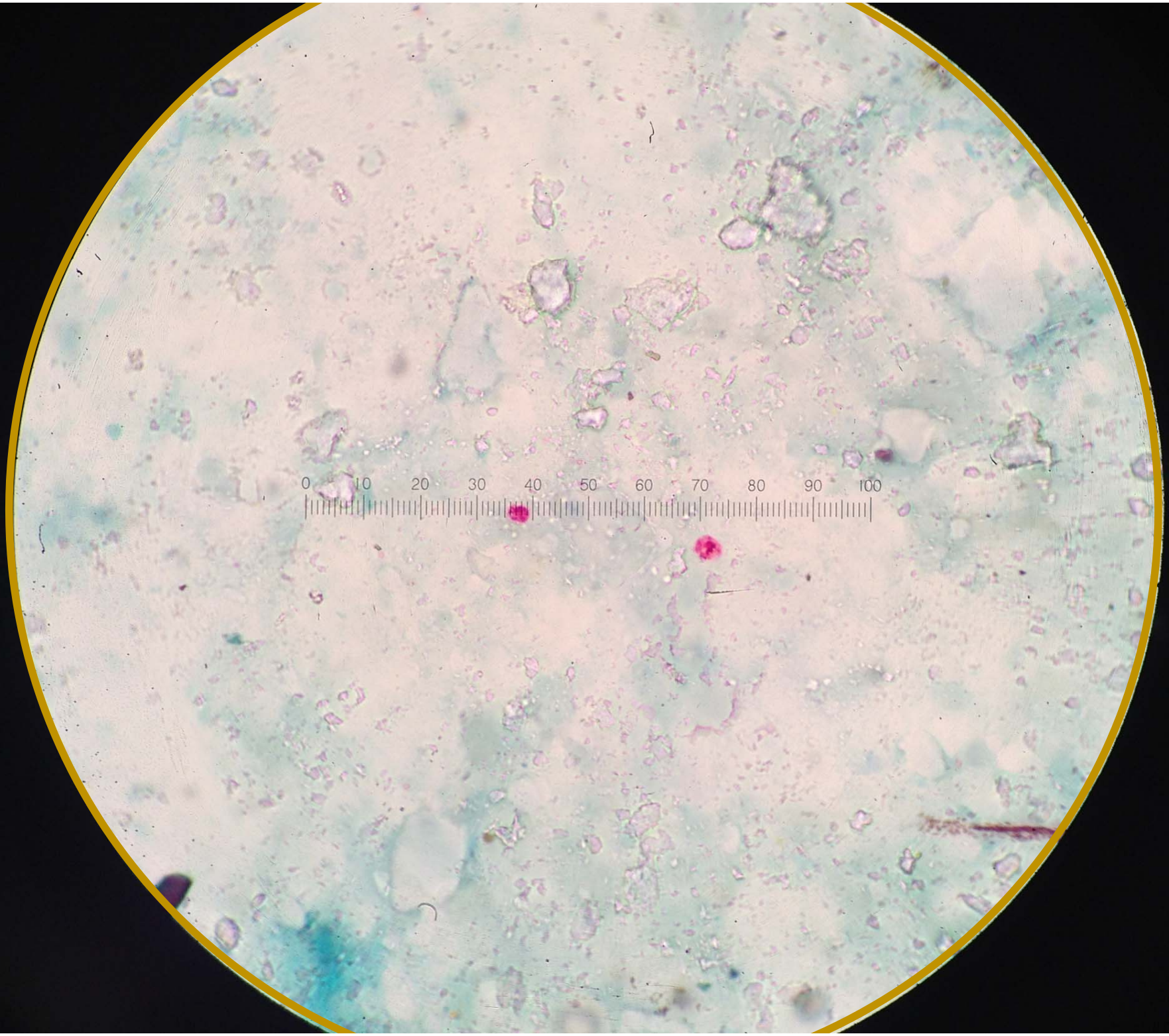
- Immunfluorescence = IFT
- Copro-Antigen-detection (ELISA)
- Molecular detection (PCR)

40 years review (Ahmed & Karanis, 2017, in press): *Cryptosporidium* detection in stool material

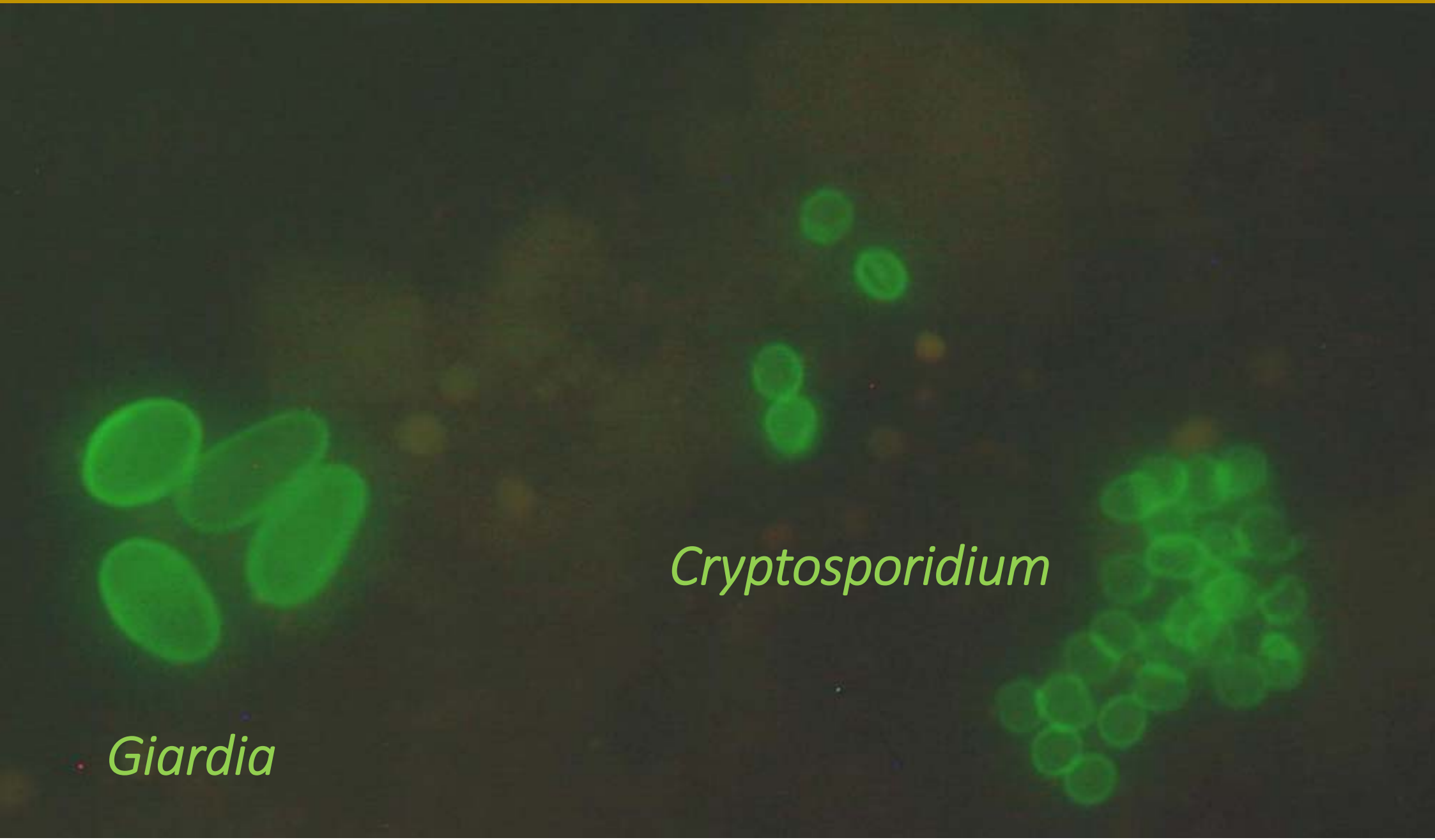


Cryptosporidium in stool (Light microscope)




0 10 20 30 40 50 60 70 80 90 100

Cryptosporidium in stool (Light microscope, IFT)



Cryptosporidiosis - endoscopy

Exogen toxic duodenitis with severe erythema.
Cryptosporidium infection leads to malabsorption syndrome and diarrhea

Pott (1998). Gastroskopie-Atlas. Schattauer-Verlag

TREATMENT / THERAPY

Cryptosporidium: No drugs

There is **no effective treatment** for cryptosporidiosis in all populations and **no vaccine** is available

Only symptomatic therapy !

PREVENTION !

- ★ Wash hands, clean toilets
- ★ Boil water
- ★ Food (particular vegetables) good washing + boiling
- ★ Know and prevent the potential infection sources + transmission routes

Note: Carriers of *Cryptosporidium* – oocysts are sources for fecal-oral transmission

WATER TREATMENT & PATHOGEN REMOVAL

JOURNAL

American Water Works Association DECEMBER 1995

Filtration

Cryptosporidium removal by multimedia filters

Water treatment

1. Backwash water (very dirty)
2. ‘First filtrate’
   (low turbidity - drinking water quality)

Note: No disinfection !

Unexpected events: dangerous for drinking water preparation

Thessaloniki, Greece, May 2018

Unexpected events: dangerous for drinking water preparation

Flash Floods Hit Rhodes, Greece

18 OCTOBER, 2013 BY RICHARD DAVIES IN EUROPE

The Greek island of Rhodes was hit by gale force winds and heavy rainfall yesterday, leading to flooding of several buildings and widespread storm damage.

The storm first struck the south eastern Aegean island on 17th October. Strong winds uprooted trees and damaged cars and buildings. Flooding was reported on many of the main roads around Rhodes town and the resort of Lindos on the southern coast of the island. However, the worst affected area has been the north east of the island.

Heavy downpours and gale-force winds brought down trees and caused floods on the Rhodes on Thursday, damaging cars, blocking traffic and flooding homes. The basements of many buildings have been flooded, but the storm passed quickly and flood waters have begun to recede.

Cryptosporidium: What are the Problems ?

- Outbreaks
- Waterborne
- Foodborne
- Children, elderlies, immunosuppressed at risk
- No disinfection
- No therapy
- Swimming pools
- Tourism industries / Hotel business in danger

CYRPTO OUTBREAKS INCREASING

Outbreaks of a parasitic infection called Cryptosporidiosis, linked to swimming pools and water playgrounds, have at least doubled since 2014.

1 – Numbers for 2015 have not yet been collected. 2 – 2016 data are preliminary, based on reports from 24 states received by February.

SOURCE Centers for Disease Control and Prevention

Frank Pompa, USA TODAY

USA TODAY

New trend: Hotel Holiday Claim Business !

New trend: Hotel Holiday Claim Business !

Has your family holiday
BEEN RUINED BY SICKNESS
in Spain?

Your Holiday Claims are experts at helping groups of holidaymakers claim the compensation they deserve.

To find out how much compensation you could claim, call us now on...

0330 100 2851

Your Holiday Claims

New trend: Hotel Holiday Claim Business !

Source: Your Holiday Claim

Spanish hotel owners say Brits took them for £42m in fake food poisoning claims after plans emerge to ban all-inclusive packages

Mirror

Britain has been dubbed the "fake sick man of Europe" as 'no win - no fee' firms are encouraging Brits to put in lucrative sickness claims

New trend: Hotel Holiday Claim Business !

Unscrupulous "no win - no fee" firms are behind the lucrative sickness claims (Image: Getty Images)

Hoteliers are demanding a block on Brits going all-inclusive (Image: Getty Images)

T Online

NEWS

Versicherungsbetrug

Britische Touristen erschleichen sich 50 Millionen Euro

09.05.2017, 13:24 Uhr | t-online.de, az

Der Strand in Alcudia auf Mallorca ist ein beliebtes Reiseziel (Quelle: fossiphoto/imago)

New trend: Hotel Holiday Claim Business !

www.t-online.de

Dieser Versicherungsbetrug hat allein im Jahr 2016 etwa 50 Millionen Euro gekostet: Britische Touristen haben mithilfe einer Masche die Kosten für ihren Urlaub erschlichen. Dazu fingierten sie Lebensmittelvergiftungen und ließen sich wegen Magen-Darm-Erkrankungen die Reisekosten von den Veranstaltern erstatten.

T Online

NEWS

"Durchfall-Masche" auf Mallorca

Hunderte Betrüger identifiziert

20.10.2017, 22:54 Uhr | dpa, pdi

Die spanische Polizei hat auf Mallorca hunderte B

Die spanische Polizei ... **Touristen auf Mallorca** ... **Lebensmittelinfektionen**

... Briten, die nach einem Balearen-Aufenthalt mit Hilfe von ... Rechtsanwaltskanzleien daheim Klagen gegen Reiseveranstalter und Hotels eingereicht ... die Policía Nacional mit.

Nur ein verschwindend geringer Teil dieser Briten habe einen Arzt aufgesucht, hieß es. Zudem hätten die betroffenen Hotels alle Gesundheitsinspektionen bestanden. Die sogenannte "Durchfall-Masche" sollen Urlauber aus Großbritannien in Spanien jahrelang praktiziert haben. Oft reichten nach Angaben der spanischen Behörden schon der Kauf eines Durchfallmittels und der dazugehörige Kassenbon als Beweis für eine Erkrankung im Hotel aus.

Die meisten der mutmaßlichen Betrüger sollen von britischen Anwälten angestiftet worden sein. Nach amtlicher Schätzung wurden auf diese Weise allein im Jahr 2013 und nur auf Mallorca mindestens 50 Millionen Euro ergaunert. Die spanische Polizei hatte die Ermittlungen Anfang 2017 aufgenommen. Den Behörden war der drastische Anstieg der Reklamationen um fast 700 Prozent im vorigen Jahr aufgefallen. Der Betrug habe vor allem in All-Inclusive-Hotels oder Unterkünften mit Halbpension stattgefunden, weil diese für eine Lücke im britischen Verbraucherschutzgesetz besonders anfällig seien.

MallorcaZeitung

Versicherungsbetrug: Immer mehr Briten kommen Mallorca-Hoteliers teuer zu stehen

50 Millionen Euro Schaden 2016: Der Hoteliersverband prüft, wie er den Tricks der Touristen beikommen kann

06.03.2017 | 09:33

New trend: Hotel Holiday Claim Business !

Immer mehr Briten machen Mallorca-Urlaub
Kosten der Hotels. Wie die
"Diario de
...schaden
...ag angerichtet.

Die claim farmer bei der Arbeit. **Foto: Federación Hotelera de Mallorca**

Die Masche läuft meist nach dem gleichen Schema ab: Urlauber werden in der englischen Urlauberhochburg Magaluf von Anwälten angesprochen. Nach einem anfänglichen Small talk teilen sie den Touristen mit, dass sie durch einen einfachen Trick kostenlos Urlaub machen könnten. Die Briten müssten nur bei ihrer Reiseagentur angeben, dass sie sich schlecht fühlen, und das rezeptfreie Medikament Amodium in der Apotheke kaufen. Dieses hilft unter anderem gegen Lebensmittelvergiftungen.

Dozens of Brits fall ill in Tenerife resort after claims of guests 'DEFECATING' in pool

DOZENS of Brits staying at a Tenerife resort have fallen ill after claiming there was poo in the swimming pool.

By JYOTI RAMBHAI
PUBLISHED: 17:04, Thu, Nov 17, 2016 | UPDATED: 18:52, Thu, Nov 17, 2016

New trend: Hotel Holiday Claim Business !

Dozens of Brits suffer from a gastro illness at a Tenerife Resort after claims of poo in the pool

Brits staying at the four-star Holiday Village Be Live resort have reported symptoms of vomiting and diarrhoea.

Holidaymakers suffering from the gastro illness have made claims of poor hygiene at the swimming pools.

Holiday Illness Claims
HELPING YOU RECOVER WHAT YOU DESERVE

HOME | ABOUT US | HOLIDAY BLACKSPOTS | INJURIES ABROAD | SUCCESS STORIES | CLAIM VALU

Multiple illnesses reported at Lanzarote's TUI Family Life Flamingo Beach resort

New trend: Hotel Holiday Claim Business !

POSTED JULY 21ST, 2017

Suggestions and Conclusions

1. Multi-barrier system for water treatment
2. Simplify detection and diagnosis procedures
3. Standardized Surveillance System in all countries + international networking
4. Revision of guidelines/recommendations for swimming pool users + prevention of transmission of infectious diseases
4. Education / skills
5. Develop culture system in vitro
6. Drug + therapy development
7. Cooperate with the experts

TAKE HOME MESSAGE

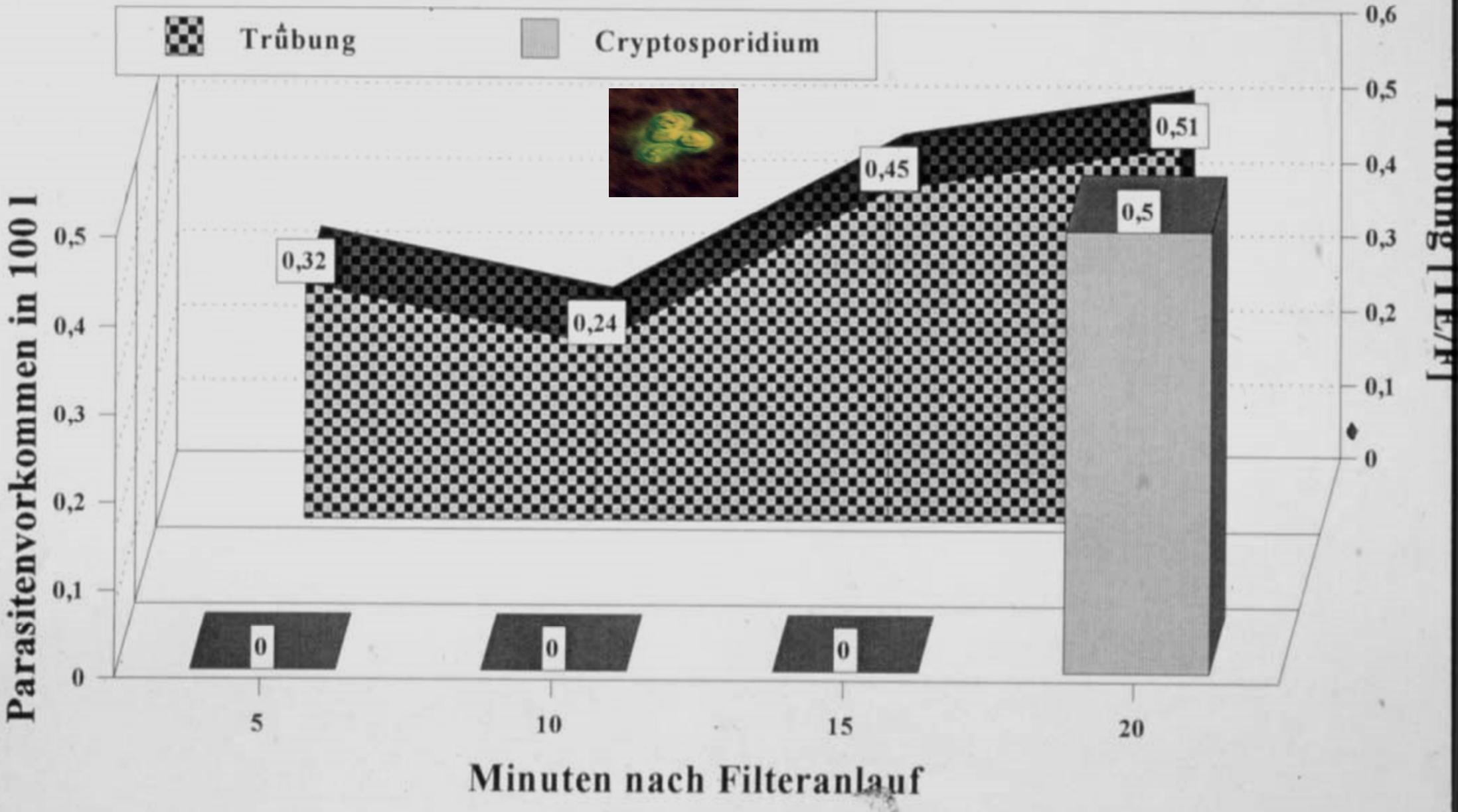
- *Cryptosporidium* is one of the most important pathogen causing diarrhea + diarrhea related death
- Underreported / Underdiagnosed
- No therapy yet / No vaccine
- Transmission by water + food
- Swimming pools: Tourism / hotel business in danger
- Fecal – oral route of transmission
- Cooperate with the experts !

Thank you for your attention !

Prof. Dr. Panagiotis Karanis

E-mail contact: panagiotis.karanis@uk-koeln.de

Korrelation zwischen Trübung und Parasitenvorkommen im Erstfiltrat eines Mehrschichtfilters



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DISTRIBUTION AND REMOVAL OF *GIARDIA* AND *CRYPTOSPORIDIUM* IN WATER SUPPLIES IN GERMANY

Panagiotis Karanis*, Dirk Schoenen** and H. M. Seitz*

** Institute for Medical Parasitology, Sigmund-Freud-Straße 25, University of Bonn, D-53127 Bonn, Germany*
*** Institute of Hygiene, Sigmund-Freud-Straße 25, University of Bonn, D-53127 Bonn, Germany*

ABSTRACT

This study has been conducted, to estimate the distribution of *Giardia* and *Cryptosporidium* in German water supplies and the removal efficiency of surface water treatment plants for *Giardia* and *Cryptosporidium* by conventional treatment. Water samples from six surface water treatment plants in different parts of Germany were simoultaneously examined for *Giardia* and *Cryptosporidium*. Investigations for both parasites were carried out in the period from July 1993 until December 1995. The results confirmed the occurrence of *Giardia* and *Cryptosporidium* in surface and raw water, in intermediate steps after treatment, in back wash

investigation period	water source	positive samples for parasites/number of investigated samples in %	*Giardia* positive samples pos./inv. (in %)	*Giardia* cysts/ 100 l, average (max.)	*Cryptosporidium.* positive samples pos./inv. (in %)	*Cryptosporidium*oocysts /100 l, average (max.)
19.07.95-05.12.95	RW	80/105 76.2%	67/105 63.8%	88.2 (1314)	49/105 46.7%	116 (1081)
	IMTS	50/150 33.3%	30/150 20%	2.86 (19.2)	44/150 29.3%	25.23 (66.6)
	DW	18/47 38.3%	7/47 14.9%	3.77 (16.8)	14/47 29.8%	3.24 (20.8)

RW =raw water, IMTS=intermediate treatment steps, DW =drinking water,