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Giardia and *Cryptosporidium* Contamination in Surface Water: From Where, by How and Does Identification Method Matter?

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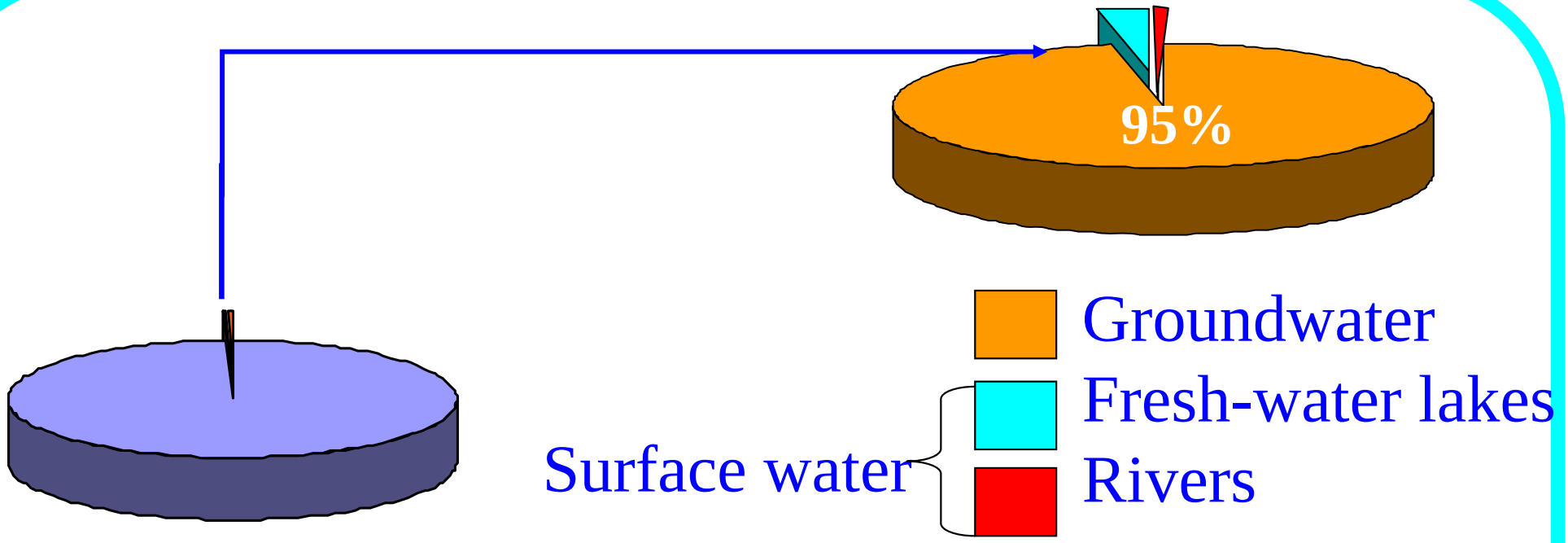
Contents

- Water contaminations and public health impacts
- From where?.... by how?
- Identification methods

Water usable by human



0.3% is usable by humans

99.7% is unusable by humans
(Oceans, glaciers, soil moisture)

Source: U.S. Geological Survey

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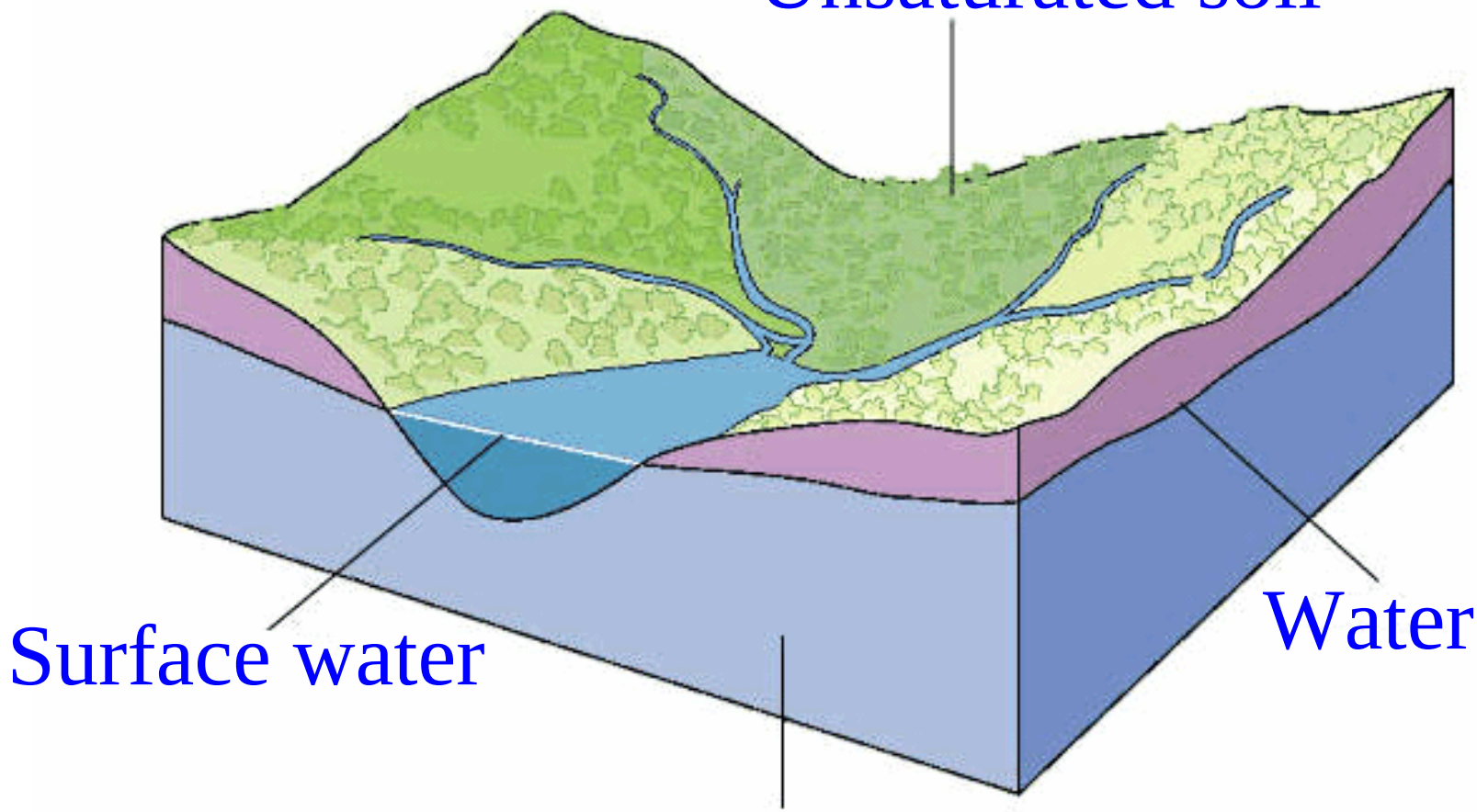
Ground water & surface water



(Rail, 2000)

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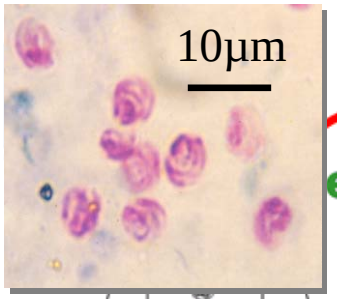
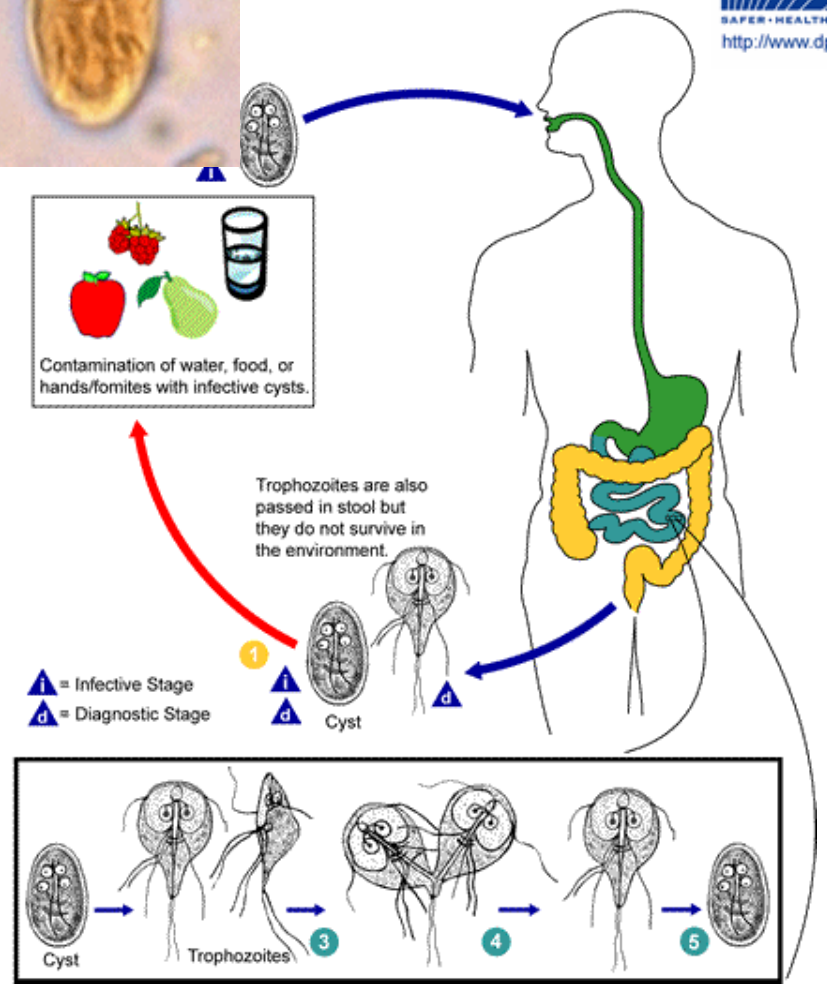
Giardia & Cryptosporidium





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Giardia & Cryptosporidium

- The infectious dose is low:
  - 10–30 (oo)cysts can cause infection in healthy persons (Dupont *et al*., 1995; Okhuysen *et al*., 1999; Cacciò, 2004)
- Survive for weeks to months in environment
- High resistance to chlorine disinfection (Korich *et al*., 1990; Shields *et al*., 2008)

Cryptosporidium Outbreaks

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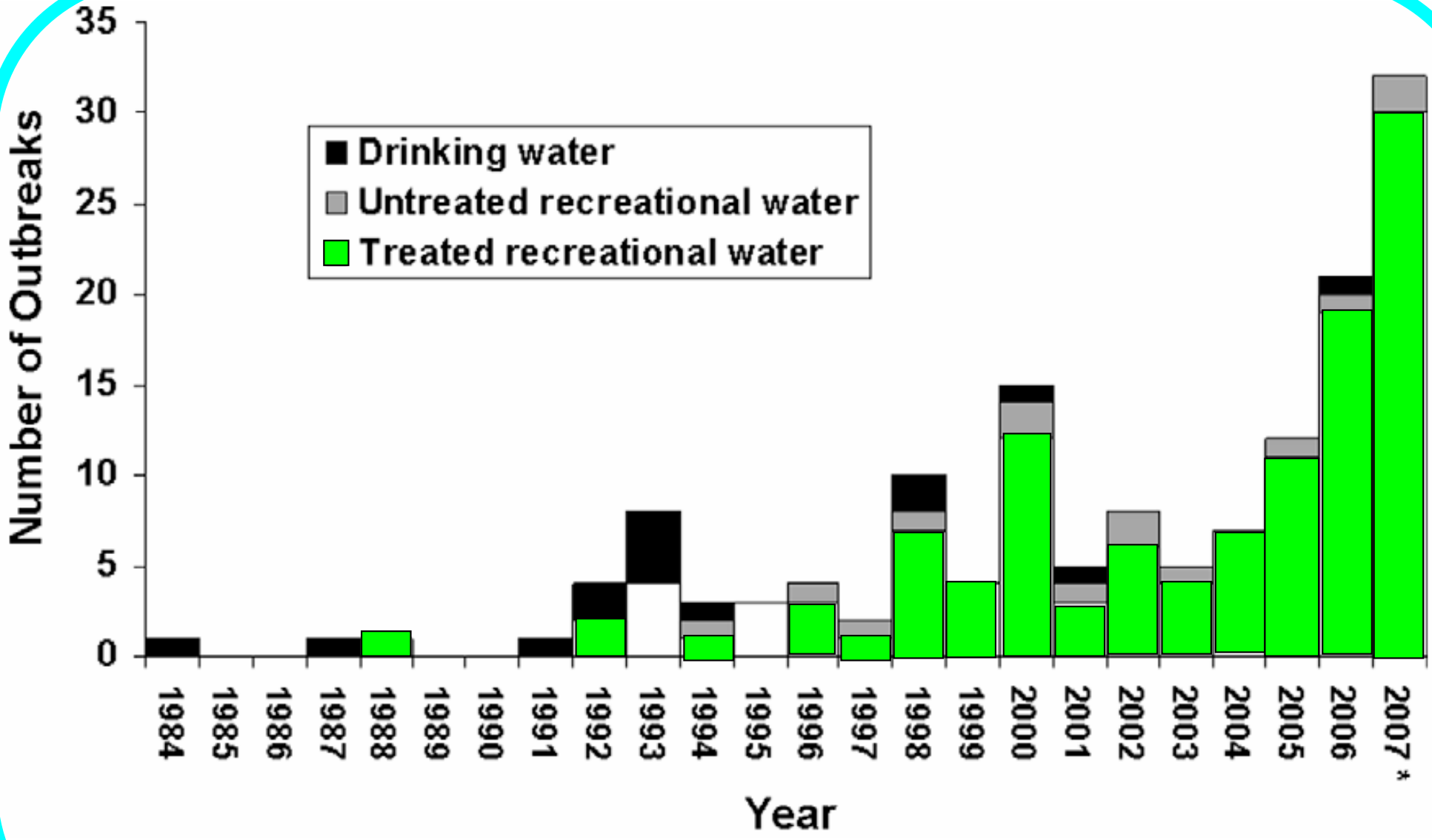

Yoder & Beach, 2009

Water Contamination

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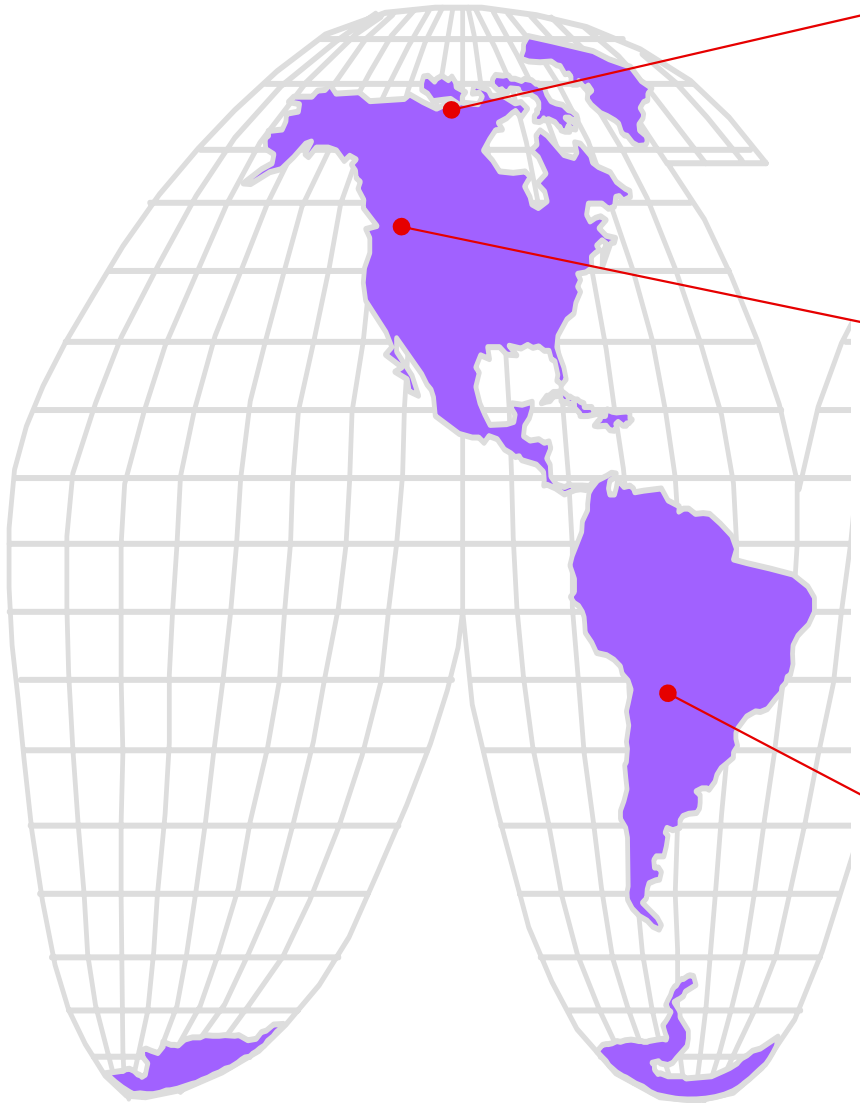
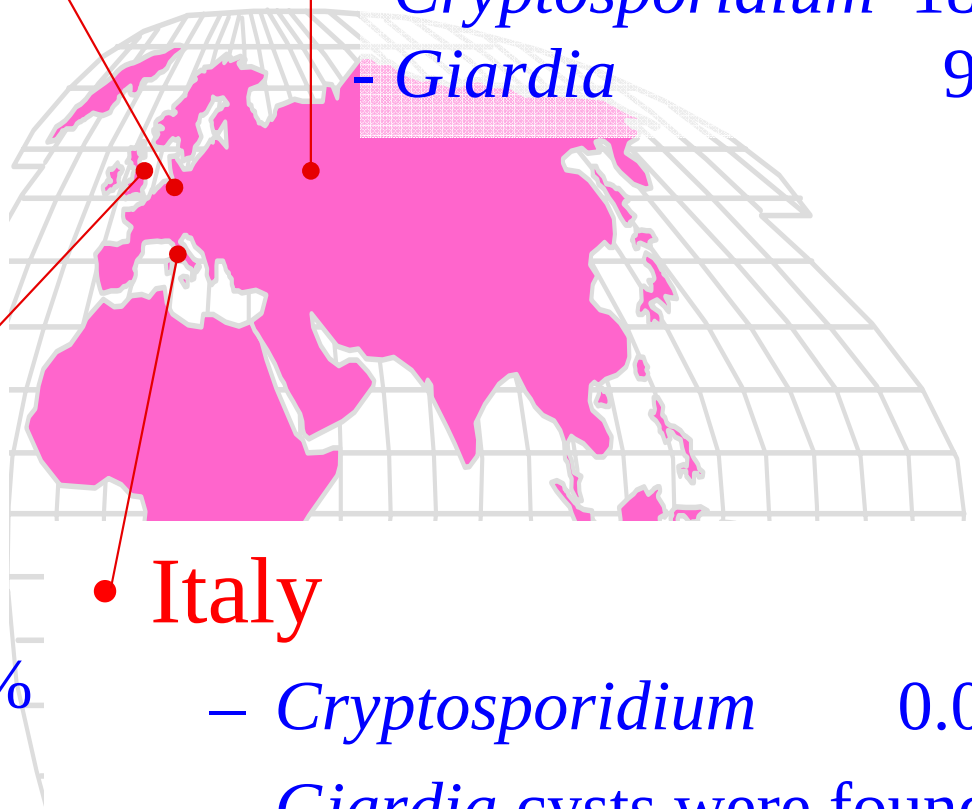


- Canada
  - Treatment water plants 87.1%
- U.S.A
  - Wastewaters 67-100%
  - Surface waters 24- 100
  - Drinking waters 17- 26.8%
- Mexico
  - *Cryptosporidium* 48%
  - *Giardia* 50%

(Fayer, 2004; Xiao, *et al*, 2004; Chaidez *et al*, 2005)

- Spain
  - –*Giardia* 93.1%
  - –*Cryptosporidium* 89.6%
  - –River water 64.5%
  - –Treated water 30.8%
  - –Tap water 26.8%

- Russia
  - - *Cryptosporidium* 18.1%
  - - *Giardia* 9.6%

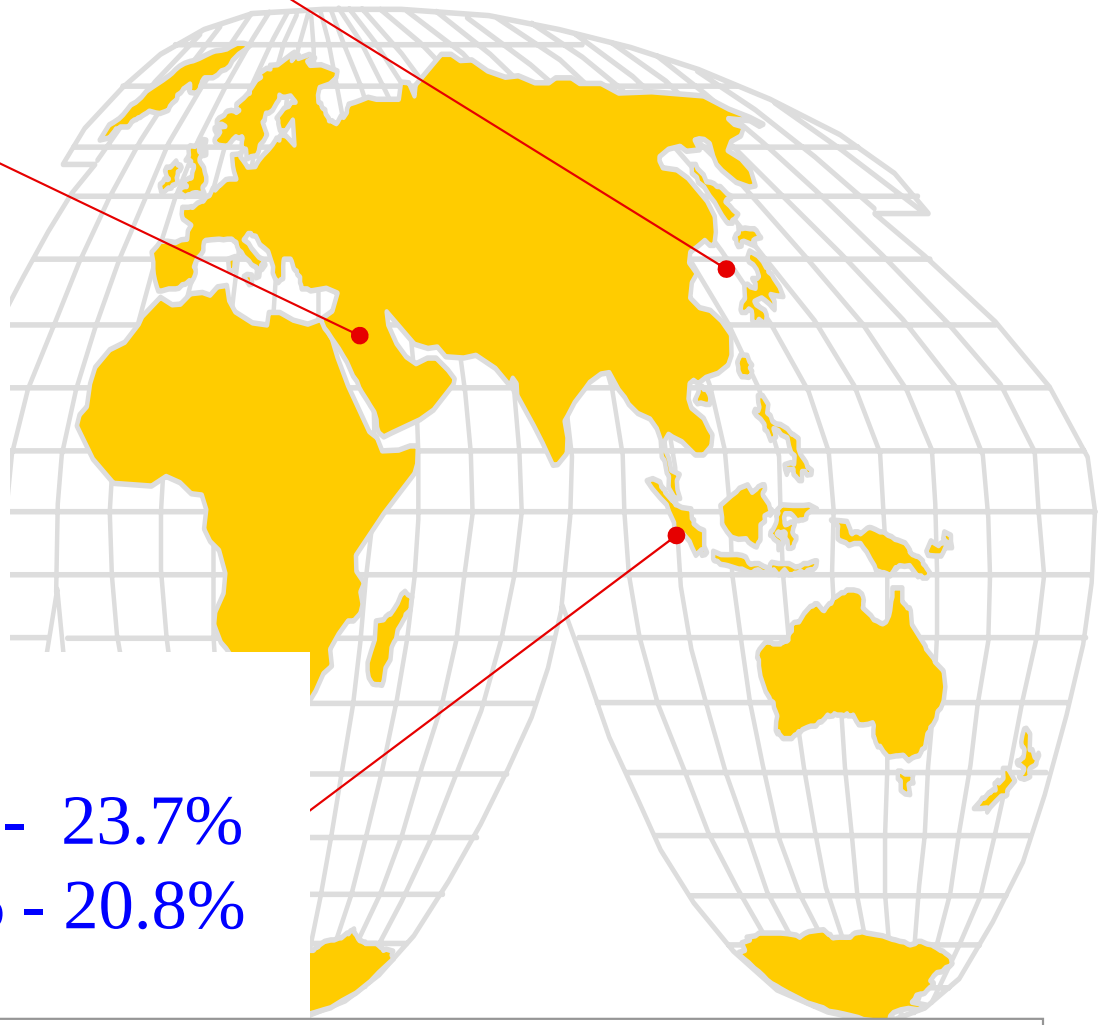


- UK
  - – raw surface water 11.5 – 57%

- Italy
  - – *Cryptosporidium* 0.0%
  - – *Giardia* cysts were found only in raw water samples

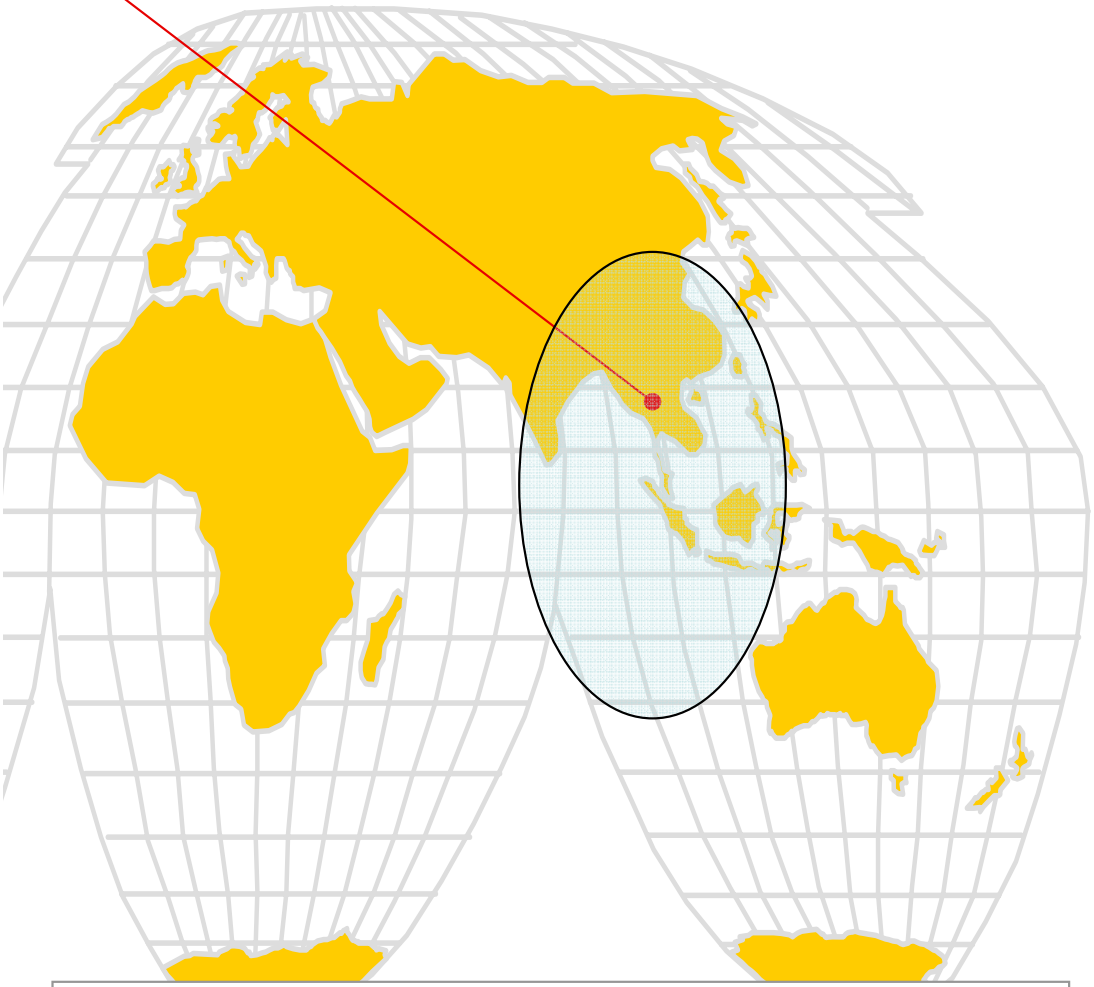
Fayer, 2004; Karanis, *et al*., 2006; Castro-Hermida, *et al*, 2009; Vernile, *et al*, 2009

- Japan
  - River water 47 – 72%
  - Treated water 35 %
- Egypt
  - Summer 31.6%
  - Autumn 22.5%
  - Spring 16.6%
  - Winter 7.5%
- Malaysia
  - *Giardia* in river water 4.2 - 23.7%
  - *Cryptosporidium* 11.6 - 20.8%



Hashimoto *et al*, 2002; Farizawati *et al*, 2005; Elshazly, 2007; Mohammed Mahdy *et al*, 2008

- Thailand
  - Groundwater
    - *Giardia* 60%
    - *Cryptosporidium* 35%
    - Both 15%
  - Surface water
    - *Giardia* 26%
    - *Cryptosporidium* 10.5%
    - Both 10.5%
  - Canals (wastewater)
    - (i) municipal
    - (ii) industrial
    - (iii) agricultural



Sutthikornchai *et al*., 2005;
Tantawiwatananon *et al*., 2007
Jitramontree *et al*., 2008;
Diallo *et al*., 2008

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Cryptosporidiosis Thai Patient

- 3.4% in pre-school children
- 9.6% – 30% in HIV patients
  - *C. hominis* (30%)
  - *C. parvum* (14%)
  - *C. meleagridis* (4.4%)
  - *C. felis* , *C. canis*, *C. muris*

(Getti *et al*, 2002; Tiangtip and Jongwutiwes, 2002; Wongstitwilairoong *et al*,2007; Saksirisampant *et al*,2009)

From Where?...

- The cattle wastewater,

  Cryptosporidium 98%
  Giardia 6.7%

  Farizawati *et al*, 2005

- Infected calves shedding more than 2.2×10^5 oocysts/gram of feces.

  Trotz-Williams, *et al*., 2007

From Where?...

Both *Cryptosporidium* oocysts and *Giardia* cysts were significantly higher in calf (<2 mo old) manure than in samples from cow and heifer (> 6 mo old)

Graczyk , *et al*., 2000

Miller *et al*, 2007

By…How?

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Samples	No. of samples	mean (max)		
		Turbidity (NTU)	*Giardia* (cysts/100L)	*Cryptosporidium* (oocysts/100L)
RS	16	1.30(3.80)	0.00(1.10)	2.40(52.20)
ES	7	47.38(93.80)	0.00(0.00)	11.40(35.50)
RS	26	3.57(10.20)	0.95(11.10)	2.65(10.30)
ES	11	28.25(54.30)	0.00(21.00)	14.30(65.60)
RS	25	11.45(36.00)	1.10 (9.10)	1.30 (23.10)
ES	14	56.99(125.30)	12.40 (21.60)	17.05 (147.10)

RS = Regular sample
ES = Event sample

Kistemann *et al.*, 2002

From Household

- The discharge of raw sewage from houses, houseboats, and pet feces

- Reclaimed water samples
  - *Cryptosporidium* 70%
  - *Giardia* 80%,
  - Viable was detected in 20%

Harwood, *et al*., 2005; Schets, *et al*., 2008

สำนักการระบายน้ำ

DEPARTMENT OF DRAINAGE AND SEWERAGE

MAHIDOL UNIVERSITY

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The Department of Drainage and Sewerage, Bangkok Metropolitan

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Our Study

6 sets of water samples

Gr. 1 = 1 hr before

Gr. 2 = soon after

Gr. 3 = at 2 hr later

Gr. 4 = at 4 hr later

Gr. 5 = at 6 hr later

All together 30 samples

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Our Study

- We recorded their turbidity, temperature, and pH.
- The collected samples were filtered through 0.1 diameter pore filter paper.
- The sediments were then washed and kept in distilled water for identification method of *Cryptosporidium* and *Giardia*.

Physical parameters

Group of samples*	Turbidity (NTU) Mean (min-max)	Temperature (°C) Mean (min-max)	pH Mean (min-max)
1	30.6 (20.9-47.2)	27.1 (26-29)	6.86 (6.8-7.1)
2	46.5 (36.0-53.8)	27 (26-28)	6.83 (6.7-7.0)
3	69.7 (44.8-112)	26.9 (26-28)	6.77 (6.7-6.9)
4	51.2 (37.8-70.1)	27.2 (26-28)	6.64 (6.7-7.9)
5	47.1 (21.2-60.6)	27.3 (26-28)	6.91 (6.7-7.2)