

# *Cryptosporidium* - a seasonal reminder

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**PWTAG Webinar series**  
**10<sup>th</sup> September 2025**

# Today's seminar

- It's always prudent to think of *Cryptosporidium*, but why now?
- What is *Cryptosporidium* and how it is transmitted through swimming pools
- What we have learnt from previous outbreaks
- How to prevent *Cryptosporidium*
- If it does occur, what might happen
- Key messages from the PWTAG project: a survey of *Cryptosporidium* in UK leisure pools
- Resources will also be provided

# Why swimming pools and why now? It's mainly because of outbreaks

An outbreak is a cluster of people with the same illness in time or place, and / or with a common exposure.

We know from outbreak surveillance that outbreaks of gastrointestinal illness linked to recreational waters in the UK are nearly all caused by *Cryptosporidium*.

Epidemiol. Infect. (2006), 134, 1141–1149. © 2006 Cambridge University Press  
doi:10.1017/S0950268806006406 Printed in the United Kingdom

## REVIEW ARTICLE

### Outbreaks of waterborne infectious intestinal disease in England and Wales, 1992–2003

A. SMITH<sup>1</sup>\*, M. REACHER<sup>1</sup>, W. SMERDON<sup>1</sup>, G. K. ADAK<sup>1</sup>, G. NICHOLS<sup>2</sup>  
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(Accepted 13 March 2006, first published online 11 May 2006)

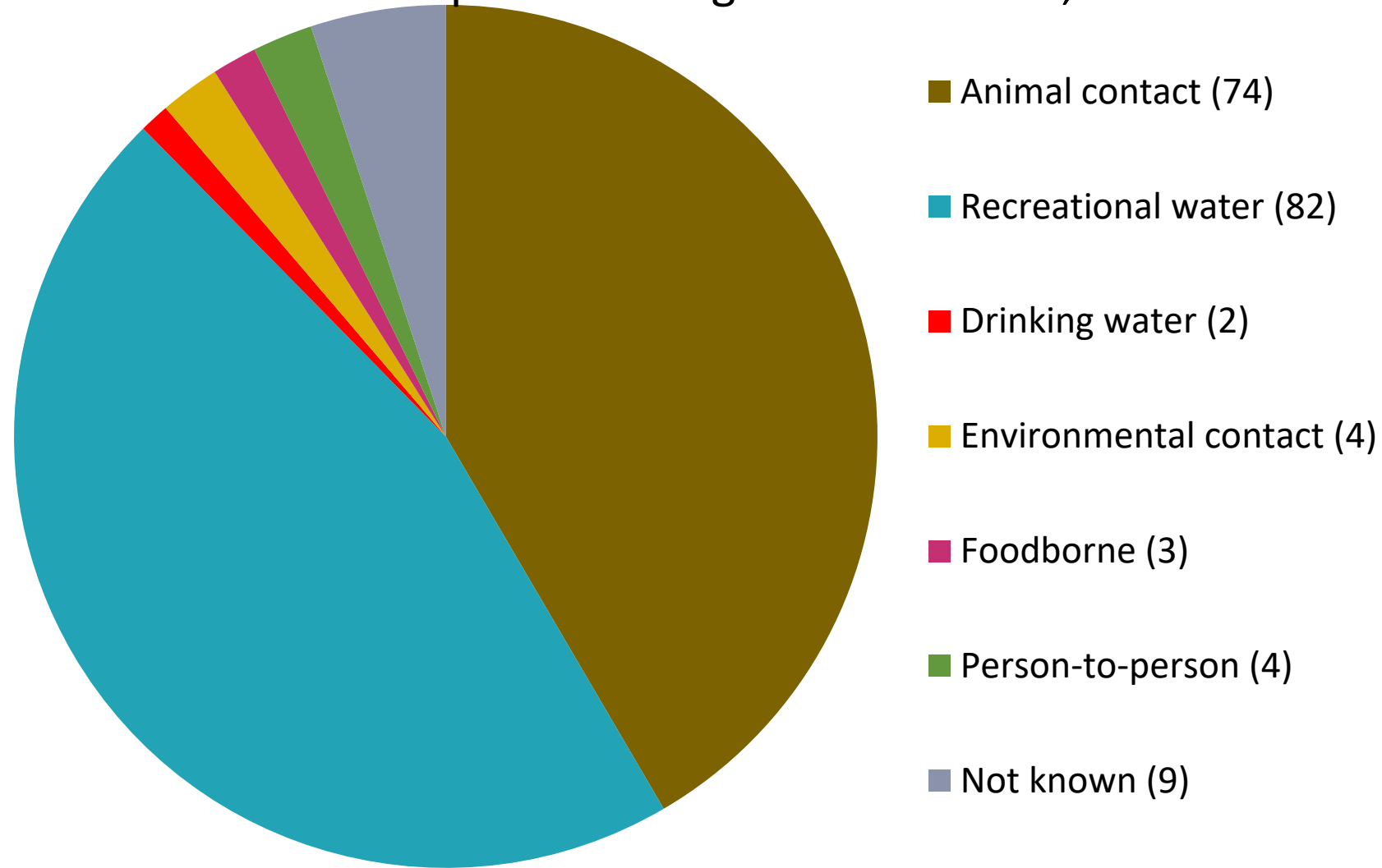


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# We know that *Cryptosporidium* outbreaks are predominantly linked to animal contact or to recreational waters.

178 outbreaks reported in England and Wales, 2009-2017:



Data sources: combined dataset of PHE eFOSS national outbreak surveillance and CRU data.

# The recreational water outbreaks are nearly all some type of swimming pool.

<b>Settings of 82 outbreaks of cryptosporidiosis linked to recreational waters, England and Wales, 2009-2017</b>	<b>Number of reported outbreaks</b>
Leisure pools	24
Unspecified pools	21
Holiday, caravan and water parks	19
Hydrotherapy pool	5
School and college pools	4
Private clubs and hotels	4
Baby swimming pool	4
Outdoor paddling pool	1

Source: combined dataset of PHE eFOSS national surveillance and CRU data. Chalmers *et al.*, 2019

Most swimming pool outbreaks are in the late summer.

Paying attention to *Cryptosporidium* now may prevent cases of illness and outbreaks.

Source: combined dataset of PHE eFOSS national surveillance and CRU data. Chalmers et al., 2019

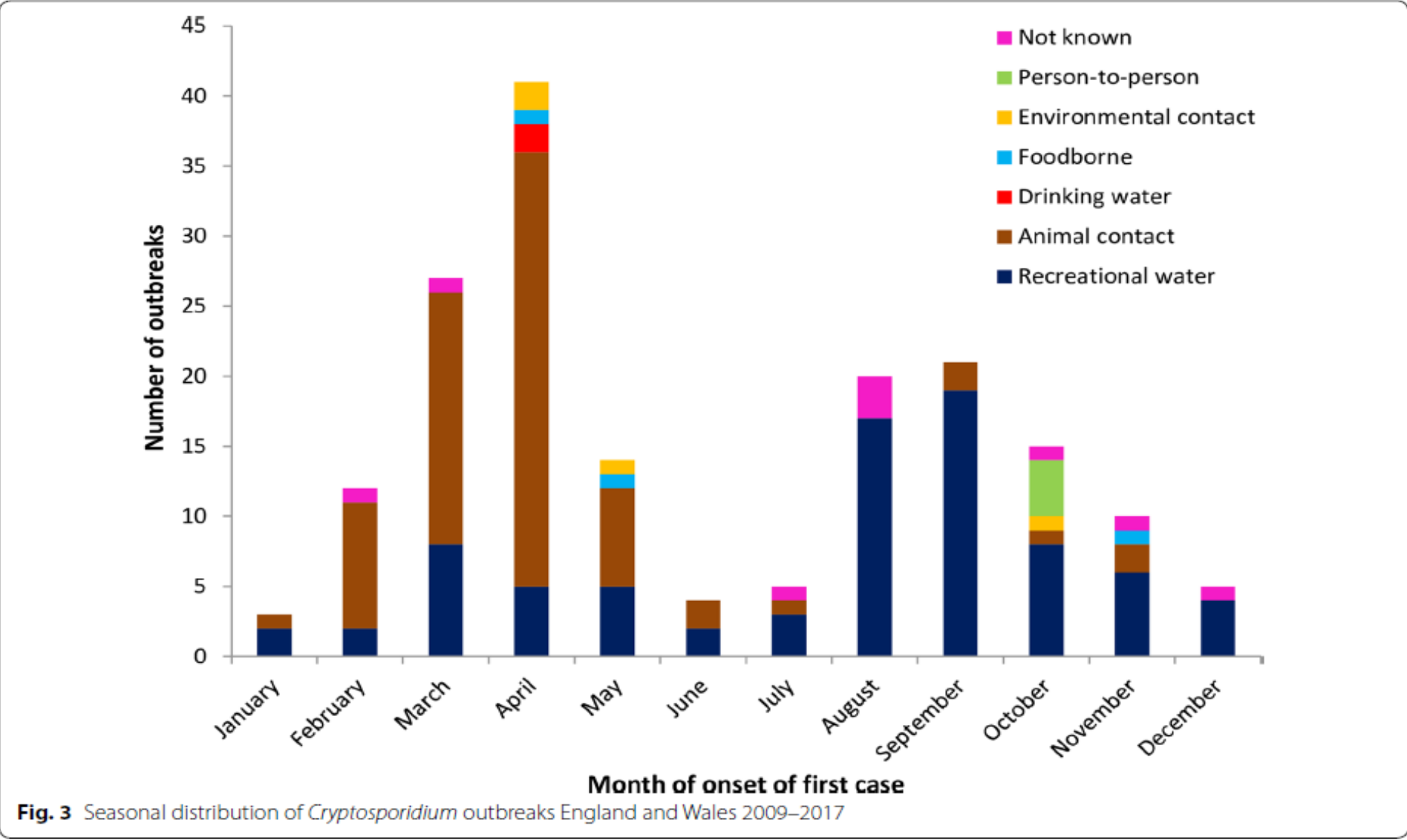
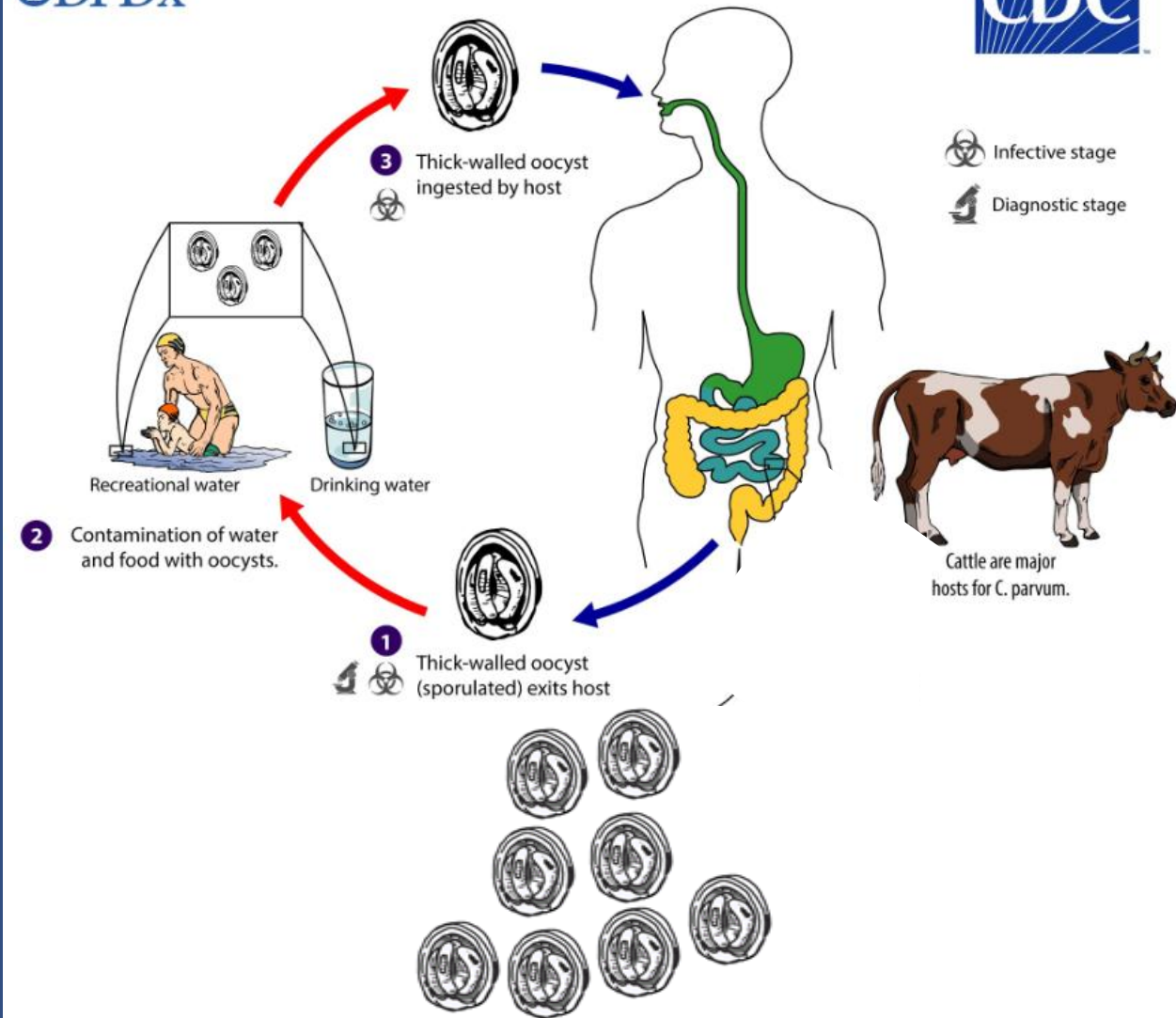


Fig. 3 Seasonal distribution of *Cryptosporidium* outbreaks England and Wales 2009–2017

# What is *Cryptosporidium*?

- Protozoan parasite: single celled animal, packaged in an oocyst
- Ingesting ONE oocyst could cause illness
- When you swallow oocysts they open up, the parasites emerge, infect cells lining the gut
- The parasites multiply, causing diarrhoea, and millions of oocysts are shed in faeces
- Life cycle occurs in the gut; no multiplication in environment
- But oocysts are robust and resistant and it only takes a few to make you ill.



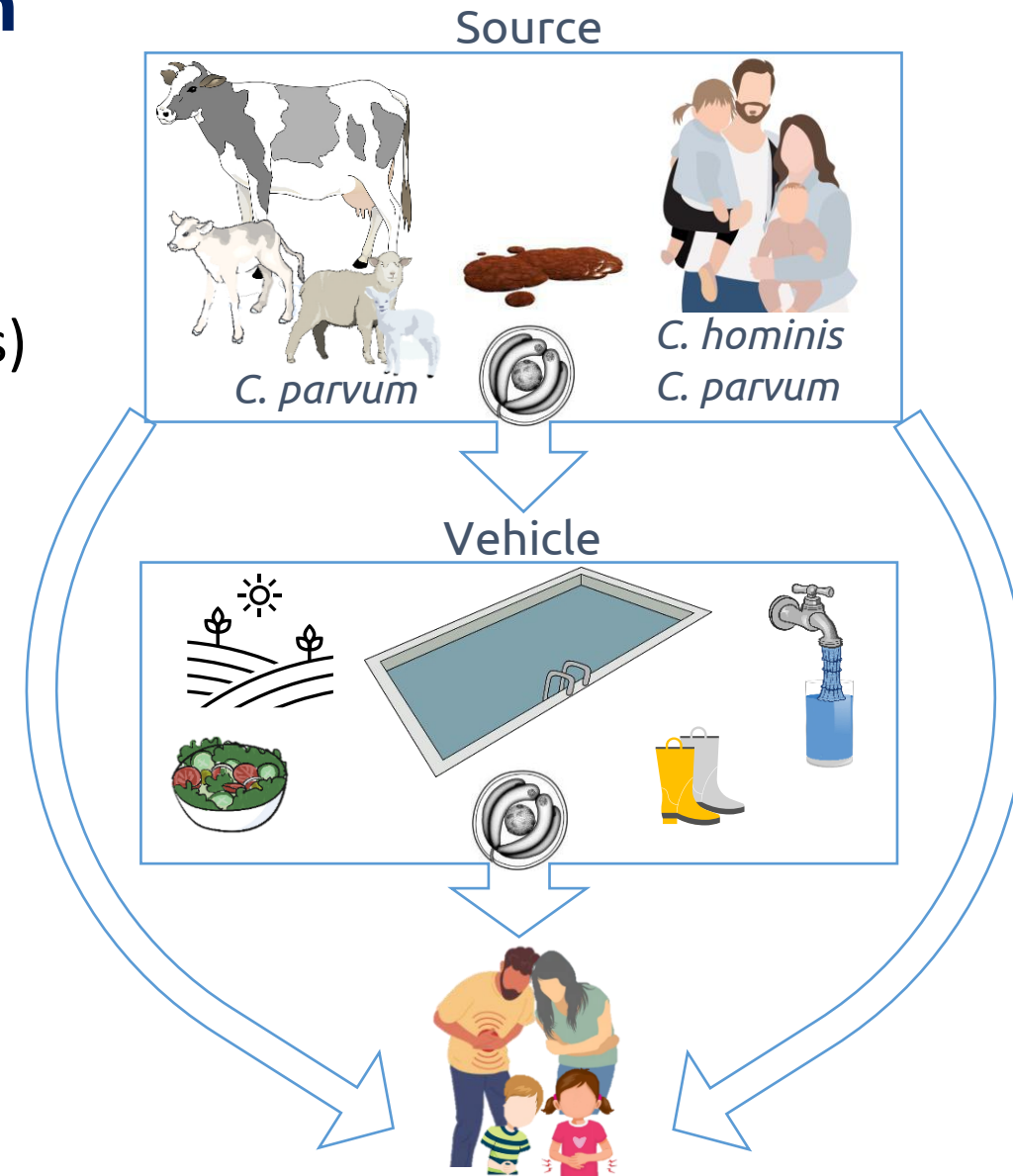
# Cryptosporidiosis

“An illness caused by *Cryptosporidium* and characterized by diarrhoea, abdominal cramps, loss of appetite, low-grade fever, nausea, and vomiting”.

- Incubation period (time between ingestion and becoming ill) is 3-12 days, usually 5-7 days
- Acute gastro symptoms:
  - can be prolonged, usually 1-2 weeks, sometimes up to a month
  - relapse, in ~third of cases
- Oocysts may continue to be shed in faeces after acute symptoms have stopped, presenting a transmission risk
- >7000 reported cases / year in the UK but certainly more occur that don't get diagnosed and reported
- Cryptosporidiosis is most common in young children and families with children
- Can be severe and life-threatening in profoundly immunocompromised patients

# Transmission

- Multiple sources (farm animals; wild animals; humans) can transmit directly
- Multiple transmission routes
  - Oocysts survive .....
  - Resistant to chlorine disinfection
  - Food, water, environment.
- Multi-barrier approach: protection from contamination and treatment to remove it.



# Transmission of *Cryptosporidium* through swimming pools is a particular problem



# *Cryptosporidium* can evade the cornerstones of swimming pool water treatment

## Filtration

- designed to provide a physically clean, clear and safe environment, not specifically to remove *Cryptosporidium* oocysts
- oocysts are small particles, ~5 µm in diameter
- most effective at rates <25m/h (low or medium rate) with continuous coagulation.

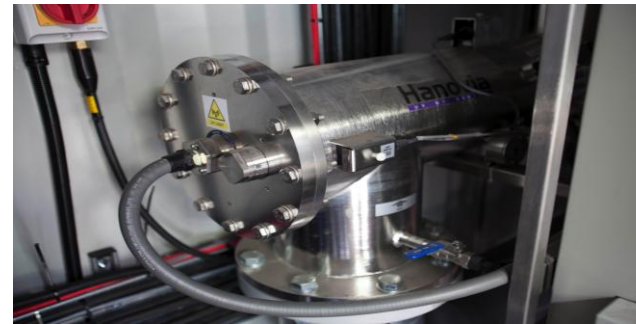
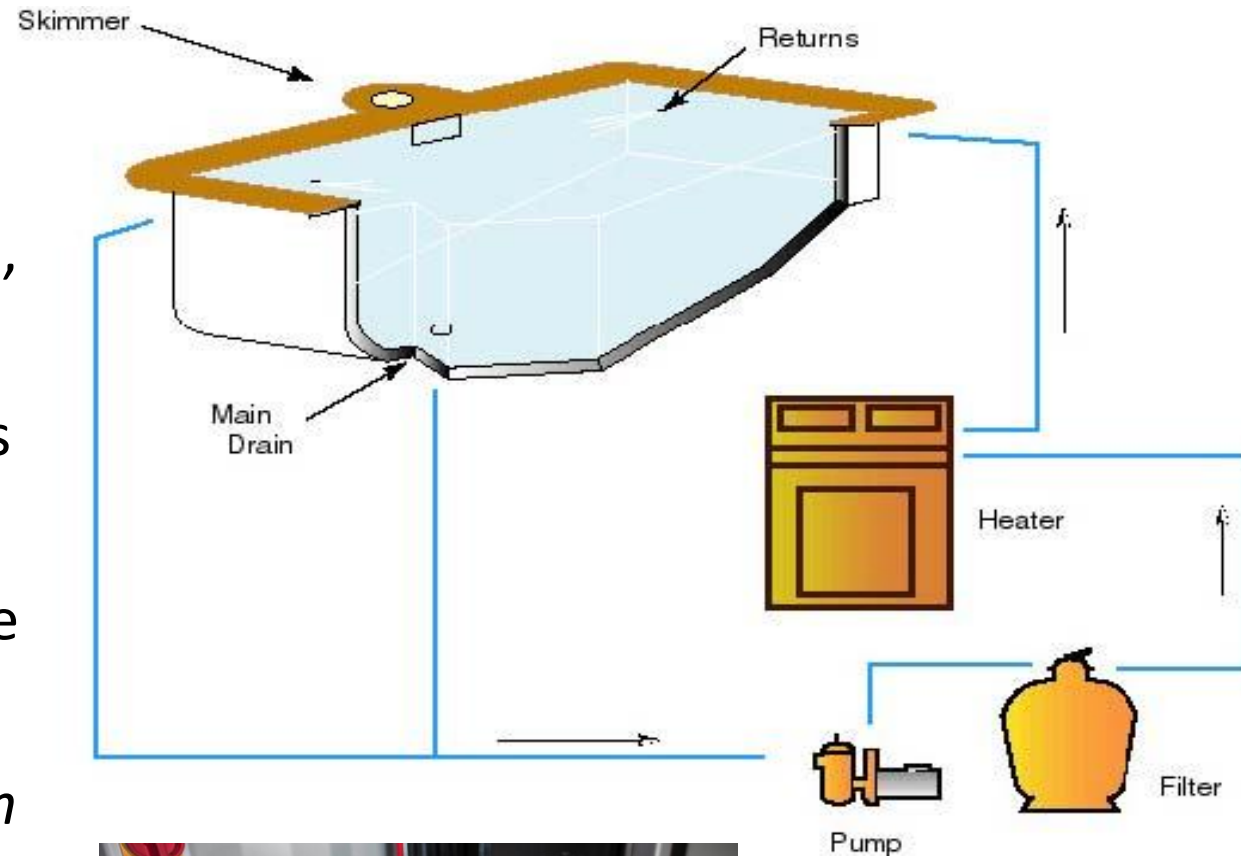
## Disinfection (3 log<sub>10</sub> reduction in numbers of pathogens)

Pathogen	Chlorine survival* 1mg/L, pH7.5, 25°C
<i>E. coli</i> O157	< 1 min
<i>Cryptosporidium</i>	10.6 days

\*Source <http://www.cdc.gov/healthywater/swimming/pools/chlorine-disinfection-timetable.html>

# Lack of residual disinfection effect = need to rely on filtration

- Removal of particles by filtration is progressive, and only occurs in the plant room
- Pool users may be exposed to oocysts if there's a faecal accident in the pool; act quickly!
- Multiple turnover cycles are needed to remove oocysts and reduce risk
- Additional treatments that kill *Cryptosporidium* e.g. UV, ozone, are also in the plant room
- See PWTAG Technical Note 2  
<https://www.pwtag.org/faecal-contamination-february-2014/>



Images: PWTAG

# Contributory factors in outbreaks: pool operation and management



- Bather load too high (challenges filters)
- Filtration efficiency poor (e.g. type of filter & flocculent; dosing; maintenance; backwashing procedures)
- Secondary disinfection (e.g. UV) absent or not working
- Pool water circulation poor (dead legs, shallow leisure pools, water features, surfaces with low flow areas)
- Slow and / or inappropriate response to faecal accidents
- Lack of training and management (breakdown in control of systems)
- Lack of as-built schematic (do you know where the water is going?)



# Contributory factors in outbreaks at swimming pools: pool users

- Outbreaks often involve young children

*Cryptosporidium* is common & defecation frequent

Carriage or asymptomatic shedding reported in 1.3% of young children (up to 4%)



- Baby and toddler management (not using swim nappies, not disposing of nappies properly)
- Accidental faecal releases
- People with diarrhoea continuing to use pools
  - $10^6$  to  $10^7$  opg during acute infection
  - Oocysts are shed even 2 weeks after symptoms cease
  - A study in Wales showed 8% (up to 15%) of people with cryptosporidiosis used swimming pools while infected

# Keeping *Cryptosporidium* out of the pool

- Implement a clear policy for recognising, reporting and dealing with faecal accidents
- Encourage parents/carers to adopt practices which will limit the chances of faecal contamination: use the double swim nappy system; use and dispose of properly; offer frequent toilet breaks; pre-swim showering
- People with diarrhoea must not swim in swimming pools or for 48 h afterwards
- This is extended to 2 weeks exclusion for *Cryptosporidium*
- Strategies to educate pool users and promote bather hygiene
- Good pool management will ensure that any contamination is dealt with promptly and appropriately and minimise risk.

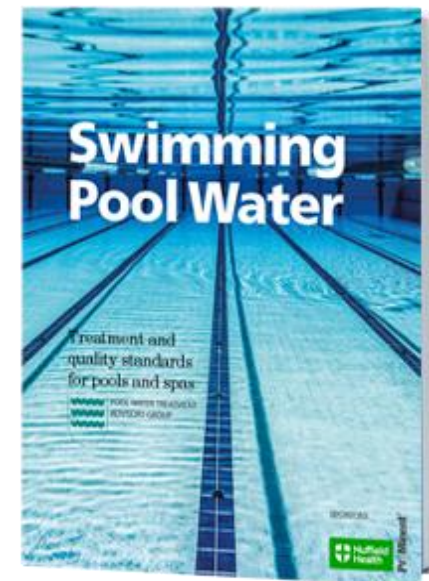
# Key points for operators

- Pay attention to your pool's bather load; especially during busy times e.g school holidays
- Ensure good pool water circulation
- Have the right sort of filters, maintain them properly and dose flocculent continually
- Keep pH within range as it effects disinfection and coagulation/filtration efficiency
- Backwash the filters when pressure differentials indicate, and after the last swimmer has left the pool
- Use secondary disinfection (e.g. UV)
- Encourage bather hygiene
- Respond quickly and appropriately to faecal accidents (PWTAG TN2)
- Keep up with training and encourage others to do so.

# Operators and managers need to be prepared, and so do health professionals

Use the resources from the Pool Water Treatment Advisory Group (PWTAG)  
<https://www.pwtag.org/>

- The book, Swimming Pool Water 2018
- The Code of Practice <https://www.pwtag.org/code-of-practice/>
- The Technical Notes <https://www.pwtag.org/technical-notes/>
- Have the resources ready to follow the guidelines and EAPs, e.g.
  - Pooper scoopers ready for use
  - Familiarise with the superchlorination process
  - Know how to make pH adjustments



## PWTAG Technical notes (some are free)

Find the full list here: <https://www.pwtag.org/technical-notes/>

Directly relevant to *Cryptosporidium* are:

- <https://www.pwtag.org/faecal-contamination-february-2014/> <= TN2
- <https://www.pwtag.org/interactive-water-features-december-2010/>
- <https://www.pwtag.org/superchlorination-of-swimming-pool-water-february-2014/>
- <https://www.pwtag.org/polyaluminium-chloride-pac-dosing-february-2014/>
- <https://www.pwtag.org/cryptosporidium-what-pool-operators-need-to-know-august-2015/>
- <https://www.pwtag.org/ultraviolet-disinfection-specification-maintenance-validation-january-2016/>
- <https://www.pwtag.org/swimming-pool-filter-specification-tn50/>

Posters to download (free) <https://www.pwtag.org/posters/> or purchase printed copies

**Simple steps for HEALTHY SWIMMING** 

Pool water is carefully treated to keep you healthy. But even the best-kept pool needs your help, so as not to introduce dirt and spread germs. If you're clean when you go in, less disinfectant is needed – and the water is nicer as well as safer.

**PLEASE TAKE THESE SIMPLE STEPS TO HELP POOL HYGIENE**

**DON'T SWIM IF YOU'RE ILL**  
You can spread germs in the water – especially if you have diarrhoea, or are recovering from it

**CLEAN YOURSELF**  
Shower with soap before you swim. Wash your hands after the loo

**DON'T PEE IN THE POOL**  
It's bad for the pool water. Use the loo first

**DON'T SWALLOW**  
Pool water should be clean, but it's not for drinking – that's you or any children

**AND PARENTS...**

**STRAIGHT TO THE LOO**  
Take children to the loo before they swim (and watch out while in the pool). Wash your child – especially the rear end – before they go in.

**NAPPIES ALERT**  
No nappies in the pool – proper swim nappies instead. Change nappies in the changing area – not poolside

For more information visit [www.pwtag.org](http://www.pwtag.org)

In partnership with  

 **HELP US TO KEEP THE POOL WATER CLEAN AND SAFE**

**ALWAYS:**

- Use the toilet and wash your hands before you swim.
- Shower thoroughly from top to toe before entering the pool.
- Make sure babies and toddlers are double-wrapped: a clean swim nappy underneath and snug fitting, waterproof swim pants over the top.

**DO NOT:**

- Swim if you have diarrhoea, or for 48 hours after diarrhoea and vomiting symptoms have stopped.
- Swim for 14 days after diarrhoea and vomiting symptoms have stopped, if you have been told you have Cryptosporidium.
- Swim if you have a fever or otherwise feel ill.
- Swim if you are under the influence of drink or drugs.

**Thank you and enjoy your swim!**

www.pwtag.org.uk

# Guidance for investigation of *Cryptosporidium* linked to swimming pools

<https://phw.nhs.wales/services-and-teams/cryptosporidium-reference-unit-water-and-environmental-services/cryptosporidium-swimming-pool-documents/guidance-for-the-investigation-of-cryptosporidium-linked-to-swimming-pools/>



Task and finish group:

- Public Health Wales and Public Health England
- Local Authorities
- Chartered Institute of Environmental Health
- Pool Water Treatment Advisory Group
- Chartered Institute for the Management of Sport and Physical Activity

# Guidance for investigation of *Cryptosporidium* linked to swimming pools

<https://phw.nhs.wales/services-and-teams/cryptosporidium-reference-unit-water-and-environmental-services/>

## Cryptosporidium Reference Unit: Water and Environmental Services

### Contact Us

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**DX 6070309**  
**Swansea 90 SA**

Tel: 01792 285341 (for results, consultation and advice during office hours)  
Tel (out of hours): 01792 205666 (ask for on-call consultant microbiologist)  
Email: Swansea.crypto@wales.nhs.uk  
Laboratory hours: 0845-1700 (Monday to Friday)

### Related content

↓ [Guidance for the investigation of \*Cryptosporidium\* linked to swimming pools \(PDF, 839Kb\)](#)

↓ [Appendix 1: \*Cryptosporidium\* Risk Assessment Check List \(Word, 681Kb\)](#)

[Cryptosporidium Reference Unit](#)

The guidance includes:

- regulatory framework
- normal pool operating parameters and standards
- emergency actions
- sources of independent advice
- methods for establishing and investigating links between cases of illness and pools
- key public health messages
- key points in inspecting swimming pools:

Developed by a task and finish group:

Public Health Wales and Public Health England; Local Authorities; Chartered Institute of Environmental Health; Pool Water Treatment Advisory Group; Chartered Institute for the Management of Sport and Physical Activity

Reviewed and updated regularly: currently v6. v7 will include a summary flow diagram

# Guidance for investigation of *Cryptosporidium* linked to swimming pools

<https://phw.nhs.wales/services-and-teams/cryptosporidium-reference-unit-water-and-environmental-services/>

## Cryptosporidium Reference Unit: Water and Environmental Services

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Cryptosporidium Reference Unit

## Appendix 1 is a CHECK LIST

Public Health Wales Microbiology Division

Guidance for the investigation of *Cryptosporidium* linked to swimming pools

### ***Cryptosporidium* Investigation Risk Assessment Check List** for the investigation of *Cryptosporidium* linked to swimming pools

**This form is in 2 sections:**

**Section 1** is an overview of the pools and pool management and can be completed with the pool operator.

**Section 2** concerns each individual pool at the premises; part 1 can be completed with the pool operator and part 2 will entail a visual inspection of the pool(s), changing facilities and plant room(s).

Please note that this checklist requires significant time to complete (especially where multiple pools and treatment plants are present) and pre-planning to ensure relevant personnel are present during the visit.

You may find it helpful to take photos during the visit.

The completed checklist should be shared with the incident or outbreak control team as required.

Swimming pools should meet the standards described in the PTWAG Code of Practice, see [www.pwttag.org](http://www.pwttag.org)

# Cryptosporidiosis and Swimming pools

CRYPTO

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## Cryptosporidium and Swimming Pools

Clip

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<https://www.youtube.com/watch?v=6RbGTdkILZk&t=1s>

# The PWTAG *Cryptosporidium* pool project

## Introduction

- *Cryptosporidium* is not tested for routinely in pools, there are no quantitative standards, and no baseline data are available for the UK.
- Sampling and testing is difficult and expensive, the specialist equipment is lacking, and not all labs can test for it. Validation data for pool samples were lacking.
- Testing as part of an outbreak response requires careful consideration:
  - investigations may be well after the suspected contamination event
  - high volume sampling equipment is not readily available
  - interpretation to inform public health actions needs clarification.

# The PWTAG *Cryptosporidium* pool project

## Primary Aim:

to investigate the occurrence and numbers of oocysts in UK leisure pools, over 10 weeks during summer and autumn 2017

## Secondary aims:

- to inform guidance for pool operators
- to provide data for modelling quantitative microbial risk assessment
- improve sampling capacity, capability and interpretation for public health investigations.

# The PWTAG *Cryptosporidium* pool project

## Objectives

1. Evaluate *Cryptosporidium* detection methods for swimming pool and backwash waters.
2. Build and install in-line, high-volume sample rigs with IDEXX Filta-Max xpress® filter modules. Installed in return from pool to treatment plant.
3. Sample up to 1000 L pool water and 1 L backwash water, weekly, for *Cryptosporidium* testing.
4. Sample and test pool waters for bacterial indicators and chemical parameters.
5. Record pool operational data, including bather load and AFRs.
6. Assess the relationships between operating conditions, bather loads, pool parameters, bacteriological counts and *Cryptosporidium* occurrence and oocyst numbers.



# The PWTAG *Cryptosporidium* pool project

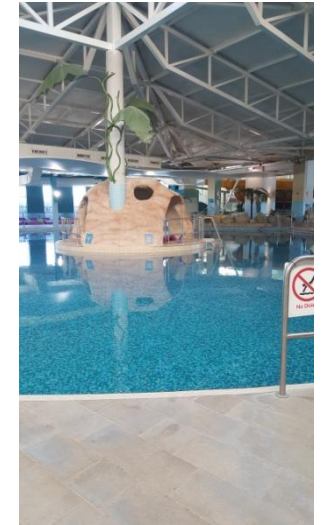
## Pool recruitment

6 volunteer free-form leisure pools with features: slides, wave machines, lazy rivers etc.

4 indoor-only pools, 2 linked to outdoor areas.

4 community leisure pools, 2 at large residential holiday parks

All pools inspected using the checklist



# The PWTAG *Cryptosporidium* pool project

## Results – *Cryptosporidium* in pool water samples

- Sample volumes were 60 to 999 L, median 493 L, taken over an 8 to 24 h period
- Oocysts were detected in 12/59 (20 %) samples
  - 1 sample invalid (sent to wrong lab)
  - 8/12 (67 %) detections were in August, when bather loads were highest.



# The PWTAG *Cryptosporidium* pool project

## Results – *Cryptosporidium* in 1 L backwash samples

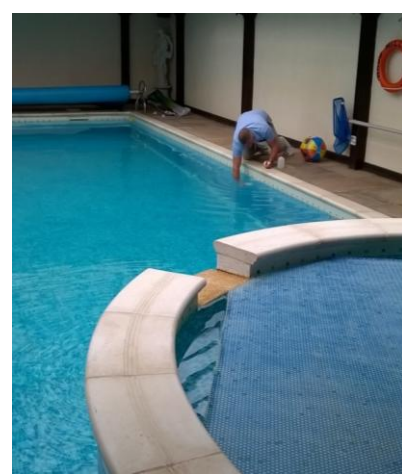
- 
- 3 pools had backwash drains that could be sampled
  - Oocysts were detected in 2/27 (7%) valid backwash samples, from 2 of the 3 pools
  - both detections were from the evening backwash of the day that oocysts were detected in pool water

# The PWTAG *Cryptosporidium* pool project

## Results - Bacti and other samples

*verified the disinfection system was being managed and controlled*

- Colony counts of total coliforms, *Escherichia coli*, *Pseudomonas aeruginosa*
  - all zero
- Aerobic colony counts (ACC) @ 37°C for 24 h
  - 12/57 (21 %) samples were unsatisfactory (>100 cfu/ml); none consecutive
  - 3 samples were invalid (1 sent to wrong lab; 2 arrived >24 h after sampling)
  - ACC failures and *Cryptosporidium* detections were NOT related
- NTU measurements and *Cryptosporidium* detections were NOT related



# The PWTAG *Cryptosporidium* pool project

## Visible accidental faecal release (AFR) reporting

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- 14 AFRs reported in 10 weeks
- Each pool reported at least one and up to four AFRs
- Two were liquid, and were at the same pool
- Recorded actions were PWTAG compliant
- 1 report preceded a *Cryptosporidium* detection at the pool



# The PWTAG *Cryptosporidium* pool project

## Key findings

- The detection of *Cryptosporidium* was when pools were busiest, suggesting targeted pool operator and health promotion activities are warranted
- *Cryptosporidium* was successfully managed by adhering to PWTAG standards
- Improved sampling capacity, capability and interpretation for public health investigations
- New data on pathogen counts were generated and contributed to mathematical modelling
- The number of oocysts detected will always be fewer than bathers were actually exposed to.

## Article

# Occurrence of *Cryptosporidium* Oocysts in Leisure Pools in the UK, 2017, and Modelling of Oocyst Contamination Events

Rachel M. Chalmers <sup>1,2,\*</sup>, Lester P. Simmonds <sup>3</sup>, Martin Wood <sup>3</sup>, Megan Luxford <sup>4</sup>, Rob Miller <sup>5</sup> and Rob Johnston <sup>6</sup>

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<sup>3</sup> Pool Sentry Ltd., Dale Cottage, Stanton Dale, Ashbourne DE6 2BX, UK; lester@poolsentry.co.uk (L.P.S.); martin@poolsentry.co.uk (M.W.)

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\* Correspondence: rachel.chalmers@wales.nhs.uk

**Abstract:** *Cryptosporidium* is a major cause of diarrhoea outbreaks linked to swimming pools, but little is known about the frequency of contamination. The primary aim was to investigate the occurrence and concentration, through sampling and modelling, of *Cryptosporidium* oocysts in leisure pools. Secondary aims were to compare detections with operational parameters, provide the evidence-base for guidance, and improve sampling capacity and interpretation for public health investigations. Up to 1000 L pool water was sampled during swim sessions once weekly for 10 weeks from 8 August 2017 at six volunteer pools. Oocysts were detected by microscopy in 12/59 (20%) pool water samples, at least once in each pool; 8/12 (66%) detections were in August when bather loads were highest. At three pools, 1 L filter backwash was sampled weekly and oocysts were detected in 2/29 (7%) samples, following detections in pool water. The probabilities of a bather contaminating the pool ranged from 1 in 1000 to over 1 in 10,000. Monte Carlo analysis showed that when high bather numbers caused contamination on over 70% of days, multiple events per day were more likely than single events. In these generally well-managed leisure pools, *Cryptosporidium* risk related to high bather loads. We conclude that public awareness campaigns for bather hygiene, and reminding pool operators of current guidance for managing faecal accidents, should be ahead of peak swim season.

**Keywords:** backwash; *cryptosporidium*; occurrence; oocyst counts; swimming pool water; probability modelling



Citation: Chalmers, R.M.; Simmonds, L.P.; Wood, M.; Luxford, M.; Miller, R.; Johnston, R. Occurrence of *Cryptosporidium* Oocysts in Leisure Pools in the UK, 2017, and Modelling of Oocyst Contamination Events. *Water* 2021, 13, 1503. <https://doi.org/10.3390/w13111503>

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## What does this mean for you and your operations?

Pool water sampling for *Cryptosporidium* may not always be helpful – seek advice.

Any oocyst detection is a risk.

Secondary disinfection (e.g. UV) is recommended if filtration is not optimal.

Controlling bather numbers, practicing good hygiene and implementing exclusions from swimming are important for a healthy pool.

Follow the PWTAG guidance!

Thank you for listening.

Any questions?