UK Health Security Agency

World Class Pool Water – A masterclass on achieving best practice in Swimming Pool Water treatment.
Pool Water Treatment Advisory Group

What Happens When It All Goes Wrong ?

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What Happens When it All Goes Wrong?

- Public Health and Infectious Diseases
- Swimming Pools and Pool Waters; Overview of pools and *The Purification of the Water of Swimming Baths Ministry of Health 1929*
- The Impact of Infectious Intestinal Diseases and Public Health
- Managing pools together; how we work to identify issues to provide safe recreational water and respond to incidents
- What could happen if water management fails
- Risk Assessments - for recreational water settings
- Getting it right – NOPs/SOPs and managing pool plant

Public Health and Infectious Diseases
Putting Public Health into Context …….

- 1832 – Poor Law Commission
- 1837 - Influenza epidemic
- 1838 - Typhoid epidemics
- 1842 - *The Sanitary Conditions of the Labouring Population* – published

- 1848 – Public Health Act; powers to create boards that could oversee - street cleansing, refuse collection, water supply and sewerage systems

Power for the appointment of - Inspector of Nuisances.

Statutory notifications of infectious diseases – over several years and statutes

The recognition that keeping people health was good for society, the individual and the economy!

Swimming and Recreational Water Pools

- Swimming pools for swimming exercise, recreation and religious activities – in existence for thousands of years
- Some of the oldest pools are around 5000 years old
- One of the oldest pools (and possibly the oldest public pool) is in modern day Pakistan, where there is the remains of a 30m bitumen/tar lined pool, known as the great bath
- Pools built by the Romans and Greeks for athletic and military purposes (including the Roman Piscina Publica baths mentioned in AD215)
- Archaeological remains of hot and cold baths for bathing are found in many parts of the world, including the UK

The revival of sea bathing in the late eighteenth century was followed by a demand for pools accessible to all !

The Purification of the Water of Swimming Baths Ministry of Health 1929

'The provision and use of swimming baths has increased greatly in recent years'.

'During the 10 years from March 1919 to March 1929 loans have been sanctioned by the Ministry to a total £3,164,955 for baths and washhouses'.

'It has thus become more important to take measures for assuring that the water of swimming baths shall be in a wholesome condition'.

'Many improvements are practical and that often with a saving of cost'.

The principal requirements are an adequate filtration plant, ……. Properly qualified supervision …….. And concise records to test the results and the costs

The Purification of the Water of Swimming Baths
Ministry of Health 1929
Transmission of infection by the water of swimming baths

- *Transmission of infection by polluted water can, and does occur*
- *Pathogenic bacteria can live in dirty water for considerable periods*
- *Swimming pool water should be free from pathogenic germs*
- *The bacteriological count of swimming pools should approximate that of drinking water*

'Purity can be maintained by continuous purification, a combination of efficient filtration and accurately controlled chlorination'

'There is no evidence to support rumours indicating that disease in epidemic form has its origin in swimming baths in this country'

Swimming and Recreational Water Pools
Pool layout and configuration

- There are 1000's of pools in the UK – estimated at greater than 3000 UK
- Pools will open - and pools will close - over recent years **some** smaller older local authority pools closed, while newer pools opened and more private clubs emerged
- Pools with public/private access will be present in clubs, hotels, cruise ships, housing complexes, schools, council operated leisure facilities and in homes, leased out for teaching etc
- There are also temporary pools and private pools used for commercial purposes

Of all such pools there are many different configurations -

There will be different water treatment regimens and operating procedures

IID1 - A Report of the Study of Infectious Intestinal Disease in England; published 2000

- The first report on infectious intestinal disease in England

(IID3 is due to be published in 2026)

- 20% of the population of England suffered IID in a year. 35 presented to their GP
- Some of these cases were most likely from viral illness but many would have been from bacterial or protozoan infections
- For every 1000 cases of IID in the community, 160 had a stool sample sent for microbiological analysis and 10 had a positive result.

Most cases of IID arising from consumption of contaminated food/water or person-to-person transmission

IID1 - A Report of the Study of Infectious Intestinal Disease in England; published 2000

'We estimated the average cost of a case of IID, whatever its cause, in England to have been £79 at 1993–1995 prices'.

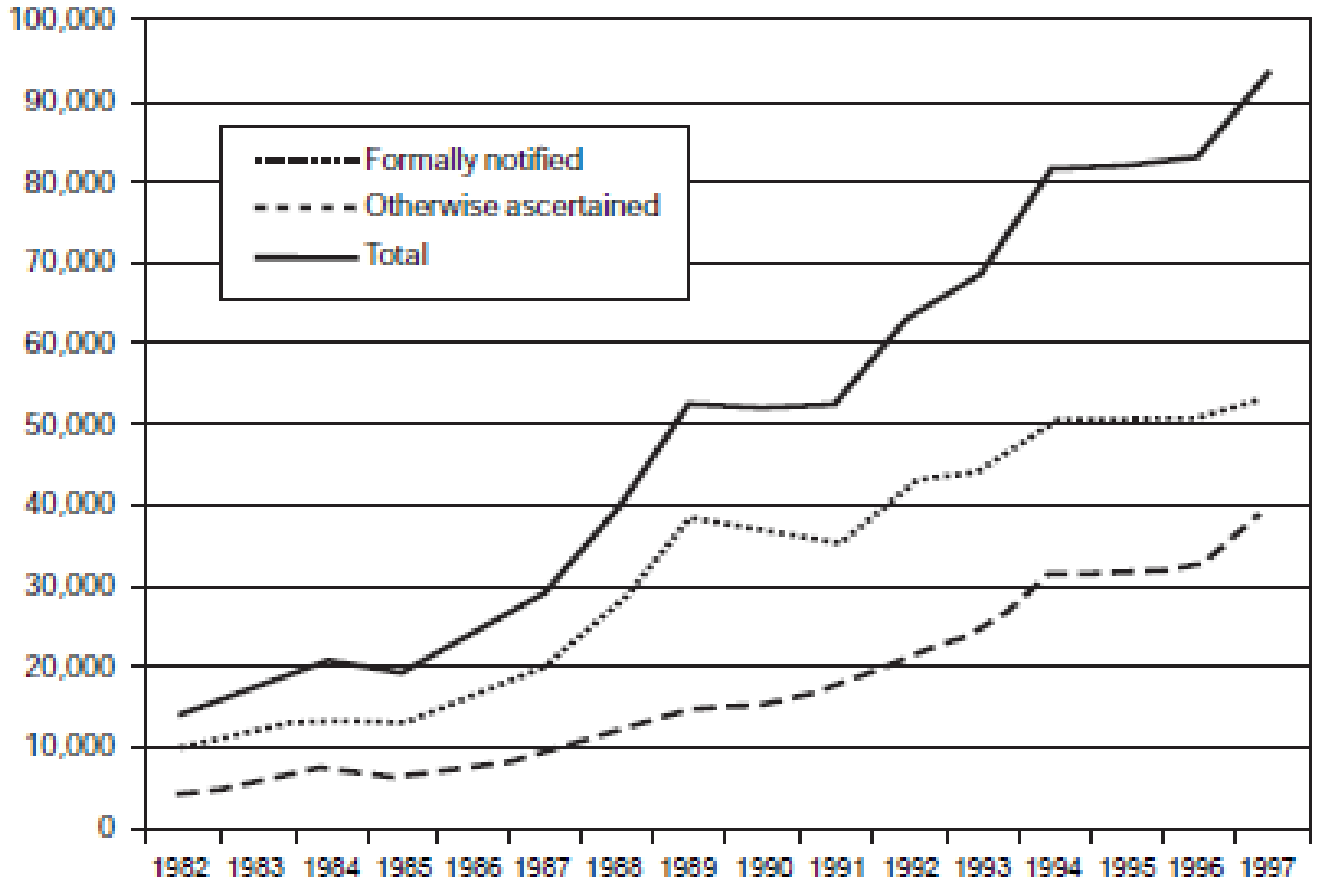
- The average cost of a case of Salmonella was calculated as some £606
- The average cost of a viral illness was some £176
- Estimate that IIDs in England cost three quarters of a billion pounds each year, ie £750,000,000

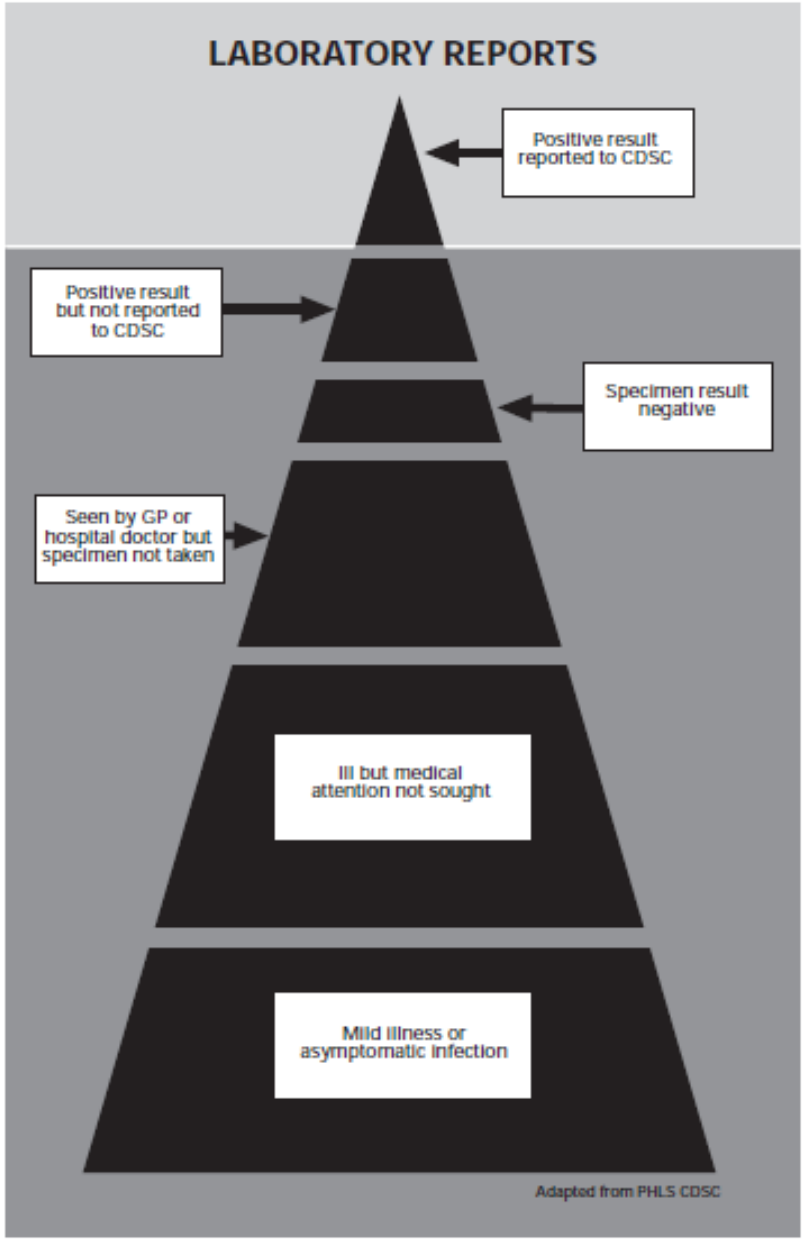
(In general – this would now be at least twice this number based upon information from the Bank of England)

Note; for each case of Salmonella notified there are 6 cases that remain unconfirmed.

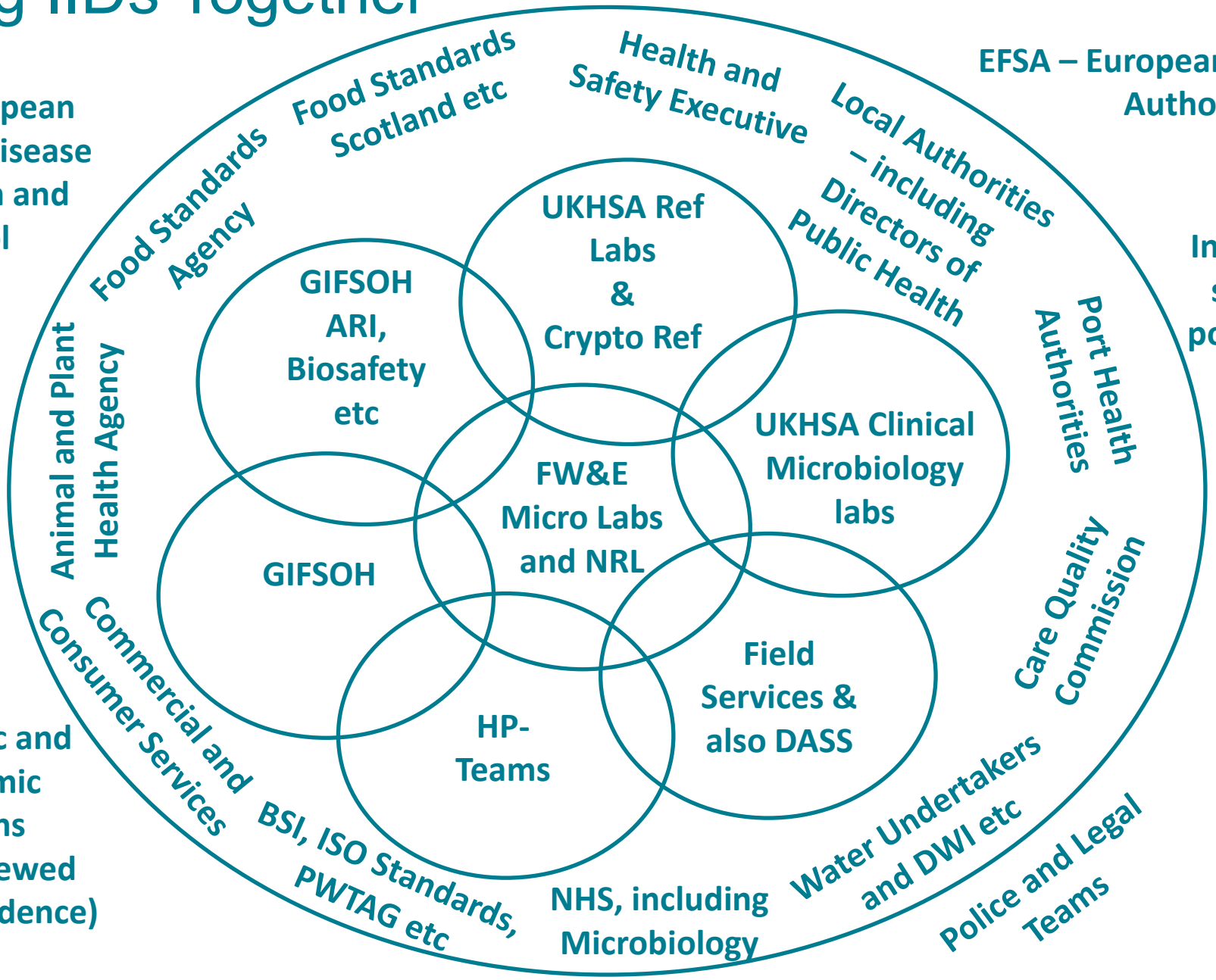
IID1 - A Report of the Study of Infectious Intestinal Disease in England; published 2000

Figure 2.1 Food Poisoning Notification in England and Wales (OPCS 1994, Anon 1996b, Anon. 1998)





Managing IIDs Together



ECDC; European Centre for Disease Prevention and Control

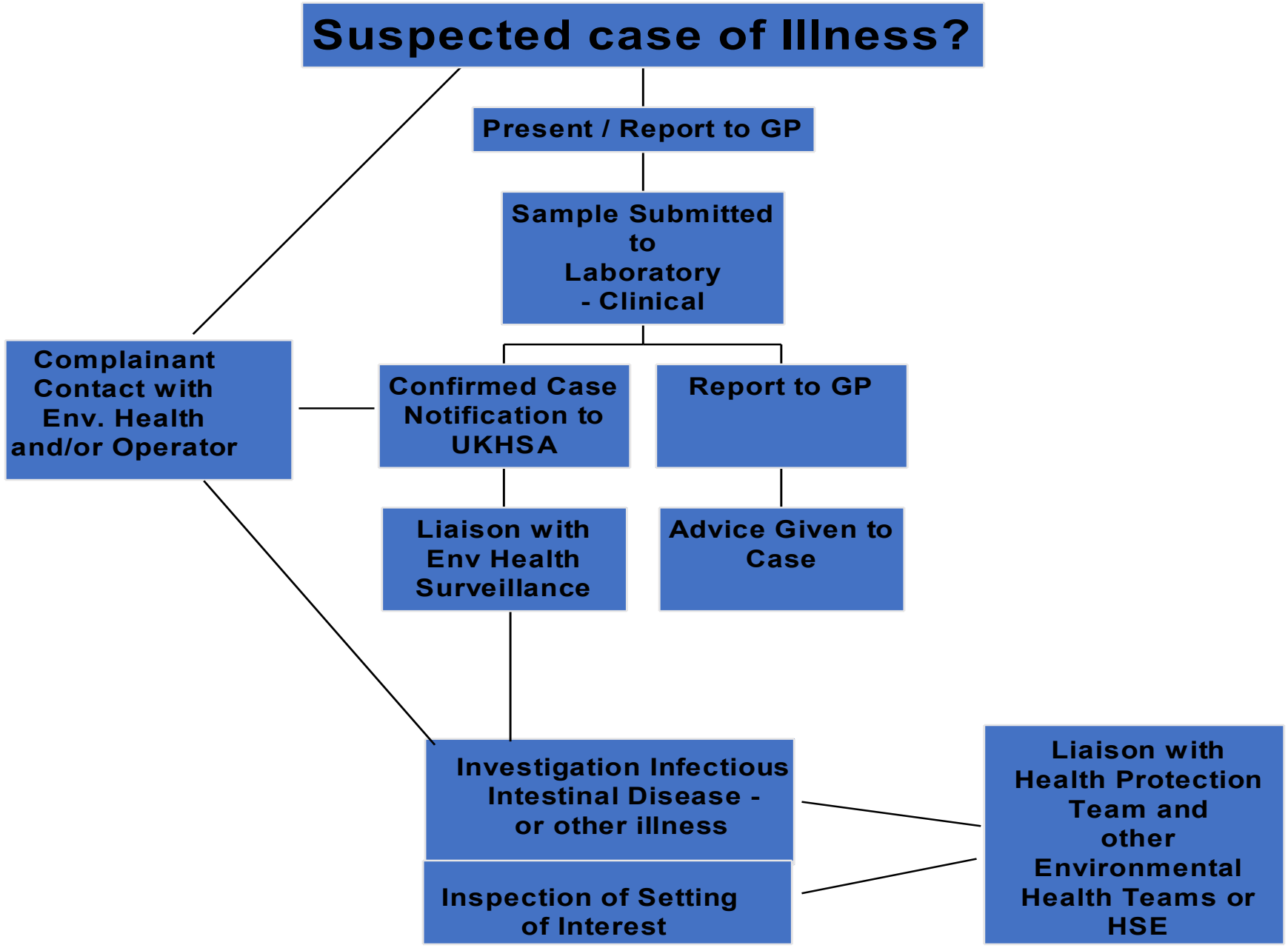
EFSA – European Food Safety Authority

Industry and commercial sector /Operators and pool water designers and consultants etc

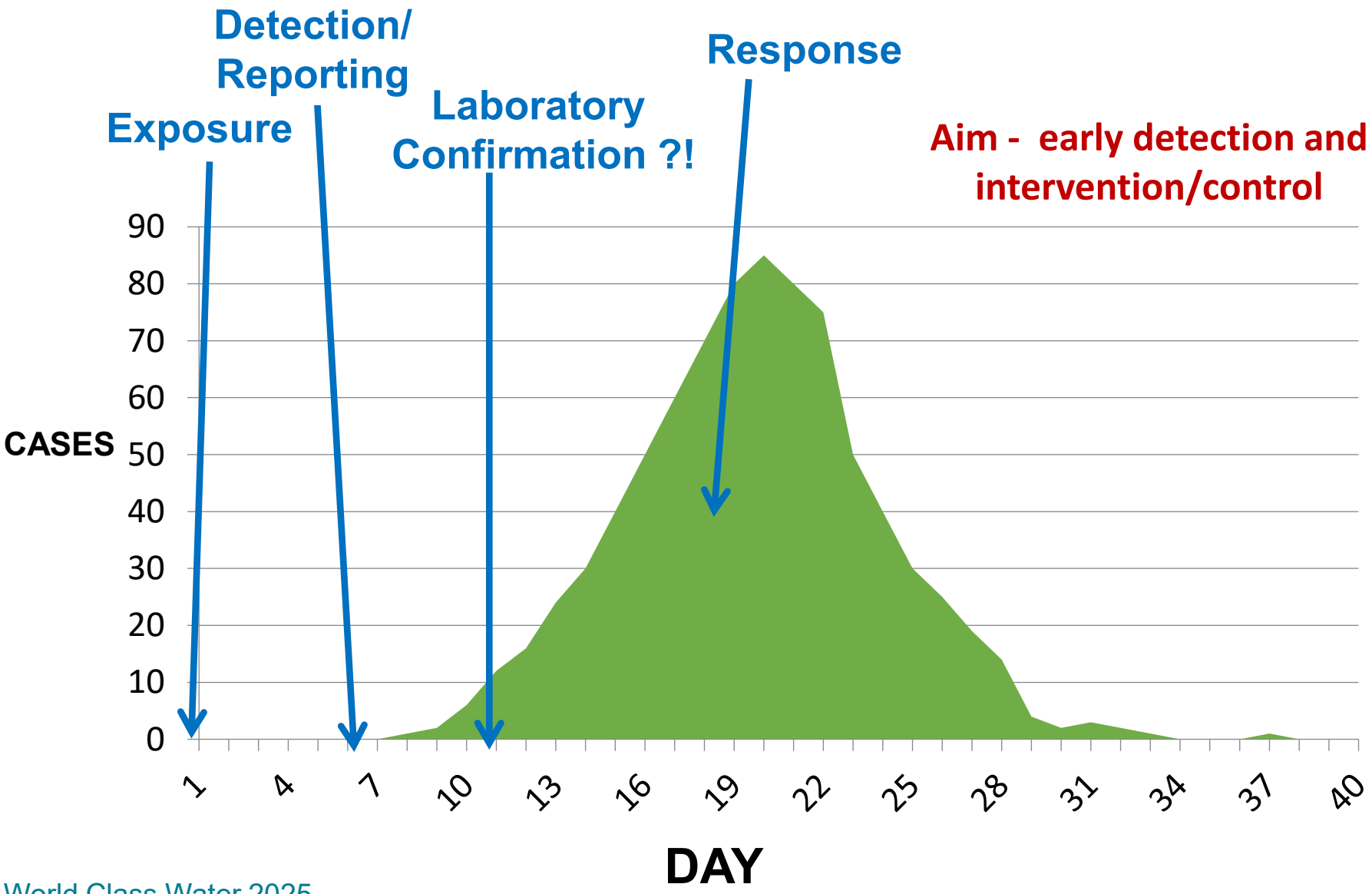
Devolved Administrations in the UK

European and International operators and colleagues in public health / health protection

Universities etc and other academic organisations (with peer reviewed research and evidence)


Suspected case of Illness?
Present / Report to GP
Sample Submitted to Laboratory - Clinical
Complainant Contact with Env. Health and/or Operator
Confirmed Case Notification to UKHSA
Report to GP
Liaison with Env Health Surveillance
Advice Given to Case
Investigation Infectious Intestinal Disease - or other illness
Inspection of Setting of Interest
Liaison with Health Protection Team and other Environmental Health Teams or HSE

Investigating Outbreaks - Detection and Response



Examples of Waterborne Infections

- **Cryptosporidium**; a chlorine resistant protozoan organism

- **Escherichia coli**;

A commensal within the gut, presence of this organism in pool waters indicates potentially anomalous water management

Toxigenic forms of E.coli can result in significant infections to the vulnerable

- **Giardia**; a water borne protozoa with resistance to chlorine
- **Legionella**; a bacterial infection with transmission through respiratory pathways, often associated with hot tubs but also potentially found in other recreational waters
- **Pseudomonas aeruginosa**; a bacteria found in many sites and settings but can (and does) cause folliculitis, ear, eye and urinary tract infections

Examples of Other Waterborne Infections

- Amoeba – Acanthamoeba, *Naegleria fowleri*
- Viruses – norovirus, adenovirus, enterovirus, Hep A, molluscum contagiosum virus, papilloma virus
- Parasites – *Microsporidia*
- Parasitic worms – *Trichobilharzia, Schistosoma*
- Other bacteria – *Shigella, Leptospira*
- Mycobacterium – *Mycobacterium marinum, Mycobacterium avium*
- Dermatophyte fungi (athlete's foot)

What can happen if we lose control of water management ?

- **8** cases of toxigenic E coli O157 - Trafford area of Manchester 2004
- Analysis of the questionnaires established a link that all four cases had been swimming in the learners' pool of a local leisure centre
- No obvious source of E. coli O157 was found – but epidemic curve, descriptive epidemiology and laboratory data consistent with a single contamination event such as faecal incontinence event on the morning – before exposure
- On that Sunday morning, the level of free chlorine in the pool was 'probably <0.5 mg/l which would have been inadequate to disinfect the pool'.

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2870659/pdf/S0950268807007947a.pdf

Note; 'Purity can be maintained by continuous purification, a combination of efficient filtration and accurately controlled chlorination' ☺

What can happen if we lose control of water management ?

- Kent Online ; News You Can Trust
- ‘Public Health England (now UKHSA) conclude Medway Council at fault following investigation into norovirus outbreak at Splashes, Rainham’
- http://www.kentonline.co.uk/medway/news/council-at-fault-over-pool-125136/

‘Purity can be maintained by continuous purification, a combination of efficient filtration and accurately controlled chlorination’ ☺

What can happen if we lose control of water management ? Challenges to pool water!

- 10 cases (8 confirmed and 2 probable) of *Cryptosporidium parvum* with identical MLVA profiles
- Cases had exposure to pool, either through swim lessons provide by the school or private (baby) swim lessons or a household contact
- Index case had history of travel, household contacts infected other cases through pool use

What can happen if we lose control of water management ?

- Child with tracheotomy presented with persistent recurring ***Pseudomonas*** infection
- Child had numerous physical and mental health impairments
- Sensory room and pool in own home
- Pool inspected and no issues identified
- Inflatables checked and parents aware of importance of drying
- Child floated on bubble wrap as unable to use noodles – bubble wrap was used repeatedly and not left out to dry like the inflatables

Swabbing of bubble wrap detected *Pseudomonas* which matched clinical isolate

What can happen if we lose control of water management ?

Photo of Spa Pool Plant Room

Spa pool plant room

'Purity can be maintained by continuous purification, a combination of efficient filtration and accurately controlled chlorination' ☺

What can happen if we lose control of water management Giardia Cases Associated with School Pool

- Death of 1 plus 1 case/s (2)who attend the school
- Cases with other risk factors and deaths not from Giardiasis (water borne protozoa)
- Whole school faecal testing carried out

2 staff members had reported giardiasis in March 2024

- Hydrotherapy pool considered by Incident Management Team
- Extensive media coverage and political interest
- Pool remained shut (extended summer break)
- Second round of whole school testing during school holidays

Pool tested to provide further reassurance; high volume

Note; high-volume water testing is not routine!

Getting it right; monitoring disinfection – biocide efficacy

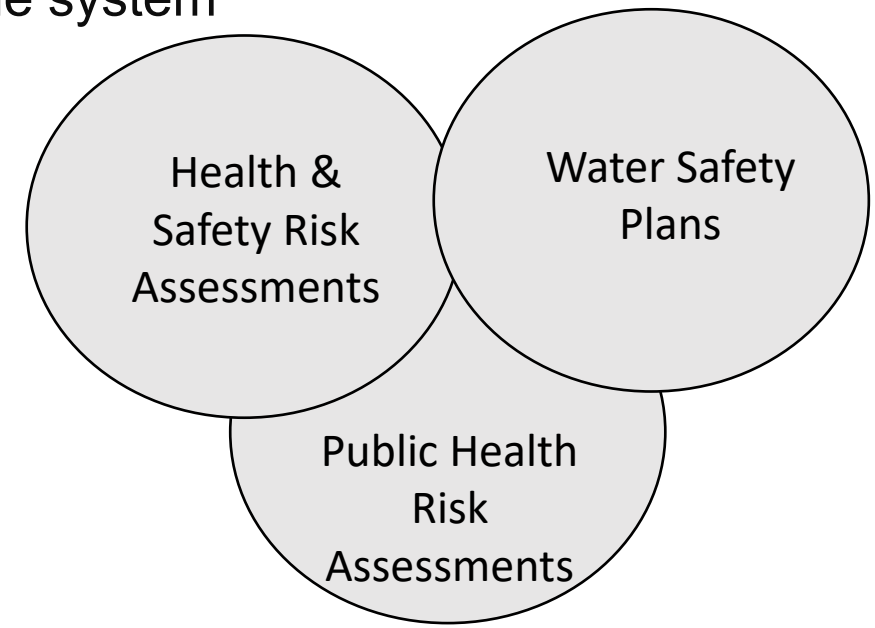
Pathogen	Health Significance	Persistence in water supplies	Tolerance to chlorine	Relative infectivity	Conc' chlorine (mg/L)	Time of chlorine exposure (min)	CT	% Inactiv-ation
E coli STEC	High	Moderate	Low	High	0.5	<0.5	< 0.25	99.98-99.99 %
Noro-virus	High	Long	Moderate	High	1.0	0.07	0.07	99.99 %
Rota-Virus	High	Long	Moderate	High	0.20	0.25	0.05	99.99 %

- In general – biocides are more effective with higher temp and lower pH
- Poor monitoring of pool water parameters can result in poor water management and potential public health impacts

Note; Protozoan pathogens are highly resistant to chlorine

Recreational Water ;
Understanding risk assessments and water safety plans

- **Public Health** based risk assessments – impact of management on public health
- **Health and Safety Risk Assessments** – health and safety of employees and others who may be impacted by the operation of the pool
- **Water Safety Plans** – systematic review of the water systems, considering the ecology of the organisms that may have an impact or colonise the system
- **All three are not mutually exclusive !**



Summary – Getting it right

- Good design, management and maintenance; Water Safety Plans and Risk Assessments
- Effective training of staff – in particular dealing with situations robustly as they occur
- Support by external expertise – water treatment / water management company, biocide chemical supplier, other plant maintenance eg U/V and filters etc
- Action plans / cards; Normal (standard) Operating Procedures and Emergency Action Plans etc
- Monitoring (eg pH and biocide regimes)
- Verification of water management (microbiology)

UK Health Security Agency

Thanks
Colleagues from UKHSA, Cryptosporidium Reference Laboratory Local Authorities, Pool Water Operators and PWTAG colleagues.