The impact of faecal PCR on *Giardia* outbreak management

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INTRODUCTION

Giardia spp. are a leading cause of treatable infectious gastroenteritis globally, with the number of reported cases increasing.

The latest figures reported by UK Health Security Agency (UKHSA) show 3,582 laboratory confirmed cases in 2022, with 6.3 reports per 100,000 population in England.

Infections can be range from severe to asymptomatic, with typical symptoms including diarrhoea, flatulence and abdominal pain. The World Health Organisation (WHO) estimate that 2% of adults and 8% of children carry *Giardia spp.* in the developed world, up to 50% asymptomatically.

A variety of diagnostic techniques are used for the detection of giardiasis, with faecal polymerase chain reaction (PCR) fast becoming the preferred method due to the wide availability of commercial platforms and the high sensitivity of the method.

This study analysed the rate of *Giardia spp.* carriage in children, staff, and household contacts screened via faecal PCR as part of the public health management of an outbreak linked to a Special Educational Needs (SEN) setting. These rates were compared to those published by the WHO and analysed to assess the impact of faecal PCR as a diagnostic tool for outbreak management compared with manual microscopy.

METHODS

The number of laboratory positive *Giardia spp.* results reported to UKHSA from the two largest laboratories in Cheshire and Merseyside were analysed using Poisson Regression (generalized linear model) to establish whether the introduction of PCR testing in the laboratories resulted in a significant change in the number of positive results reported to the Health Protection Team.

Seasonality was accounted for using sine-cosine pairs derived from periodograms. Autocorrelation was assessed via Autocorrelation Function and Partial Autocorrection Function plots, with lag terms included accordingly. Likelihood ratio tests evaluated the contribution of additional predictors, and stepwise selection using Akaike information criterion identified the most parsimonious model for each infection.

The data reviewed was taken from two years either side of the introduction of PCR testing in both laboratories.

The results obtained during mass testing of pupils, staff and household contacts associated with the outbreak were reviewed and *Giardia spp.* carriage rates in each group were calculated. These were compared to the rates published by the WHO.

The turnaround times (TAT) of faecal PCR results during the outbreak were analysed and an average was calculated. This was compared to figures for microscopy TAT.

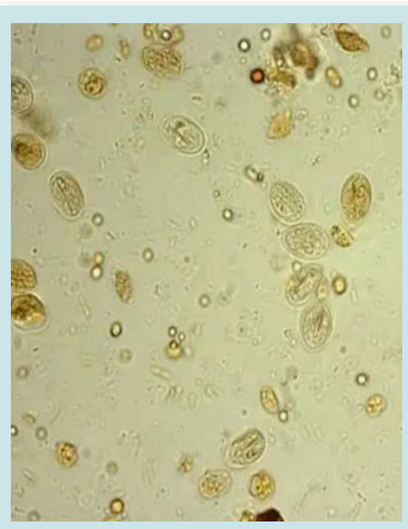

Figure 1 – Cysts of *Giardia spp*. viewed by light microscopy

RESULTS

- The introduction of PCR testing was associated with a significant increase in monthly *Giardia spp*. reports from both laboratories
- Laboratory 1 indicated more than a twofold increase in the number of positive *Giardia spp*. results reported following the introduction of PCR
- Laboratory 2 demonstrated a considerably higher effect with an incidence rate ratio of 9.58 following the introduction of PCR testing for *Giardia spp.*
- Laboratory 1 - Incidence rate ratio (IRR) 2.33 (95% CI: 1.27-4.46; *P* = 0.008)
- Laboratory 2 - Incidence rate ratio (IRR) 9.58 (95% CI: 4.48-22.1; *P* < 0.001)
- Percentage of Individuals testing positive for *Giardia spp*. During testing as part of the outbreak – Staff 5%, Students 38%, Contacts 17%
- The average TAT during this outbreak was 1.5 days. Average published TAT for microscopy is 6 days.

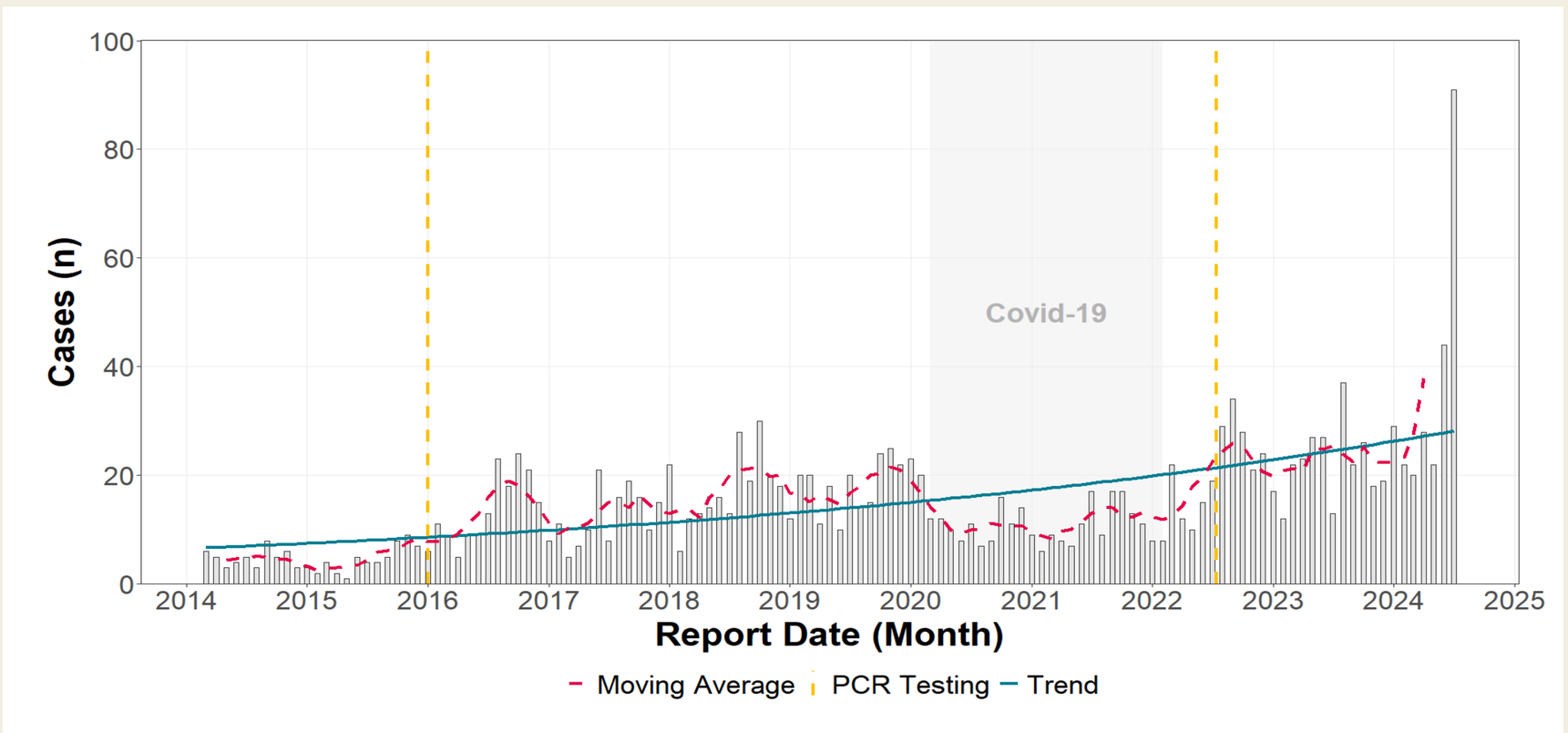

Figure 2. Reported cases of *Giardia* spp. among Cheshire and Merseyside residents captured via UKHSAs' Health Protection Case Management System from March 2014 to July 2024. The figure reflects the implementation PCR testing across two diagnostic laboratories serving the region. Case counts are presented with a 6-month centred moving average to smooth short-term fluctuations. The trend line represents predicted case incidence over time, modelled using a generalised linear model with a Poisson distribution.

DISCUSSION

The introduction of PCR testing for giardiasis in clinical laboratories has resulted in an increase in detection of *Giardia spp*. in stool samples. This is due to a combination of the increased sensitivity and specificity of PCR when compared to microscopy, and the numbers of specimens tested for *Giardia spp*. Prior to PCR, samples were only examined for *Giardia* cysts on specific request by clinicians and/or suggestive clinical details.

PCR is significantly more efficient for clinical laboratories compared to traditional microscopy, hands on time per sample is reduced thus increasing the laboratories capacity to process the large numbers of samples associated with outbreaks, reducing TAT.

The rate of *Giardia spp*. carriage in those tested as part of the outbreak was significantly greater than the WHO estimate. There is no WHO estimate for *Giardia* carriage in SEN populations.

Increased sensitivity, efficiency, and reduced TAT result in a more timely public health response. This allows outbreaks to be controlled quickly and efficiently.

CONCLUSIONS

- The higher rate of carriage in this cohort is due to a combination of factors linked to the vulnerability of index cases. The WHO figures may underestimate carriage due to the testing methods available at the time they were published.
- Faecal PCR allowed for more timely outbreak detection and resolution due to the increased sensitivity of the method compared to light microscopy.
- Faecal PCR had a positive impact on the management of this, and potential future outbreaks.
- Faecal PCR leads to improved health outcomes of cases and their contacts.
- Faecal PCR allows for carriage rates to be studied in vulnerable populations, such as the SEN pupils in this outbreak.

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