



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



ELSEVIER

Contents lists available at ScienceDirect

Journal of Infection

journal homepage: [www.elsevier.com/locate/jinf](http://www.elsevier.com/locate/jinf)

## Letter to the Editor

**Regular mass screening for SARS-CoV-2 infection in care homes already affected by COVID-19 outbreaks: Implications of false positive test results**

Dear Editor,

We recently reported in the *Journal of Infection* high rates of symptomatic and asymptomatic SARS-CoV-2 infections associated with high fatality in residents across four London care homes experiencing a COVID-19 outbreak during the peak of the COVID-19 pandemic in England.<sup>1</sup> Similar findings were reported in other London care homes.<sup>2</sup> By 11 May 2020, 44% of all London care homes had experienced a COVID-19 outbreak,<sup>3</sup> leading to the national implementation of widespread screening of care home staff every week and of residents every 28 days to identify and isolate infected individuals and limit the spread of SARS-CoV-2 in care homes.<sup>4</sup> In July 2020, Public Health England (PHE) was informed of two asymptomatic staff and one asymptomatic resident in the same care home who tested positive for SARS-CoV-2 through national screening (Table 1). This care home had been part of the initial outbreak investigation in April 2020 and all three individuals were known to have SARS-CoV-2 antibodies.<sup>5</sup> We, therefore, undertook additional investigations to assess whether these were re-infections or false positive results and discuss the implications of our findings for residents, staff and care homes in general.

Following our initial COVID-19 outbreak investigations in April 2020,<sup>3</sup> the four London care homes implemented strict lockdown procedures, with closure to new admissions and cessation of family visits. To prevent re-introduction of SARS-CoV-2 into the care homes, we implemented a local intervention to collect weekly nasal swabs from all residents and staff for four consecutive weeks in mid-May. No new infections were identified. SARS-CoV-2 antibody testing after the 4-week swabbing using the Abbott SARS-CoV-2 IgG assay<sup>6</sup> found two-thirds of residents and staff to be seropositive,<sup>5</sup> consistent with other care home investigations in London.<sup>7</sup> Since July 2020, the four London care homes have been participating in national screening for SARS-CoV-2, whereby swabs for residents and staff are ordered online and sent to one of several national testing centres.<sup>4</sup> Only qualitative results with no RT-PCR cycle threshold (Ct) values or other parameters are reported back to the care home.

Between 22–25 July 2020, three asymptomatic individuals – a care worker, a resident and an office staff member – in one of the London care homes under investigation tested positive for SARS-CoV-2 RNA as part of national screening. These tests were performed in two different national testing centres and on different days. The three individuals had all had a history of COVID-19 like symptoms during March–April 2020, had subsequently repeatedly tested negative for SARS-CoV-2 RNA during the weekly local nasal

swab screening during May–June 2020 and were seropositive for SARS-CoV-2 antibodies in June 2020 (Table 1).

The care home immediately re-instituted lockdown procedures. Following the new positive SARS-CoV-2 RT-PCR result, all three individuals were re-tested at the PHE national reference laboratory within 24 h and were RT-PCR negative with detectable SARS-CoV-2 antibodies. Additionally, all residents and staff in the care home – including the three individuals – were re-tested for SARS-CoV-2 RNA as part of the outbreak management and were all negative. Four weeks later, repeat testing in the two staff showed no rise in SARS-CoV-2 antibodies. The resident was also antibody positive 4 weeks later but the test was performed in a different laboratory which did not report quantitative results.

The protective role of SARS-CoV-2 antibodies against re-infection and disease remains to be established, but there is increasing evidence showing that those with neutralising antibodies are unlikely to be infected with live virus,<sup>8</sup> which in turn reduces their risk of infecting others. Despite the large numbers of ongoing COVID-19 outbreaks in England,<sup>9</sup> these four London care homes did not have any additional cases prior to the national screening programme. The reporting of three positive results in a single care home was, therefore, unexpected and prompted additional investigations, which included repeat swabs that were all negative, and blood sampling which confirmed their seropositivity at the time of re-testing. The lack of an antibody rise four weeks later confirmed that these detections were not new infections and, therefore, false positive screening tests.

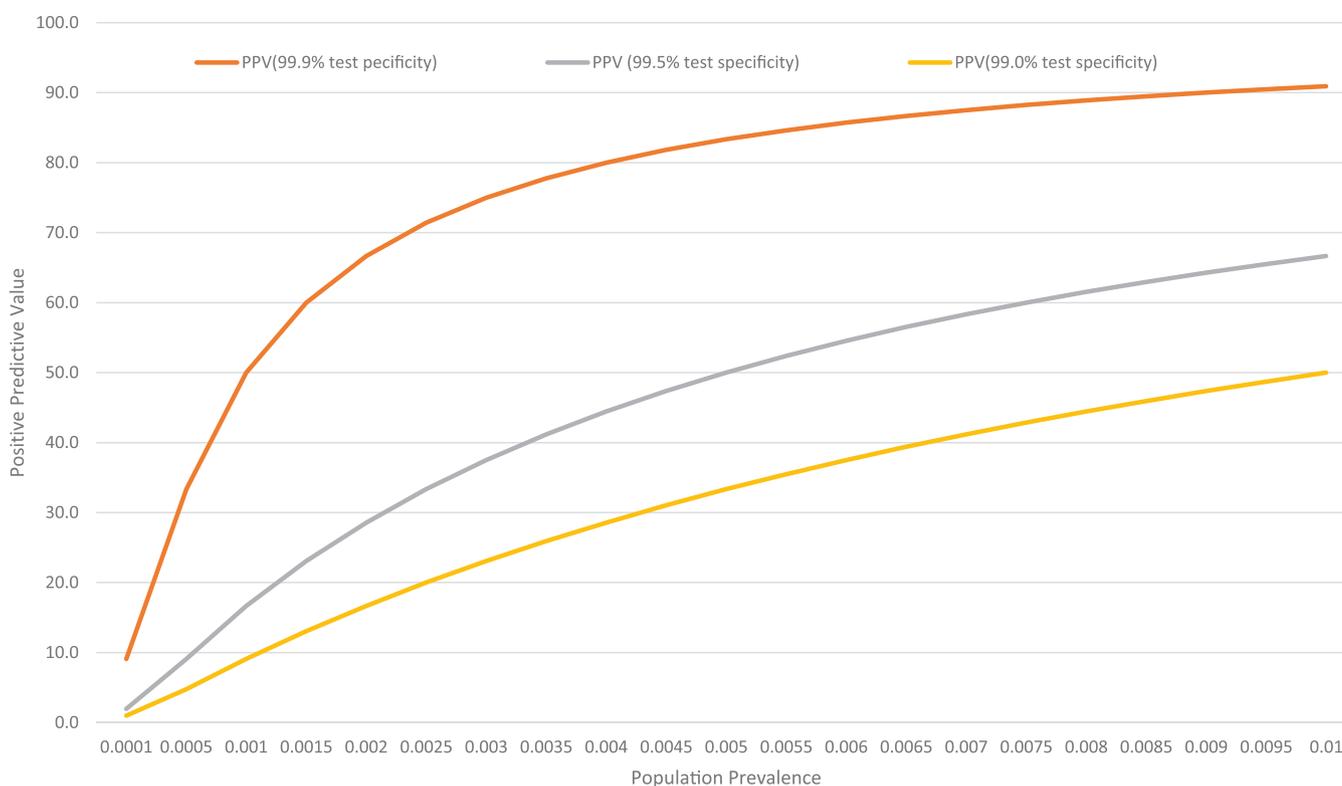
Further work needs to be undertaken to assess the value of repeated mass swab testing in care homes during periods of low community prevalence,<sup>10</sup> particularly if SARS-CoV-2 positivity rates fall below 1%, when the likelihood of false positive results increases exponentially even with RT-PCR assays that have very high specificity (Fig. 1). This can have a significant impact on care homes, in terms of unnecessary isolation of vulnerable residents and loss of workforce leading to suboptimal care provision.<sup>11</sup> Declaration of an outbreak places additional constraints on the care home, including closures to external visitors and new residents.<sup>4</sup> Repeated unnecessary interventions are also likely to be detrimental to the long-term mitigation strategy in care homes, have significant resource implications and impact on the wellbeing of residents and staff. In addition, there is the danger of behavioural fatigue so that, when strict infection control measures are required in a genuine outbreak, recommended measures may not be adhered to.

This problem of false positivity has recently been recognised, with new national guidance published on how to interpret low level RT-PCR positive samples, including a recommendation to retest all samples testing that are positive at the level of detection of the assay before undertaking wider public health action.<sup>12</sup> It is

**Table 1**  
Tests performed in two staff members and a resident who tested positive in the national SARS-CoV-2 infection screening programme for care homes in England.

Staff or resident	Floor in care home	Previous illness	Confirmed COVID-19?	SARS-CoV-2 Swab Results	SARS-CoV-2 IgG antibody Results	New outbreak: date swab result*	Date results available	New outbreak: date repeat swab result	Repeat SARS-CoV-2 antibody test
Staff	1st floor	Yes (March 2020)	No	Negative (04 June)	Positive 2.91 (04 June)	Positive (18 July)	22 July	Negative (24 July)	Positive 1.3 (24 July) Positive 1.1 (24 August)
Resident	Ground	Yes (April 2020)	Yes	Positive (16 April) Positive (13 May) Negative (28 May) Negative (05 June)	Positive (25 June)	Positive (21 July)	23 July	Negative (24 July)	Positive (24 July) Positive (24 August) Positive (24 August)
Staff	office	Yes (March 2020)	No	Negative (15 May) Negative (22 May) Negative (01 June) Negative (05 June)	Positive 5.93 (05 June)	Positive (22 July)	25 July	Negative (25 July)	Positive 5.35 (25 July) Positive 5.40 (24 August)

\*subsequent investigations identified that only one of three RT-PCR targets was positive at the limit of detection of the assay (Ct 34) at the national testing centre.



**Fig. 1.** Positive predictive value (PPV) of testing based on population prevalence and specificity of the test. PPV falls rapidly when prevalence falls below 1% even with the most specific test assay. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

hoped that this recommendation will reduce the number of similar closures of care homes or other institutions exposed to mass testing as a result of non-reproducible positive SARS-CoV-2 RT-PCR results.

In conclusion, in care homes that have already experienced a COVID-19 outbreak, up to two-thirds of staff and surviving residents develop neutralising antibodies which is likely to reduce the risk of new infections and, consequently, further outbreaks. Whilst community SARS-CoV-2 prevalence is low, rather than repeated mass swabbing, there is an opportunity to assess a role for wider testing for SARS-CoV-2 antibodies to assess past exposure accompanied with early and rapid testing for SARS-CoV-2 RNA as needed. Any positive result could then initiate wider testing for SARS-CoV-2 RNA in the care home, include re-testing the index case, and a more nuanced risk assessment of the likelihood of a true outbreak.

Ethics: PHE has legal permission, provided by Regulation 3 of The Health Service (Control of Patient Information) Regula-

tions 2002, to process patient confidential information for national surveillance of communicable diseases and as such, individual patient consent is not required.

#### Conflicts of interest: none

None.

#### Funding

None.

#### References

- Graham N, Junghans C, Downes R, et al. SARS-CoV-2 infection, clinical features and outcome of COVID-19 in United Kingdom nursing homes. *J Infect* 2020. <https://doi.org/10.1016/j.jinf.2020.08.040>.

2. Ladhani SNC JY, Janarthanan R, et al. Investigation of SARS-CoV-2 outbreaks in six care homes in London, April 2020: the London care home investigation. *E Clin Med* 2020. <https://doi.org/10.1016/j.eclinm.2020.100533>.
  3. The Health Foundation. Do all care home residents face an equal risk of dying from COVID-19? 22 May 2020. Available at <https://www.health.org.uk/news-and-comment/charts-and-infographics/do-all-care-home-residents-face-an-equal-risk-covid-19>. Accessed: 09 September 2020.
  4. Department of Health and Social Care (DHSC). Regular retesting rolled out for care home staff and residents, 3 July 2020. Available at <https://www.gov.uk/government/news/regular-retesting-rolled-out-for-care-home-staff-and-residents>. Accessed: 09 September 2020.
  5. Graham NSNJ C, McLaren R, et al. High rates of SARS-CoV-2 seropositivity in nursing home residents. *J Infect* 2020. <https://doi.org/10.1016/j.jinf.2020.08.040>.
  6. Public Health England (PHE). Evaluation of the Abbott SARS-CoV-2 IgG for the detection of anti-SARS-CoV-2 antibodies, 08 June 2020. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/890566/Evaluation\\_of\\_Abbott\\_SARS\\_CoV\\_2\\_IgG\\_PHE.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/890566/Evaluation_of_Abbott_SARS_CoV_2_IgG_PHE.pdf). Accessed: 09 September 2020.
  7. Ladhani SN, Jeffery-Smith AJ, Patel M, et al. High prevalence of SARS-CoV-2 antibodies in care homes affected by COVID-19; a prospective cohort study in England. *MedRxiv* August 2020;12. <https://doi.org/10.1101/2020.08.10.20171413>.
  8. van Kampen JJA, van de Vijver DA, Fraaij PLA, et al. Shedding of infectious virus in hospitalized patients with coronavirus disease-2019 (COVID-19): duration and key determinants. *MedRxiv* 2020. 09 June <https://doi.org/10.1101/2020.06.08.20125310>.
  9. Department of Health and Social Care (DHSC). Vivaldi 1: COVID-19 care homes study report. 03 July 2020. Available at: <https://www.gov.uk/government/publications/vivaldi-1-coronavirus-covid-19-care-homes-study-report/vivaldi-1-covid-19-care-homes-study-report>. Accessed: 09 September 2020.
  10. Public Health England. Weekly Coronavirus disease 2019 (COVID-19) surveillance report: summary of COVID-19 surveillance systems. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/880925/COVID19\\_Epidemiological\\_Summary\\_w17.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/880925/COVID19_Epidemiological_Summary_w17.pdf). Accessed: 09 September 2020.
  11. Care Home Professional. Staffing shortages the number one problem for care home operators, 7 October 2019. Available at <https://www.carehomeprofessional.com/staffing-shortages-the-number-one-problem-for-care-home-operators/>. Accessed: 09 September 2020.
  12. Public Health England (PHE). Research and analysis: assurance of SARS-CoV-2 RNA positive results during periods of low prevalence, 07 September 2020. Available at <https://www.gov.uk/government/publications/sars-cov-2-rna-testing-assurance-of-positive-results-during-periods-of-low-prevalence/assurance-of-sars-cov-2-rna-positive-results-during-periods-of-low-prevalence>. Accessed: 09 September 2020.
- Shamez N. Ladhani\*, J. Yimmy Chow, Sara Atkin, Kevin E. Brown, Mary E. Ramsay  
Public Health England, London, United Kingdom
- Paul Randell, Frances Sanderson  
Imperial College and NHS Trust, London, United Kingdom
- Cornelia Junghans  
London School of Hygiene and Tropical Medicine, London, United Kingdom
- Kate Sendall, Rawlida Downes  
Imperial College and NHS Trust, London, United Kingdom
- David Sharp, Neil Graham  
Department of Brain Sciences, Imperial College London, London, United Kingdom
- UK Dementia Research Institute, Care Research & Technology Centre, London, United Kingdom
- David Wingfield  
Hammersmith and Fulham Integrated Care Partnership, London, United Kingdom
- Rob Howard  
Imperial College and NHS Trust, London, United Kingdom
- Robert McLaren  
Hammersmith and Fulham Integrated Care Partnership, London, United Kingdom
- Nicola Lang  
Hammersmith and Fulham Council, London, United Kingdom
- \*Corresponding author.  
E-mail address: [shamez.ladhani@phe.gov.uk](mailto:shamez.ladhani@phe.gov.uk) (S.N. Ladhani)