

COVID-19 outbreaks following full reopening of primary and secondary schools in England: retrospective, cross-sectional national surveillance

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Abstract

Background

The full reopening of schools in September 2020 was associated with an increase in COVID-19 cases and outbreaks in educational settings across England.

Methods

Primary and secondary schools reporting an outbreak (≥ 2 laboratory-confirmed cases within 14 days) to Public Health England (PHE) between 31 August and 18 October 2020 were contacted to complete an online questionnaire.

Interpretation

There were 969 primary (n=450) and secondary school outbreaks (n=519) reported to PHE, representing 3% of primary schools and 15% of secondary schools in England. Of the 369 schools contacted, 190 geographically-representative schools completed the questionnaire; 2,425 cases were reported. Secondary school students (1.20%; 95%CI, 1.13-1.28%) had higher attack rates than primary school students (0.84%; 95%CI, 0.75-0.94%). Outbreaks were larger and across more year groups in secondary schools than in primary schools. When an outbreak occurred, attack rates were higher in staff (926/19,083; 4.85%; 95%CI, 4.55-5.17%) than students, especially among primary school teaching staff (9.81%; 95%CI, 8.90-10.82%) compared to secondary school teaching staff (3.97%; 95%CI, 3.79-5.69%). Staff represented 59% (471/799) of cases in primary school outbreaks and 27% (410/1515) in secondary schools ($P < 0.001$). Teaching staff were more likely to be the index case in primary (48/100, 48%) than in secondary (25/79, 32%) schools ($P = 0.027$).

Conclusions

Secondary schools were more likely to be affected by a COVID-19 outbreak than primary schools and to experience larger outbreaks across multiple school years. The higher attack rate among teaching staff during an outbreak suggests that additional protective measures may be needed.

Funding: PHE

Research in Context

Evidence before this study

We searched PubMed for articles published between 01 January and 31 November 2020 with the terms “COVID-19” or “SARS-CoV-2” with “school”, “education”, “staff” or “student” to identify publications relating to COVID-19 cases and outbreaks in educational settings globally, with no language restrictions. Countries that kept their preschools and primary schools open early in the pandemic reported very few cases in school-aged children or outbreaks in educational settings. Similar experiences were reported by countries that reopened their schools after their national lockdown, when local community infection rates were low. A number of countries reported larger and more extensive COVID-19 outbreaks in secondary schools than in primary schools.

Added Value of this study

We rapidly investigated 190 outbreaks in educational settings following the full reopening of educational settings during the autumn term in England. Unlike the summer mini-term, when very few cases and outbreaks were reported in educational settings, we found both an increase in the proportion of settings experiencing outbreaks, especially in secondary schools, and important differences in outbreak characteristics. While outbreaks were less common in primary schools, they were more likely to affect staff members. Outbreaks in secondary schools were more extensive, affecting more students than staff and across multiple year groups.

Implications of all the available evidence

Numerous mitigation processes have been recommended for the full reopening of schools, but little is known about the feasibility or implementation of these measures across different educational settings. We found significantly higher SARS-CoV-2 infection rates in staff compared to students, especially in primary schools. In England, face coverings are optional for staff in primary schools and, in secondary schools, are recommended for staff and students in communal areas outside the

classroom if physical distancing was difficult to maintain. Further studies are needed to identify the most effective interventions to protect staff and students against SARS-CoV-2 in educational settings.

Introduction

SARS-CoV-2, the virus responsible for COVID-19, first emerged in Wuhan, China, in December 2019 and spread rapidly worldwide. Many countries were forced to implement national lockdown to control the exponential rise in cases, which included school closure because the role of children in infection and transmission of SARS-CoV-2 was not known at the time.¹ Children represent less than 5% of COVID-19 cases and generally develop a mild and transient illness; severe disease, hospitalisation and deaths are rare in children.² School closure not only affects children's education, but has a wider negative impact on their physical, emotional and social well-being, with those from disadvantaged backgrounds likely to be the most affected.^{3,4}

In England, the first imported cases of SARS-CoV-2 were confirmed at the end of January 2020 and cases started increasing rapidly from March 2020.⁵ Schools were closed to all except vulnerable children and children of keyworkers on 20 March, with a wider national lockdown imposed from 23 March 2020, which included home working, and closure of non-essential shops and hospitality venues.⁶ Cases of SARS-CoV-2 plateaued in mid-April and then declined gradually until the end of May 2020.⁵ From 01 June 2020, preschools and some primary school years were allowed to physically re-open, followed by some secondary school years from 15 June 2020, until the end of the summer mini-term in mid-July 2020.⁷ During this period, the number of open educational settings increased from 20,500 to a peak of 23,500, and the number of students attending school increased from 475,000 to a peak of 1,672,000.⁸ Stringent physical distancing and infection control measures were put in place, including frequent hand washing, regular cleaning of classrooms and small class sizes restricted to 15 students and organised into discrete bubbles that did not physically or socially interact with each other.⁷ These measures, along with low community SARS-CoV-2 infection rates, were associated with very few infections or outbreaks in educational settings.⁹

From 31 August 2020, educational settings opened for all students in England. The same guidelines for physical distancing and other infection control measures remained in place but the large

numbers of children attending school precluded small class sizes or organisation into small bubbles. The re-opening of schools was associated with increases in both confirmed SARS-CoV-2 infections and outbreaks across all academic year groups.⁵ In order to better understand risk factors, evolution and outcomes of outbreaks in educational settings, we initiated a retrospective investigation of COVID-19 outbreaks reported to Public Health England (PHE) during the first half of the autumn term in primary and secondary schools across England.

Methods

This was a retrospective surveillance study using a cross-sectional survey of primary and secondary schools in England experiencing outbreaks of COVID-19 in the period 31 August to 18 October 2020. Educational settings that re-opened during this period included 16,795 state-funded primary schools, 3,456 state-funded secondary schools, 348 state-funded alternative provision educational settings, 1,062 state-funded special educational needs schools, 2,350 independent schools, 229 further education schools, 127 special institutes for >16 year-olds and 196 other educational settings each day (Source: Department for Education). The same stringent physical distancing and infection control measures were implemented as in the summer mini-term.⁷ Face masks and face coverings were not recommended in classrooms, but staff and children in secondary schools were advised to wear them in communal areas outside the classroom if physical distancing was difficult to maintain.⁷ Primary schools had the discretion to recommend face masks or face coverings for staff or visitors. Educational settings are advised to report SARS-CoV-2 cases and outbreaks to their PHE local Health Protection Teams (HPTs), which provide local public health advice and support.⁹ Owing to the volume of reported outbreaks after schools re-opened in September, however, a National Schools Advice Line opened on 17 September 2020, providing support and advice for smaller outbreaks of <5 cases without HPT involvement. Arrangements were also made to allow some local authorities and other stakeholders to support HPTs with outbreak management. Outbreaks reported to PHE are

routinely recorded in HPZone, an online national case management system used by PHE HPTs to record events that require public health management.⁹ HPZone, however, records limited data on individual outbreaks. The PHE national COVID-19 surveillance team use a weekly HPZone extract to report a summary of COVID19 outbreaks linked to educational and other settings.¹⁰ In order to collect more detailed information on individual outbreaks in educational settings, PHE contacted Headteachers or nominated Senior Management Team (SMT) members of primary and secondary schools reporting an outbreak during the first half of the autumn term in England (31 August to 18 October 2020) and asked them to complete a secure online questionnaire developed using SnapSurvey v.11 or to provide the information over the telephone (**Supplement Table S1**). We aimed to contact as many schools as possible during the first two weeks of November 2020. A purposive sampling strategy was employed to ensure that national geographical representation of reported school outbreaks was achieved during the investigation period.

Definitions

A case of COVID-19 was defined as any child or adult testing positive for SARS-CoV-2 by RT-PCR on an upper respiratory tract swab. Primary school and secondary school children were aged 4-11 and 11-18 years, respectively. Teaching staff were defined as any member of staff with a teaching role and included teachers, teaching assistants and specialist teachers, who were more likely to have direct close contact with students. Non-teaching staff were defined as members of staff in a non-teaching role, such as administrative and domestic staff. An outbreak was defined as two or more laboratory-confirmed cases of COVID-19 in a primary or secondary school with illness onset dates, or test positivity dates if asymptomatic, within 14 days of each other.

Data management and analysis

Data collected through SnapSurvey were downloaded into Microsoft Excel 365 and Stata v.15 (Statacorp, Tx) for analysis. Outbreaks were categorised into relevant educational settings (primary schools, secondary schools or combined schools that hosted both primary and secondary school

years). Nurseries and schools for Special Educational Needs and Disabilities (SEND) were not included. SARS-CoV-2 confirmation in the index case was used to identify the start of an outbreak. Data are mainly descriptive. Denominators for total student and staff numbers were reported by individual schools in the questionnaire. Continuous data that did not follow a normal distribution were described as medians with interquartile ranges. Proportions were compared using the chi-squared or Fisher's Exact test, as appropriate. Attack rates were calculated by dividing the number of cases by the number at risk in a specific population (e.g. primary school teachers); 95% confidence intervals (95% CI) were calculated for attack rates using a proportional test in R studio (version 1.3.1056). Analyses were not adjusted for multiple comparisons.

Results

Between 31 August and 18 October 2020, 969 outbreaks of COVID-19 in primary and secondary schools were reported to PHE across England. Of these, 450 were in primary schools (3% of primary schools) and 519 in secondary schools (15% of secondary schools) (**Figure 1**). Reported outbreaks increased rapidly after schools reopened, peaking during the week of 14-20 September and remained high until the end of the investigation period (week of 12-18 October 2020) (**Supplement Figure S2**). Outbreaks were reported across all English regions, with the greatest number of outbreaks in the London region and the West Midlands. Although there are nearly five times as many primary schools as secondary schools in England, there were more secondary than primary school outbreaks in six of the nine English regions (**Figure 1**).

In total, 369 schools reporting an outbreak (38% of total reported outbreaks) were contacted during the first two weeks of November 2020. Of these 369 schools, 197 (53%) completed the survey. Five schools provided insufficient information, and two were excluded because the outbreak occurred in a nursery attached to the primary school. Therefore, 190 geographically-representative schools with

confirmed COVID-19 outbreaks across England were included in the analysis. Of these, 100 (53%) were primary schools, 79 (42%) were secondary schools and 11 (6%) were combined schools which included both primary and secondary schools on the same site (**Figure 1**). The latter group included five primary and 6 secondary school outbreaks.

Attack Rates in Staff and Students

There were 2,425 SARS-CoV-2 cases reported in the 190 schools included in the analysis (**Table 1**). Staff members represented 59% (471/799) of cases in primary schools but only 27% (410/1,515) in secondary schools ($P < 0.001$). The outbreaks were larger in secondary schools than in primary schools. In students, SARS-CoV-2 attack rates increased with increasing school academic year, peaking in academic year 11 (15-16 year-olds) (**Supplement Figure S3**). Attack rates in secondary school students (1.20%; 95%CI, 1.13-1.28%) were significantly higher than in primary school students (0.84%; 95%CI, 0.75-0.94) (**Table 2**), while attack rates in staff members (4.85%; 4.55-5.17 %) were almost five times higher than in students (1.08%; 95%CI, 1.02-1.13%). Additionally, teaching staff (5.76%; 95%CI, 5.35-6.19%) had higher attack rates than non-teaching staff (3.31%; 95%CI, 2.91-3.76%) (**Table 2**). Within an outbreak setting, primary school teaching staff had the highest attack rate (9.81%; 95%CI, 8.90-10.82%) across all school settings. Teaching staff in secondary schools by comparison had an attack rate of 3.97% (95%CI, 3.54-4.46%), while non-teaching staff had the lowest attack rate (2.98%) (**Table 2**).

Outbreaks

Primary and combined schools had outbreaks involving 2-35 cases and 2-26 cases, respectively, while secondary schools experienced larger outbreaks involving 2-100 cases (**Table 1**). Most outbreaks occurred across more than one year group in both primary and secondary schools, but 68% (54/79) of secondary school outbreaks occurred across more than three year groups, compared to only 13% (13/100) in primary schools ($P < 0.001$). Outbreaks involving staff only were rare in both primary schools (6/100, 6%) and secondary schools (1/79, 1.3%) (**Table 3**). Across the educational

settings, the reported index cases were mainly teaching staff (77/190, 41%) or students (87/190, 46%) and not non-teaching staff (16/190, 8%). Teaching staff were, however, more likely to be the index case in primary schools (48/100, 48%), than in secondary schools (25/79, 32%; $P=0.027$) (**Table 3**). Most outbreaks involved both staff and students, irrespective of the educational setting or whether the index case was a staff member or a student. While some outbreaks in secondary schools involved only students, reported outbreaks in primary schools always involved staff and students (**Table 3**). The source of infection was not known for the majority of cases in the outbreak. The most common reason for testing for SARS-CoV-2 infection in the first four cases involved in the outbreak was the development of COVID-19 symptoms (fever, new onset cough or loss of smell or taste) in 68% (454/668) with 6% (41/726) tested because they were contacts of a confirmed case in school, while 16% (115/726) reported contact with a household case (**Supplement Table S4**).

Discussion

The reopening of all schools after 31 August 2020 was associated with nearly 1,000 primary and secondary school outbreaks of COVID-19 reported to PHE during the first half of the autumn term. These represented 3% of primary schools and 15% of secondary schools across England, and 32% of all outbreaks reported to PHE across all settings (care homes, hospital, prisons, workplaces, food outlets and other).¹⁰ Detailed follow-up of 190 schools reporting an outbreak identified 2,425 cases among staff and students. When an outbreak occurred, teaching staff were more likely to be affected than non-teaching staff, with the highest rates reported in primary school teachers, who were also more likely to be the index case in primary schools than students. Among students, secondary school students had higher attack rates than primary school students and were more likely to be the index case in secondary schools than the teaching staff. Outbreaks were larger and across multiple year groups in secondary schools compared to primary schools. Most outbreaks

involved both staff and students across both educational settings, although some outbreaks in secondary schools involved students only.

In England, the reopening of schools in the autumn term was a very different experience compared to the summer mini-term, when national lockdown was still in place. In June, community SARS-CoV-2 infection rates were very low, only a few academic years were allowed back in school (mainly in preschool and primary school years), class sizes were restricted to small numbers and staff to student ratios were higher than usual.⁷ Additionally, staff and students were segregated into distinct bubbles that did not interact with each other and could easily be identified for self-isolation if a case was confirmed in the bubble.⁷ Consequently, there were very few confirmed cases and outbreaks of COVID-19 reported in schools during the summer mini-term, and a large proportion of confirmed outbreaks involved staff members only and more than half the outbreaks involved only two cases.⁹ At that time, the experience in England was consistent with reports from the few countries that had kept their preschools and primary schools open throughout the first wave of pandemic in the spring of 2020,⁴ and with schools that re-opened after their national lockdown in the summer of 2020.^{4,11-14} There were, however, reports of higher numbers of cases and outbreaks in secondary schools than in primary schools in the same region (i.e. areas where both educational setting types had the same community infection risk).¹⁵⁻¹⁷ In the Netherlands, public health investigations found that just over half the cases in secondary school clusters were acquired outside school, mainly during intensive contact with friends or classmates in their free time.¹³ Additionally, infections in secondary schools were seen mainly in small groups of students and separately in teachers. Accordingly, the Netherlands does not recommend self-isolation for classmates unless they had intensive contact with a confirmed case.¹³ In the outbreaks investigation, we also observed an increasing risk of infection with age, which is consistent with national data in England,⁵ and there were some outbreaks that were restricted to secondary school students only. Older children appear to be at increased risk of SARS-CoV-2 infection,¹⁸ may be more efficient transmitters of the virus,¹⁹ and have

increased social contacts and mixing patterns than younger children, which may all increase the risk of more widespread infection in this group.

Compared to the students, however, SARS-CoV-2 infection rates during school outbreaks were significantly higher in school staff, predominantly teaching staff. This was particularly the case for teaching staff in primary schools, who were also more likely to be the index case in primary school outbreaks. For both staff and students, SARS-CoV-2 may have been acquired in the community or within the educational setting. Cases in staff members, however, are more concerning because adults are more likely to develop severe disease, require hospitalisation, intensive care and die of COVID-19 compared to children.^{20,21} We were unable to ascertain the potential source of infection for the reported cases because outbreak information was obtained from headteacher/SMT interviews. Notably though, most cases in the outbreaks were tested because they were symptomatic for COVID-19, with fewer than 10% tested because they were contacts of a confirmed case in school. In addition, the offer of testing in these outbreaks followed national guidelines and was mainly restricted to symptomatic individuals.²² We were, therefore, unable to assess the role of asymptomatic infection and transmission among staff and students.

The higher infection rates in primary compared to secondary school staff during outbreaks could be due to difficulties in maintaining physical distancing between staff and students (and among the students themselves) in primary school settings. Primary schools are also usually physically smaller than secondary schools. Another important difference is that face coverings are discretionary for staff or students in primary schools but, in secondary schools, are recommended for use in communal areas outside the classroom.⁷ Reassuringly, though, recent ONS analysis found no evidence of differences in the positivity rate between primary and secondary school teachers, other key workers and other professions between 02 September and 16 October 2020.²³ This could be a reflection of the extensive physical distancing and infection control practices in educational settings compared to other places of employment.

Strengths and Limitations

The strength of this analysis lies in the real-time national surveillance undertaken by PHE of outbreaks in institutional settings, including schools, with daily updates through a national online electronic data management system. However, because of the large numbers of cases and outbreaks reported to PHE at the start of the autumn term, smaller outbreaks were subsequently managed by the schools themselves, with support from the National Schools Advice line and other partners such as Local Authorities, without input from PHE. Smaller outbreaks may, therefore, not have been recorded on HPZone. Currently, for example, the London region only records outbreaks involving more than five cases on HPZone, the North East only reports complex outbreaks, and the North West and East of England only report outbreaks which require public health intervention. In addition, the investigated outbreaks relied on passive identification and notification of confirmed cases and, because wider testing was not performed, it is not possible to assess the extent of asymptomatic spread among other staff and students attending affected settings.

Another limitation is that the study is limited to a sample of 20% of the outbreaks reported during the period of interest, although these were temporally and geographically representative of total reported outbreaks. Of the contacted schools, 47% did not participate due to lack of time/capacity to complete the survey and general survey fatigue. Additionally, this was a retrospective interview rather than a detailed prospective investigation and, therefore, the data collected was limited by the information available to the interviewee. Specific limitations include lack of information on the source of the infection in the index case, lack of wider testing of contacts and their household members to better understand asymptomatic infection and transmission within educational settings and between schools and households. Because of the lack of viral genomic data, too, it was not possible to determine whether these were genuine outbreaks caused by the same SARS-CoV-2 or a result of multiple separate introductions into the school. We were also unable to assess adherence to nationally recommended infection control measures in the schools reporting an outbreak.

Implications of findings

There is increasing evidence that SARS-CoV-2 infections in educational settings are strongly associated with community infection rates. We have previously shown that the risk of school outbreaks correlated with regional SARS-CoV-2 infection rates during the summer mini-term in England.⁹ Maintaining low community infection rates is, therefore, critical for reducing the risk of virus introduction into educational settings. Additionally, despite the challenges in implementing national recommendations for the large numbers of students returning to school (as evidenced by most outbreaks involving both staff and students), it is highly likely that the implemented measures have helped reduce SARS-CoV-2 transmission within schools. This may explain why only 3% of primary schools and 15% of secondary schools reported an outbreak to PHE during the first half of the autumn term in England.

Further studies are needed to understand the contribution of in-school and outside-school transmission to SARS-CoV-2 spread and especially the role of asymptomatic infection and transmission among staff and students. These should include detailed prospective outbreak investigations including genomic sequencing of SARS-CoV-2 strains to determine whether the same strain is responsible for the reported outbreaks as well as antibody testing to detect prior asymptomatic infections. Such studies are currently underway in the School Infection Survey (SIS) in England,²⁴ which should provide important data to help keep educational settings open and allow staff and students to attend school safely during the current pandemic.

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Ethical approval:

PHE has legal permission, provided by Regulation 3 of The Health Service (Control of Patient Information) Regulations 2002, to process patient confidential information for national surveillance of communicable diseases and as such, individual patient consent is not required.

Role of the funding source

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Declaration of interests:

The authors declare no conflicts of interest.

Data sharing

Applications for relevant anonymised data should be submitted to the Public Health England Office for Data Release: <https://www.gov.uk/government/publications/accessing-public-health-england-data/about-the-phe-odr-and-accessing-data>.

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Figure 1. COVID-19 outbreaks by region that were (A) reported and (B) investigated by Public Health England during the first half of the autumn term (31 August to 18 October 2020) in England

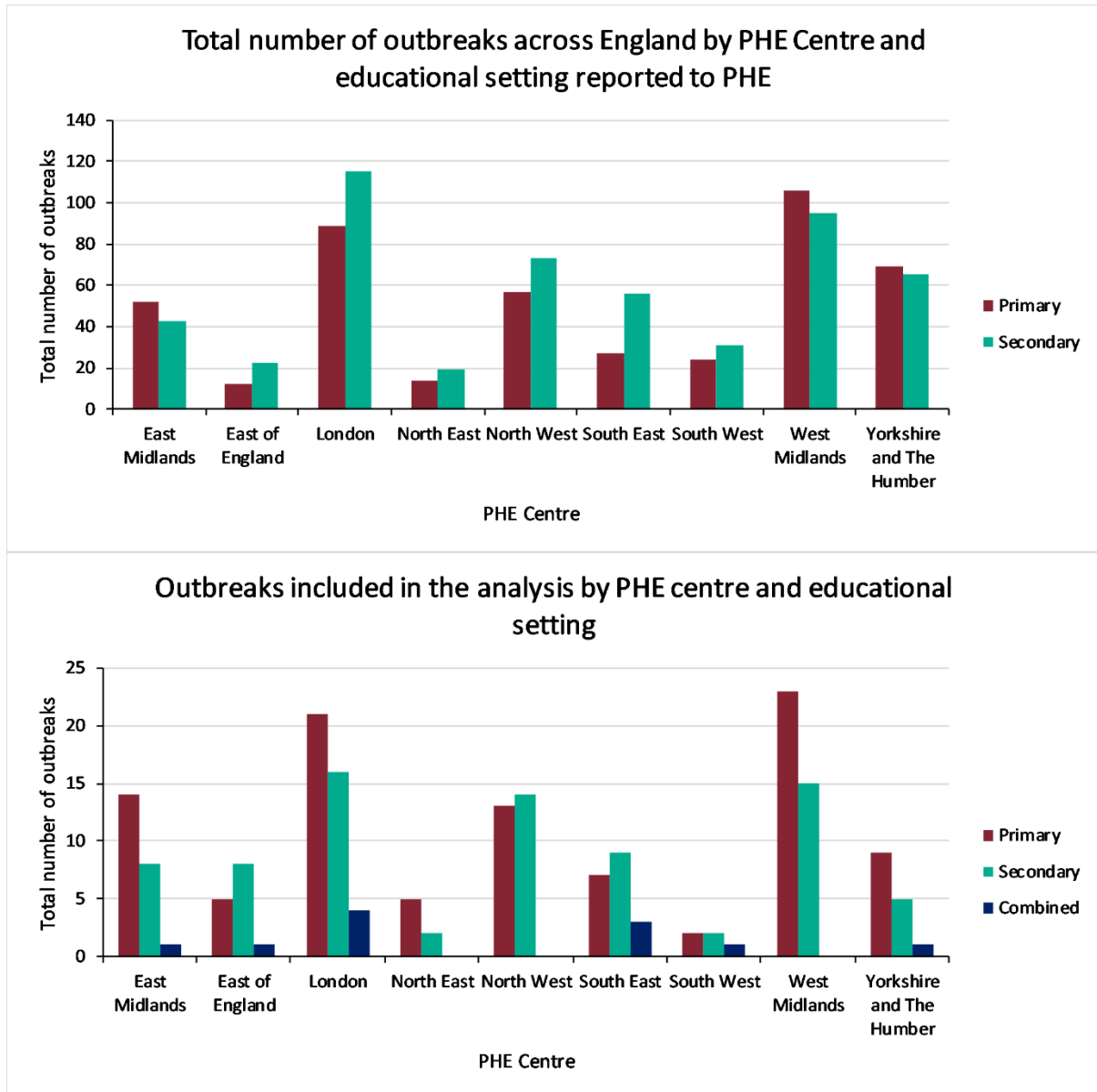


Table 1. Summary of cases and size of outbreaks reported to Public Health England (PHE) during the first half of the autumn term (31 August to 18 October 2020) in England

	School Type			All settings n (%)
	Primary n (% of cases in the setting)	Secondary n (% of cases in the setting)	Combined (% of cases in the setting)	
Student cases	328 (41%)	1105 (73%)	66 (59%)	1499 (62%)
Staff cases	471 (59%)	410 (27%)	45 (41%)	926 (38%)
Total cases	799 (33%)	1515 (62%)	111 (5%)	2425 (100%)
Number of outbreaks	100	79	11	190
Median, days (25 th and 75 th centiles)	6 (4-10)	15 (8.5-27)	6 (4.5-15.5)	9 (5-16)
Interquartile range	6	18.5	11	11
Mode number of cases	3	6	5	6
Range per outbreak	2-35	2-100	2-26	2-100

TABLE 2 Attack rate by education setting for staff and students

	School Type			
	Primary (100 schools)	Secondary (79 schools)	Combined (11 schools)	All schools (190 schools)
Total student cases	328	1105	66	1499
Total students	39,027	91,919	8,551	139,497
Student attack rate, % (95% CI)	0.84% (0.75-0.94%)	1.20 (1.13-1.28%)	0.77% (0.60-0.99%)	1.08% (1.02-1.13%)
Total staff cases	471	410	45	926
Total staff	5852	11510	1721	19083
Staff attack rate, % (95% CI)	8.05% (7.37-8.78%)	3.56% (3.24-3.92%)	2.62% (1.94-3.51%)	4.85% (4.55-5.17%)
Teaching staff cases	378	284	31	637
Total teaching staff	3852	7146	1039	12,037
Teaching staff attack rate, % (95% CI)	9.81% (8.90-10.82%)	3.97% (3.54-4.46%)	2.98% (2.07-4.26%)	5.76% (5.35-6.19%)
Non-teaching staff cases	93	126	14	233
Total non-teaching staff, % (95% CI)	2000	4364	682	7,046
Staff attack rate	4.65% (3.79-5.69%)	2.89% (2.42-3.44%)	2.05% (1.17-3.51%)	3.31% (2.91-3.76%)
Total cases	799	1515	111	2425
Total population (staff & students)	44879	103429	10272	158580
Attack rate, % (95% CI)	1.78% (1.66-1.91%)	1.47% (1.39-15.4%)	1.08% (0.89-1.31%)	1.53% (1.47-1.59%)

TABLE 3. Source and spread of outbreaks across year groups in schools by educational setting

	School type			
	Primary	Secondary	Combined	Total
Index case in the outbreak	n (%)	n (%)	n (%)	%
Teaching staff	48 (48%)	25 (32%)	4 (36%)	77 (40.5%)
Student	35 (35%)	47 (59%)	5 (45%)	87 (45.8%)
Non-teaching staff	9 (9%)	6 (8%)	1 (9%)	16 (8%)
Another source	1 (1%)	0 (0%)	0 (0%)	1 (1%)
Not reported	7 (7%)	1 (1%)	1 (9%)	9 (5%)
Groups affected by the outbreak	n (%)	n (%)	n (%)	%
Staff only	6 (6%)	1 (1%)	1 (9%)	8 (4%)
1 year group only	39 (39%)	5 (6%)	2 (18%)	46 (24%)
More than 1 year group	55 (55%)	73 (92%)	8 (73%)	136 (72%)
More than 3 year groups	13 (13%)	54 (68%)	5 (45%)	72 (38%)
Total	100	79	11	190

TABLE 4. Involvement of students and staff according to the index cases in outbreaks reported to Public Health England (PHE) during the first half of the autumn term in England

Index Case	Group affected	School type			
		Primary	Secondary	Combined	All
Teaching staff	Staff only	4/48 (08%)	0/25 (-)	1/4 (25%)	5/77 (06%)
	Student only	0/48 (-%)	0/25 (-)	0/4 (-)	0/77 (-)
	Both	44/48 (92%)	25/25 (100%)	3/4 (75%)	72/77 (94%)
Student	Staff only	0/35 (-)	1/47 (2%)	0/5 (-)	1/87 (1%)
	Student only	10/35 (29%)	6/47 (13%)	0/5 (-)	28/87 (32%)
	Both	25/35 (71%)	40/47 (85%)	5/5 (100%)	48/87 (55%)
Non-teaching staff	Staff only	2/9 (22%)	0/6 (-)	0/1 (-)	2/16 (13%)
	Student only	0/9 (-)	0/6 (-)	0/1 (-)	0/16 (-%)
	Both	7/9 (78%)	6/6 (100%)	1/1 (100%)	14/16 (88%)

SUPPLEMENT SECTION

SUPPLEMENT TABLE S1

Supplement Table S1. Summary of online questionnaire for data collection for individual outbreaks reported to Public Health England (PHE) during the first half of the autumn term in England

Minimum Data Set (MDS) form

1. Name of school
2. Postcode
3. School type

Overview

4. Do you have a linked nursery?
5. Total number of students in nursery
6. Total number of teaching staff in nursery/kindergarten (e.g. teachers, teaching assistants and special needs teachers, full time and part time)
7. Total number of non-teaching staff in nursery/kindergarten (e.g. kitchen staff, cleaning staff, admin)
8. Total number of students by year group (Primary)
9. Total number of students by year group (Secondary)
10. Total number of teaching staff (Primary) (e.g. teachers, teaching assistants and special needs teachers, full time and part time)
11. Total number of teaching staff (Secondary) (e.g. teachers, teaching assistants and special needs teachers, full time and part time)
12. Total number of non-teaching staff (Primary) (e.g. kitchen staff, cleaning staff, admin)
13. Total number of non-teaching staff (Secondary) (e.g. kitchen staff, cleaning staff, admin)
14. Further comments

Total confirmed cases

15. Total number of student confirmed cases in nursery/kindergarten
16. Total number of student confirmed cases by year group (Primary)

17. Total number of student confirmed cases by year group (Secondary)
18. Total number of teaching staff confirmed cases in nursery/kindergarten (e.g. teachers, teaching assistants and special needs teachers, full time and part time)
19. Total number of teaching staff confirmed cases (Primary) (e.g. teachers, teaching assistants and special needs teachers, full time and part time)
20. Total number of teaching staff confirmed cases (Secondary) (e.g. teachers, teaching assistants and special needs teachers, full time and part time)
21. Total number of non-teaching staff confirmed cases in nursery/kindergarten (e.g. kitchen staff, cleaning staff, admin)
22. Total number of non-teaching staff confirmed cases (Primary) (e.g. kitchen staff, cleaning staff, admin)
23. Total number of non-teaching staff confirmed cases (Secondary) (e.g. kitchen staff, cleaning staff, admin)
24. Number of hospitalised cases (staff and students)
25. Number of deaths (staff and students)
26. Was this setting closed due to COVID-19?
27. For how many days was the setting closed?
28. Why was the setting closed? (i.e deep cleaning, to break transmission etc.)
29. Further Comments

Case 1 (INDEX CASE)

30. First name
31. Last name
32. Date of Birth (dd/mm/yyyy)
33. Postcode of residence during term time
34. Sex
35. Date of symptom onset, if symptomatic (dd/mm/yyyy)
36. Date of test (dd/mm/yyyy)
37. Was the index case staff, student or other?
38. Class year (and bubble name if appropriate) of the case (i.e. year 6, yellow bubble)
39. If other, please specify
40. Why was this index case tested?
41. If other, please specify
42. How many students were sent home as a result?
43. How many members of staff were sent home as a result?

44. Did anyone have symptoms after being sent home
45. How many students had symptoms after being sent home?
46. How many members of staff had symptoms after being sent home?
47. Did anyone test positive
48. How many students tested positive for COVID-19 after being sent home?
49. How many members of staff tested positive for COVID-19 after being sent home?
50. Further comments

Case 2

51. First name
52. Last name
53. Postcode of residence during term time
54. Date of Birth (dd/mm/yyyy)
55. Sex
56. Date of symptom onset, if symptomatic (dd/mm/yyyy)
57. Date of test (dd/mm/yyyy)
58. Was the case staff, student or other?
59. Class year (and bubble name if appropriate) of the case (i.e. year 6, yellow bubble)
60. If other, please specify
61. Why was this case tested?
62. If other, please specify
63. Is this case is linked to the previous case?
64. How many students were sent home as a result of this case
65. How many members of staff were sent home as a result of this case?
66. Did anyone have COVID-19 symptoms after being sent home
67. How many students had COVID-19 symptoms after being sent home?
68. How many members of staff had COVID-19 symptoms after being sent home?
69. Did anyone test positive for COVID-19 after being sent home?
70. How many students tested positive for COVID-19 after being sent home?
71. How many members of staff tested positive for COVID-19 after being sent home?
72. Further comments

Case 3

73. First name
74. Last name

75. Postcode of residence
76. Date of Birth (dd/mm/yyyy)
77. Sex
78. Date of symptom onset, if symptomatic (dd/mm/yyyy)
79. Date of test (dd/mm/yyyy)
80. Was the case staff, student or other?
81. Class year (and bubble name if appropriate) of the case (i.e. year 6, yellow bubble)
82. If other, please specify
83. Why was this case tested?
84. If other, please specify
85. Is this case is linked to any previous case?
86. Which case was this linked to?
87. How many students were sent home as a result of this case?
88. How many members of staff were sent home as a result of this case?
89. Did anyone have COVID-19 symptoms after being sent home
90. How many students had COVID-19 symptoms after being sent home?
91. How many members of staff had COVID-19 symptoms after being sent home?
92. Did anyone test positive for COVID-19 after being sent home?
93. How many students tested positive for COVID-19 after being sent home?
94. How many members of staff tested positive for COVID-19 after being sent home?
95. Further comments

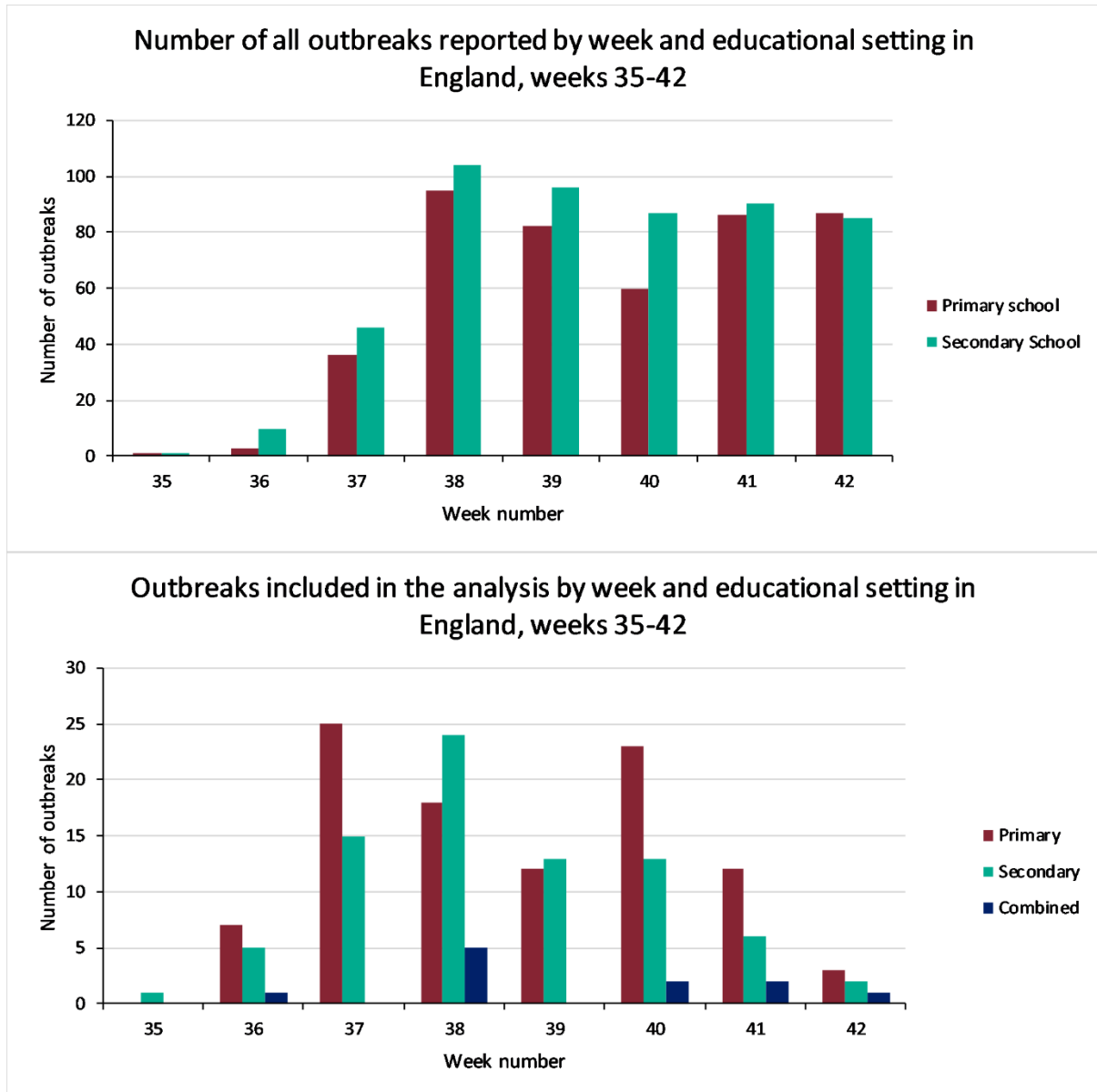
Case 4

96. First name
97. Last name
98. Postcode of residence during term time
99. Date of Birth (dd/mm/yyyy)
100. Sex
101. Date of symptom onset (dd/mm/yyyy)
102. Date of test (dd/mm/yyyy)
103. Was the case staff, student or other?
104. Class year (and bubble name if appropriate) of the case (i.e. year 6, yellow bubble)
105. If other, please specify
106. Why was this case tested?
107. If other, please specify

108. Is this case is linked to any previous case?
109. Which case was this linked to?
110. How many students were sent home as a result of this case?
111. How many members of staff were sent home as a result of this case?
112. Did anyone have COVID-19 symptoms after being sent home?
113. How many students had COVID-19 symptoms after being sent home?
114. How many members of staff had COVID-19 symptoms after being sent home?
115. Did anyone test positive?
116. How many students tested positive for COVID-19 after being sent home?
117. How many members of staff tested positive for COVID-19 after being sent home?
118. Further comments

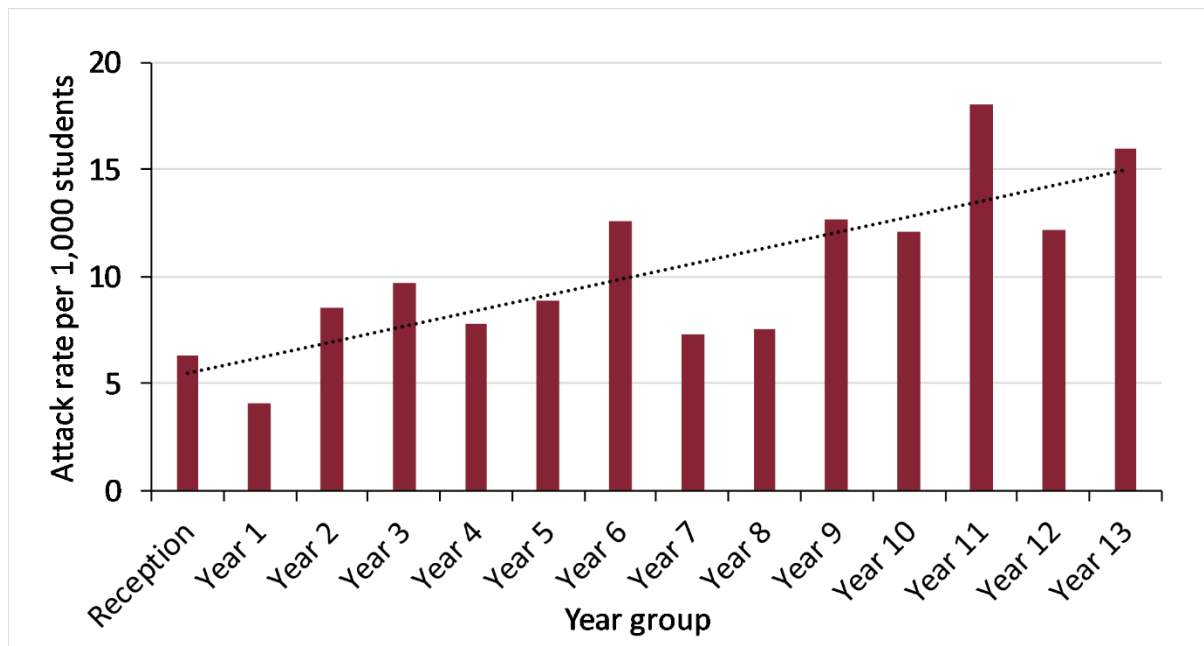
SUPPLEMENT Figure S2

Supplement figure S2. (A) Weekly reports of COVID-19 outbreaks in primary and secondary schools during the first half of the autumn term (31 August to 18 October 2020) in England; (B) Schools recruited in the outbreak investigation by Public Health England (PHE).



Supplement Figure S3

Supplement Figure S3. COVID-19 attack rate 19 by academic year in primary and secondary school students reporting an outbreak to Public Health England (PHE) during the first half of the autumn term (31 August to 18 October 2020) in England. The dotted line represents the line of best fit using linear trends for attack rates in students across the academic years



Supplement TABLE S4

Supplement Table S4. Reason for testing (where reported) in the first four cases in each outbreak reported to Public Health England during the first half of the autumn term (31 August to 18 October 2020) in England

Reason for testing	Number of cases									
	Case 1 (n=176)		Case 2 (n=175)		Case 3 (n=166)		Case 4 (n=151)		All cases (n=668)	
	n	%	n	%	n	%	n	%	n	%
Symptomatic	126	72%	121	69%	113	68%	94	62%	454	68%
Contact of community case	6	3%	1	1%	3	2%	6	4%	16	2%
Contact of household case	35	20%	29	17%	21	13%	30	20%	115	17%
Contact of a school case	0	0%	14	8%	14	8%	13	9%	41	6%
Other	9	5%	10	6%	15	9%	8	5%	42	6%