COVID-19 School Transmission Analysis

January to June 2021

Fraser Health Authority

Objective and inclusion criteria

- **Objective:** To determine the extent and characteristics of in-school transmission of COVID-19 in the Local Health Areas (LHAs) of Surrey and South Surrey/White Rock
  - These two LHAs, which align with the boundaries of Surrey School District
  - Surrey schools, which are comprised of a diverse mix of public and independent schools, saw approximately 40% of school-associated COVID-19 cases, the most of all schools in the region
  - It was expected that findings from analyzing Surrey schools would be applicable across the region and therefore, Surrey schools were the focus of this study
- **Inclusion criteria**:
  - **Case-level:**
    - Lab-confirmed cases of COVID-19 reported to Fraser Health between December 21 (14 days before school start date) and July 9, 2021 (14 days after school end date)
    - Enrolled in a Kindergarten to Grade 12 (K-12) school in a student or staff capacity (e.g. teacher, education assistant, janitor, etc.)
  - **School-level:**
    - Public or independent K-12 schools with at least one lab-confirmed COVID-19 case from different households reported within a 14-day period

Methodology

- **Data sources**
  - COVID-19 assessment form and vaccination status from the PARIS Clinical Information System
  - Variants of Concern (VoC) screening and whole genome sequencing (WGS) data provided by the BC CDC Public Health Laboratory
  - Ministry of Education for school denominators

- **Methods:**
  - Retrospective chart review of included cases conducted by a team of epidemiologists and analysts to confirm source and/or setting of acquisition
  - Acquisition setting for COVID-19 infection was identified based on standardized definitions, using exposure information, contact tracing data and symptom onset dates
  - When available, WGS and VoC data were used to deduct or confirm connection between cases
  - A Medical Health Officer (MHO) was consulted for complex and ambiguous cases, and reviewed a number of cases independently to identify any reproducibility issue

Standardized definitions: Acquisition setting

- **In-school acquisition**
  - **Likely:**
    - Case attended school during acquisition period
    - Case has no known exposure to a household or community case with symptom onset >1 day earlier, or other clusters or outbreaks identified by Fraser Health
    - Acquisition period of cases overlaps with infectious period of another case in the same school area (e.g. classroom, administrative area, school bus) and symptom onset dates are ≥2 days apart
  - **Possible:**
    - Case attended school during acquisition period
    - At least one other case in the same school area (e.g. classroom, administrative area, school bus) with a symptom onset <2 days apart, OR
    - Acquisition is equally possible in school and household/community setting (e.g. asymptomatic case where timing of acquisition could not be ascertained)

- Other possible acquisition settings:
  - Household acquisition
  - Community acquisition
  - Unknown acquisition

Additional methodological considerations

- If a case had potential acquisition from more than one setting, the hierarchy of classification was as follows:
  1. Household
  2. Community
  3. School

- Data from the BC CDC Public Health Laboratory for Variants of Concern (VoC) were used to rule out acquisition/transmission events when two cases has different variants identified. Data for VoCs were not available for all cases due to lab capacity and changes in screening and sequencing strategies over time.

Standardized definitions: Clusters and outbreaks

- **Confirmed cluster:**
  - At least one in-school transmission event (likely or possible) identified in a 14-day period in a school
- **Declared outbreak:**
  - Cluster with evidence of transmission to multiple classrooms and/or administrative areas, declared at discretion of MHO
- **Size of confirmed cluster or declared outbreak:**
  - Based on the number of likely or possibly in-school acquisition cases and the identified index case, regardless of index case's acquisition source

TRENDS IN SCHOOL ASSOCIATED CASES

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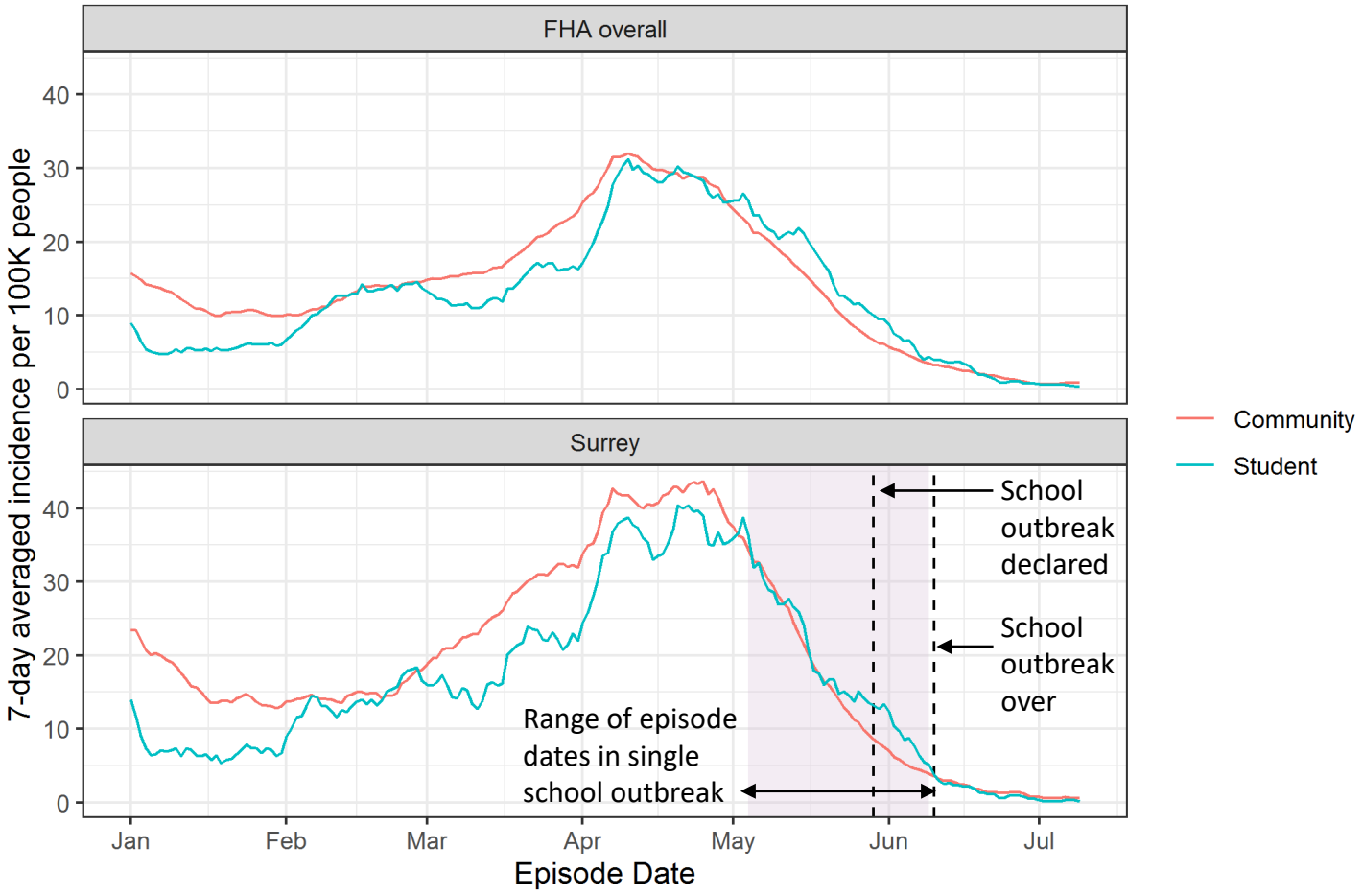
Similar trends in incidence among community and student cases



Key points:

- Trends in student case incidence were similar to trends in community incidence for both FHA overall and Surrey
- Student incidence in Surrey was below or at community incidence levels with exception of a school outbreak in late spring

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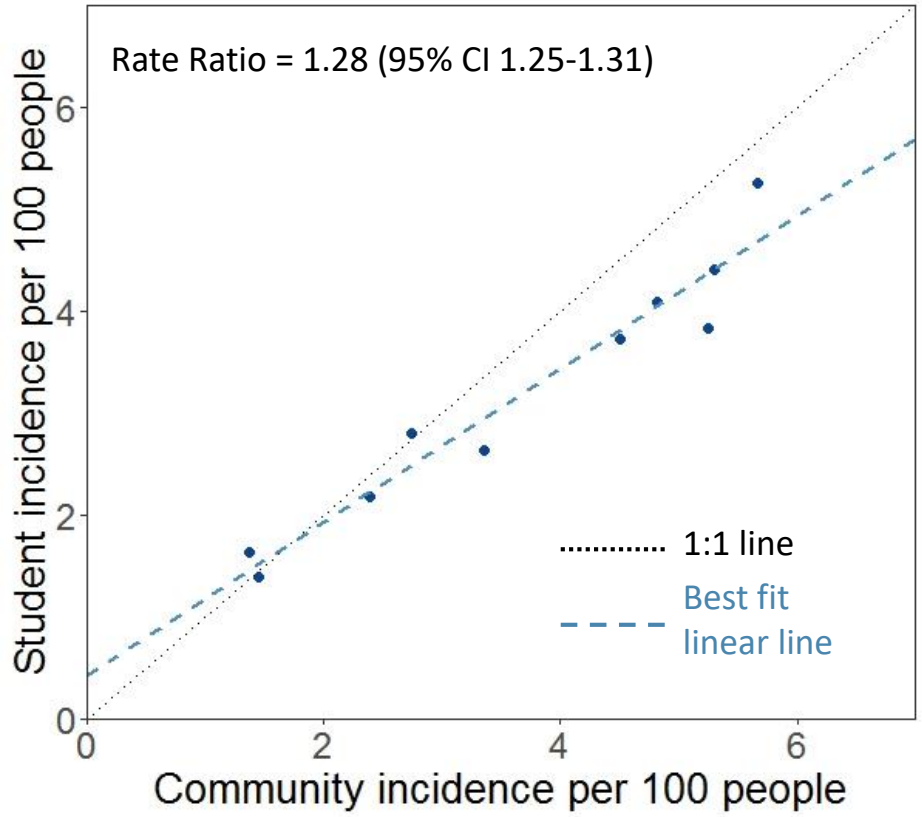
Increase in community incidence correlated with increase in school incidence



* Incidence refers to the cumulative incidence of cases with episode date between Jan 1 and July 9, 2021 in respective CHSAs

Key point:

- The risk of student cases increased by 28% (95% CI 25–31) for every 1 case per 100 population increase in community incidence (p<0·0001)

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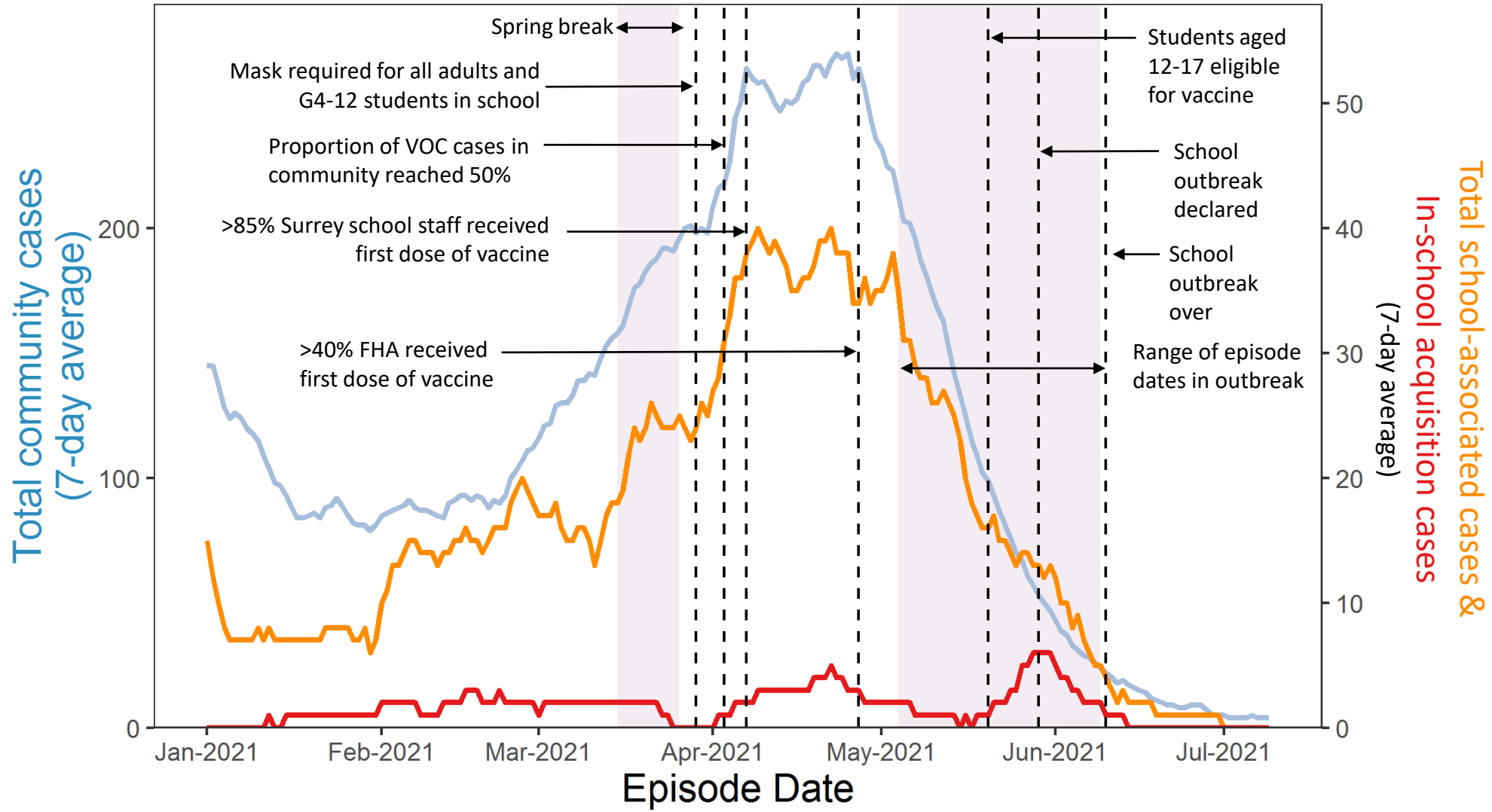
COVID-19 cases in Surrey/White Rock: Overall vs school



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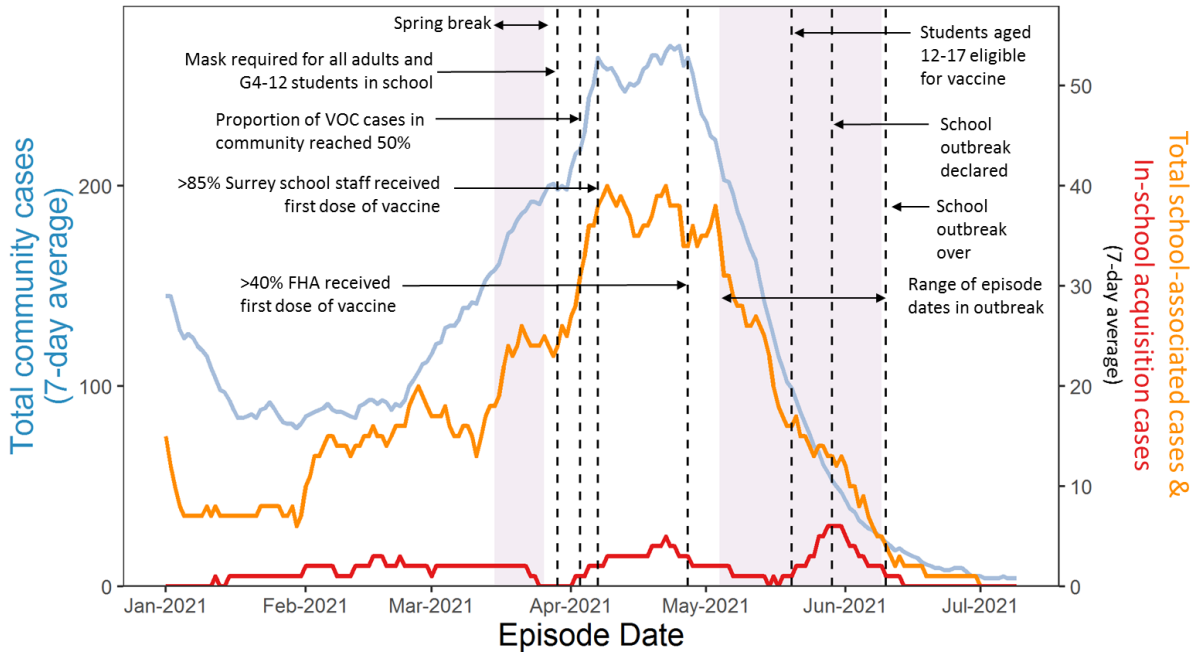
COVID-19 cases in Surrey/White Rock: Overall vs school



Key points:

- School-associated cases tended to match total community case trends over time.
- Cases continued to rise in the community during spring break.
- In-school acquisition represented the minority of total school-associated cases even when VoCs were more prevalent in the community, with exception of the period associated with the single school outbreak.
- Decline in community incidence in May occurred despite VoC prevalence and likely due to vaccination coverage.
    - School incidence matched this trend.

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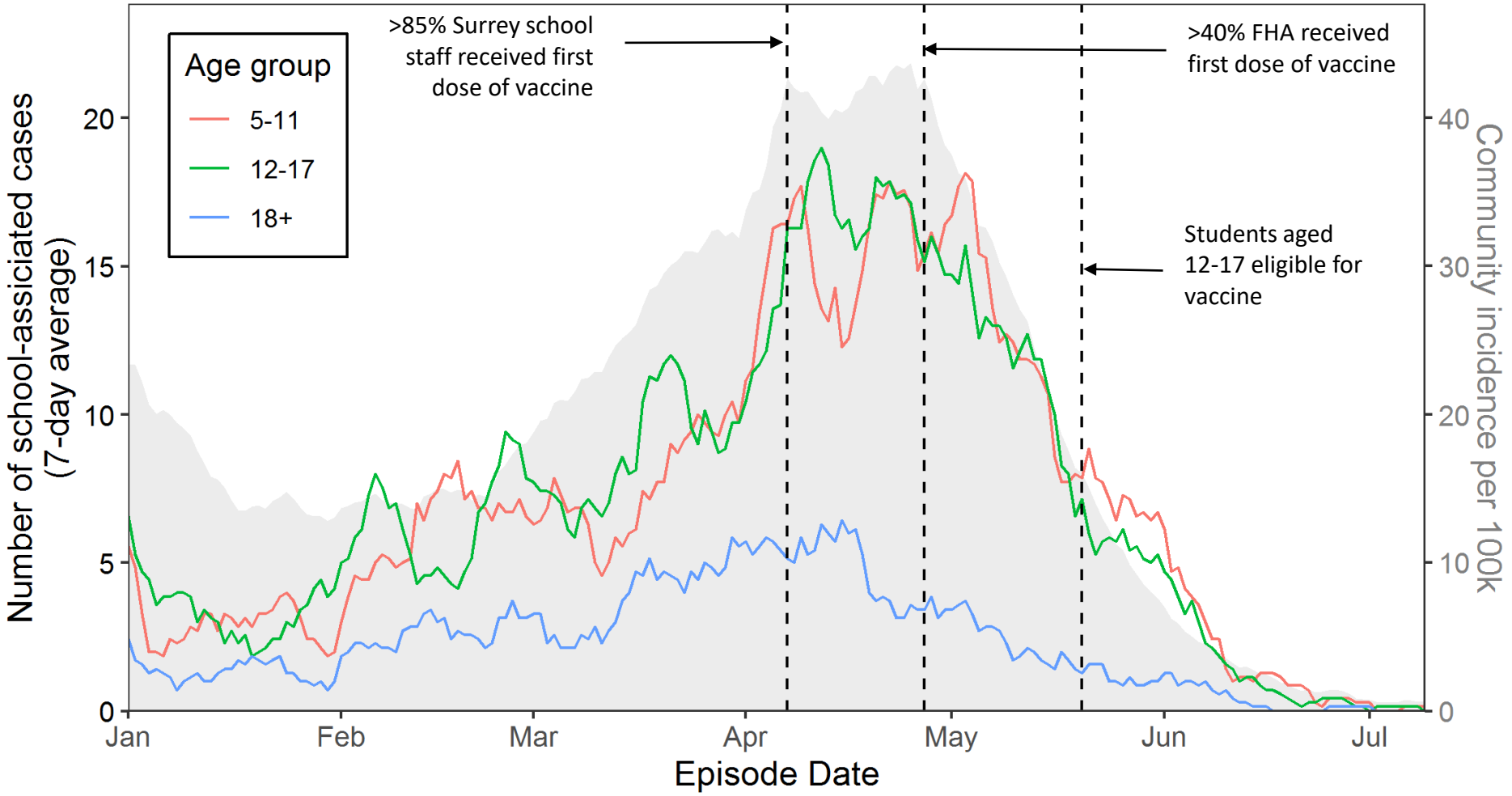
Relative proportions of staff vs student cases pre- & post-vaccination campaigns



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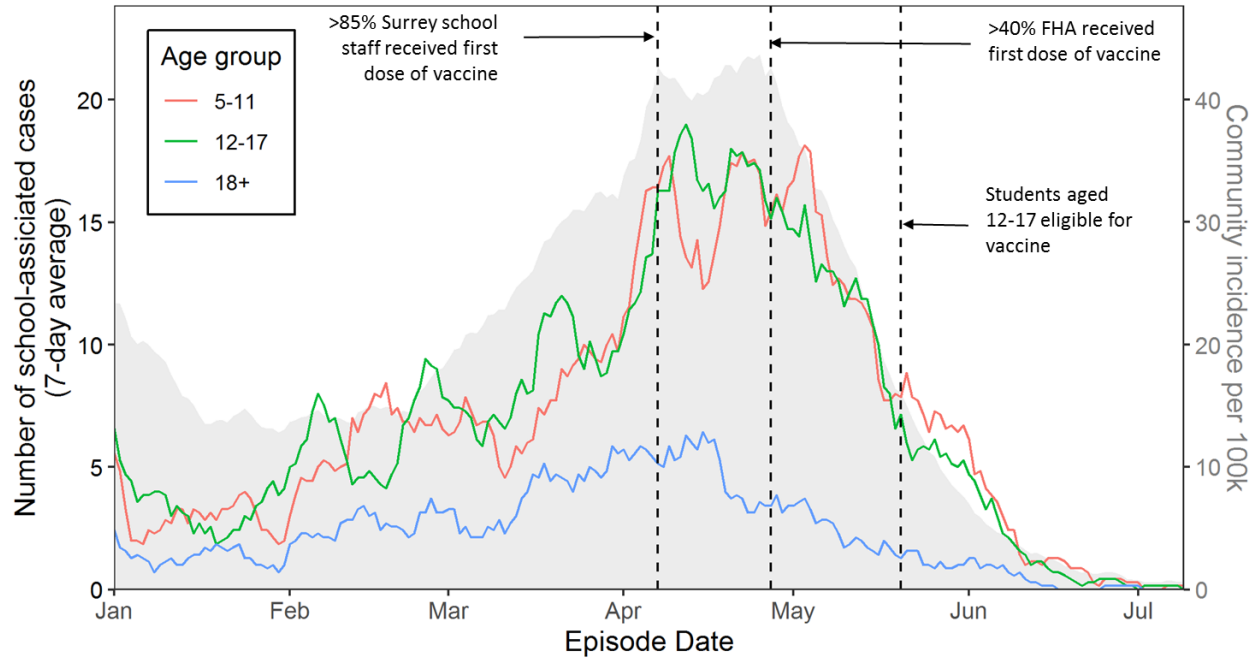

Key points:

- Cases in 18+ age group notably declined two weeks after >85% of staff received their first dose of vaccine.
- Decline in cases less notable for younger age groups, however, community incidence had declined as students ages 12-17 years were able to receive their first dose.

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RESULTS OF TRANSMISSION ANALYSIS

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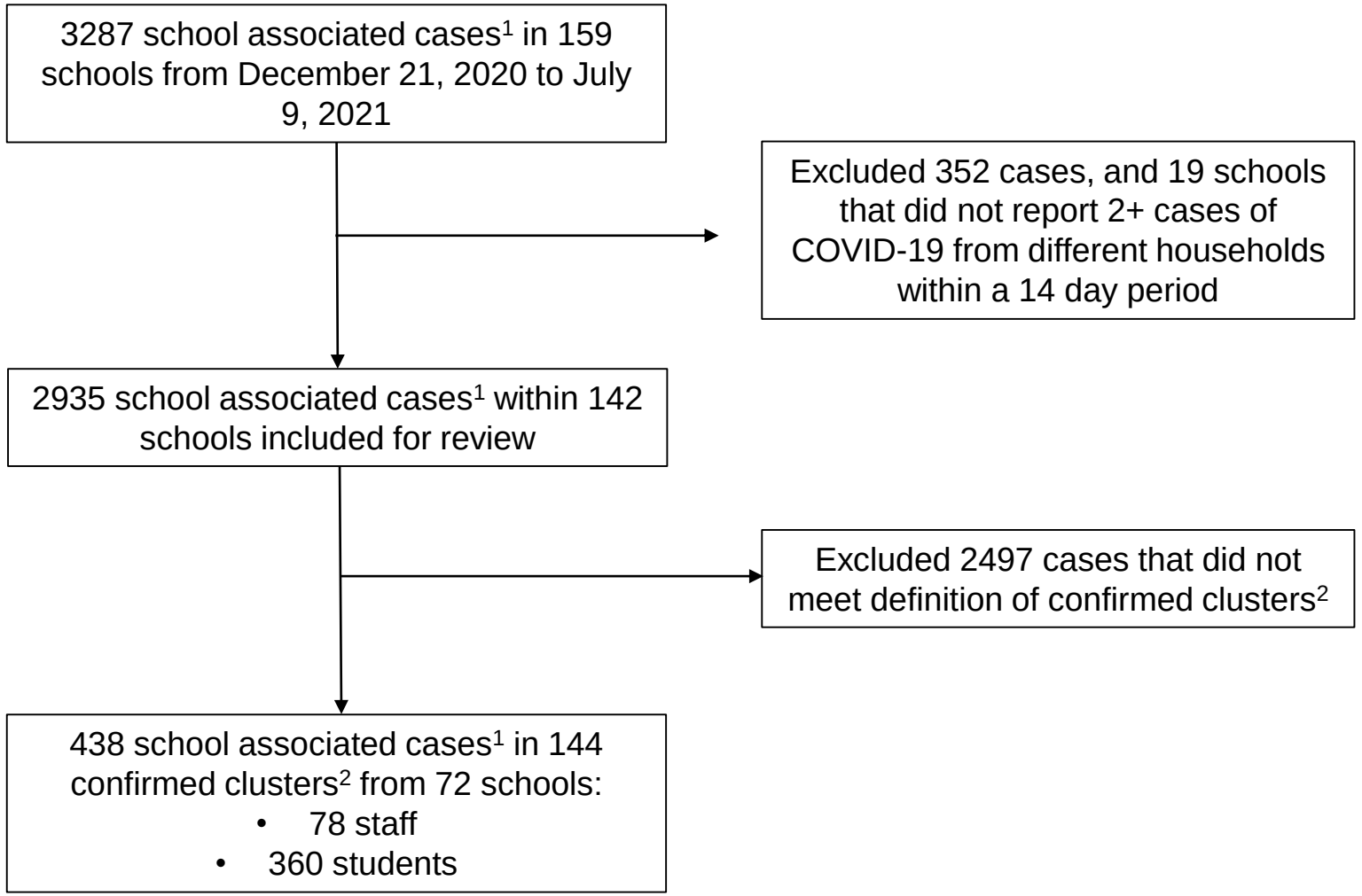
Data inclusion for transmission analysis



[1] School associated case: lab-confirmed cases of COVID-19 enrolled in a Kindergarten to Grade 12 (K-12) school in a student or staff capacity (e.g. teacher, education assistant, janitor, etc.) within the Surrey and South Surrey/White Rock Local Health Area (LHA).
[2] Confirmed cluster: At least one in-school transmission event (likely or possible) identified in a 14-day period in a school

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Characteristics of cases included in the review

Key points:

- A total of 2935 cases were included in the review, of which 89.1% were students and 10.9% were staff
- Serious outcomes were limited for confirmed cases

	Students		Staff		Total	
	n	**%**	**n**	**%**	**n**	**%**
Number of cases	2619	89.2	316	10.8	**2935**	**100**
Sex						
Female	1229	82.9	253	17.1	**1482**	**50.5**
Male	1390	95.7	63	4.3	**1453**	**49.5**
Mean age (range)	11.8 (5-20)		42.1 (19-75)		**15.0 (5-75)**	
Age category						
0-12	1435	100	0	0	**1435**	**48.9**
13-18	1180	100	0	0	**1180**	**40.2**
19-59	<5	-	293	98.7	**297**	**10.1**
>=60	0	0	23	100	**23**	**0.8**
Symptoms at testing						
Yes	2037	87.1	302	12.9	**2339**	**79.7**
No	582	97.7	14	2.3	**596**	**20.3**
Outcome						
Hospitalized	9	52.9	8	47.1	**17**	**0.6**
ICU admission	<5	-	<5	-	**5**	**0.2**
Died	0	0	0	0	**0**	**0**

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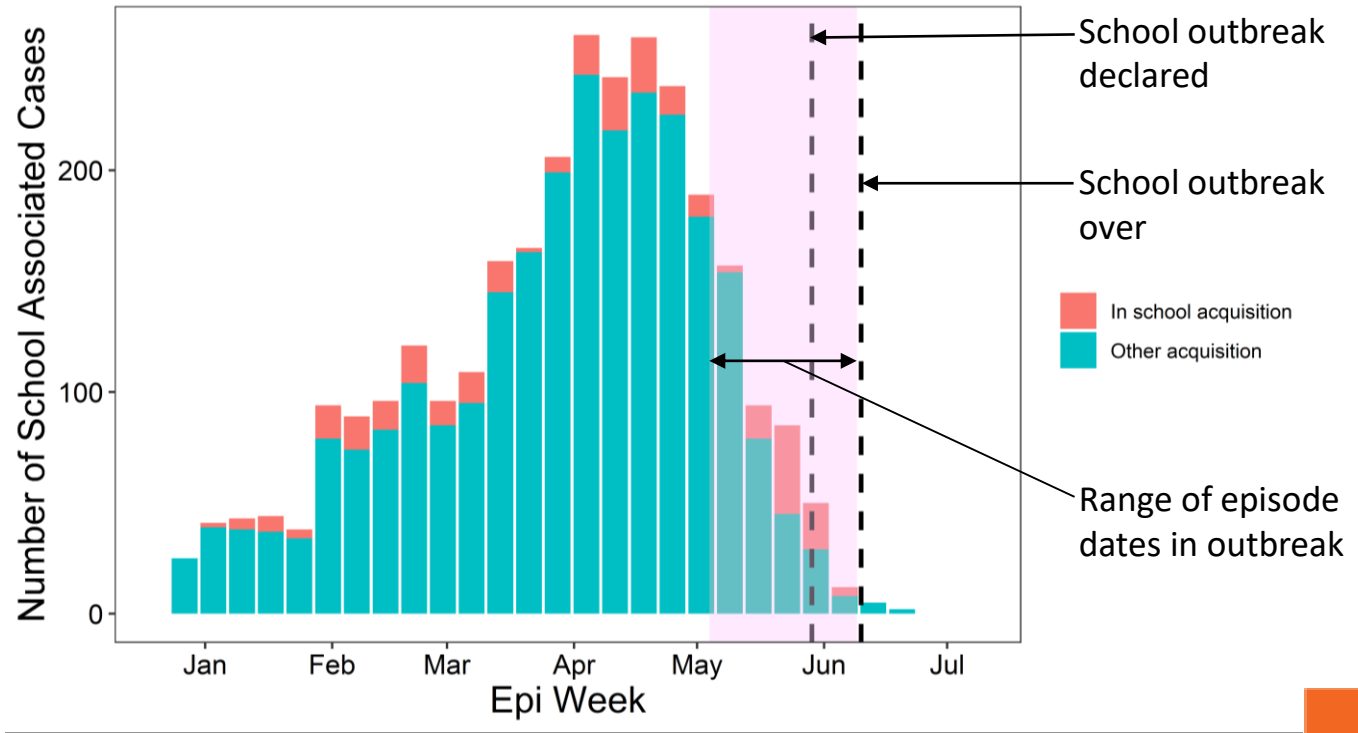
Acquisition setting among students and staff

Key points:

- A minority of cases had evidence of in-school acquisition over the study period, with exception of during the single school outbreak
- Staff were more likely to have acquired in school compared to students (15.5% vs 9.5%, p=0.002)

	Student cases		Staff cases		
	n	%	n	%	P-value
School					
Likely	197	7.5	39	12.3	0.005
Possible	53	2.0	10	3.2	0.195
Household	1413	54.0	89	28.2	<0.001
Community	577	22.0	70	22.2	0.988
Unknown	379	14.5	108	34.2	<0.001



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CONFIRMED CLUSTERS IN SCHOOLS

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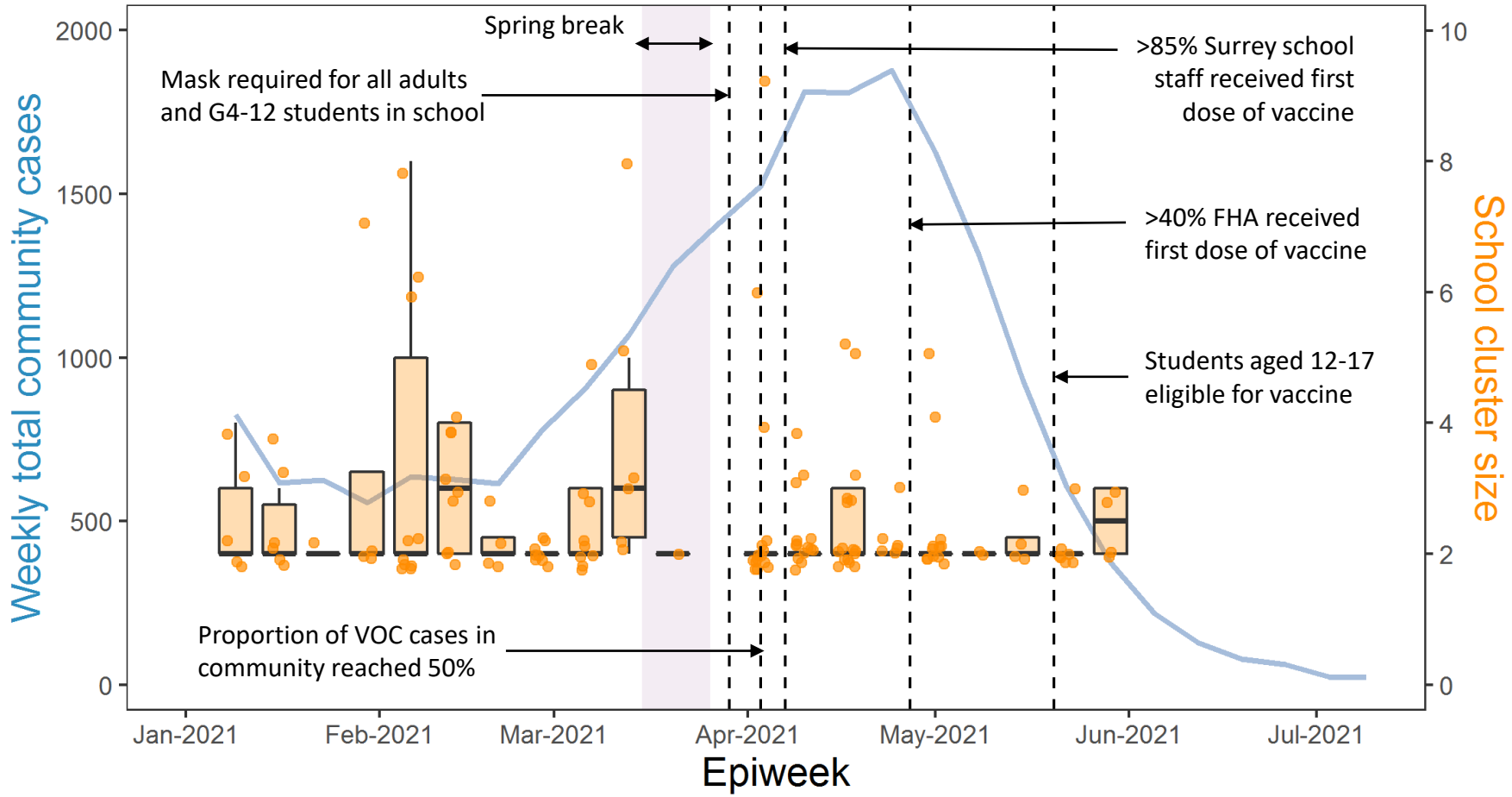
COVID-19 cases in Surrey/White Rock: Cluster size



*Epiweek for the clusters was based on the episode date of the first case in the cluster. Cases from the declared outbreak were not included in this figure.

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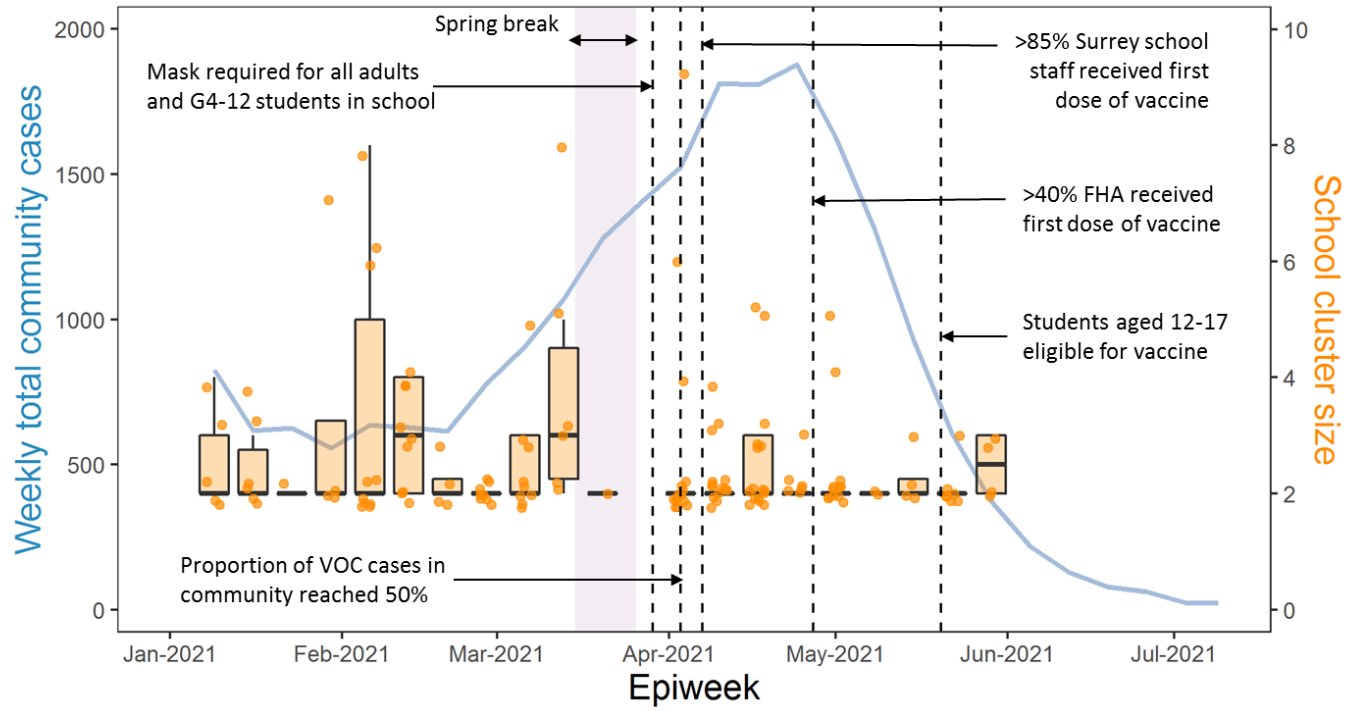
COVID-19 cases in Surrey/White Rock: Cluster size



*Epiweek for the clusters was based on the episode date of the first case in the cluster. Cases from the declared outbreak were not included in this figure.

Key point:

- Clusters were overall smaller following spring break, despite the increased prevalence of circulating VoCs.

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Characteristics of Confirmed School Clusters

Key point:

- Majority of public school clusters and nearly half of independent school clusters were limited to a size of two, that is, the index and one secondary case.

		School type				Total[1] N=143	
		Public n=120		Independent[1] n=23			
		n	%	n	%	n	%
Size of clusters	*Min, max*	2, 8		2, 9		2, 9	
	Median	2		3		2	
	Mean	3.1		3.9		3.3	
	Only 2 cases	90	75.0	11	47.8	102	71.3
Index case role	*Student*	82	68.3	15	65.2	97	67.8
	Staff	22	18.3	5	21.7	27	18.9
	Unknown index	16	13.3	3	13.0	19	13.3
Index case vaccination status	*Fully vaccinated[2]*	19	15.8	3	13.0	22	15.4
	1 dose	30	25.0	6	26.1	36	25.2
	Unvaccinated	55	45.8	11	47.8	66	46.2
	Unknown index	16	13.3	3	13.0	19	13.3
School level	*Elementary*	69	57.5	13	56.5	82	57.3
	Middle/Secondary	51	42.5	2	8.7	53	37.1
	All levels[3]	0	0.0	8	34.8	8	5.6
VoC detected	*Yes*	69	57.5	15	65.2	84	58.7
	No	51	42.5	8	34.8	59	41.3

[1] Excludes one declared outbreak with cluster size of 64 cases

[2] 'Fully vaccinated' includes receipt of 2 doses >7 days before symptom onset date (or specimen collection date if case is asymptomatic)

[3] 'All levels' includes elementary, middle, and secondary

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Variants of Concern (VoC) Among Cases of Confirmed Clusters

	VoC detected[1,2] n=84		VoC not detected n=59	
	n	**%**	**n**	**%**
Size of clusters				
Median	2		2	
Mean	2.7		2.5	
Min, max	2, 9		2, 7	
Number of cases per cluster				
2 cases	60	71.4	42	71.2
3 or more cases	24	28.6	17	28.8

[1] VOC screening for all SARS-CoV-2 PCR-positive specimen was implemented on April 6, 2021 by the BC CDC Public Health Laboratory

[2] Excludes one declared outbreak with cluster size of 64 cases that was predominately associated with Alpha VoC.

Key point:

- Clusters where a VoC was detected were not significantly larger than non-VoC associated clusters (mean= 2.7 vs 2.5, respectively, P=0.244)

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Variants of Concern Among Cases of Confirmed School Clusters

	Alpha[1,2] (B.1.1.7)	Beta (B.1.351)	Delta (B.1.617.2)	Gamma (P.1)	VoC unspecified[3]
Number of clusters	n=58	n=0	n=4	n=21	n=2
Size of clusters					
Median	2	0	2	2	2
Mean	3.9	0	2.75	2.2	2
Min, max	(2, 64)	0	(2, 5)	(2, 4)	(2, 2)
Number of cases per cluster (%)					
2 cases	37 (63.8)	0	3 (75)	18 (85.7)	2 (100)
3 or more cases	21 (36.2)	0	1 (25)	3 (14.3)	0

[1] VOC screening for all SARS-CoV-2 PCR-positive specimen was implemented on April 6, 2021 by the BC CDC Public Health Laboratory
[2] Includes one declared outbreak with cluster size of 64 cases
[3] 'VoC unspecified' refers to variants of concern detected through PCR screening but the specific variant was not classified

Key point:

- The majority of confirmed clusters were identified as Alpha variant (68.2%), followed by Gamma (24.7%)

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IN-SCHOOL TRANSMISSION EVENTS

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Directionality of transmission of cases included within confirmed clusters

	VoC not detected		VoC detected		Total	
Direction of transmission	**n**	**%**	**n**	**%**	**n**	**%**
Student-student	55	39.9	83	60.1	138	46.2
Student-staff	16	55.2	13	44.8	29	9.7
Staff-staff	10	62.5	6	37.5	16	5.4
Staff-student	20	50	20	50	40	13.4
Unclear direction	29	38.2	47	61.8	76	25.4
Total	130	43.5	169	56.5	299	100

Key points:

- Student-to-student (46.2%) was the majority of transmissions occurring during study period

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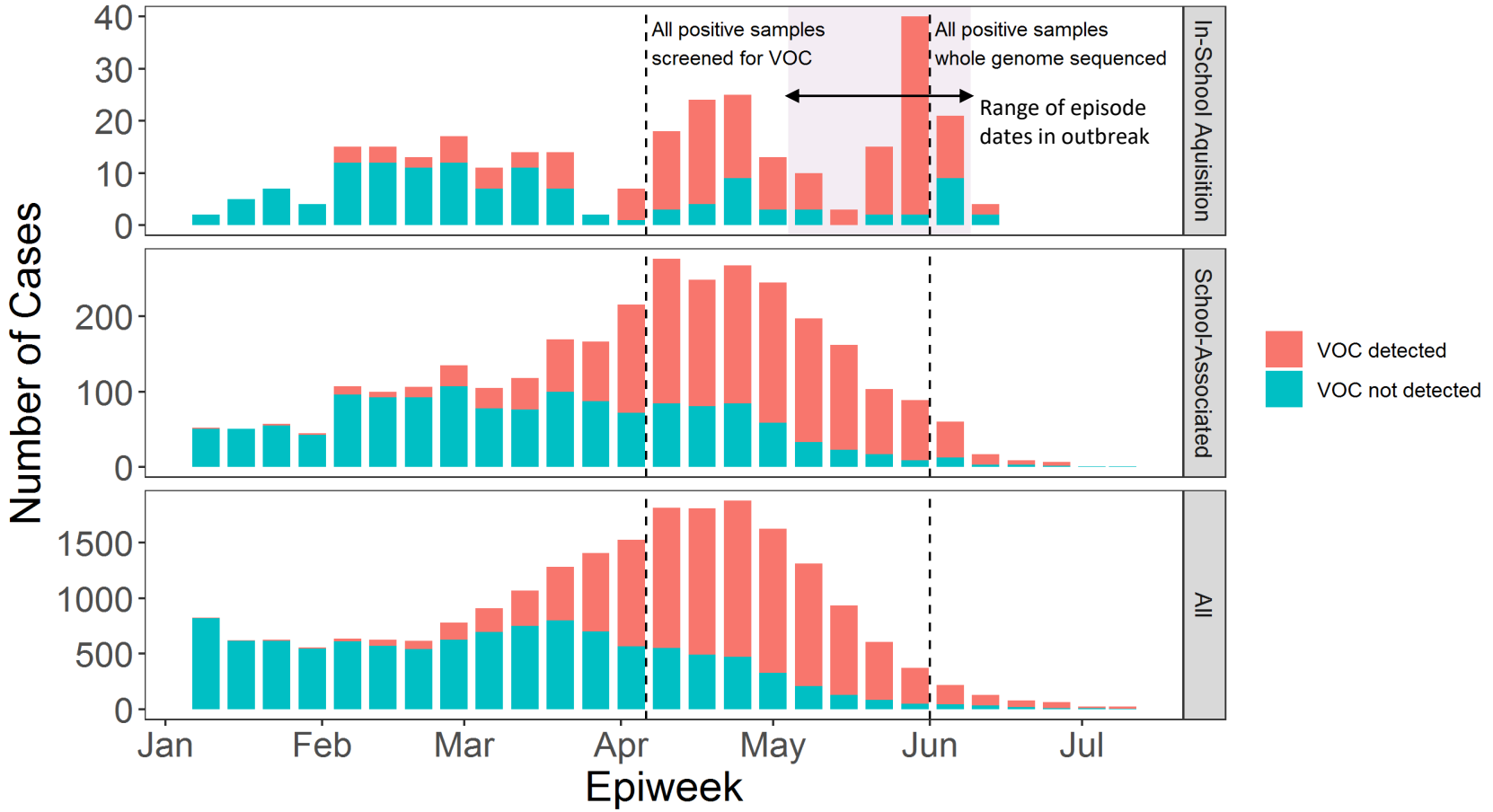
Variants of Concern among cases with in-school acquisition[1]



Key points:

- VoCs comprised an increasing proportion of confirmed cases over time overall in the Surrey and South Surrey/White Rock LHAs.
- This trends was reflected in school-associated cases and in cases of in-school acquisition.

[1] VOC screening for all SARS-CoV-2 PCR-positive specimen was implemented on April 6, 2021 by the BC CDC Public Health Laboratory

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Number of household/community transmissions that resulted from cases acquired at school

2935
cases examined

↓

299 (**10.2**%)
likely or possibly acquired from school among confirmed clusters

↓

183 (61.2%) led to no household or community transmission
116 (38.8%) led to household and/or community transmission

- Any household: N = 110 (36.8%)
- Any community: N = 12 (5.0%)

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Household/community transmission resulting from in-school acquisition of COVID-19

Household transmission[1]

Household transmission events	School-acquired case (n)	School-acquired case (%)
0	189	63.2
1	51	17.1
2	26	8.7
3	16	5.3
4	11	3.7
5 or more	6	2
Total	299	100.0%

[1] Household transmission events do not account for total number of household members

Household transmission events per school-acquired case:
Mean: 0.76
Median: 0

Community transmission

Community transmission events	School-acquired case (n)	School-acquired case (%)
0	284	95.0
1	15	5.0
Total	299	100.0%

Community transmission events per school-acquired case:
Mean: 0.06
Median: 0

Key point:
- Onward transmission from in-school acquisition was limited in both households and in the community

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Key findings (1)

- A total of 2935 school-associated cases were reported
  - This represents 2.9% of the total estimated staff and school population in Fraser region (approximately 101,900 staff and students)
- 14.9% were associated with a confirmed cluster or outbreak
  - 144 confirmed clusters in 72 schools involving 438 cases (78 staff, 360 students), with cluster size tending to be limited to 2 cases (median = 2.0 cases)
  - 1 outbreak in one school involving 64 cases
  - There 169 schools in Surrey School District boundaries including 135 public and 34 independent schools

Key findings (2)

- 67.4% (n=97) of confirmed school clusters were attributed to introduction of COVID-19 into schools by students
  - This was expected as students proportionately make up the majority of the school population
  - Staff are known to be involved in 18.8% (n=56) of transmission events
  - Approximately 59% (n=85) of in school transmission in confirmed clusters had identified VoC case(s), of which 68.2% (n=58) were predominantly the Alpha VoC
- Of the 299 cases (10.2% of all school-associated cases) who were likely/possibly acquired from school, 116 (4% of all school-associated cases) led to household/community transmission, and mostly within the household
  - Put another way, 89.8% of school-associated cases were acquired in the household/community

Key findings (3)

- Trends in school associated cases match community trends with incidence largely matched except during school outbreaks.
- While VoC were more predominant after spring break, clusters with VoC detected were comparable in size compared to non-VoC associated clusters (mean= 2.7 vs 2.5, respectively), with the exclusion of an outbreak with cluster size of 64 cases.
- Staff vaccination campaign was associated with noticeable drop in cases among 18+years of age in two weeks after >85% of staff had their first dose.

Limitations

- This study does not account for undetected cases (e.g. who did not get tested), which might lead to an under-estimate of the size of clusters and the number of cases associated with schools.
  - Children are more likely than staff to remain undetected due to a larger proportion of asymptomatic infections among this group.
- This study does not account for compliance with provincial K-12 measures and characteristics of the schools that may have impacted transmission such as classroom size and configuration, nature of instructional activity, and ventilation.
- Impact of newer VoCs, specifically the Delta variant, cannot be inferred from this study period as not yet prevalent in the community.

Recommendations and next steps

- Continue to promote vaccination as one of the most important measures to reduce COVID-19 cases in schools, in addition to a layered approach, including masks, to prevent COVID-19 transmission as outlined by provincial K-12 guidance

- Broad school closures are *not* recommended as spring break was not associated with a decline in cases in the community and in-school acquisitions had limited spread in households and in the community

- Continue to monitor school-associated cases across Fraser region as school re-opens for the fall