UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

ADRIANA AVILES, Individually and as Parent and Natural Guardian of N.A., N.A. and A.A., **STEPHANIE DENARO**, Individually and as Parent and Natural Guardian of D.D. and H.D., **CHRISTINE KALIKAZAROS,** Individually and as Parent and Natural Guardian of Y.K., **GAETANO LA MAZZA**, Individually and as Parent and Natural Guardian of R.L., **CRYSTAL LIA**, Individually and as Parent and Natural Guardian of F.L., and **CHILDREN'S HEALTH DEFENSE**,

Plaintiffs,

Against

BILL de BLASIO, in his Official Capacity as Mayor of the City of New York, **DR. DAVID CHOKSHI**, in his Official Capacity of Health Commissioner of the City of New York, **NEW YORK CITY DEPARTMENT OF EDUCATION, RICHARD A. CARRANZA**, in his Official Capacity as Chancellor of the New York City Department of Education and **THE CITY OF NEW YORK**,

Defendants.

APPENDIX OF EXHIBIT IN SUPPORT OF FIRST AMENDED COMPLAINT

Civil No.: 1:20−cv−09829−PGG

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Attorneys for Plaintiffs

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EXHIBIT NUMBER	**CITATION**
1	*COVID-19 Testing for Students and Staff*, NYC Dept., https://www.schools.nyc.gov/school-year-20-21/return-to-school-2020/health-and-safety/covid-19-testing.
2	*Chancellor Richard A. Carranza, Letter to Families dated Nov. 29, 2020,* https://hsmse.org/wp-content/uploads/2020/12/update-for-families-november-29-2020.pdf.
3	*NYC DOE Consent Form for COVID-19 Testing,* https://www.schools.nyc.gov/docs/default-source/default-document-library/student-covid-19-testing-consent-form---september-27-2020.
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7	*Silverberg and Sauve, Caring for Children with COVID-19,* BC Centre for Disease Control, BC Ministry of Health, April 3, 2020, http://www.bccdc.ca/Health-Professionals-Site/Documents/Caring-for-children.pdf.
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11	Armann et al, *Anti-SARS-CoV-IgG antibodies in adolescent students and their teachers in Saxony, Germany: very low seropraevalence and transmission rates*, MEDRXIV, Oct. 2020, https://www.medrxiv.org/content/10.1101/2020.07.16.20155143v4.
12	*COVID-19 Pandemic Planning Scenarios*, CENTERS FOR DISEASE CONTROL AND PREVENTION (Sept. 10, 2020), https://www.cdc.gov/coronavirus/2019-ncov/hcp/planning-scenarios.html (last accessed 12.15.20)
13	John Henry, *Schools are 'one of the safest places' for kids during pandemic, CDC director says*, WUSA9.COM (Nov 20, 2020) https://www.wusa9.com/article/news/health/coronavirus/cdc-director-schools-are-one-of-the-safest-places-for-kids-during-pandemic/65-b1cc9e39-d05f-4d56-8ac6-bab061228d59 (last accessed 12.15.20)
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15	*Mayor de Blasio and Chancellor Carranza Announce Plan to Return to In-Person Learning in New York City Schools*, (Nov. 29, 2020), https://www1.nyc.gov/office-of-the-mayor/news/817-20/mayor-de-blasio-chancellor-carranza-plan-return-in-person-learning-new-york#:~:text=NEW%20YORK%E2%80%94Mayor%20Bill%20de,rigorous%20testing%20protocols%20in%20place.&text=Middle%20and%20High%20Schools%20will%20remain%20remote%20for%20the%20time%20being.
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20	Hernández-Huerta, María Teresa PhD et al., *Should RT-PCR be considered a gold standard in the diagnosis of COVID-19?*, *JOURNAL OF MEDICAL VIROLOGY*, (Jul. 14, 2020), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7361438/ (last accessed 12.15.20)
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22	*Parents' Bill of Rights for Data Privacy and Security*, NYC DEPARTMENT OF EDUCATION, https://www.schools.nyc.gov/school-life/know-your-rights/parents-bill-of-rights-for-data-privacy-and-security

EXHIBIT 1

COVID-19 Testing for Students and Staff

On this page...

School-based Testing

Keeping school buildings open depends upon awareness of and immediate action on any COVID-19 concerns in our buildings. To do this, we need students and staff in our buildings to get tested! That's why we're instituting mandatory random weekly testing in all reopened school buildings as of December 7, 2020. Our testing partners will come to district schools each week and test a randomly selected group of staff and students from grades 1-12. The number of people to be tested will depend on the size of the school, but will consist of 20% of a school's population each month, students and staff included.

Exhibit 1

In order for your child to return to in-person learning, you must submit the consent form for in-school COVID-19 testing by the first day your child returns to their school building .

COVID-19 Testing in Schools | #ReturntoSchool2020

from NYC Public Schools

01:15

Mandatory in-school testing will happen weekly for a random selection of staff and students in all reopened school buildings. In order for your child to return to in-person learning, you must submit the consent form for in-school COVID-19 testing by the first day your child returns to their school building. 3K, Pre-K, and Kindergarten students are excluded from random testing.

- Submitting consent have your child tested for COVID-19 in school is quick and easy. If you have already submitted consent, we encourage you to do so again to ensure your student has the latest form on file. There are two easy ways to submit:
- Fill out the form online using a New York City Schools Account (NYCSA)
    - If you already have a NYCSA account linked to your student(s): Log in, click your student's name, click "Manage Account," and then when a dropdown menu appears, click "Consent Forms." Read the page, and then choose the consent option at the end for your student.

Exhibit 1

    - If you do not already have a NYCSA account: You can create one right away! If you have an account creation code from your school, you can create a full account in approximately five minutes, and then provide consent as described above. If you do not have an account creation code from your school, you can still provide your consent right away by clicking “Manage Consent” under “COVID-19 Testing” and filling out your and your child’s information to provide consent.
- Print and sign the form and bring it to your child’s school on the first day they are back in the school building. A printable PDF file is available in ten languages, under Consent Forms below.

This testing initiative is organized by our partners at NYC Health + Hospitals, the New York City Department of Health and Mental Hygiene (DOHMH), and the NYC Test & Trace Corps. The test is easy, quick, and safe. Instead of the “long swab” that goes in the back of the nose, this test is a short, small swab (like a Q-Tip) that goes just in the front of the nose. Later this school year, it is possible that tests will be administered by collecting a small amount of saliva (spit). The whole test will take about two minutes.

We want to assure you that if your child is selected for testing but is uncomfortable or unable to be tested, we will not test your child and will work with you to address any concerns so that they can participate in future testing. We are focused on making this a brief, and gentle experience for our students, led by trained testers.

If your child is tested, we will let you know they were tested and when and how you will receive the results, which will typically be provided within 48-72 hours.

Visit the Supplemental Information for Parents About DOE Agreements With Outside Entities to read answers to a number of questions vendors provided about their privacy and data security practices. The vendors are BioReference Laboratories, Fulgent Genetics, and Somos Healthcare.

Consent Forms

Student COVID-19 Testing Consent Form

Available in

Exhibit 1

English | Español | 中文 | বাংলা | Русский | اُردُو | عربي | Kreyòl
English | Spanish | Chinese | Bengali | Russian | Urdu | Arabic | Haitian Creole

한국어 | Français
Korean | French

Staff can use the Health Screening application to quickly and easily give consent to testing, or can use the consent form (log in to the InfoHub for access) to print out and return to your school.

Exemptions

Exemptions will only be granted in certain limited cases:

- For students who need a medical exemption, due to a health condition that would make it unsafe to undergo testing (e.g., facial trauma, nasal surgery), use the **Student Medical Exemption Form**, below. This form must be signed by a physician and you must submit medical documentation from a health care provider.
- For students with disabilities who cannot be safely tested in school due to the nature of their disability, use the **Student with Disabilities Exemption Form**, below.

Student Medical Exemption Form

Available in

English | Español | 中文 | বাংলা | Русский | اُردُو | عربي | Kreyòl
English | Spanish | Chinese | Bengali | Russian | Urdu | Arabic | Haitian Creole

한국어 | Français
Korean | French

Exhibit 1

Student with Disabilities Exemption Form

Available in

English_ English
Español_ Spanish
中文 _ Chinese
বাংলা _ Bengali
Русский _ Russian
اُردُو _ Urdu
عربي _ Arabic
Kreyòl _ Haitian Creole
한국어 _ Korean
Français_ French

Testing Results

Visit the COVID In-school Testing Results page to get school-based, borough and citywide date on testing.

Frequently Asked Questions

Special Cases

General Information

Consent from Families

Testing Process

Test Results

Priority Testing Outside of Schools

Get information and locations for testing at 22 Health and Hospital (H+H) testing sites during the 2020-2021 school year. Testing is being prioritized for all students and staff.

Sign the COVID testing consent form using your NYCSA account

Exhibit 1

Related Links

- COVID Testing Results
- Daily COVID Case Map
- Priority Testing
- Building Safety

Calendar

Wed, Dec 09, 2020

#NYCOfficeHours Virtual Town Hall en Espanol ▸

Thu, Dec 24, 2020 - Fri, Jan 01, 2021

Winter Recess: Schools Closed ▸

Mon, Jan 04, 2021

Return from Winter Recess ▸

Exhibit 1

Mon, Jan 18, 2021

Rev. Dr. Martin Luther King Jr. Day: Schools Closed ▸

View Key Dates Calendar ▸

Find a School

Transportation

School Meals

Exhibit 1

NYC Department of Education

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Accessibility Privacy Policy Sitemap

Exhibit 1

EXHIBIT 2

Department of Education
Chancellor Richard A. Carranza

November 29, 2020

Dear Families,

I hope you have had a restful break, and an opportunity to enjoy time with family.

As you are aware, on November 18, we temporarily closed school buildings for teaching and learning, and all New York City public school students transitioned to fully remote learning. Today, I am pleased to write to you with our plan to reopen school buildings for in-person instruction for many of our students. As always, health and safety remain our highest priorities, and this letter also contains information regarding mandatory weekly in-school testing for COVID-19 in all reopened buildings, and how you can submit the required consent forms.

The guidance below applies to students in blended learning, who have already chosen to learn in the school building part of the week, and from home the rest of the week. Students who chose fully remote learning prior to building closures will continue to learn remotely full time.

When can my child return to in-person learning?

- Students in Grades 3K through Grade 5 will return to in-person learning beginning on **Monday, December 7**.
  - This includes all students in grades 3K through 5, across early education and elementary school types (e.g., in K-2 schools, K-3 schools, K-5 schools, as well as District Pre-K Centers, K-8 schools, and K-12 schools).
  - This excludes schools currently located in State-designated Orange Zones, or Red Zones if they are declared. You can see if your school is currently in one of these Zones at http://nyc.gov/covidzone.

- Students in all grade levels in District 75 will return to in-person learning beginning on **Thursday, December 10**.
  - This also excludes schools located in State-designated Orange Zones, or Red Zones.

- Students in grades 6 through 12 (outside of District 75) will continue to learn remotely until further notice.

- Students who have recently traveled outside of New York to a place on the State's travel advisory list must quarantine for 14 days. You also have the option of testing out of quarantine based on the State's guidelines: https://coronavirus.health.ny.gov/covid-19-travel-advisory. Students should continue to complete the health questionnaire daily.

- These return dates apply to students in blended learning, including those who selected blended learning during the recent opt-in period.

What do I need to do to return to my school building?

In order for your child to return to in-person learning, you must submit the consent form for in-school COVID-19 testing by the first day your child returns to their school building. Testing will happen weekly for a random selection of staff and students in your child's school. Given the ongoing fight against a citywide resurgence of COVID-19, this mandatory weekly testing for COVID-19 is a crucial part of our plan to keep all schools safe.

Exhibit 2

Department of Education
Chancellor Richard A. Carranza

Any student in grade 1 or higher returning to school buildings must submit a consent form for COVID-19 testing in school by their first day back in school buildings.

- Any student in grade 1 or higher returning to school buildings must submit a consent form for COVID-19 testing in school by their first day back. 3K, Pre-K, and Kindergarten students are excluded from random testing.
- The test is quick, safe, and easy. A video showing the testing process is available at schools.nyc.gov/covidtesting.

How do I submit consent?

Submitting consent to have your child tested for COVID-19 in school is quick and easy. ***Even if you have already submitted consent, we ask you to do so again to ensure your student has the latest consent form on file***. There are two easy ways to submit:

1) Fill out the form online using a New York City Schools Account (NYCSA) at mystudent.nyc.

- If you already have a NYCSA account linked to your student(s): Log in, click your student's name, click "Manage Account," and then when a dropdown menu appears, click "Consent Forms." Read the page, and then choose the consent option at the end for your student.

- If you do not already have a NYCSA account: You can create one right away! If you have an account creation code from your school, you can create a full account in approximately five minutes, and then provide consent as described above. If you do not have an account creation code from your school, you can still provide your consent right away by clicking "Manage Consent" under "COVID-19 Testing" and filling out your and your child's information to provide consent.

2) Print and sign the attached form and bring it to your child's school on the first day they are back in the school building. A printable PDF file is available in ten languages at schools.nyc.gov/covidtesting.

Can my child receive an exemption from weekly random testing?

Exemptions will only be granted in certain limited cases:

- For students who need a medical exemption, due to a health condition that would make it unsafe to undergo testing (e.g., facial trauma, nasal surgery), you will be able to submit a separate form for consideration. This form must be signed by a physician and you must submit medical documentation from a health care provider.

- For students with disabilities who cannot be safely tested in school due to the nature of their disability, you will be able to submit a separate request for an exemption.

- The exemption forms will be available in English on Monday, November 30 at schools.nyc.gov/covidtesting. Translations will be available shortly thereafter.

Exhibit 2

Department of Education
Chancellor Richard A. Carranza

What happens if I don’t submit consent?

You must submit consent by the day that your child returns to your school building; this is the due date, and we need all students to participate.

- If your child comes to school on their first day back for in-person instruction without a consent form on file, principals and school staff will contact you to obtain consent.
- **After that, students without consent forms on file, who do not have a medical or disability-based exemption submitted, must be moved to fully remote instruction.** More information on exemptions will be provided by your child’s school principal this week.

What if my child’s school is in an Orange or Red Zone?

- As of now, schools in Orange Zones remain closed for in-person learning. We are working with the State to develop a plan to reopen buildings in Orange Zones as soon as possible.
- We will share information as soon as a plan is confirmed with the State of New York.
- There are currently no Red Zones in New York City, but per the State, school buildings in Red Zones would also be closed.

As always, I am grateful for your flexibility and patience as we continue our journey together through this unprecedented year. All of us at the DOE are focused on a strong, supportive education for your child every day—no matter where they are learning—and that will never change.

We look forward to welcoming students back into school buildings in the coming weeks.

Sincerely,

Richard A. Carranza
Chancellor
New York City Department of Education

To view a copy of this document in your language, visit schools.nyc.gov/messagesforfamilies

للاطلاع على نسخة مترجمة من هذه الوثيقة، يرجى زيارة الرابط schools.nyc.gov/messagesforfamilies	এই ডকুমেন্টের অনুবাদকৃত সংস্করণটি দেখতে, schools.nyc.gov/messagesforfamilies ভিজিট করুন	如要查看本文件的中文譯本，請上網到 schools.nyc.gov/messagesforfamilies
Pour voir une version traduite de ce document, allez sur schools.nyc.gov/messagesforfamilies	Pou wè yon vèsyon dokiman sa a nan lòt lang, ale nan schools.nyc.gov/messagesforfamilies	이 문서의 번역본은 schools.nyc.gov/messagesforfamilies에 있습니다.
Перевод документа находится по адресу: schools.nyc.gov/messagesforfamilies	Para ver una versión traducida de este documento, visite schools.nyc.gov/messagesforfamilies	اس دستاویز کی ترجمہ شدہ اشاعت دیکھنے کے لیے ذیل پر جائیں schools.nyc.gov/messagesforfamilies

Exhibit 2

EXHIBIT 3

NYC DOE CONSENT FORM FOR COVID-19 TESTING

What is this form?

We are seeking your consent to test your child for COVID-19 infection. The New York City Department of Education (NYC DOE), working with NYC Health + Hospitals and the New York City Department of Health and Mental Hygiene, has partnered with laboratories and other providers to test NYC DOE students, teachers, and staff members for COVID-19 infection.

How often would you test my child?

We are arranging for our laboratory and provider testing partners to come to every school at least once a month to test some of the students and staff. If you consent, your child may be selected for testing on one or more of these occasions. In addition, your child may also be tested throughout the school year (1) in accordance with state and city mandates, such as weekly testing in schools in Yellow Zones, or (2) if they exhibit one or more symptoms of COVID-19, or (3) if they are a close contact of a student, teacher, or staff person with COVID-19 infection.

What is the test?

If you consent, your child will receive a free diagnostic test for the COVID-19 virus. The attached letter provides more information about the types of tests that may be used. Collecting a specimen for testing involves inserting a small swab, similar to a Q-Tip, into the front of the nose and/or collecting saliva (spit).

How will I know if my child tests positive?

If your child has a specimen collected for testing at school, we will send information home with them to let you know. COVID-19 test results will generally be provided within 48-72 hours.

What should I do when I receive my child's test results?

If your child's test results are positive, please contact your child's doctor immediately to review the test results and discuss what you should do next. You should keep your child at home and inform your child's school. If your child's test results are negative, this means that the virus was not detected in your child's specimen. Tests **sometimes** produce incorrect negative results (called "false negatives") in people who have COVID-19. If your child tests negative but has symptoms of COVID-19, or if you have concerns about your child's exposure to COVID-19, you should call your child's doctor. If you need help finding a doctor, call (844) NYC-4NYC.

TO BE COMPLETED BY PARENT, GUARDIAN OR ADULT STUDENT

Parent/Guardian Information			
Parent/Guardian Print Name:			
Parent/Guardian Address:			
Parent/Guardian Tel./Mobile #:			
Parent/Guardian Email address:			
Best way to contact you			

Child/Student Information			
Child/Student Print Name:			
Child/Student School ID/OSIS #:		Child/Student Date of Birth:	

Exhibit 3

Child/Student School	
Child/Student Address:	

NOTIFICATION OF INFORMATION SHARING	
The law allows some information about your child to be shared with and among certain New York City and New York State agencies and their contracted service providers, including those listed below. This information will be shared only for public health purposes, which may include notifying close contacts of your child if they have been exposed to COVID-19, and taking other steps to prevent the further spread of COVID-19 in your school community. Information about your child that may be shared with these agencies and service providers conducting COVID-19 Testing includes your child's name and COVID-19 test results, date of birth/age, gender, race/ethnicity, school name(s), teacher(s), classroom/cohort/pod, enrollment and attendance history, and afterschool or other program participation, names of other family members or guardians, address, telephone, mobile number, and email address. Sharing of information about your child will **only** be done so in accordance with applicable law and City policies protecting student privacy and the security of your child's data.	
• NYC Department of Education	• NYC Department of Youth and Community Development
• NYC Department of Health and Mental Hygiene	• NYC Health and Hospitals Corporation
• NYS Department of Health	• Contracted Service Providers for COVID-19 Testing

CONSENT

By signing below, I attest that:

- I have signed this form freely and voluntarily, and I am legally authorized to make decisions for the child named above.
- I consent for my child to be tested for COVID-19 infection.
- I understand that my child may be tested at multiple times through September 30, 2021, and that testing may occur (1) on days scheduled by the NYC DOE in accordance with state and city mandates, such as weekly testing in schools in Yellow Zones, or (2) if they exhibit one or more symptoms of COVID-19, or (3) if they are a close contact of a student, teacher, or staff person with COVID-19 infection.
- I understand that this consent form will be valid through September 30, 2021, unless I notify the designated contact person from my child's school **in writing** that I revoke my consent.
- I understand that if I revoke my consent or refuse to sign, my child may be required to continue their education via remote learning.
- I understand that my child's test results and other information may be disclosed as permitted by law.
- I understand that if I am a student age 18 or older, or may otherwise legally consent for my own health care, references to "my child" refer to me and I may sign this form on my own behalf.

Signature of Parent/ Guardian* (if child is under age 18)		Date
Signature of Student (if age 18 or over or otherwise authorized to consent)		Date

Exhibit 3

EXHIBIT 4

COVID-19: Data

Latest Data

NEW: Our data layout now includes information on antigen testing and probable COVID-19 cases. Unless otherwise specified, most of our data will continue to reflect the results of molecular tests, such as PCR tests.

This page shows the latest data on COVID-19 in New York City. We update data every day in the early afternoon. You can also download our data and technical notes on Github.

Jump to:

- Latest Data Summary
- Percent Positive and Test Rate of Molecular Testing by ZIP Code (last 7 days)
- Cases, Hospitalizations and Deaths (last 3 months)
- Molecular and Antigen Testing (last 3 months)
- Molecular Testing Citywide and by Age (last 3 months)
- Emergency Department Visits (last 3 months)
- About the Data, Reporting Turnaround Time and Health Inequities

Exhibit 4

Summary

The table below compares the most recent week of key data to the weekly averages for the last four weeks.

Measure	Last 7 days	Weekly average (last 4 weeks)	Trend
Percent Positive Percent of people tested who test positive	**See Milestones**	**4.69%**	Increasing
Confirmed Cases People with a positive molecular test	**16,027**	**14,322**	Increasing
Probable Cases People with a positive antigen test, or symptoms and confirmed exposure, or probable death	**4,955**	**4,497**	Increasing
Total Cases	**20,982**	**18,818**	Increasing
Hospitalizations People hospitalized within 14 days of diagnosis	**1,368**	**1,046**	Increasing
Confirmed Deaths* Deaths with a positive molecular test	**116**	**100**	Increasing

Updated: December 15, at 1 p.m.

**Due to delays in death reports, the count of people who died in the last 7 days will likely be greater than what is currently reported.*

About the data for this chart. Get the data.

Expand All

Collapse All

Defining Confirmed and Probable Cases and Deaths

Types of Tests

Back to the top

Percent Positive and Test Rate of Molecular Testing by ZIP Code

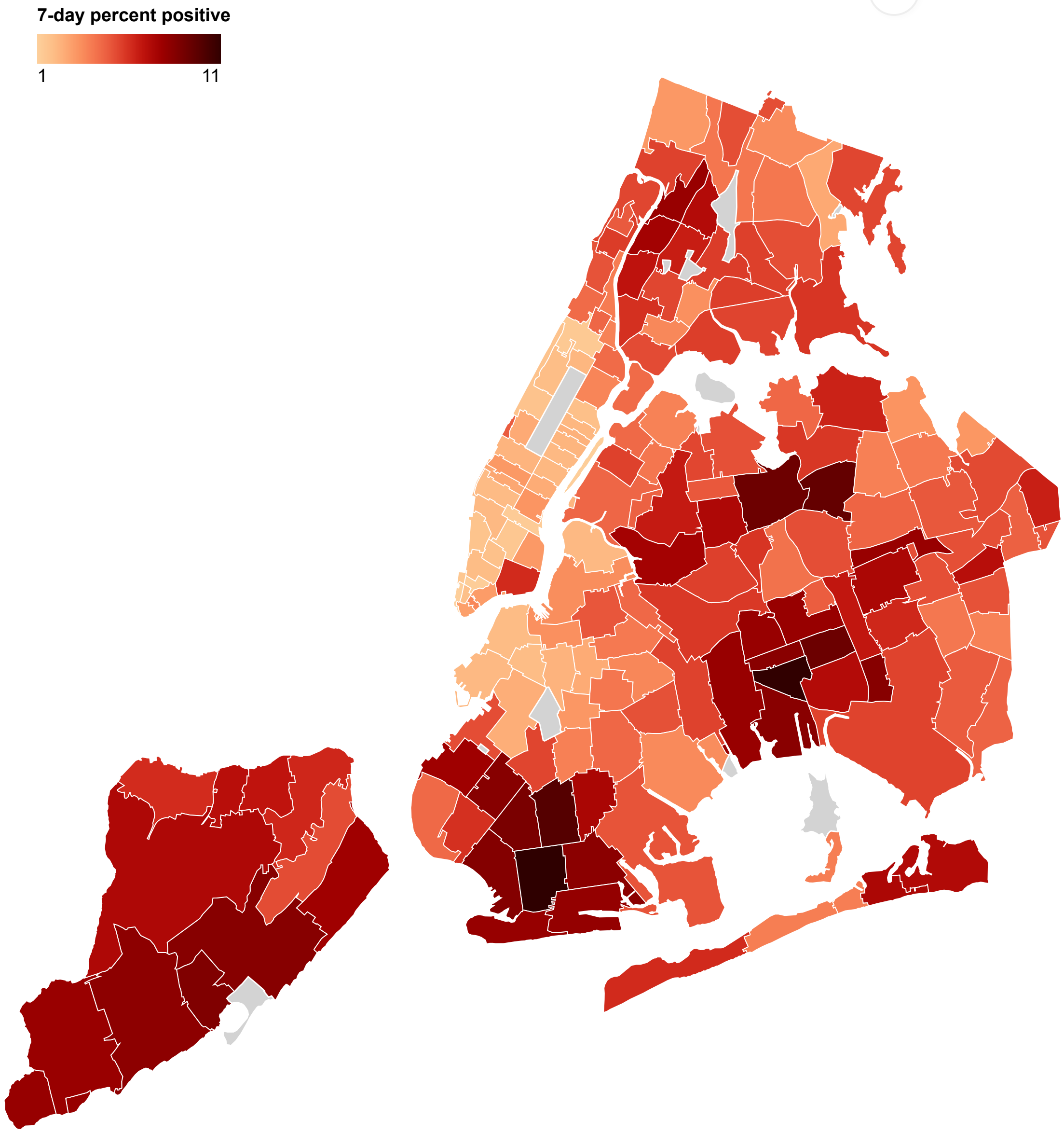
These data show the percent of people given a molecular test who tested positive, by ZIP code, for the most recent seven days of available data. The borough comparison charts include data by ZIP code from the past three months.

The data also show the rate of people given a molecular test during the most recent seven days. A neighborhood is considered to have adequate testing when at least 260 residents per 100,000 have been

Exhibit 4

tested in the past week. This metric of adequate testing may change depending on future testing data.

Map Table By borough



New people positive does not include people who previously tested positive. All data are incomplete. Data will be backfilled as new data are reported.

Get the data

Back to the top

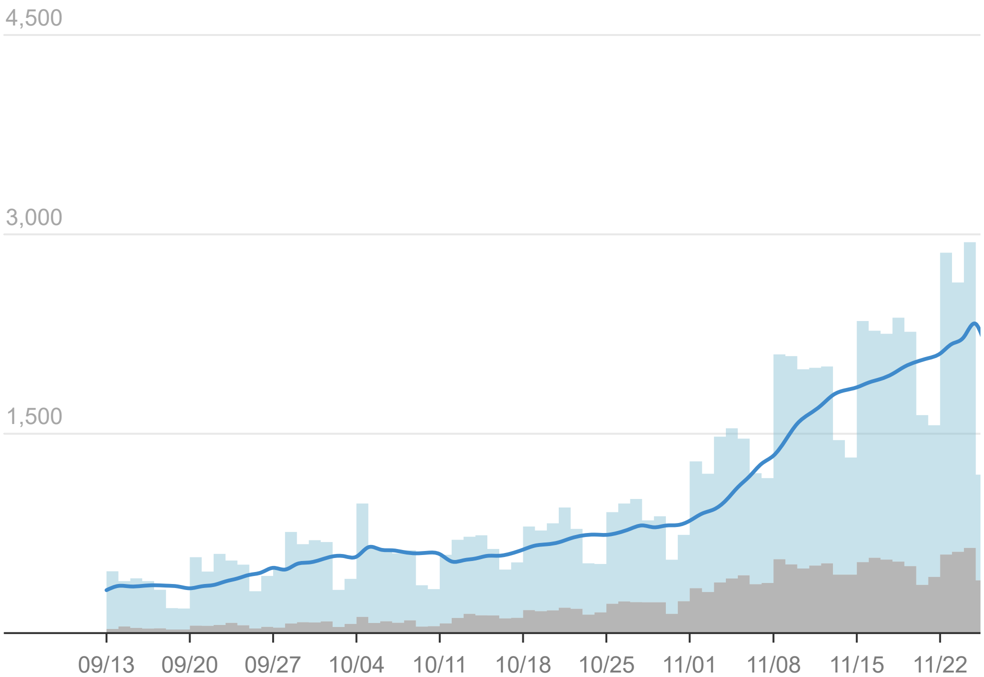
Daily Cases, Hospitalizations and Deaths

Exhibit 4

The charts below show the daily number of cases, hospitalizations and deaths over the past three months citywide and for each borough. This data includes both confirmed and probable cases and deaths, based on molecular and antigen testing, respectively. Due to delays in reporting, which can take as long as a week, recent data are incomplete.

Cases Hospitalizations Deaths By Borough

Citywide: cases Data from the most recent days are incomplete.



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Diagnostic Testing

This chart show the number of people tested by molecular tests and antigen tests.

Exhibit 4

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Molecular Testing Citywide and by Age

These charts show percent positivity and test rate for molecular tests.

Percent positive Percent positive, by age Test rate, by age

Exhibit 4

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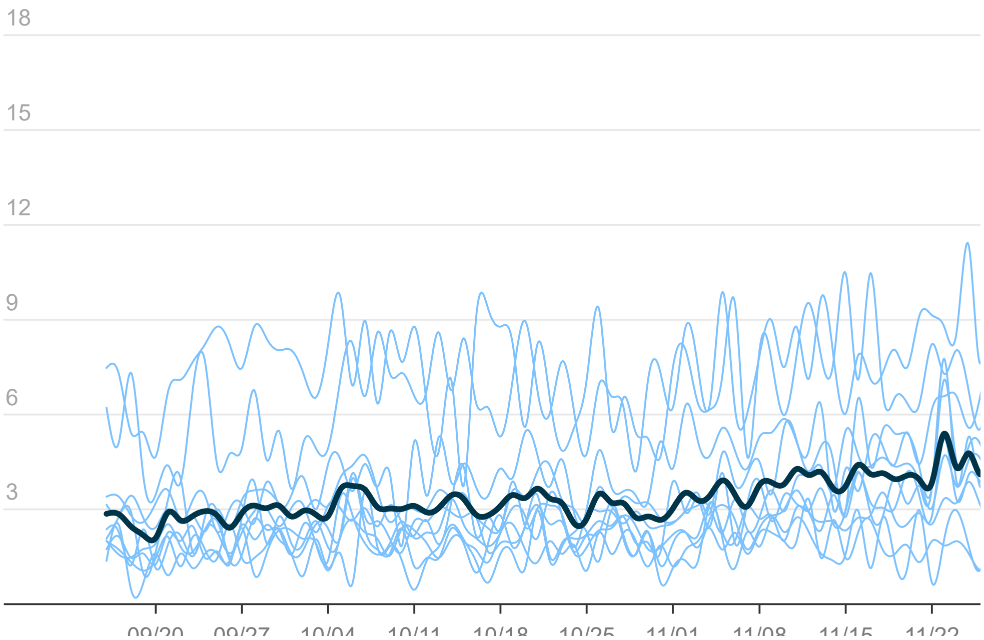
Emergency Department Visits

These charts show people who visited the emergency department with clinical signs and symptoms consistent with COVID-19 illness (including flu-like illnesses and pneumonia) during the past three months, and those who were then admitted to the hospital. While some of these people did not have a positive molecular or antigen test, these charts can be an early warning sign for community transmission of COVID-19.

Visits   Admissions

Rate of emergency department visits for influenza-like illness and pneumonia, per 100,000 people



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About the Data: All of the data on these pages were collected by the NYC Health Department. Data will be updated daily but are preliminary and subject to change.

Reporting Turnaround Time: Our data are published with a three-day turnaround time, meaning that the most recent data in today's update are from three days before.

This turnaround time is due to the standard delays (up to several days) in reporting to the Health Department a new test, case, hospitalization or death. Given the delay, our counts of what has happened in the most recent few days are artificially small. We delay publishing these data until more reports have come in and the data are more complete.

Exhibit 4

Health Inequities in Data: Differences in health outcomes among racial and ethnic groups are due to long-term structural racism, not biological or personal traits.

Structural racism — centuries of racist policies and discriminatory practices across institutions, including government agencies, and society — prevents communities of color from accessing vital resources (such as health care, housing and food) and opportunities (such as employment and education), and negatively affects overall health and well-being. The disproportionate impact of COVID-19 on New Yorkers of color highlights how these inequities negatively influence health outcomes.

Review how we are working to address inequities during this public health emergency (PDF).

Additional Resources

- NYC Public Schools COVID-19 Data
- NYC Contact Tracing Data
- COVID-19 Zone Finder

More Information

- Download archived data files (March 17 to May 17).

Exhibit 4

EXHIBIT 5

Covid-19 in schoolchildren

A comparison between Finland and Sweden

Folkhälsomyndigheten
PUBLIC HEALTH AGENCY OF SWEDEN

Terveyden ja hyvinvoinnin laitos

Exhibit 5

Article number: 20108-1

Exhibit 5

About the report

- This report has been written to compare the effect of different approaches in regards to school closure, as a response to the covid-19 pandemic.
- It adds to the knowledge of the effectiveness of measures aimed at the mitigation of covid-19.
- It could be of interest for any decision maker involved in choosing the most effective measures.
- This report has been produced in cooperation with the Finnish Institute for Health and Welfare THL, represented by Dr Hanna Nohynek, MD PhD and Dr Otto Helve, MD PhD.

The Public Health Agency of Sweden

Johan Carlson
General Director

Exhibit 5

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Abbreviations/glossary

Covid-19 – the infection caused by the new coronavirus SARS-CoV-2

ICU - intensive care unit

SARS-CoV-2 – the new coronavirus that causes covid-19

Exhibit 5

Summary

This report is a comparison between Finland and Sweden, two in many ways similar countries who applied different measures regarding schools during the covid-19 pandemic. There is no difference in the overall incidence of the laboratory confirmed covid-19 cases in the age group 1-19 years in the two countries and the number of laboratory confirmed cases does not fluctuate with school closure or change in testing policy in Finland. In Sweden, the number of laboratory confirmed cases is affected by change in testing policy. Severe covid-19 disease as measured in ICU admittance is very rare in both countries in this age group and no deaths were reported. Outbreak investigations in Finland has not shown children to be contributing much in terms of transmission and in Sweden a report comparing risk of covid-19 in different professions, showed no increased risk for teachers.

In conclusion, closure or not of schools had no measurable direct impact on the number of laboratory confirmed cases in school-aged children in Finland or Sweden. The negative effects of closing schools must be weighed against the positive indirect effects it might have on the mitigation of the covid-19 pandemic.

Exhibit 5

Background

This report is a comparison between Finland and Sweden, two in many ways similar countries who applied different measures regarding schools during the covid-19 pandemic. As covid-19 is a completely new infection to humankind there are still many question marks regarding what mitigation measures to apply for maximum effect.

Sweden is one of very few countries that decided to keep day care and primary schools open during the pandemic. School closure may have many negative effects, mainly of social character but also secondary effects such as parents having to stay at home with their children (1, 2). This could add to staffing problem for example in hospitals or other for society critical areas.

Children in general seem to be much less affected by covid-19 than adults (3, 4). They do not become severely ill in the same extent as adults and because of less severe symptoms or none at all, might be less infectious (5).

In Sweden this assumption and weighing in the negative effects of a school closure, resulted in the decision not to close day care or primary schools for children, when secondary schools and universities were closed on March 17.

In Finland on the other hand, all schools were closed on March 18 until May 13 with the exception of children in grades 1-3, who had the possibility to participate in regular on site teaching if their caretakers were working in areas that were considered critical for the society (18.3.-13.5) or if the caretakers deemed participation necessary (23.3.-13.5). However, caretakers of children in grades 1-3 were encouraged to have their children participate in distance learning from home.

Both in Finland and Sweden children usually start attending day care during their second year of life and preschool the year they turn six years old. Primary school is from seven to fifteen years of age followed by three to four years of secondary school. Regarding the population, Finland is about half the size of Sweden with 5,5 million inhabitants compared to 10,3 million.

Table 1. Number of schools and pupils

Country	Number of primary schools	Number of pupils (class 1-9, 7-15 y)	Mean number of children per school unit
Finland*	2 333	550 509	235
Sweden**	4 829	1 086 180	225

* Finnish National Agency for Education, 2018

**Swedish National Agency for Education 2019

Exhibit 5

Data

Table 2, Finland: Number of reported cases, number admitted in intensive care unit (ICU), number of deaths due to covid-19 and cumulative incidence of reported cases, per June 14, 2020.

Age group (school level)	Number of reported cases	Number admitted in ICU	Number of deaths	Population*	Incidence of reported cases (per 100 000)
1-5 years (day care)	96	0	0	269 246	36
6-15 years (pre- and primary school)	257	0	0	616 516	42
16-19 years (secondary school)	231	1	0	236 199	98
Total 1-19 years	584	1	0	1 121 961	52
Percentage of total number	8.2%	0.3%	0%	20.3%	
Total all ages	7 110	288	320	5 525 292	129

* Population numbers from Statistics Finland, as reported December 2019

Table 3, Sweden: Number of reported cases, number admitted in intensive care unit (ICU), number of deaths due to covid-19 and cumulative incidence of reported cases, per June 14, 2020.

Age group (school level)	Number of reported cases	Number admitted in ICU	Number of deaths	Population*	Incidence of reported cases (per 100 000)
1-5 years (day care)	98	2	0	610 904	16
6 -15 years (pre- and primary school))	370	6	0	1 225 478	30
16-19 years (secondary school)	680	6	0	451 965	150
Total 1-19 years	1124	14	0	2 288 347	49
Percentage of total number	2,1%	0,6%	0%	22.2%	
Total all ages	52 424	2 328	5 051	10 327 589	508

* Population numbers from Statistics Sweden, as reported November 2019

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Figure 1. Cases in Finland by age group and week of diagnosis. All schools closed week 12 to week 20. Extended testing started midweek 16.

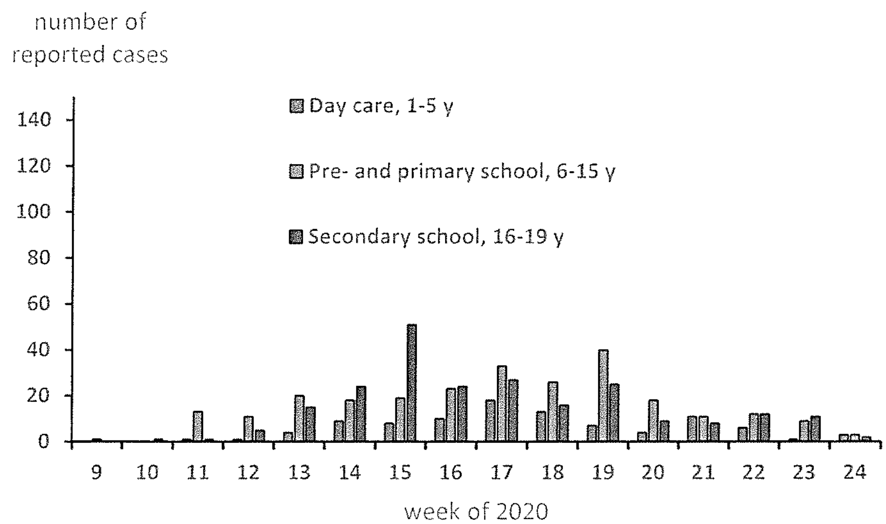

Figure 2. Cases in Sweden by age group and week of diagnosis. Secondary school closed week 12 and extended testing started week 22.

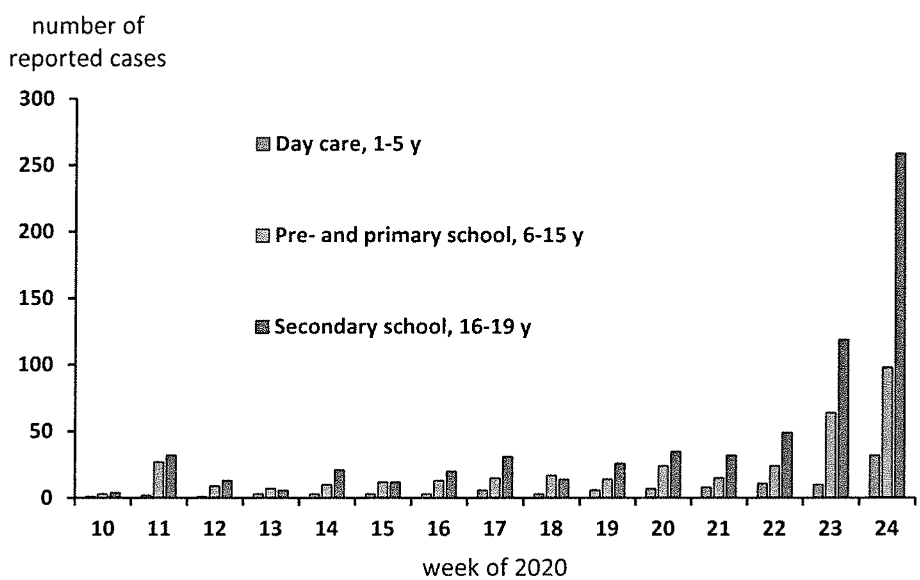

Table 4, Sweden: Number of teachers, cases among them and relative risk compared to other professions.

Teachers in	Number of teachers 2019/2020	Number of cases	Median age at diagnosis	Relative risk* (95% CI)
Day care	157 263	192	45	0.9 (0.7-1.1)
Primary school	105 418	160	50	1.1 (0.9-1.3)
Secondary school	30 357	29	47	0.7 (0.5-1)

* compared to other professions

Exhibit 5

Analysis/results

In Finland, primary school closures took place between March 18 and May 13. Primary schools were reopened between May 14 and May 31. During this reopening period, there were 23 primary school exposures (index cases) in 21 primary schools. Of the index cases, 16 were pupils and seven adults. There were 392 pupils and 54 adults placed under quarantine and the last quarantine ended on June 12. The Finnish Institute for Health and Welfare and the Ministry of Education issued restriction guidelines for primary school openings on the 4th of May. A key component of these guidelines was limiting the number of contacts in schools and therefore minimizing the number of possible quarantines. During the period May 14 to June 12 (the end of the last quarantine period), there were no secondary cases in any of the primary schools.

Primary school closure and reopening did not have any significant impact on the weekly number of laboratory-confirmed cases in primary school aged children (**figure 1**).

In Finland, the number of cases in primary school aged children has been less than half of their percentage of the population (**table 2**). In general, the testing guidelines for SARS-CoV-2 have not differed between children and adults and children with symptoms have been tested according to the same protocols as adults. Until April 15, testing was mostly focused on those belonging to risk groups and staff in healthcare. Thereafter testing was encouraged among all suspected cases of covid-19 infection.

The extremely low percentage of SARS-CoV-2 positive children requiring intensive care and no deaths underlines the age-specific pathology of covid-19.

In Sweden, the percentage of reported cases among schoolchildren is only one tenth of their percentage of the population. Also very few cases have been admitted to ICU and there has been no deaths reported in cases aged 1-19 years (**table 3**). **Figure 2** shows the epidemic curve for schoolchildren in Sweden per week where the somewhat higher number week 11 is related to extensive testing of people returning from spring break in Italy. In week 12 testing was limited to cases seeking hospital care. Also in week 12, secondary school and universities switched to on-line teaching, but day care and primary schools remained open. Because of the reduction in testing, contact tracing was limited in most parts of the country and no outbreak investigations performed in schools, missing any opportunity to fill the knowledge gap on the role of children in propagating the epidemic. The increase in number of cases from week 22 coincides with introduction of a more generous testing policy again, testing all with symptoms. In **table 4,** data from Statistics Sweden on individuals and profession was matched with reported cases to get an idea of which professions were overrepresented among reported cases (6). Compared to other professions, the relative risk among teachers in day care, primary and secondary school were close to one, indicating no increased risk of exposure and infection in this group.

Exhibit 5

The Public Health Agency of Sweden published a report on covid-19 and school children on May 29, summarising the findings and effects of keeping day care and primary schools open in Sweden (7).

Exhibit 5

Discussion

Schools have been closed in most countries affected by the pandemic, with the intention to protect children from being infected and to reduce the spread in general. It has been suggested that children may be important in spreading this infection, especially since they usually do not become very ill but still can have a high viral load (8-10).

The overall cumulative incidence among school-aged children in Finland and Sweden is similar even though Finland closed schools for most children and Sweden did not. Sweden has been much more affected by the pandemic than Finland but this does not show in the incidence among children. It is likely that many mild cases in children in Sweden never been detected since testing during week 12 to 22 mainly focused on persons seeking hospital care. By now it is evident that children are much less likely to develop serious disease if they become infected (3, 10, 11), meaning that keeping schools open might be less harmful for children than closing them.

In Sweden, outbreak investigations have been very limited in the regions with the highest number of cases due to strained resources. In the contact tracings in primary schools in Finland, there has been hardly any evidence of children infecting other persons. The Swedish comparison of number of reported cases among staff in day care and primary school to number of cases in other professions does not show any increased risk for teachers. This also indicates that the role of children in propagating this infection is likely to be small. Various papers on contact tracing have also found that children rarely are the first case in family clusters (4, 12, 13).

In the US, a peer reviewed paper has been published suggesting that children might be the best group to target for covid-19 immunization in order to reduce the spread of the virus also to other groups, comparing it with other respiratory infections like influenza and pneumococcal infections (14). This theory is not supported by the findings in our report.

Another study, still only available as a pre-print, finds school closure to be the most effective non-pharmaceutical intervention when looking at a number of countries and different interventions (15). However, as they do point out, it might be a confounded finding as it was one of the first interventions in most countries, thus raising the awareness of the gravity of the situation, which would affect behaviour in general.

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Conclusions

- Closing of schools had no measurable effect on the number of cases of covid-19 among children.
- Children are not a major risk group of the covid-19 disease and seem to play a less important role from the transmission point of view, although more active surveillance and special studies such as school and household transmission studies are warranted.
- The negative effects of closing schools must be weighed against the possible positive indirect effects it might have on the mitigation of the covid-19 pandemic.

Exhibit 5

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EXHIBIT 6

Children are unlikely to have been the primary source of household SARS-CoV-2 infections

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YZ: Masters
CJB: Bachelors
KDH: Bachelors
JES: Bachelors
MT: Masters
LES: Bachelors
ECN: Bachelors
JL: PhD
KYC: PhD
JP: PhD
CG: PhD
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Exhibit 6

ABSTRACT

BACKGROUND: Since its identification on the 7th of January 2020, SARS-CoV-2 has spread to more than 180 countries worldwide, causing >11,000 deaths. At present, viral disease and transmission amongst children is incompletely understood. Specifically, there is concern that children could be an important source of SARS-CoV-2 in household transmission clusters.

METHODS: We performed an observational study analysing literature published between December 2019 and March 2020 of the clinical features of SARS-CoV-2 in children and descriptions of household transmission clusters of SARS-CoV-2. In these studies the index case of each cluster defined as the individual in the household cluster who first developed symptoms.

FINDINGS: Drawing on studies from China, Singapore, South Korea, Japan, and Iran a broad range of clinical symptoms were observed in children. These ranged from asymptomatic to severe disease. Of the 31 household transmission clusters that were identified, 9.7% (3/31) were identified as having a paediatric index case. This is in contrast other zoonotic infections (namely H5N1 influenza virus) where 54% (30/56) of transmission clusters identified children as the index case.

INTERPRETATION: Whilst SARS-CoV-2 can cause mild disease in children, the data available to date suggests that children have not played a substantive role in the intra-household transmission of SARS-CoV-2.

FUNDING: KRS was supported by the Australian Research Council [DE180100512]. ACB receives funding from the National Health and Medical Research Council with an Investigator Award (1175509). The sponsors of this study had no role in the study design, collection, analysis, and interpretation of data, report writing, or the decision to submit for publication.

INTRODUCTION

On the 31st of December 2019, the World Health Organisation (WHO) was informed of a series of unknown pneumonia cases emerging in Wuhan City, Hubei Province, China. On the 7th of January, 2020 the causative agent of these infections was identified as a novel coronavirus subsequently named SARS-CoV-2. This virus eventually spread to more than 180 different countries worldwide and in March 2020 the WHO declared SARS-CoV-2 a pandemic. At the time of writing (22nd March, 2020) SARS-CoV-2 has infected >274,000 people resulting in >11,000 deaths.[1] Large data analyses have shown that the elderly are particularly susceptible to severe forms of COVID-19 (the clinical manifestation of SARS-CoV-2 infection).[2] However, disease severity and transmission amongst the paediatric population is less well defined. In an analysis of the 44,672 confirmed COVID-19 cases in China only 2·1% were found to be in children (≤19 years of age),[2] suggesting a reduced rate of infection in this age group. However, this observation remains controversial as others have suggested that the rate of SARS-CoV-2 infection in children under ten (7·4%) is similar to the population average (7·9%).[3] The current consensus is that clinical symptoms of COVID-19 are, on average, milder in children (although severe infections can still occur).[4–8] Such observations are consistent with the lower incidence of severe disease amongst children following infection with other coronaviruses including severe acute respiratory distress syndrome (SARS) or Middle East respiratory syndrome (MERS).[9,10] However, this lower incidence of clinical symptoms (and therefore lower incidence of detected disease) raises concerns that children could be an important source of SARS-CoV-2 in household transmission clusters.[8]

To address this question we performed an observational study using currently published literature of the clinical features of SARS-CoV-2 in children and descriptions of household transmission clusters of SARS-CoV-2.

METHODS

Data collection

We retrospectively investigated published and publically released, de-identified, data made available between Dec 1, 2019, and March 18, 2020. Information was accessed from World Health Organization news[11], local health authority's news releases, Google Scholar, PubMed, the Lancet COVID-19 resource centre[12], Clinical Infectious Disease Journal, New England Journal of Medicine, and three Chinese databases (CNKI, Wanfang, and CQVIP).

We performed the searching and reviewing using the terms ("severe acute respiratory syndrome coronavirus 2"[All Fields]) OR ("SARS-CoV-2"[All Fields]) OR ("COVID-19" [All Fields]) AND ("Children"[All Fields] OR "Paediatric"[All Fields]) OR ("Family"[MeSH Terms] OR "Family"[All Fields])". To examine H5N1 avian influenza household transmission eventS, we used search queries "H5N1[All Fields] AND ("Children"[All Fields] OR "Paediatric"[All Fields]) AND (family cluster[All Fields])". A total of 166 articles were

Exhibit 6

retrieved and reviewed (available in either English or Chinese). Of these, 126 articles were excluded because i) they did not report paediatric infections ii) did not report sufficient individual case data and/or iii) did not report family clusters. Individual paediatric patient data was obtained from the reviewed studies and was only excluded if the individual was recorded as having leukaemia (n = 1) or if the blood panel data was descriptive, rather than numerical (e.g. 'elevated platelets') (n=10). The intra-household transmission clusters were also sourced from information provided by local health authority's news of China, Europe, France, Germany, Italy, Japan, and South Korea when available. Any intra-household cluster identified in these local sources was included in the study.

SARS-CoV-2 case definition and diagnosis

Case definitions and diagnosis, epidemiological investigation of SARS-CoV-2 cases and laboratory-confirmed test assays were according to the relevant national diagnostic criteria. The incubation period was defined as the time from exposure to the onset of illness, which was estimated among patients who could provide the exact date of close contact with individuals with confirmed SARS-CoV-2 infection.

Definitions of household transmission clusters

A household transmission cluster was defined as a group of ≥ 2 confirmed cases of SARS-CoV-2 or H5N1 influenza virus infection in co-habiting individuals in whom the onset of cases occurred within 2 weeks of each other. Co-habiting individuals were defined as parents, children, partners, siblings, grandparents, grandchildren, uncle/aunts, nieces/nephews, family-in-law and live-in employees. The index case of each cluster was defined as the individual in the household cluster who first developed symptoms. Adults were defined as individuals equal to or over the age of 18 whilst children were defined as individuals less than 18 years of age. The decision tree used to classify household transmission clusters is shown in Figure 1.

Role of the funding source – The sponsors of this study had no role in the study design, collection, analysis, and interpretation of data, report writing, or the decision to submit for publication.

RESULTS

We identified 166 articles that described SARS-CoV-2 infection in children, rejected 126 articles due to a lack of sufficient and or appropriate data and derived a total of 40 articles in addition to case information obtained from local news sources.

A broad range of disease severity was observed (Table 1). Whilst approximately 19% of paediatric cases were asymptomatic, severe cases (12%) were still observed. In children, the predominant symptoms associated with disease onset were fever (77%) and cough (59%), whilst only a minority of children were reported to display fatigue (2%). The majority of children showed abnormal chest computer tomography (CT) although almost 30% of cases had normal chest CTs. The mean incubation period across these studies was 7.74 d ± 3.22.

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Mean complete blood counts were largely unremarkable, with the mean values falling within the normal reference ranges for children aged 6-12 years[46]. (Table 1). In contrast, blood chemistry analysis showed that the mean value of c-reactive protein (18.46 mg/L) was elevated compared to the 10mg/L suggested as the upper limit of the normal reference range for children[47]. Similarly, the mean level of lactate dehydrogenase level detected in the blood of children infected with SARS-CoV-2 (315.75U/L) was elevated relative to the recommended reference range for children aged 1 to 10 years (<305U/L)[48]. Together, these data suggest that SARS-CoV-2 induces a broad range of clinical symptoms in children and can manifest as either an asymptomatic, mild or severe infection.

Asymptomatic infections experienced by children infected with SARS-CoV-2 could have important implications for transmission. Specifically, a number of asymptomatic or mild paediatric cases could result in children driving the intra-household transmission of SARS-CoV-2.[8] To investigate this hypothesis, we examined the available published data on SARS-CoV-2 household transmission clusters. A total of 31 household transmission clusters were identified with sufficient information available to include in this analysis (Table 2). These cases were drawn from China, Singapore, the USA, Vietnam, and South Korea. Of these transmission clusters, only three (9·7%) were identified as having a paediatric index case (Table 2). Importantly, these data do not suggest that children are not becoming infected with SARS-CoV-2, as isolated paediatric SARS-CoV-2 infections would not be captured in reports of household transmission (and are indeed shown in Table 1). Rather, these data suggest that to date, children have not been the primary source of household SARS-CoV-2 infections.

The limited number of defined SARS-CoV-2 household clusters with children as the index case could have been influenced by the fact that disease in children can be asymptomatic. Accordingly, it is possible that within a household cluster children were not correctly identified as the index case of the infection (i.e. the first to develop symptoms) and were instead mistakenly identified as a contact case. To exclude this possibility, we reanalysed the data looking at the number of families where an adult was identified as the index but one or more children were identified as asymptomatically infected (Figure 1). However, even if we assume that all asymptomatic children in these families were in fact the index case, only 6/28 (21%) children were identified as the index case in the household cluster (Table 2). These data suggest that even if children are being mistakenly overlooked as the index case, they are still likely to only have accounted for a limited percentage of household cluster transmissions of SARS-CoV-2.

It is also possible that these data were influenced by the fact that early in the SARS-CoV-2 outbreak, infections were associated with travel to outbreak areas (i.e. initially to Wuhan itself and later to the entirety of the Hubei province). Travel is much more likely to be undertaken by an adult in the family, rather than a child under the age of 16 years, potentially cofounding the results. To control for this factor, we reanalysed the data only including household transmission clusters where the index case had no history of travel or the whole family was located in (or had a history of travel) to an outbreak area. This resulted in a total 23 cases, two of which (9%) were identified as having a child as the index case in the cluster.

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Finally, we wished to determine if the limited number of paediatric index cases was specific to SARS-CoV-2 or if it was a typical phenomenon associated with zoonotic infections. To do so, we examined 56 family clusters of highly pathogenic H5N1 avian influenza transmission events (Table 3). Here, 54% (30/56) of transmission clusters identified children as the index case. These data suggest that whilst children can facilitate the intra-household transmission of some viral infections, the data available to date suggest that children have not played a substantive role in the intra-household transmission of SARS-CoV-2.

DISCUSSION

Understanding the pathogenesis and transmission of SARS-CoV-2 in children is of paramount importance to reducing the severity of the pandemic and implementing appropriate public health controls.

Here, we analyse previously published literature from China, Singapore, South Korea, Japan, and Iran to show that children infected with SARS-CoV-2 displayed a broad range of clinical characteristics. Whilst some children developed severe disease, others presented asymptomatically with normal chest CT findings. These data are consistent with current consensus is that clinical symptoms of COVID-19 are, on average, milder in children (although severe infections can still occur).[4–8] Similarly findings have been made in children infected with either SARS or MERS.[9,10] At present, it remains unclear why children may develop less severe forms of COVID-19. It has been suggested that the receptor for SARS-CoV-2, ACE2, may be expressed at a lower level in children than in adults.[16] Alternatively, these observations may reflect the fact that the paediatric immune system is more adept than that of adults at dealing with infections for which there is no pre-existing immunity.[58,59] This is reflected in the comparatively mild infections experienced by children upon infection with measles virus and varicella zoster virus.[60,61] Understanding age-dependent differences in the pathogenesis of SARS-CoV-2 remains a key priority for future research.

We showed that of the 31 recorded SARS-CoV-2 household transmission clusters there were only three incidences of children being identified as the index case in the family. This observation is supported by previous evidence from China, where a study of 66 family transmission clusters showed that children were never the first in the family to be diagnosed with COVID-19.[62] Similarly, a separate study of 419 household SARS-CoV-2 transmission clusters in China did not detect a single cluster where the index case was under the age of 15, and only three where the index case was under the age of 18.[63] Early observations from Wuhan also suggested that children were most likely to be diagnosed with SARS-CoV-2 following an exposure history to a household infection, indicating that even in epidemic areas children were more likely to be contact, rather than index cases.[64,65] The reasons for these observations remain unclear. These data may reflect an overall lower incidence of infection in children.[2] Alternatively, these data may reflect altered viral shedding (either in titre or duration) in children or an alternate, less efficient route of virus transmission from infected children to adults.[24,66] It is also possible that children simply have fewer interactions outside

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of the home than adults and are therefore less likely to be index cases. This may be magnified in countries which have implemented school closures in an attempt to control the outbreak. However, it is worth noting that Singapore did not mandate the closure of schools and yet still did not detect any household clusters of transmission of SARS-CoV-2 with children as the index case.[13,67] Similarly, should children have fewer interactions outside the home it would suggest that children would be unlikely to be the index case in any household transmission event. In contrast, our analysis of household transmission clusters of highly pathogenic H5N1 avian influenza show that children were frequently the index case. Whether this difference simply reflects the different route of transmission of these infections (poultry-to-human vs person-to-person spread) remains to be determined.

There is a growing body of evidence suggesting that asymptomatic individuals play an important role in the transmission of SARS-CoV-2 in the community[68-70]; However, such studies do not negate the results of the present study, as both children AND adults can present with an asymptomatic infection. This is perhaps best demonstrated by the outbreak of SARS-CoV-2 on board the Diamond Princess cruise ship[66]. Here, 634 individuals were infected. Of these infected individuals, only six were aged 0–19 years, 152 were aged 20–59 years and 476 were 60 years and older. Despite the near absence of children on the ship, 328 of the 634 infected individuals were asymptomatic. These data clearly indicate that asymptomatic infections are not limited to the paediatric population. Therefore, perhaps one of the most effective public health intervention strategies would be to identify and isolate asymptomatically infected adults, as it is these individuals who have numerous contacts outside the home and may be contributing to viral spread.

There are important caveats that need to be acknowledged when interpreting these data for public health policy. Our analysis of household transmission clusters was also based on the assumption that the incubation period for SARS-CoV-2 was approximately equivalent in children and adults. Whilst we did not observe any significant difference in the incubation time of infected children and their infected adult relatives (data not shown), others have suggested there might be a longer incubation period for SARS-CoV-2 in children[71]. It is also possible that the analysis performed herein was impaired by the policy within particular countries to only test contacts of a known COVID-19 patient when and if they become symptomatic. This could result in the number of asymptomatically infected individuals being underestimated. Importantly, China rapidly implemented a policy to test both symptomatic and non-symptomatic contacts, suggesting that this limitation would only apply to transmission clusters detected outside of China. Nevertheless, despite these important limitations, these data suggest that children are unlikely to be driving the household transmission of SARS-CoV-2.

As the global SARS-CoV-2 situation continues to evolve it will be important to validate these data with a larger number of case studies across a wider geographic distribution. It is also possible that as community spread of the virus becomes more common, the transmission dynamics and clinical characteristics of disease will change. However, in the interim our analyses show that, to date, children have not been the primary source of household transmission clusters.

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RESEARCH IN CONTEXT

Evidence before this study

Before undertaking this study, evidence published between December 2019 and March 2020 in English or Chinese was considered from data made available between Dec 1, 2019, and March 18, 2020. Information was accessed from World Health Organization news[11], local health authority's news releases, Google Scholar, PubMed, the Lancet COVID-19 resource centre[12], Clinical Infectious Disease Journal, New England Journal of Medicine, and three Chinese databases (CNKI, Wanfang, and CQVIP).

We performed the searching and reviewing using the terms ("severe acute respiratory syndrome coronavirus 2"[All Fields]) OR ("SARS-CoV-2"[All Fields]) OR ("COVID-19" [All Fields]) AND ("Children"[All Fields] OR "Paediatric"[All Fields]) OR ("Family"[MeSH Terms] OR "Family"[All Fields])". To examine H5N1 avian influenza household transmission event, we used search queries "H5N1[All Fields] AND ("Children"[All Fields] OR "Paediatric"[All Fields]) AND (family cluster[All Fields])". A total of 166 articles were retrieved and reviewed. Of these, 126 articles were excluded because i) they did not report paediatric infections ii) did not report sufficient individual case data and/or iii) did not report family clusters. The intra-household transmission clusters were also sourced from information provided by local health authority's news of China, Europe, France, Germany, Italy, Japan, and South Korea when available. Any intra-household cluster identified in these local sources was included in the study.

Added value of this study

Our findings add value to the existing body of evidence by not only supporting previous suggestions that COVID-19 can have numerous different clinical manifestations in children but also suggesting that, to date, children have not driven the household transmission of SARS-CoV-2.

Implications of all the available evidence

Understanding the pathogenesis and transmission of SARS-CoV-2 in children is of paramount importance to reducing the severity of the pandemic and implementing appropriate public health controls. Specifically, our findings hold important implications for policies regarding school and day-care closures during this period. As the global SARS-CoV-2 situation continues to evolve it will be important to validate these data with a larger number of case studies across a wider geographic distribution

FUNDING

KRS was supported by the Australian Research Council [DE180100512]. ACB receives funding from the National Health and Medical Research Council with an Investigator Award (1175509).

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CONTRIBUTIONS

YZ and KRS contributed to data acquisition; study design; data analysis; manuscript writing and revising. CJB contributed to data analysis; manuscript writing and revising. KDH contributed to data acquisition; data analysis; manuscript writing and revising. JES contributed to data acquisition; data analysis; manuscript revising. MT, LES, ECN, JL contributed to data acquisition; data analysis. KYC contributed to the study design; data acquisition; data analysis. JLP contributed to data interpretation and critical review of the manuscript. CG contributed to the contributed to critical review of the manuscript. ACB contributed to critical review of the manuscript and reviewed for clinical content.

DECLARATION OF INTERESTS

No conflict of interests to declare.

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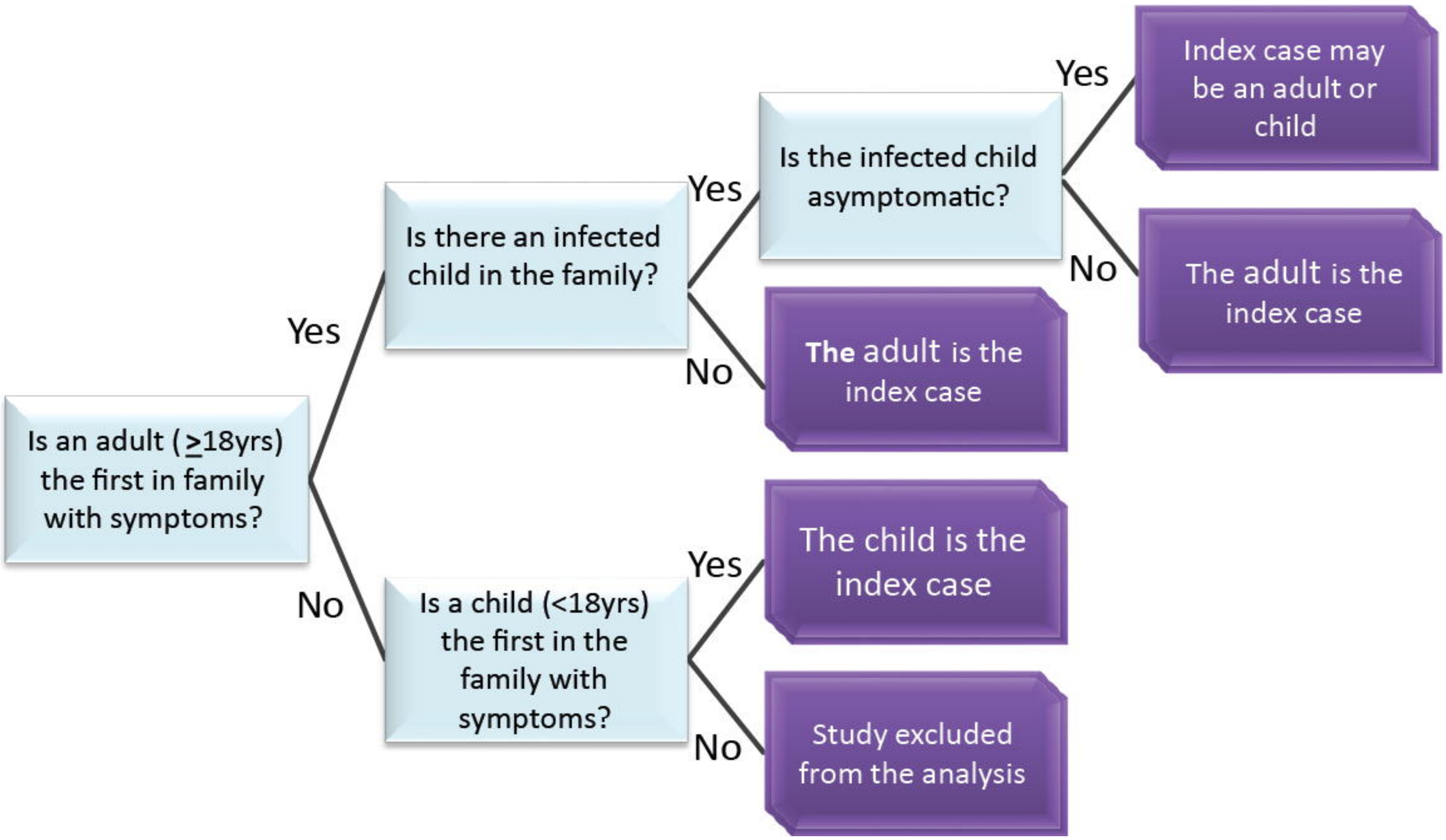
Is an adult (≥18yrs) the first in family with symptoms?
Yes
No
Is there an infected child in the family?
Yes
No
Is the infected child asymptomatic?
Yes
No
Index case may be an adult or child
The adult is the index case
The adult is the index case
Is a child (<18yrs) the first in the family with symptoms?
Yes
No
The child is the index case
Study excluded from the analysis

Exhibit 6

Table 1: Clinical characteristics of SARS-CoV-2 in children

Characteristic	Value
Age (n = 103)	5.35 y ± 4.65 (n = 103)
Sex (n = 105)	56.19% female (n = 105)
Severity of infection (n = 102)	19% Asymptomatic
	69% Mild - Moderate
	12% Severe
Onset symptoms (n = 81)	77% Fever
	59% Cough
	17% Runny Nose/ Rhinorrhea
	12% Tachypnea
	12% Nausea/ vomiting
	12% Sore Throat
	11% Chills
	11% Retraction
	6% Diarrhoea
	2% Fatigue/ Myalgia/weakness
Temperature at hospital admission (n = 71)	37.5 °C ± 3.78
CT Findings (n = 89)	33.71% Opacities
	29.21% Normal
	29.21% Patch Shadows
	12.36% Consolidations
	3.37% Signs of Viral Infection/ Pneumonia
Average incubation period	7.74 d ± 3.22
Haemoglobin	15.88 ± 15.21 g/dL (n = 48)
White Blood Cells	7.63 ± 3.49 x 10^9/ L (n = 61)
Neutrophil Count	3.55 ± 2.96 x 10^9/ L (n = 47)
Lymphocyte Count	2.9 ± 1.8 x 10^9/ L (n = 48)
Platelet Count	262.16 ± 91 x 10^9/L (n = 44)
C-Reactive Protein Level	18.47 ± 25.74 mg/L (n = 48)
D-dimer	1.78 ± 7.44 µg/mL (n = 29)
Alanine Aminotransferase	29.95 ± 33.88 U/L (n = 38)
Creatinine	41.7 ± 37.11 µ/mol/L (n =31)
Lactate Dehydrogenase	315.75 ± 182.36 U/L (n = 35)

[1]Data sourced from multiple studies.[5,7,13,15,17–45]

Exhibit 6

Table 2: Household transmission clusters of SARS-CoV-2

Cluster	Country	Province (China) or city (outside	Age	Sex	Relation to Index case	Laboratory (L) or clinically	Symptomatic infection?	History of travel?	Source
1	China	Guangdong	35 y	M	Index	L	Y	Yes – travel to Wuhan	[20]
1	China	Guangdong	33 y	F	Wife	L	N	Yes – travel to Wuhan	[20]
1	China	Guangdong	3 y	M	Son	L	N	Yes – travel to Wuhan	[20]
2	China	Hubei	9 y	M	Index	L	Y	No – local resident of Wuhan	[19]
2	China	Hubei	71 y	F	Grandmother	L	Y	No – local resident of Wuhan	[19]
2	China	Hubei	31 y	F	Mother	L	Y	No – local resident of Wuhan	[19]
3	China	Guangdong	65 y	F	Index	L	Y	Yes – travel to Wuhan	[33]
3	China	Guangdong	66 y	M	Father	L	Y	Yes – travel to Wuhan	[33]

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3	China	Guangdong	37 y	F	Daughter	L	Y	Yes – travel to Wuhan	33
3	China	Guangdong	36 y	M	Son-in-law	L	Y	Yes – travel to Wuhan	33
3	China	Guangdong	10 y	M	Grandson	L	N	Yes – travel to Wuhan	33
3	China	Guangdong	7 y	F	Granddaughter	C	N	Yes – travel to Wuhan	33
3	China	Guangdong	63 y	F	Mother of son-in-law	L	Y	No	33
4	China	Guangdong	36 y	M	Index	L	Y	Yes – travel to Wuhan	49
4	China	Guangdong	38 y	F	Wife	L	Y	No	49
4	China	Guangdong	60 y	F	Mother	L	Y	No	49
4	China	Guangdong	62 y	M	Father	L	Y	No	49
4	China	Guangdong	3 y	M	Son	L	Y	No	49

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5	China	Guangdong	58 y	F	Index	L	Y	Yes – travel to Hubei	49
5	China	Guangdong	38 y	M	Son	L	Y	No	49
5	China	Guangdong	33 y	F	Daughter-in-law	L	Y	No	49
5	China	Guangdong	16 m	M	Grandson	L	Y	Yes – travel to Hubei	49
6	China	Guangdong	59 y	M	Index	L	Y	No – local resident of Wuhan	49
6	China	Guangdong	10 m	F	Granddaughter	L	Y	No – local resident of Wuhan	49
6	China	Guangdong	57 y	F	Wife	L	Y	No – local resident of Wuhan	49
6	China	Guangdong	38 y	M	Son-in-law	L	N	No – local resident of Wuhan	49
7	China	Guangdong	32 y	F	Index	L	Y	No – local resident of Wuhan	49
7	China	Guangdong	6 y	M	Son	L	N	No – local resident of Wuhan	49

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8	China	Zhejiang	29 y	M	Index	L	Y	No	40
8	China	Zhejiang	28 y	F	Wide	L	N	No	40
9	China	Zhejiang	42 y	M	Index	L	Y	No	40
9	China	Zhejiang	41 y	F	Wife	L	N	No	40
9	China	Zhejiang	12 y	M	Son	L	N	No	40
10	USA	Illinois	60-70 y	F	Index	L	Y	Yes – travel to Wuhan	50
10	USA	Illinois	..	M	Husband	L	Y	No	50
11	Vietnam	Ho Chi Minh City	65 y	M	Index	L	Y	Yes – travel to Wuhan	51
11	Vietnam	Ho Chi Minh City	27 y	M	Son	L	Y	No	51
12	Singapore	Singapore	28 y	F	Index	L	Y	No	52

Exhibit 6

12	Singapore	Singapore	45 y	M	Husband	L	Y	No	[52]
12	Singapore	Singapore	44 y	F	Domestic helper	L	Y	No	[52]
12	Singapore	Singapore	6 m	M	Son	L	Y	No	[52]
13	Singapore	Singapore	42 y	M	Index	L	Y	No	[52]
13	Singapore	Singapore	40 y	F	Sister	L	Y	No	[52]
13	Singapore	Singapore	65 y	F	Mother-in-law	L	Y	No	[52]
14	Singapore	Singapore	86 y	M	Index	L	Y	No	[13]
14	Singapore	Singapore	57 y	M	Family member	L	Y	No	[13]
14	Singapore	Singapore	80 y	F	Family member	L	Y	No	[13]
15	Singapore	Singapore	30 y	M	Index	L	Y	Yes – travel to France	[13]

Exhibit 6

15	Singapore	Singapore	62 y	F	Family member	L	Y	No	13
16	Japan	Saitama	40-50 y	M	Index	L	Y	Yes – travel to Wuhan	45
16	Japan	Saitama	3-6 y	M	Son	L	Y	Yes – travel to Wuhan	45
17	Japan	Nakafurano	<10 y	M	Index	L	Y	No	45
17	Japan	Nakafurano	10 y	M	Older brother	L	Y	No	45
18	South Korea	Seoul	Adult	M	Index	L	Y	Yes – travel to Wuhan	37
18	South Korea	Seoul	Adult	F	Sister	L	Y	No	37
18	South Korea	Seoul	10	F	Niece	L	Y	No	37
19	China	Sichuan	Adult	F	Index	C	Y	No	39
19	China	Sichuan	7 m	F	Daughter	C	Y	No	39

Exhibit 6

19	China	Sichuan	Adult	F	Mother-in-law	C	Y	No	39
19	China	Sichuan	Adult	M	Husband	C	N	No	39
20	China	Sichuan	Adult	M	Index	C	Y	Yes – chartered out of Wuhan	39
20	China	Sichuan	5 y	M	Son	C	Y	No	39
20	China	Sichuan	Adult	F	Wife	C	Y	No	39
21	China	Hunan	53 y	M	Index	C	Y	Yes – travel to Wuhan	32
21	China	Hunan	Adult	F	Wife	C	Y	No	32
21	China	Hunan	28 y	M	Son	C	Y	No	32
21	China	Hunan	28 y	F	Daughter-in-law	C	Y	No	32
21	China	Hunan	34 y	M	Son-in-law	C	Y	No	32

Exhibit 6

21	China	Hunan	32 y	F	Daughter	C	Y	No	32
21	China	Hunan	4 y	M	Grandson	C	Y	No	32
21	China	Hunan	4 y	F	Granddaughter	C	Y	No	32
22	China	Guangdong	43 y	F	Index	C	Y	Yes – chartered out of Wuhan	49
22	China	Guangdong	42 y	M	Husband	C	Y	No	49
22	China	Guangdong	15 y	M	Son	C	Y	No	49
23	China	Hainan	3 m 19 d	F	Index	L	Y	Exposure to an epidemic area	23
23	China	Hainan	Adult	M	Father	L	Y	··	23
23	China	Hainan	Adult	F	Mother	L	N	··	23
24	China	Henan	20 y	F	Index	L + C	N	Yes – chartered out of Wuhan	53

Exhibit 6

24	China	Henan	42-57 y	··	Family member	L + C	Y	No	53
25	Singapore	Singapore	64 y	M	Index	L	Y	No	13
25	Singapore	Singapore	59 y	F	Family member	L	Y	No	13
26	Singapore	Singapore	71 y	M	Index	L	Y	No	13
26	Singapore	Singapore	71 y	F	Family member	L	Y	No	13
27	Singapore	Singapore	62 y	M	Index	L	Y	No	13
27	Singapore	Singapore	30 y	M	Family member	L	Y	No	13
27	Singapore	Singapore	61 y	F	Family member	L	Y	No	13
28	Singapore	Singapore	23 y	F	Index	L	Y	Yes – travel to Malaysia	13
28	Singapore	Singapore	27 y	M	Family member	L	Y	Yes – travel to Malaysia	13

Exhibit 6

29	Singapore	Singapore	40 y	M	Index	L	Y	No	13
29	Singapore	Singapore	35 y	M	Family member	L	Y	No	13
30	Singapore	Singapore	27 y	M	Index	L	Y	Yes – travel to Indonesia	13
30	Singapore	Singapore	26 y	M	Family member	L	Y	Yes – travel to Indonesia	13
31	Singapore	Singapore	32 y	F	Index	L	Y	No	13
31	Singapore	Singapore	40 y	M	Husband	L	Y	No	13

*F, female; M, male; Y, Yes; N, No

Exhibit 6

Table 3: Household transmission clusters of highly pathogenic avian influenza H5N1

Cluster	Onset of index case	Country	Age(y)	Sex	Relation to Index Case	Source
1	Dec-97	China, HK	5	F	Index	54
1	Dec-97	China, HK	2	M	Cousin	54
2	Jan-03	China, HK	8	F	Index	55
2	Jan-03	China, HK	33	M	Father	55
2	Jan-03	China, HK	9	M	Sibling	55
3	Dec-03	Vietnam	12	F	Index	56,57
3	Dec-03	Vietnam	30	F	Mother	56,57
4	Dec-03	Vietnam	7	F	Index	56,57
4	Dec-03	Vietnam	5	M	Sibling	56,57
5	Jan-04	Vietnam	31	M	Index	56,57
5	Jan-04	Vietnam	30	F	Sibling	56,57
5	Jan-04	Vietnam	28	F	Wife	56,57
5	Jan-04	Vietnam	23	F	Sibling	56,57
6	Jan-04	Thailand	6	M	Index	56,57
6	Jan-04	Thailand	33	F	Mother	56,57
7	Jan-04	Vietnam	9	F	Index	56,57
7	Jan-04	Vietnam	4	M	Sibling	56,57
8	Jul-04	Vietnam	19	M	Index	56,57
8	Jul-04	Vietnam	22	F	Cousin	56,57
8	Jul-04	Vietnam	23	F	Sibling	56,57
9	Sep-04	Thailand	11	F	Index	56,57
9	Sep-04	Thailand	26	F	Mother	56,57

Exhibit 6

9	Sep-04	Thailand	32	F	Aunt	56,57
9	Sep-04	Thailand	6	M	Aunt's son	56,57
10	Dec-04	Vietnam	42	M	Index	56,57
10	Dec-04	Vietnam	36	M	Sibling	56,57
11	Jan-05	Vietnam	35	F	Index	56,57
11	Jan-05	Vietnam	13	F	Daughter	56,57
12	Jan-05	Cambodia	14	M	Index	56,57
12	Jan-05	Cambodia	25	F	Sibling	56,57
13	Feb-05	Vietnam	21	M	Index	56,57
13	Feb-05	Vietnam	14	F	Sibling	56,57
14	Mar-05	Vietnam	13	F	Index	56,57
14	Mar-05	Vietnam	5	M	Sibling	56,57
14	Mar-05	Vietnam	Adult	F	Aunt	56,57
15	Mar-05	Vietnam	35	M	Father	56,57
15	Mar-05	Vietnam	31	F	Mother	56,57
16	Mar-05	Vietnam	0.3	F	Index	56,57
16	Mar-05	Vietnam	3	F	Sibling	56,57
16	Mar-05	Vietnam	10	F	Sibling	56,57
17	Jun-05	Indonesia	8	F	Index	56,57
17	Jun-05	Indonesia	1	F	Sibling	56,57
17	Jun-05	Indonesia	38	M	Father	56,57
18	Oct-05	China	12	F	Index	56,57
18	Oct-05	China	9	M	Sibling	56,57
19	Oct-05	Thailand	48	M	Index	56,57
19	Oct-05	Thailand	7	M	Son	56,57

Exhibit 6

20	Aug-05	Indonesia	37	F	Index	56,57
20	Aug-05	Indonesia	9	M	Nephew	56,57
21	Sep-05	Indonesia	21	M	Index	56,57
21	Sep-05	Indonesia	5	M	Sibling	56,57
21	Sep-05	Indonesia	4	M	Nephew	56,57
22	Oct-05	Indonesia	19	F	Index	56,57
22	Oct-05	Indonesia	8	M	Sibling	56,57
23	Nov-05	Indonesia	7	M	Index	56,57
23	Nov-05	Indonesia	20	M	Sibling	56,57
23	Nov-05	Indonesia	16	M	Sibling	56,57
24	Dec-05	Turkey	14	M	Index	56,57
24	Dec-05	Turkey	15	F	Sibling	56,57
24	Dec-05	Turkey	12	F	Sibling	56,57
24	Dec-05	Turkey	5	M	Neighbour	56,57
25	Dec-05	Turkey	9	F	Index	56,57
25	Dec-05	Turkey	3	M	Sibling	56,57
26	Jan-06	Turkey	14	F	Index	56,57
26	Jan-06	Turkey	5	M	Sibling	56,57
27	Jan-06	Indonesia	13	F	Index	56,57
27	Jan-06	Indonesia	4	M	Sibling	56,57
27	Jan-06	Indonesia	14	F	Sibling	56,57
27	Jan-06	Indonesia	43	M	Father	56,57
28	Jan-06	Iraq	15	F	Index	56,57
28	Jan-06	Iraq	39	M	Uncle	56,57
30	Feb-06	Azerbaijan	24	M	Index	56,57

Exhibit 6

30	Feb-06	Azerbaijan	21	F	Sibling	[56,57]
31	Feb-06	Indonesia	12	F	Index	[56,57]
31	Feb-06	Indonesia	10	M	Sibling	[56,57]
32	Mar-06	Egypt	6	F	Index	[56,57]
32	Mar-06	Egypt	1.5	F	Sibling	[56,57]
33	Apr-06	Indonesia	37	F	Index	[56,57]
33	Apr-06	Indonesia	15	M	Son	[56,57]
33	Apr-06	Indonesia	17	M	Son	[56,57]
33	Apr-06	Indonesia	28	F	Sibling	[56,57]
33	Apr-06	Indonesia	1.5	F	Niece	[56,57]
33	Apr-06	Indonesia	25	M	Sibling	[56,57]
33	Apr-06	Indonesia	10	M	Nephew	[56,57]
33	Apr-06	Indonesia	32	M	Sibling	[56,57]
34	May-06	Indonesia	10	F	Index	[56,57]
34	May-06	Indonesia	18	M	Sibling	[56,57]
35	May-06	Indonesia	15	F	Index	[56,57]
35	May-06	Indonesia	27	M	Sibling	[56,57]
36	May-06	Indonesia	10	M	Index	[56,57]
36	May-06	Indonesia	7	F	Sibling	[56,57]
38	Sep-06	Indonesia	11	M	Index	[56,57]
38	Sep-06	Indonesia	21	F	Sibling	[56,57]
39	Sep-06	Indonesia	24	M	Index	[56,57]
39	Sep-06	Indonesia	20	M	Sibling	[56,57]
40	Dec-06	Egypt	30	F	Index	[56,57]
40	Dec-06	Egypt	26	M	Sibling	[56,57]

Exhibit 6

40	Dec-06	Egypt	16	F	Niece	56,57
41	Jan-07	Indonesia	37	F	Index	56,57
41	Jan-07	Indonesia	18	M	Son	56,57
42	Jan-07	Nigeria	52	F	Index	56,57
42	Jan-07	Nigeria	22	F	Daughter	56,57
43	Mar-07	Egypt	6	F	Index	56,57
43	Mar-07	Egypt	4	M	Sibling	56,57
44	Jul-07	Indonesia	5	F	Index	56,57
44	Jul-07	Indonesia	29	F	Mother	56,57
45	Oct-07	Pakistan	25	M	Index	56,57
45	Oct-07	Pakistan	22	M	Sibling	56,57
45	Oct-07	Pakistan	25	M	Sibling	56,57
45	Oct-07	Pakistan	32	M	Sibling	56,57
46	Nov-07	China	24	M	Index	56,57
46	Nov-07	China	51	M	Father	56,57
47	Jan-08	Indonesia	38	F	Index	56,57
47	Jan-08	Indonesia	15	F	Daughter	56,57
48	Dec-08	Vietnam	13	F	Index	56,57
48	Dec-08	Vietnam	8	F	Sibling	56,57
49	Dec-08	China	26	F	Index	56,57
49	Dec-08	China	2	F	Daughter	56,57
50	Feb-11	Cambodia	19	F	Index	56,57
50	Feb-11	Cambodia	1	M	Son	56,57
51	Feb-11	Indonesia	31	F	Index	56,57
51	Feb-11	Indonesia	2	F	Daughter	56,57

Exhibit 6

52	Sep-11	Indonesia	5	F	Index	[56,57]
52	Sep-11	Indonesia	10	M	Sibling	[56,57]
52	Sep-11	Indonesia	29	F	Mother	[56,57]
53	Nov-11	Egypt	27	F	Index	[56,57]
53	Nov-11	Egypt	1.5	F	Child	[56,57]
54	Dec-11	Indonesia	23	M	Index	[56,57]
54	Dec-11	Indonesia	5	F	Family contact	[56,57]
55	Jan-14	Cambodia	8	M	Index	[56,57]
55	Jan-14	Cambodia	3	F	Sibling	[56,57]
56	Mar-15	Indonesia	2	M	Index	[56,57]
56	Mar-15	Indonesia	40	M	Father	[56,57]

* F, female; M, male

Exhibit 6

EXHIBIT 7

Caring for Children with COVID-19

April 3, 2020

By Sarah Silverberg (MD) and Laura Sauvé (MD, MPH, FRCPC)

Key Points

- COVID-19 virus has a very low infection rate in children estimated at 1-5% worldwide.
- The majority of cases in children are the result of a household transmission by droplet spread from another family member with symptoms of COVID-19.
- Children who are infected with the virus and develop COVID-19 have milder symptoms if any, and very few become critically ill.
- Children with COVID-19 illness typically have a fever, dry cough and fatigue. Some may also experience nausea, vomiting, abdominal pain and diarrhea.
- Unlike adults the rates of transmission are unknown. There is no documented evidence of child-to-adult transmission. There are no documented cases of children bringing an infection into the home, from school or otherwise. This is likely the result of the limited number of cases and the mild symptoms in those who do have COVID illness.
- There is no conclusive evidence that children who are asymptomatic pose a risk to other children or to adults.
- There is no evidence indicating children of HCWs are at increased risk of COVID-19 infection than children of non-HCWs. This is likely due to the careful monitoring of HCWs for symptoms and follow-up of their household contacts.
- Like adults, children with any common cold, influenza or COVID-19 like symptoms should stay home and isolate for 10 days following onset of symptoms and until symptoms resolve.
- More research is needed to fully characterize infection, transmission and COVID-19 disease in children.

COVID-19 Illness in Children

1. Case counts of SARS-CoV2 infection and COVID-19 illness in children are low, representing only 1-5% of confirmed cases worldwide.
2. The severity of disease in children appears to be lower, with only a few documented cases of severe illness and/or death. Younger infants (those <1 year of age) have the highest rates of severe or critical illness.
3. Children are more likely to have few, if any symptoms. Up to 32% of children have been asymptomatic with presumed or confirmed COVID-19.
4. Typically, children with COVID-19 have a fever, dry cough and fatigue. In rare cases, dyspnea and respiratory compromise appear after a week of disease progression. These are associated with systemic symptoms including malaise, restlessness, and poor appetite.

Exhibit 7

5. Some children experience GI symptoms, including abdominal discomfort, nausea, vomiting, abdominal pain and diarrhea.

Children and Infectivity

1. The majority of children with COVID-19 have a positive household contact.
2. The incubation period in children is approximately two days, with a range of 2-10 days (similar to adults). The mean incubation period between household exposure and pediatric symptom onset is approximately 1 day longer than observed in adult cases.
3. Children typically have negative swabs within 6-22 days of symptom onset, but often not until 2 weeks' time. Children have been found to have high viral loads despite mild symptoms, with prolonged shedding in nasal secretions.
4. As a result of the lower symptom burden, the rates of asymptomatic transmission or transmission with mild symptoms are unknown.
5. There is no documented evidence of child-to-adult transmission of SARS-CoV2. This is different than outbreaks of other viruses such as Influenza where children have been found to have a high rate of infection outside of the household and significant inter-generational transmission.
6. It is unlikely the children of health care workers have more frequent COVID-19 than other children, however, no evidence is available.

Recommendations for care for children with suspected or confirmed cases of COVID-19

1. Children are at a lower risk of developing COVID-19, including developing severe disease. Most children who have COVID-19 can be cared for at home, with supportive care performed by their parents.
2. Children under 1 year of age and those who are immunocompromised or have pre-existing pulmonary conditions are at a higher risk of severe disease.
3. As for all members of the community at this time, children should physically distance themselves as much as possible outside of the family unit.
4. Children, and particularly young children, who develop fever, cough or shortness of breath should be evaluated, as influenza as well as other viral illnesses are still circulating in B.C. Symptomatic children should be cared for using droplet and contact precautions (with airborne precautions if aerosol generating medical procedures are needed).
5. While evidence is limited at this time, children with COVID-19 may shed the virus for longer than adults.

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EXHIBIT 8

COVID-19 in schools and early childhood education and care services – the Term 2 experience in NSW

Prepared by the National Centre for Immunisation Research and Surveillance (NCIRS)
31 July 2020

Overview

- This report provides an overview of investigation into all COVID-19 cases in the state of New South Wales (NSW), Australia in all schools and early childhood education and care (ECEC) services between 10 April 2020 and 3 July 2020 (school term 2 of the academic year).
- 6 individuals (4 students and 2 staff members) from 6 educational settings (5 schools and 1 ECEC service) were confirmed as primary COVID-19 cases who had an opportunity to transmit the SARS-CoV-2 virus to others in their school or ECEC service.
- 521 individuals (459 students and 62 staff members) were identified as close contacts of these primary 6 cases.
- No secondary cases were reported in any of the 6 educational settings.
- In Term 2 no student or staff member contracted COVID-19 from a school or ECEC setting.
- For details on Term 1 data refer to NCIRS report here or publication in The Lancet Child and Adolescent Health here.

Background

Our first report of schools and early childhood education and care (ECEC) services reported 27 primary cases in school term 1 (28 January to 9 April 2020), coinciding with the emergence of COVID-19 pandemic and the first wave in New South Wales, Australia. By 6 April, incidence of COVID-19 was declining and was very low from 20 April (less than 10 cases/day) due to increased availability of testing coupled with public health mitigation strategies such as restrictions on population mobility, home or hotel isolation of returning travellers and increased hygiene measures.

Schools reopened on 29 April, allowing for vulnerable students and children of essential workers to return onsite. Between 29 April and 22 May there was an incremental increase in the number of students returning to school, and full face-to-face teaching commenced on 25 May. ECEC services remained open throughout the autumn school holidays and into Term 2.

The National Centre for Immunisation Research and Surveillance (NCIRS), with the support of the NSW Ministry of Health and NSW Department of Education, continued surveillance of SARS-CoV-2 transmission in educational settings. Through this investigation, we aimed to monitor the transmission of SARS-CoV-2 in schools and childcare centres in NSW. This report summarises the preliminary findings of this work in NSW ECEC services and primary and high schools.

Methods

COVID-19 is a notifiable disease in Australia. When a person is diagnosed with COVID-19 a public health response is initiated that includes follow up of each case to identify their close contacts and dates of exposure to the person (case) while infectious. A 'close contact' is defined as a person who has been in face to face contact for at least 15 minutes or in the same room for 2 hours with a case while infectious. Once close contacts are identified, they are required to enter home quarantine for 14 days from the date of last exposure to the infectious case, watch for any symptoms and if they become unwell, have a nose/throat swab taken to test for COVID-19. NSW Health and NCIRS followed up all close contacts of COVID-19 cases in the schools and ECEC services that an adult or child with COVID-19 attended while infectious. For schools and ECEC services, all close contact staff and students who agreed

Exhibit 8

to participate in enhanced surveillance also had all or combination of the following: a) filled out a symptom questionnaire; b) were swabbed to test for COVID-19 within the first 2 weeks after the last contact with the case, irrespective of whether they had symptoms; and c) had a blood sample taken to detect antibodies to the SARS-CoV-2 virus (which is evidence of an immune response to infection) at 4 to 6 weeks after the exposure. Some primary cases were reviewed by an expert panel once additional test results (repeat swabs and antibody testing 4 weeks after a positive swab) and data (evidence of any epidemiological link or secondary transmission) became available.

Results

10 educational settings (three high schools, six primary schools and one ECEC service) were investigated for having a case with COVID-19 in staff member or student who attended while infectious. Three primary cases from three of these educational settings were reviewed by an expert panel and deemed to be not true COVID-19 cases and one case from one educational setting was thought to have had COVID-19 several months prior to diagnosis. Public health measures were implemented and these educational settings participated in enhanced surveillance prior to the expert panel review.

In the remaining six educational settings (two high schools, three primary schools and one ECEC service) there were a total of six COVID-19 cases (two staff members, four students/children). The public health staff identified 521 close contacts of these six cases (459 students/children and 62 staff members). In total, 61% (n=319) of the close contacts had a nose/throat swab taken and 8% (n=44) underwent antibody testing. There were no secondary cases identified.

High schools

A total of two COVID-19 primary cases (2 students) were identified who had attended two high schools while infectious. The total number of close contacts in these two high schools was 165 students and 23 staff members (188 close contacts total). Nose/throat swabs were taken from 55% (n=103) of contacts, all of whom tested negative, as shown in Figure 2.

Primary schools

A total of three primary cases (one student and two staff members) were identified in three primary schools. The total number of close contacts in these three primary schools was 210 students and 21 staff members (231 close contacts total). Nose/throat swabs were taken from 57% (n=132) of contacts. Antibody testing was performed on 39 cases. Overall, as shown in Figure 3, no individuals were identified to have been infected following close contact with a school case in these three primary schools. SARS-CoV-2 antibodies were not detected in all 39 samples.

ECEC services

One primary case (one child) was identified in one ECEC service. The total number of close contacts was 84 students and 18 staff members (102 close contacts total). Nose/throat swabs were taken from 82% (n=84) of contacts. Six of the 24 children who shared the same class underwent SARS-CoV-2 antibody tests, all of which were negative. Overall, as shown in Figure 4, no individuals were identified to have been infected following close contact with an ECEC case.

Exhibit 8

Figure 1: NSW schools and ECEC services with a COVID-19 primary case(s) from Term 2

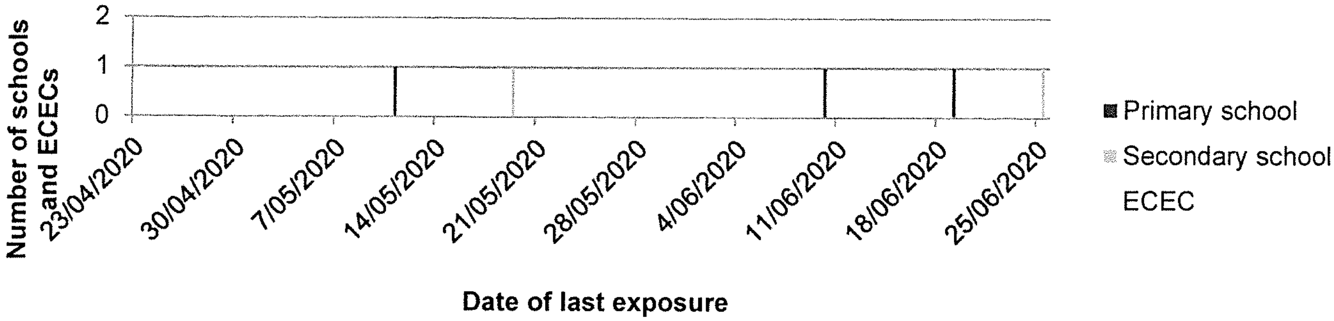


Figure 2: Cases and close contacts among staff members and students in 2 NSW high schools in Term 2 showing no transmission

Figure 3: Cases and close contacts among teachers and students in 3 NSW primary schools in Term 2 showing no transmission

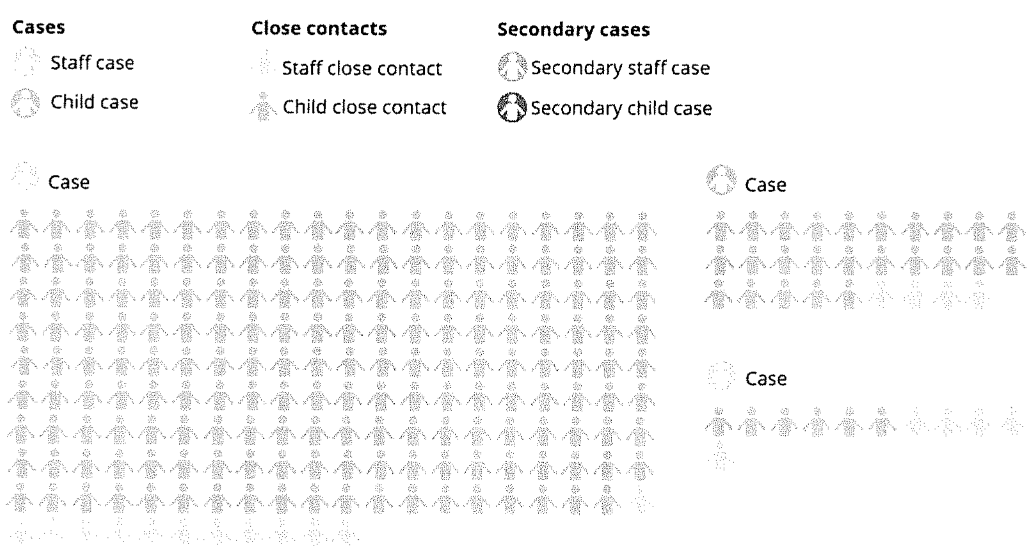
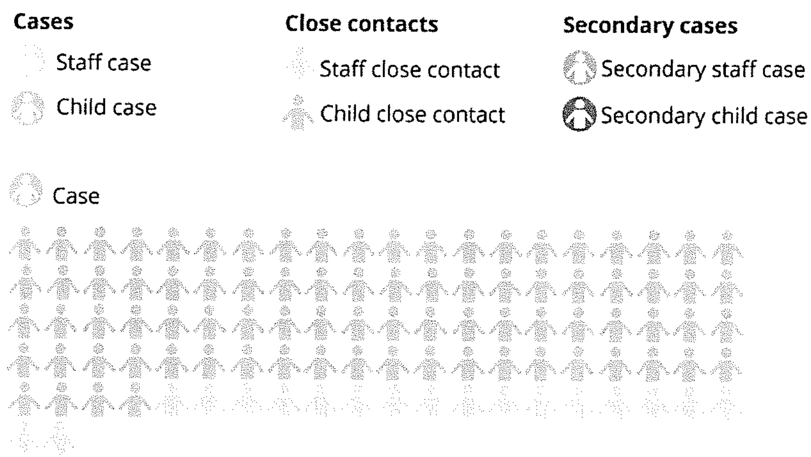


Exhibit 8

Figure 4: Cases and close contacts among staff and children in 1 NSW ECEC service in Term 2 showing no transmission



Excluded cases

One high school and two primary schools had possible COVID-19 cases and underwent public health response and enhanced surveillance. After additional information was received and additional testing (including antibody testing in some cases) and review undertaken, these cases were deemed by an NSW Health expert panel to have had false positive results. All these cases had no epidemiological link to another COVID-19 case and occurred while community transmission in NSW was negligible.

One primary school had a case that was later deemed to have been historical. That person's SARS-CoV-2 infection was deemed likely to have occurred 3 months earlier (based on epidemiological data and the person's antibody response to the virus).

However, given the importance of ensuring a timely public health response, those schools did undergo contact tracing, cleaning and self-isolation of close contacts (441 students and 22 staff members). A total of 216 close contacts (47%) had a nose/throat swab taken and 54 (12%) underwent blood tests for SARS-CoV-2 antibodies. All of the tests were negative. As a result, data from these schools were excluded from this report.

Conclusion

Our investigation of COVID-19 cases in schools and ECEC services continued in Term 2, between 10 April and 3 July. Because of effective public health mitigation strategies, community circulation of SARS-CoV-2 was extremely low in NSW. Schools remained open throughout the term (29 April to 3 July) following a graded return to face-to-face teaching, with full face-to-face learning resuming by week 5 (25 May) of Term 2. Schools and ECEC services were not required to follow all adult physical distancing guidelines but to follow good hygiene practices and additional cleaning in line with guidance from the Australian Health Protection Principal Committee (AHPPC) and NSW Health.

There were three primary schools, two high schools and one ECEC service with primary cases of COVID-19, of which two were staff members and four were students/children. There were a total of 521 close contacts (62 adults and 459 students/children) with no evidence of secondary transmission.

Our previous investigation in Term 1 2020, published in The Lancet Child and Adolescent Health, showed that transmission in educational settings is limited. Ongoing surveillance is important as outbreaks within educational settings have been shown to occur, especially when infection is unrecognised and exposure is prolonged. Our data from Term 2 highlight that with community awareness, implementation of hygiene and mitigation strategies, staying at home when symptomatic, early testing and contact tracing, transmission can continue to be limited in these settings.

Exhibit 8

Acknowledgements

We would like to thank all schools, staff and student contacts and their families who participated in this investigation, especially those who assisted with the enhanced investigation.

The following people have contributed to the COVID-19 schools transmission investigation project:
NCIRS core clinical and epidemiological team: Kristine Macartney, Nicholas Wood, Noni Winkler, Helen Quinn, Archana Koirala, Lucy Deng, Catherine Glover and Alexis Pillsbury
NCIRS interview and home visit team: Lisa Pelayo, Ajay Jadhav, Evangeline Gardiner
ICPMR/NSW Pathology: Kerri Basile, Jen Kok, Matthew O'Sullivan, Linda Hueston, Dominic Dwyer
NSW Health: Caroline Sharpe, Craig Dalton, Paula Spokes
Western Sydney PHU: Anthea Katelaris, Shopna Bag, Stephen Corbett; **Northern PHU:** Michael Staff; South West **Sydney PHU**: Stephen Conaty, Christine Harvey, Kate Alexander; **Nepean-Blue Mountains PHU**: Brad Forssman, Sheena Kakar; **South Eastern Sydney PHU**: Vicky Sheppeard, Mark Ferson

Exhibit 8

EXHIBIT 9

Transmission of SARS-CoV-2 in Australian educational settings: a prospective cohort study

*Kristine Macartney, Helen E Quinn, Alexis J Pillsbury, Archana Koirala, Lucy Deng, Noni Winkler, Anthea L Katelaris, Matthew V N O'Sullivan, Craig Dalton, Nicholas Wood, and the NSW COVID-19 Schools Study Team**

Summary

Background School closures have occurred globally during the COVID-19 pandemic. However, empiric data on transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) among children and in educational settings are scarce. In Australia, most schools have remained open during the first epidemic wave, albeit with reduced student physical attendance at the epidemic peak. We examined SARS-CoV-2 transmission among children and staff in schools and early childhood education and care (ECEC) settings in the Australian state of New South Wales (NSW).

Methods Laboratory-confirmed paediatric (aged ≤18 years) and adult COVID-19 cases who attended a school or ECEC setting while considered infectious (defined as 24 h before symptom onset based on national guidelines during the study period) in NSW from Jan 25 to April 10, 2020, were investigated for onward transmission. All identified school and ECEC settings close contacts were required to home quarantine for 14 days, and were monitored and offered SARS-CoV-2 nucleic acid testing if symptomatic. Enhanced investigations in selected educational settings included nucleic acid testing and SARS-CoV-2 antibody testing in symptomatic and asymptomatic contacts. Secondary attack rates were calculated and compared with state-wide COVID-19 rates.

Findings 15 schools and ten ECEC settings had children (n=12) or adults (n=15) attend while infectious, with 1448 contacts monitored. Of these, 633 (43·7%) of 1448 had nucleic acid testing, or antibody testing, or both, with 18 secondary cases identified (attack rate 1·2%). Five secondary cases (three children; two adults) were identified (attack rate 0·5%; 5/914) in three schools. No secondary transmission occurred in nine of ten ECEC settings among 497 contacts. However, one outbreak in an ECEC setting involved transmission to six adults and seven children (attack rate 35·1%; 13/37). Across all settings, five (28·0%) of 18 secondary infections were asymptomatic (three infants [all aged 1 year], one adolescent [age 15 years], and one adult).

Interpretation SARS-CoV-2 transmission rates were low in NSW educational settings during the first COVID-19 epidemic wave, consistent with mild infrequent disease in the 1·8 million child population. With effective case-contact testing and epidemic management strategies and associated small numbers of attendances while infected, children and teachers did not contribute significantly to COVID-19 transmission via attendance in educational settings. These findings could be used to inform modelling and public health policy regarding school closures during the COVID-19 pandemic.

Funding NSW Government Department of Health.

Lancet Child Adolesc Health 2020; 4: 807–16

Published Online August 3, 2020 https://doi.org/10.1016/S2352-4642(20)30251-0

See Comment page 796

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Introduction

The global COVID-19 pandemic has been addressed through implementation of aggressive public health measures focused on restricting mobility and ensuring physical distancing. Most countries have enforced school closures to mitigate transmission.[1] However, evidence suggests that COVID-19 is less prevalent in children and generally causes milder illness, when compared with adults.[2–6] The extent to which children are asymptomatically infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and what role they have in virus transmission, particularly in schools, remains unclear. It appears children are less likely to be the primary infection source in household clusters, compared with adults.[7,8]

School closures might be effective in controlling pandemic influenza because children are important in transmission, and have high hospitalisation rates and severe outcomes from influenza.[9,10] However, school closures have significant social and economic impacts on children and families, with widespread implications for national and global economies.[11] Although past experiences of school closures might inform expectations of social and economic impacts, modelled effects of school closures have varied depending on the assumptions regarding children's role in SARS-CoV-2 transmission.[12] In China, schools were already closed for school holidays and remained so for a number of months,[13] and, to date, data on COVID-19 from school or childcare settings are scarce.[14–16]

Australian strategies to delay and reduce the impact of COVID-19 following the first case in a traveller from Wuhan, China, on Jan 25, 2020, included thorough incoming traveller and community surveillance, high

Exhibit 9

Research in context

Evidence before this study
Data on COVID-19 in schools are scarce, particularly given many schools have been closed in response to the pandemic. We searched PubMed and medRxiv on June 5, 2020, for studies published from Jan 1, 2020, reporting transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in educational settings since the start of the outbreak in China, using the search terms COVID-19, SARS-CoV-2, transmission, schools, and children, as well as manually searching the references used in other relevant papers. Terms were searched individually and in combination as necessary, and no language restrictions were used. We identified some studies that included mention of student cases as part of a larger outbreak. We identified one article that detailed transmission in a school setting in Ireland in children aged 10 years and older; however, this study had few participants, a short study period (10 days), no data on testing rates, or serological testing in follow-up.

Added value of this study
We examined SARS-CoV-2 transmission among children and adults in 25 educational settings (primary and secondary schools, and early childhood education and care settings) together with the rate and characteristics of all paediatric COVID-19 cases in the Australian state of New South Wales over a 3-month period. We found a low incidence of attendance of children and staff members with COVID-19 at educational facilities, and low rates of SARS-CoV-2 transmission in the 15 schools and childcare settings where a case occurred. The exception was an outbreak in a childcare centre. The use of enhanced surveillance and serological testing of close contacts within the educational setting enabled detection of a small number of asymptomatic SARS-CoV-2 secondary infections in schools and the childcare setting.

Implications of all the available evidence
This is the first comprehensive population-based assessment of SARS-CoV-2 transmission among children and adults in educational facilities. Our results show that where effective case-contact testing and epidemic control strategies exist for the population, children and teachers did not contribute significantly to COVID-19 transmission via attendance in educational settings. This study will assist modellers, policy makers, health-care providers, and the public to understand the risk of COVID-19 occurring in educational facilities and help in decision making around school closures and reopenings. Our data also provide insights that can assist in comparing the economic and community costs of school closures against the potential benefits of reduced virus transmission.

testing rates, rapid case isolation and contact tracing, and border closures and quarantine.[17] Major changes in population behaviour and a low infection rate have ensued.[17] Consistent with national policy, most of Australia's eight states and territories, including the most populous state New South Wales (NSW), kept schools open during the pandemic.[18] In NSW, guidance for physical distancing, hygiene measures, and educational facility cleaning was issued. At the epidemic peak on March 23, 2020, distance (online) learning was implemented, and physical attendance recommended to be limited to children who needed to attend in person (eg, children of health-care workers or those without other care options).[18] Early childhood education and care (ECEC) settings for children aged 6 weeks to 5 years remained open.

This study aimed to prospectively examine SARS-CoV-2 transmission among children and adults in educational settings and to provide real-time evidence for decision making on school-based policies related to COVID-19. We secondarily aimed to examine the rate and characteristics of NSW paediatric COVID-19 cases in both educational settings and the wider population.

Methods

Study setting

This study was done in NSW, Australia, population 8·1 million, of which 1·8 million residents (23·0%) are aged 18 years or younger.[19] Among laboratory-confirmed COVID-19 cases in NSW, we identified all children (aged ≤18 years) and staff who attended school or ECEC settings while considered infectious (defined as 24 h before symptom onset based on national guidelines during the study period[20]). All NSW schools (n=3103; public, independent, and Catholic) providing either primary (ages approximately 5–12 years), or secondary school education (ages approximately 13–18 years), or both, and any ECEC setting (approximately n=4600; ages approximately 6 weeks to 5 years) were eligible for inclusion. The estimated numbers of school staff and enrolled students state wide for 2020 were 143 084 and 1 232 367, respectively. Estimates of numbers of ECEC setting staffing and enrolment were not available.

The study period for index case identification was from Jan 25 (first NSW COVID-19 case notification) to April 9, 2020 (when the 10-week school term 1 ended and scheduled holidays commenced). From March 22, 2020, children were encouraged to stay home for distance learning until term 1 end; however, schools remained open if home schooling was not an option. The follow-up period for close contacts of COVID-19 cases extended to May 1, 2020.

The study was commissioned by the NSW Department of Health under the Public Health Act 2010 (NSW) and

Exhibit 9

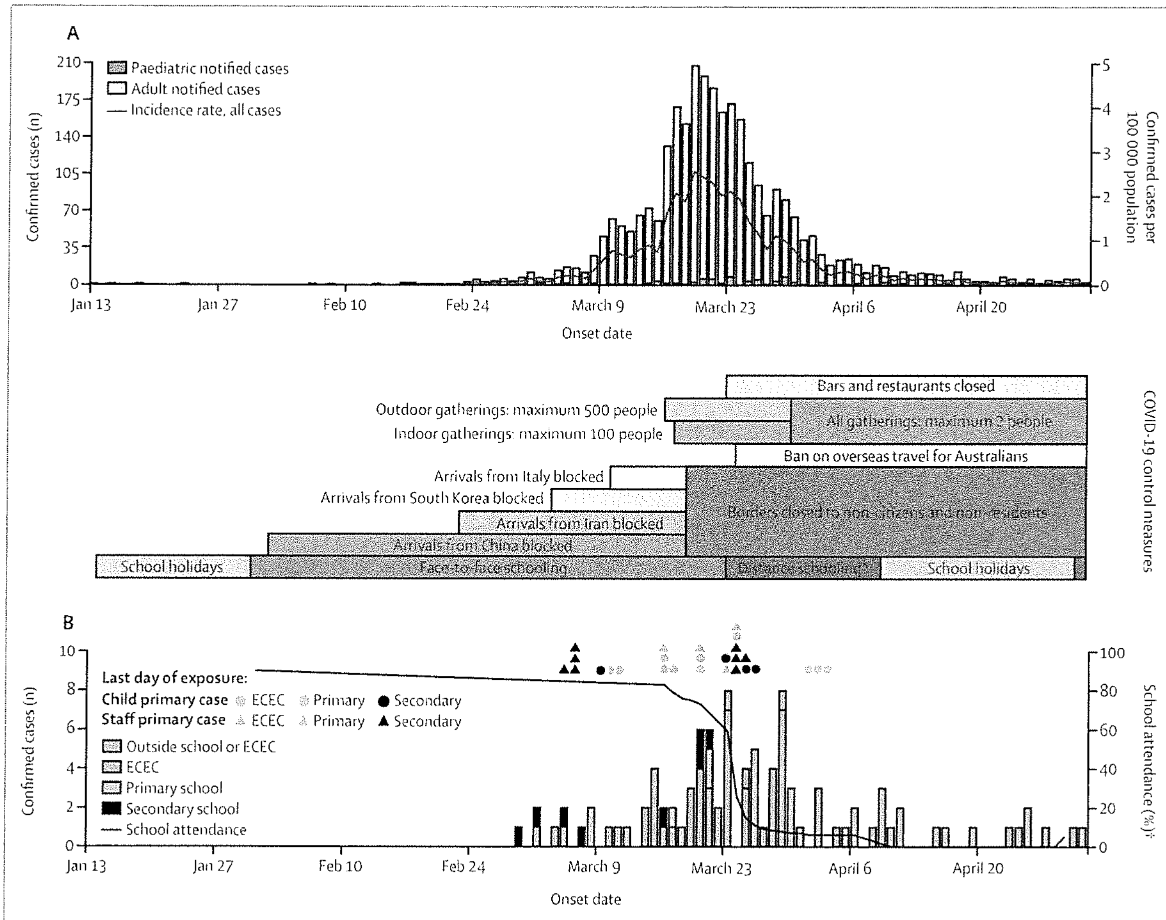

Figure: **Onset date of total (A) and paediatric (B) confirmed COVID-19 cases in NSW, Jan 13–May 1, 2020, relative to control measures and school attendance**
Nucleic acid testing used for confirmation of severe acute respiratory syndrome coronavirus 2 infection, and definition of COVID-19 case. If people were asymptomatic, specimen positive date was used. ECEC=early childhood education and care settings. NSW=New South Wales. *Distance (remote) learning recommended, but schools also remained open for face-to-face attendance as required. After school holidays, preference for distance learning continued for 2 weeks before resumption of full face-to-face learning. †Excluding ECEC.

implemented in conjunction with approval and support from the NSW Department of Education.

Population-level data

All laboratory-confirmed COVID-19 cases in NSW, using SARS-CoV-2 nucleic acid testing,[20] were recorded and monitored daily using the NSW Notifiable Conditions Information Management System. All cases (or their parent or carers) were interviewed at diagnosis to determine links to known COVID-19 cases, ascertain movements, and identify close contacts while infectious, including at educational facilities. Descriptive data for all laboratory-confirmed cases with onset from Jan 13 to May 1, 2020, were analysed.

School and ECEC setting case and close contact definitions and management

A COVID-19 school or ECECs index case was defined as the first identified laboratory-confirmed case who attended the facility while infectious. A school or ECEC setting primary case was defined as the initial infectious case or cases in that setting, and might or might not have been the index case. A secondary case was defined as a close contact with SARS-CoV-2 infection (detected through nucleic acid testing or serological testing, or both), which was considered likely to have occurred via transmission in that educational setting (based on no other epidemiological link or risk factor). Data on all cases' potential sources of infection and close contacts were obtained from interviews with cases, families, and school officials, and review of school timetables. Close contacts were defined as children or staff with face-to-face contact for at least 15 min, or who shared a closed indoor space for at least 40 min (generally the same class or lesson, typically consisting of 20–30 students) with a case during their infectious period. All close contacts quarantined at home for 14 days, had regular text message or telephone call contact to enquire about symptoms, and were instructed to be tested if they developed COVID-19-related symptoms at designated

Exhibit 9

	Sex		Age group						Existing medical condition	Hospitalisation	ICU admission	Total (rate per 100 000 population)
	Male	Female	0 to <5 years	5 to <13 years	13 to ≤18 years	19 to ≤39 years	40 to ≤59 years	≥60 years				
Paediatric cases												
Within school or ECEC	13 (68%)	6 (32%)	9 (47%)	3 (16%)	7 (37%)	..	..	..	5 (26%)	3 (16%)	0	19
Primary case	6 (50%)	6 (50%)	3 (25%)	2 (17%)	7 (58%)	..	..	..	4 (33%)	3 (25%)	0	12
Secondary case	7 (100%)	0	6 (86%)	1 (14%)	0	..	..	..	1 (14%)	0	0	7
Outside school or ECEC	35 (44%)	43 (55%)	11 (14%)	27 (34%)	40 (51%)	..	..	..	9 (12%)	6 (8%)	1 (1%)	78
All	48 (49%)	49 (51%)	21 (21%)	30 (31%)	47 (48%)	..	..	..	14 (14%)	9* (9%)	1 (1%)	97 (5)
Adult cases												
Within school or ECEC	1 (5%)	21 (95%)	..	..	..	12 (55%)	9 (41%)	1 (5%)	4 (18%)	4 (18%)	2 (9%)	22
Primary case	1 (7%)	14 (93%)	..	..	..	8 (53%)	6 (40%)	1 (7%)	3 (20%)	2 (13%)	0	15
Secondary case	0	7 (100%)	..	..	..	4 (57%)	3 (43%)	0	1 (14%)	2 (29%)	2 (29%)	7
Outside school or ECEC	1450 (50%)	1463 (50%)	..	..	..	1156 (40%)	821 (28%)	937 (32%)	849 (29%)	296 (10%)	75 (3%)	2914
All	1451 (49%)	1484 (51%)	..	..	..	1168 (40%)	830 (28%)	938 (32%)	853 (29%)	300 (10%)	77 (3%)	2936 (47)

Data are n (%), unless otherwise stated. ECEC=early childhood education and care setting. ICU=intensive care unit. NSW=New South Wales. *Most were hospitalised early in the epidemic response for isolation purposes only and had mild symptoms.

Table 1: **Demographic and clinical data on all paediatric and adult COVID-19 cases in NSW, Australia, from Jan 13 to May 1, 2020, including links to an educational setting as either a primary or secondary case**

COVID-19 testing facilities. Schools and ECEC settings closed temporarily on case notification and generally reopened within 24–48 h after environmental cleaning and public health measures were instituted. We reviewed data for all close contacts for a minimum of 30 days from last exposure to the primary case, to ensure that any potential new cases were identified and investigated.

Targeted enhanced school and ECEC setting-based investigations

Selected educational settings were offered participation in enhanced investigations, in addition to routine public health management if logistically feasible and authorisation was provided by local public health and education authorities. Close contacts or their parents or carers were provided with information on enhanced investigations and informed consent was obtained (appendix). Participants could opt out at any time.

See Online for appendix

Enhanced investigations of close contacts included a survey requesting more details on extent of contact with the case, and symptoms before and during quarantine; upper respiratory tract (nasopharyngeal) swab for nucleic acid testing 5–10 days after last case contact if not previously collected and irrespective of symptoms; and serological testing after day 21 following last case contact. Swabs were collected at home either by visiting health-care workers, or by the case or parent or carer using written and video instructions. Blood was collected at home visits, dedicated school-based collection days, or pathology collection centres.

Laboratory testing

Ten public and three private NSW laboratories were validated and did SARS-CoV-2 nucleic acid testing during the study period. Blood and nasopharyngeal specimens for enhanced surveillance were tested by the NSW Pathology reference laboratory, the Institute for Clinical Pathology and Medical Research. Nucleic acid testing was done using an in-house real-time PCR as previously described.[21] SARS-CoV-2-specific IgG, IgA, and IgM detection was done using an indirect immunofluorescence assay (IFA) that has a sensitivity compared with nucleic acid testing of detecting any of SARS-CoV-2-specific IgG, IgA, or IgM when samples were collected at least 14 days after illness onset of 91·3% (95% CI 84·9–95·6) and specificity of 98·9% (95% CI 98·4–99·3%; MVNO, personal communication).

Data analyses

Percentages were calculated to describe demographic, laboratory, and epidemiological characteristics of all NSW cases, school or ECEC setting cases, and close contacts. Attack rates were calculated for different transmission scenarios and with denominators including all close contacts or only close contacts who were tested for SARS-CoV-2. School attendance data were obtained from the NSW Department of Education. Population

Exhibit 9

	Primary cases			Days when contacts' NAT done post last exposure*	Child close contacts				Staff close contact			
	Age (years), sex (M or F)	Source of infection (all acquired locally)	Days infectious at school*		Age (years)	n	Contacts' NAT done†	NAT positive of contacts tested†	Age (years)	n	Contacts' NAT done†	NAT positive of contacts tested†
SS												
SS 1	16, M	Household	4	3 (2–5)	16 (16–16)	58	19 (33%)	0	51 (48–53)	11	2 (18%)	0
SS 2‡	14, M; 15, F	Household	Unknown§; 5	5 (3–8)	15 (15–15)	193	117 (61%)	0	41 (27–49)	18	12 (67%)	0
SS 3	12, F	Household	4	4 (4–5)	12 (12–12)	66	20 (30%)	0	38 (34–39)	11	5 (46%)	0
SS 4	48, F	Source unknown	1	6 (5–7)	15 (13–15)	46	15 (33%)	0	47 (42–53)	11	6 (54%)	0
SS 5	53, F	Source unknown	1	4 (4–4)	14 (13–15)	4	1 (25%)	0	38 (36–46)	6	5 (83%)	0
SS 6‡	13, F; 15, M	Household	5; 2	10 (8–13)	15 (13–15)	65	13 (20%)	0	41 (30–45)	9	2 (22%)	0
SS 7	16, M	Household	3	11 (11–12)	16 (16–16)	131	9 (7%)	0	55 (48–64)	8	1 (13%)	0
SS 8	18, M	Household	2	14 (11–14)	17 (16–17)	8	1 (13%)	0	44 (31–56)	7	3 (43%)	0
SS 9	34, F	Source unknown	1	NA	16 (16–16)	10	0	0	NA	0	0	0
SS 10	65, F	Source unknown	4	12 (10–15)	13 (13–15)	19	1 (5%)	0	50 (44–53)	15	3 (20%)	0
All SSs	8, 4¶	NA	3 (2–4)||	5 (4–8)	15 (14–16)	600	196 (33%)	0	44 (34–53)	96	39 (41%)	0
PS												
PS 1‡**	46, F	Non-household contact	1	6 (6–7)	7 (6–10)	66	28 (42%)	1 (4%)	45 (37–52)	15	8 (53%)	1 (13%)¶
PS 2†	10, F	Source unknown	10	12 (11–12)	10 (10–10)	43	6 (14%)	0	60 (60–61)	2	1 (50%)	0
PS 3	31, F	Household	3	7 (7–8)	10 (10–11)	15	1 (7%)	0	32 (31–47)	7	5 (71%)	0
PS 4	21 ,M	Non-household contact	4	7 (5–8)	7 (5–9)	27	4 (15%)	0	24 (23–24)	2	2 (100%)	0
PS 5	19, F	Non-household contact	5	7 (6–10)	7 (6–8)	28	3 (11%)	0	25 (20–29)	13	4 (31%)	0
All PSs	1, 4¶	NA	4 (3–5)||	6 (6–11)	9 (7–10)	179	42 (23%)	1 (2%)	36 (26–52)	39	20 (51%)	1 (5%)
ECEC												
ECEC 1‡	36, F	Non-household contact	1	10 (8–13)	4 (4–4)	16	16 (100%)	0	NA	0	0	0
ECEC 2	50, F	Non-household contact	2	5 (3–6)	4 (3–4)	43	18 (42%)	0	47 (42–50)	6	2 (33%)	0
ECEC 3‡	56, F	Acquired locally, source unknown	9	7 (7–9)	2 (1–3)	151	79 (52%)	0	30 (26–36)	25	19 (76%)	0
ECEC 4	30, F	Source unknown	1	8 (7–8)	2 (1–3)	31	13 (42%9)	0	32 (26–39)	9	2 (22%)	0
ECEC 5	3, F	Source unknown	1	18 (15–19)	3 (3–4)	34	1 (3%)	0	26 (22–32)	18	3 (17%)	0
ECEC 6‡	49, F	Source unknown	1	16 (14–17)	1 (2–3)	25	23 (92%)	6 (26%)	38 (31–43)	12	11 (92%)	6 (55%)
ECEC 7	2, M	Source unknown	1	17 (15–17)	3 (2–4)	43	11 (26%)	0	40 (38–50)	14	5 (36%)	0
ECEC 8	21, F	Non-household contact	2	4 (4–4)	N/A	0	0	0	31 (25–36)	15	9 (60%)	0
ECEC 9	1, F	Source unknown	1	3 (3–3)	1 (1–1)	8	5 (63%)	0	23 (20–31)	5	3 (60%)	0
ECEC 10	38, F	Source unknown	2	5 (5–7)	3 (2–3)	55	16 (29%)	0	29 (27–36)	24	9 (38%)	0
All ECEC	3, 7¶	NA	1 (1–2)||	8 (6–12)	3 (2–4)	406	182 (45%)	6 (3%)	34 (26–41)	128	63 (49%)	6 (10%)
All settings	12 (14), 15 (38)††	9 household; 6 non-household contact; 12 source unknown	2 (1–4)||	7 (5–10)	10 (3–15)	1185	420 (35%)	7 (2%)	37 (27–48)	263	122 (46%)	7 (6%)

Data are n; median (IQR); or n (%), unless otherwise stated. M=male. F=female. NAT=nucleic acid test. SS=secondary school. PS=primary school. NA=Not applicable. ECEC=early childhood education and care setting. NSW=New South Wales. *Day test done post last day of exposure (D0) to the infectious cases. †Close contacts were managed in home quarantine and instructed to be tested if symptoms developed; also includes some asymptomatic cases (see table 3). ‡Settings where enhanced surveillance was done (see table 3). §Unknown exposure duration as asymptomatic case. ¶Data are number of children, number of staff. ||Data are median (IQR). **The primary case notification was late after exposure and symptom onset and occurred shortly before notification of the secondary staff case. Close contact follow-up for the primary case was incomplete and probably reduced the total number of primary case contacts having an NAT test. Close contacts of the secondary case included the child who was a tertiary case in this setting (see table 3). ††Data are number of children (median), number of staff (median).

Table 2: **Primary COVID-19 cases and close contacts who attended 25 educational settings from March 5 to April 9, 2020, in NSW, Australia**

Exhibit 9

	Symptomatic (n=65)				Asymptomatic (n=223)				Symptoms unknown (n=352)*				Total secondary cases	Percentage of contacts tested
	n	NAT	Serology	Any test	n	NAT	Serology	Any test	n	NAT*	Serology	Any test		
Child contacts														
SS 2	20	0/19	1/16 (6%)	1/20 (5%)	90	0/51	0/52	0/74	83	0/47	0/3	0/47	1	73%
SS 6	4	0/4	0/3	0/4	43	0/5	1/36 (3%)	1/36 (3%)†	18	0/4	0/4	0/6	1	70%
PS 1	2	1/2 (50%)	1/2 (50%)	1/2 (50%)	18	0/18	0/13	0/18	46	0/8	0/1	0/8	1	42%
PS 2	1	0/1	0/1	0/1	8	0/1	0/6	0/6	34	0/4	0/8	0/12	0	44%
ECEC 1	0	0/0	0/0	0/0	0	0/0	0/0	0/0	16	0/16	0/5	0/16	0	100%
ECEC 3	21	0/18	0/4	0/20	22	0/6	0/7	0/11	108	0/55	0/4	0/59	0	60%
ECEC 6	7	3/6 (50%)	3/6 (50%)	4/7 (57%)	13	3/13 (23%)	2/8 (25%)	3/13 (23%)	5	0/4	0/2	0/4	7	96%
All	55	4/50 (8%)	5/32 (16%)	6/54 (11·%)	194	3/94 (3%)	3/122 (3%)	4/158 (3%)	310	0/138	0/27	0/152	10	65%
Adult contacts														
SS 2	1	0/1	0/0	0/1	8	0/4	0/3	0/5	9	0/7	0/2	0/7	0	72%
SS 6	0	0/0	0/0	0/0	7	0/1	1/5 (20%)	1/5 (20%)	2	0/1	0/1	0/1	1	67%
PS 1	1	1/1 (100%)	0/0	1/1 (100%)	5	0/3	0/4	0/5	9	0/4	0/1	0/4	1	67%
PS 2	0	0/0	0/0	0/0	0	0/0	0/0	0/0	2	0/1	0/2	0/2	0	100%
ECEC 1	0	0/0	0/0	0/0	0	0/0	0/0	0/0	0	0/0	0/0	0/0	0	100%
ECEC 3	2	0/2	0/1	0/2	4	0/1	0/1	0/1	19	0/16	0/2	0/17	0	80%
ECEC 6	6	6/6 (100%)	2/2 (100%)	6/6 (100%)	5	0/4	0/2	0/4	1	0/1	0/1	0/1	6	92%
All	10	7/10 (70%)	2/3 (67%)	7/10 (70%)	29	0/13	1/15 (7%)	1/20 (5%)	42	0/30	0/9	0/32	8	77%
Total	65	11/60 (18%)	7/35 (20%)	13/64 (20%)	223	3/107 (3%)	4/137 (3%)	5/178 (3%)	352	0/168	0/36	0/184	18	67%

Data are n/N (% positive of those contacts tested), unless otherwise stated. NAT=nucleic acid test. SS=secondary school. PS=primary school. ECEC=early childhood education and care setting. NSW=New South Wales. *55% of all contacts did not complete a detailed symptom questionnaire and other data on symptoms at time of testing could not be obtained. †Asymptomatic in post-exposure period but reported influenza-like illness in period before primary case onset.

Table 3: **Details of secondary cases resulting from COVID-19 transmission in seven NSW educational settings where enhanced surveillance of symptomatic and asymptomatic close contacts was done**

data were obtained from the Australian Bureau of Statistics. Data cleaning and analysis were done using Stata, version 14.2.

Role of the funding source

The funder of the study had no role in study design, data analysis, data interpretation, or writing of the report. The funder contributed to collection of data. KM, HEQ, AJP, AK, LD, NWi, ALK, MVNO, CD, and NWo had access to the raw data. The corresponding author had full access to all of the data and the final responsibility to submit for publication.

Results

As of May 1, 2020, NSW had 3033 confirmed COVID-19 cases, representing 37·5 cases per 100 000 population and 44·8% of 6777 cases nationally (figure). In NSW, 1760 (58·0%) of 3033 cases were acquired overseas and 54 (1·8%) of 3033 cases were acquired interstate. Of 1220 locally acquired cases, 416 (34·1%) had an unknown source or were under investigation. Children aged 18 years or younger accounted for 97 (3·2%) of 3033 cases in NSW. 9% (n=9) of children with COVID-19 were admitted to hospital (most for isolation purposes only), with one child, aged 18 years, admitted to intensive care (table 1).

Notification of the first COVID-19 case in an educational setting was on March 5, 2020 (figure). Among 97 nucleic acid testing-confirmed cases in children to April 9, 2020, 19 (19·6%) attended an educational setting while infectious and were included in the study (table 1; figure). Of the other 78 paediatric cases, 44 (56·4%) were locally acquired from contact with a confirmed case, mostly from their household (70·5%; table 1).

The timing of measures implemented to ensure physical distancing and decrease population movement and school attendance rates are shown in the figure. Rates declined from approximately 90·0% to 5·0% after recommendations for distance learning were made on March 23, 2020, and immediately before school holidays commenced on April 10, 2020. Cases peaked in late March, with primary cases in schools occurring earlier in the outbreak and primary cases in ECEC settings occurring later in the outbreak (figure).

There were 27 primary cases identified in 25 schools (n=15) and ECEC settings (n=10); of 27 cases, 15 (55·6%) were staff and 12 (44·4%) were children (tables 1, 2). Of the child cases, eight (median age 15 years; range 14–16) were in secondary schools, with one (age 10 years) in primary school. Three ECEC setting primary cases were children (median age 2 years; range 2–3). Staff (median age 38 years; range 31–50) were the primary cases in four (40·0%) of

ten secondary schools, four (80·0%) of five primary schools, and seven (70·0%) of ten ECEC settings. The median time that primary cases attended the setting while infectious was 2 days (range 1–10). Infection was locally acquired for all primary cases, but the source was unknown for many (12 [44·4%] of 27). Where known, a household member was usually the source, especially for children (table 2).

Secondary transmission occurred in four of 25 settings: three schools (five cases), and one ECEC setting that had an outbreak (table 2). In total, 663 (43·7%) of 1448 close contacts were tested by nucleic acid testing or serology, or both; 18 secondary cases were identified among the total 1448 close contacts (attack rate 1·2%). Among close child and staff contacts who had laboratory testing done, the attack rate was 2·8% (tables 3, 4).

Seven of the 25 educational settings (four schools; three ECEC settings) participated in enhanced investigations (table 3). Among contacts who completed symptom questionnaires (44·9%), 65 (22·6%) of 288 developed symptoms consistent with COVID-19 during the 14-day quarantine, such as fever, sore throat, cough, or rhinorrhea. In these seven settings, 426 (66·6%) of 640 close contacts had nucleic acid testing or serological testing, or both. Secondary attack rates among symptomatic and asymptomatic contacts are shown in table 3.

Five secondary cases occurred in schools: one child in one secondary school; one child and one staff member in another secondary school; and one staff member, followed by one child in one primary school (table 3). This primary school was the only school to have a second-generation infection. Overall, two children were symptomatic and had nucleic acid testing (one positive on day 6 and the other negative on day 4 after last exposure), whereas one child and one staff member were asymptomatic and did not have nucleic acid testing. One symptomatic staff member had nucleic acid testing only (table 3). The attack rate in the tested population in schools was five (1·3%) of 375.

No SARS-CoV-2 transmission occurred in two of the three ECEC settings that participated in enhanced surveillance (25 staff and 167 child contacts). The third ECEC setting had a large outbreak first recognised via an index case in a child aged 2 years, but subsequently found related to a primary case in one staff member (infection source unknown; tables 2 and 3). Overall, six other staff and seven children were infected (attack rate 35·1%). Among the infected close contacts, three of 13 were infants (age 1 year) who remained asymptomatic.

The overall child to child transmission rate was 0·3%, and the attack rate for child to staff member was 1·0% (table 4). The rate of staff member to child transmission was lower (1·5%) than staff to staff transmission (4·4%). Excluding the single ECEC setting with the large outbreak, staff member to child (0·2%) and staff member to staff member (0·7%) transmission rates were lower compared with all settings.

	Secondary attack
All settings, all contacts, including single ECEC outbreak	1·2% (18/1448)
All settings, all contacts, excluding single ECEC outbreak*	0·4% (5/1411)
All settings, all child case to child contacts	0·3% (2/649)
All settings, all child case to staff member contacts	1·0% (1/103)
All settings, all staff member case to child contacts	1·5% (8/536)
All settings, all staff member case to staff member contacts	4·4% (7/160)
All settings, all staff member case to child contact, excluding single ECEC outbreak*	0·2% (1/511)
All settings, all staff member case to staff member contacts, excluding single ECEC outbreak*	0·7% (1/148)
All settings, tested population	2·8% (18/633)
All settings, tested population, excluding single ECEC outbreak	0·8% (5/598)
All schools, all contacts	0·5% (5/914)
All schools, tested population	1·3% (5/375)
Single ECEC outbreak,* all contacts	35·1% (13/37)
Child close contacts	28·0% (7/25)
Staff close contacts	50·0% (6/12)

Data are rate % (n/N). SARS-CoV-2=severe acute respiratory syndrome coronavirus 2. ECEC=early childhood education and care. *This outbreak resulted in at least four generations of infection and there was no evidence of child to child or child to staff transmission (unpublished).

Table 4: **Secondary attack rates of SARS-CoV-2 infection by educational setting and testing approach**

Discussion

This study of SARS-CoV-2 transmission in schools and early childcare settings in a defined population of 8·1 million Australians shows low case rates and secondary infections among children and staff attending educational facilities throughout the first epidemic wave of the COVID-19 pandemic. School closures during the COVID-19 pandemic have affected more than 90% of the world's student population,[1] and contributed to reducing overall population mobility, including via reduced parent and carer workforce participation. However, the insufficiency of data on age-specific and setting-specific susceptibility and transmissibility of SARS-CoV-2 has limited our understanding of what school closure, or reopening, might contribute to COVID-19 control.[9,12] Our data provide multiple insights that need to be viewed in the context of our setting. First, and related to overall epidemic activity in NSW, the reported incidence of an infectious child or staff member attending an educational facility was low, occurring in only 25 of 7700 NSW facilities. Second, despite only 10·0% of school attendees being staff during the first part of the epidemic, when student attendance was high, overall, primary COVID-19 cases were staff members in 56·0% of educational settings; this is consistent with higher population-based rates of COVID-19 in adults than children. Third, secondary transmission of SARS-CoV-2 only occurred in three of 15 schools and one of ten ECEC settings. Only one setting,

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an ECEC setting, had a sustained outbreak of COVID-19 following infection in a staff member, which was not apparent until investigation of a child index case. Excluding this single ECEC setting outbreak, the overall attack rate was five (0·4%) in 1411, or one in every 282 contacts. Continued operation of schools throughout the moderate first epidemic wave in NSW, albeit with reduced face-to-face attendance in line with public health guidance, did not appear to contribute significantly to SARS-CoV-2 transmission (attack rate 0·5%). Attendance rates were still high during the period when transmission, in the two secondary and one primary schools, occurred. This finding was in contrast to other settings in NSW, where multiple outbreaks were contemporaneously identified, including aged-care facilities and mass gatherings, such as weddings and religious services.[22]

An important component of our study was enhanced follow-up in a subset of educational settings, including in both asymptomatic and symptomatic adult and child contacts. This resulted in laboratory testing in two-thirds of close contacts. The use of serology facilitated identification of four additional secondary cases, including an asymptomatic student and staff member, who were not detected using routinely deployed nucleic acid testing and increased secondary case numbers from that in our preliminary report[23] to the NSW and Australian Government (n=2). By comparison, a small study[16] from Ireland of six COVID-19 cases in three schools, over less than 2 weeks, suggested no transmission to 1115 close contacts. However, children aged younger than 10 years and data on testing rates were not included. In our study, the attack rate among the tested population across all schools was low (1·3%) and was zero in nine of the ten ECEC settings. The single ECEC setting outbreak was complex and occurred early on in the epidemic in NSW. 13 (35·1%) of 37 contacts in this small centre were infected; three of the seven infected children (all aged <3 years) remained asymptomatic and the others had mild disease. Transmission chains between staff and from staff to children were apparent. Child to child or child to staff transmission appeared unlikely to have occurred but could not be excluded. In addition, delayed primary case diagnosis, due to adherence to narrow nucleic acid testing criteria recommended at the time, close mixing of staff and children and shared physical amenities, probably contributed to the several generations of transmission (data not shown; unpublished). In summary, our findings add to emerging data[7,9] on the direction of transmission from household and similar settings, such as ECEC settings, that suggest children are unlikely to initiate, or propagate, outbreaks.

We report a correspondingly low rate of paediatric disease (97 cases among 1·8 million aged 18 years or younger; 5·2 per 100 000; 3·2% of total) across NSW, providing additional evidence of reduced transmission resulting in clinical disease to and between children. Studies from multiple countries have consistently shown lower rates of COVID-19 and mild disease in children compared with adults, even in settings with much higher population-based disease rates than Australia.[2–5,24] Multiple hypotheses are being explored to explain the decreased susceptibility of children to SARS-CoV-2, including differences in immune responses[25] and age-dependent expression of the angiotensin converting enzyme 2 (ACE2) virus receptor;[26] however, the mechanisms responsible for this phenomenon remain unclear.

The low case and transmission rates in NSW schools and childcare settings reported here were underpinned by rapid and effective state and national public health, and community, responses.[17] Although community-based transmission occurred in some areas, particularly in Sydney (based on the proportion of cases [34·2%] with a local or unknown source of infection despite intensive contact tracing, and an effective reproductive number above 1 until mid-March, 2020), the NSW epidemic was smaller and of shorter duration compared with that seen in many other countries.[17,27] Tracking SARS-CoV-2 transmission was possible in this epidemic context because frequent simultaneous case introductions to schools and ECEC settings were not occurring, and enabled by continued operation of educational facilities throughout the epidemic period, albeit with reduced face-to-face attendance in the weeks before school holidays. Higher SARS-CoV-2 primary case and transmission rates might have occurred in schools and ECEC settings if the epidemic had escalated or if extensive testing, tracing, quarantine of exposed close contacts, and other public health mitigation measures were not simultaneously and effectively implemented. Although there are no specific data on adherence to these measures by the public in NSW, several strategies were in place to support a high compliance rate, including for quarantine of close contacts identified in this study. These strategies included regular wellbeing calls by public health staff to facilitate access to essential goods without breaching isolation, and issuing of fines to people found in breach of isolation requirements during random house calls by NSW police. Interpretation of our findings needs to be made in the context of the epidemic characteristics and COVID-19 response in NSW.

Our study is also limited by several factors. First, the majority of close contacts were tested after developing symptoms, so infected contacts with no or mild symptoms might have been missed. Symptom data were also incomplete and might have been affected by participant recall bias. Additional enhanced surveillance was limited by geographical location and school or ECEC settings' willingness to participate during a challenging time. Second, transmission rates reported might have been affected by the sensitivity and specificity of assays (nucleic acid testing and the IFA for virus-specific antibody) used for the detection of SARS-CoV-2 infection. When compared with nucleic acid testing for the diagnosis of SARS-CoV-2 infection, the IFA is reported to have high sensitivity and specificity in a mixed patient population

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(asymptomatic individuals to patients requiring intensive care unit admission). We did not attempt transmission rates to adjust for test performance characteristics, given the non-uniform application of diagnostic testing methods in this study. Third, variation in close contact definitions used across settings, declining school attendance rates in the 2 weeks before school holidays, and differing types of contact could not be controlled for and might have influenced attack rates. However, although face-to-face attendance declined rapidly later in the study period in response to public health advice, the number of close contacts monitored (1411; 1185 children and 263 adults) was still substantial. The national public health definition of the infectious period for cases was extended from 24 h to 48 h before symptom onset after our study period based on the latest evidence. It is probable that additional close contacts would have been identified in our study had the 48-h presymptomatic contact definition been operational before the commencement of our study. Future studies in school settings in Australia or other countries using this criteria for the potential infectious period will build on our findings. Finally, we were unable to assess adherence to or the effect on transmission of recommendations regarding hygiene or physical distancing in educational settings, and these progressively increased in magnitude over the study period.

The possible benefits of school closures on SARS-CoV-2 transmission reduction must be considered against the adverse effects on child wellbeing, including the potential to exacerbate inequality.[28] Although this study did not aim to assess the impact of school operation on the NSW epidemic, and it is unlikely that the effect of school closure alone can be disentangled from other broader pandemic control measures,[29] our findings provide evidence that SARS-CoV-2 transmission in educational settings can be kept low and manageable in the context of an effective epidemic response. These data should inform modelling and decision making regarding planned return of children and teachers to classrooms as pandemic control evolves. Where pandemic mitigation measures result in strong disease control, we anticipate that schools can be open in a safe way, for the educational, social, and economic good of the community as we adapt to living with COVID-19.

Contributors

KM, HEQ, AK, LD, NWi, ALK, CD, and NWo contributed to the study design. KM, HEQ, AJP, AK, LD, NWi, ALK, and NWo contributed to the literature review. KM, HEQ, AJP, AK, LD, NWi, MVNO, and NWo analysed the data. KM, HEQ, AJP, AK, LD, NWi, and NWo contributed to writing of the Article. KM, HEQ, AJP, AK, LD, NWi, ALK, and NWo contributed to the preparation of the Article. ALK contributed to data collection and MVNO contributed to laboratory testing. All authors contributed to data interpretation and Article review. The NSW COVID-19 Schools Study Team contributed to the study design, study recruitment, specimen collection, and participant interviews and follow-up.

NSW COVID-19 Schools Study Team

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Declaration of interests

KM, HEQ, AJP, AK, LD, NWi, and NWo report receiving a grant from NSW Government Department of Health for the conduct of this study. NWo also reports other funding from the University of Sydney and the Sydney Children's Hospital Network outside of the submitted work. All National Centre for Immunisation Research and Surveillance-based members of the Study Team (DB, CG, ND, AD, AJ, RJ, RK, KMe, LP, LR, and GS) also report receiving a grant from the NSW Government Department of Health for the conduct of this study. RK also reports an Emerging Leader Fellowship from the National Health and Medical Research Council. All other authors declare no competing interests.

Acknowledgments

NSW Health funded the National Centre for Immunisation Research and Surveillance for the COVID-19 schools transmission study entitled, Enhanced investigation and analysis of education setting-related COVID-19 in NSW. We thank all schools, staff, and student contacts and their families who participated in this work, especially those who assisted with the enhanced investigations. We acknowledge the following people who contributed to this work: Kerri Basile, at the Institute of Clinical Pathology and Medical Research, Westmead/NSW Pathology; and Lisa McCallum, Caroline Sharpe, Paula Spokes, and Jeremy McAnulty at the NSW Ministry of Health.

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Exhibit 9

EXHIBIT 10

SARS-CoV-2 infection in primary schools in northern France: A retrospective cohort study in an area of high transmission

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Exhibit 10

SARS-CoV-2 infection in primary schools in northern France: A retrospective cohort study in an area of high transmission

Abstract

Background: The extent of SARS-CoV-2 transmission among pupils in primary schools and their families is unknown.

Methods: Between 28-30 April 2020, a retrospective cohort study was conducted among pupils, their parents and relatives, and staff of primary schools exposed to SARS-CoV-2 in February and March 2020 in a city north of Paris, France. Participants completed a questionnaire that covered sociodemographic information and history of recent symptoms. A blood sample was tested for the presence of anti-SARS-CoV-2 antibodies using a flow-cytometry-based assay.

Results: The infection attack rate (IAR) was 45/510 (8.8%), 3/42 (7.1%), 1/28 (3.6%), 76/641 (11.9%) and 14/119 (11.8%) among primary school pupils, teachers, non-teaching staff, parents, and relatives, respectively (P = 0.29). Prior to school closure on February 14, three SARS-CoV-2 infected pupils attended three separate schools with no secondary case in the following 14 days among pupils, teachers and non-teaching staff of the same schools. Familial clustering of cases was evidenced by the high proportion of antibodies among parents and relatives of infected pupils (36/59 = 61.0% and 4/9 = 44.4%, respectively). In children, disease manifestations were mild, and 24/58 (41.4%) of infected children were asymptomatic.

Interpretation: In young children, SARS-CoV-2 infection was largely a- or pauci-symptomatic and there was no evidence of onwards transmission from children in the school setting.

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Introduction

As the coronavirus (COVID-19) pandemic continues to evolve, the extent of SARS-CoV-2 infection in children has not been well estimated and the role children may play in virus transmission remains unclear. During the first epidemic wave, many countries included school closures among the measures implemented to limit viral transmission, based on the prior knowledge of the impact of school closures on influenza transmission[1,2]. As many schools are now reopening, it is critical to evaluate the risk of viral circulation among pupils and their teachers in schools[3].

Initial epidemiological data from China indicated that children were significantly less affected than adults, whether considering the total number of clinical cases, disease severity or fatal outcomes[4]. Similar findings were also reported in other countries[5-7]. It is now understood that children, when infected, present with mild and asymptomatic forms of the disease more often than adults[8-10], with severe and fatal outcomes remaining rare in children[11-12].

Younger children are generally thought to be less susceptible to infection as compared to adults[13-16], and, when infected, are usually contaminated by a household member[17]. Some studies have nevertheless documented secondary attack rates in families as high in children as in adults[18]. Children, when found infected, may carry the virus in their throats for 9-11 days[17] and for up to one month in stools[19]. Viral loads have been found to be similar between infected children and adults[20-21], which would suggest that children may be as infectious as adults. It is therefore unclear why children would be less susceptible, and less infectious, as compared to adults[22]. Seroepidemiological studies are thus needed to determine the extent of infection in children and to decipher the role they may play in transmission

To our knowledge, the number of SARS-CoV-2 secondary transmissions in school setting documented in scientific literature is limited, with very few or no secondary case out of several investigations in Australia[23], Ireland[24], and France[25], with the exception of one important cluster in a high school north of Paris in February 2020[26].

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It is all the more important to understand the extent of infection in children and the role they may play in transmission given the likely negative effects of school closures on educational achievement and economic outcomes[3]. To investigate the extent of infection in younger children, a follow-up seroepidemiologic investigation to that in the high school was conducted across primary schools in the same city north of Paris, France. Here, we present the results of the follow up investigation in primary schools.

Methods

Study setting

An initial retrospective epidemiological investigation was conducted in the Crépy-en-Valois city (15,000 inhabitants) north of Paris, France after the diagnosis of the first case of COVID-19 on 24 February 2020. This investigation identified an epidemic around a local high school with two teachers having symptoms consistent with COVID-19 as early as on 2 February 2020. Since there was no known circulation of SARS-CoV-2 at that time in the region, no public health or social measures intended to limit the viral transmission had been implemented and no active SARS-CoV-2 testing had been conducted. A preliminary rapid investigation among symptomatic adults and pupils at the high school on 5-6 March 2020 revealed that 11/66 (16.7%) adults and 2/24 (8.3%) pupils had acute infection, as determined by a positive RT-PCR test result. As a follow-up to this rapid investigation, the decision was made to further examine by serological testing the extent of infection among pupils, their parents and relatives, teaching staff and non-teaching staff of 1) the high school where the two teachers worked and 2) the primary schools in the same city. The high school investigation has previously been reported[26]. Here, we describe the follow-up seroepidemiologic investigation across six primary schools from the same city, with children aged 6 to 11 years.

Study design

A retrospective cohort study was conducted by inviting all pupils, teachers and non-teaching staff (administrative, cleaners, catering) from each of the six primary schools who were registered at the school from the beginning of the epidemic (estimated around 13 January 2020) up to the time of the investigation (28-30 April 2020). Since pupils were minor, at least one parent was invited to provide informed consent for their child. They were also invited to participate in the study if they were willing to do so, as well as any of the other children or relatives over the age of 5 years of the household.

Following informed consent, participants (with the help of their parents in the case of pupils) completed a questionnaire that covered sociodemographic information, underlying medical conditions, history of

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recent symptoms, and history of COVID-19 diagnosis prior to this investigation. A 5-mL blood sample was taken from all participants.

Laboratory analyses

Samples were conveyed to and stored in the Clinical Investigation and Access to BioResources (ICAReB) biobank platform of Institut Pasteur (Paris, France), which collects and manages human bioresources for scientific purposes, following ISO 9001 and NF S 96-900 quality standards (BRIF code n°BB-0033-00062). Serological testing was conducted using the S-Flow assay, a flow-cytometry-based serological test developed by the Institut Pasteur. The assay is based on the recognition of the SARS-CoV-2 Spike protein expressed at the surface of 293T cells. In previous studies, the sensitivity of the assay was estimated at 99.4% (95% confidence interval (CI) = 96.6% - 100%) on a panel of 160 RT-PCR confirmed mild forms of COVID-19[27], while its specificity was found to be 100% (one-sided 97.5% CI = 97.4% - 100%) on a panel of 140 pre-epidemic sera[28].

Case definitions

Any participant with a positive serology at the time of blood sampling was considered as having had SARS-CoV-2 infection. Each infection was categorized as symptomatic if any recent symptoms were reported by the participant up until 7 days prior to the date of sample collection to allow sufficient time for seroconversion[29,30], or, alternatively, as asymptomatic. Symptoms were further categorized as major (fever, dry cough, dyspnea, anosmia and ageusia) or minor (sore throat, rhinitis, muscle pain, diarrhea, headache, asthenia, vomiting, nausea, chest pain, abdominal pain).

Statistical analyses

The IAR was defined as the proportion of all participants with SARS-CoV-2 infection based on antibody detection in the collected blood sample by the end of the first COVID-19 epidemic wave. Participants were further categorized as children if under 18 years of age (pupils, relatives of the pupil living in the same household) and adults if 18 years or older. The analysis was also broken down by school, and by time period (before and after February 14, date of the school closure for two-week

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holidays immediately followed by a local lockdown on March 1st). The IAR was compared according to participants characteristics using chi-square test and Fisher exact test, where appropriate. All statistical analyses were performed using Stata 15.0 (StataCorp, College Station, TX, USA).

Ethical considerations

This study was registered with ClinicalTrials.gov (NCT04325646) and received ethical approval by the Comité de Protection des Personnes Ile de France III. Informed consent was obtained from all participants.

Results

From 28 to 30 April 2020, 1047 pupils and 51teachers, from six primary schools, with children aged 6 to 11 years, were invited by email to participate in the investigation. Of these, 541 (51.5%) pupils and 46 (90.2%) teachers accepted to participate in the study. Thirty-one pupils were excluded as they refused phlebotomy, as were four teachers not affiliated with any of the six schools. This resulted in 510 pupils and 42 teachers being analyzed. In addition, 641 parents of pupils, 119 relatives of pupils sharing the same household, and 28 non-teaching staff completed the study population (Figure 1). Table 1 indicates the characteristics of the 1340 participants. Pupils and their parents constituted the majority of the study population (38.1% and 47.8%, respectively).

Most participants were female (57.4%), particularly among teaching (90.5%) and non-teaching (89.3%) staff. The pupils were aged 6-11 years, while the median (IQR) age was 40 (37-44) years for parents, 47.5 (40-51) years for teachers, and 47.5 (32-54) years for non-teaching staff (Table 1).

The overall IAR across study participants was 139/1340 (10.4%). It did not differ by gender, age categories, or type of participants (Table 2). The epidemic curve, based on symptoms experienced by participants with SARS-CoV-2 antibodies, had no specific pattern, and transmission does not appear to have been impacted by the closure of schools for holidays on February 14 (end of week 7) (Figure 2A). There were three instances in three separate schools of high suspicion of SARS-CoV-2 infection in pupils before the closure of the school for holidays (end of week 7), one in week 6, and two in week 7. There were no secondary cases in pupils, teachers and non-teaching staff of the corresponding schools in the 14 days following these initial cases, except for one teacher who had onset of symptoms nine days later, but also had a close contact with a confirmed case outside of the school five days prior to becoming sick. Parents of infected pupils had higher IAR compared to parents of non-infected pupils (61.0% versus 6.9%; P <0.0001), and relatives of infected pupils had higher IAR compared to relatives of non-infected ones (44.4% versus 9.1%; P = 0.002) (Table 2 & Figure S1).

Among adults, fever, cough, dyspnea, ageusia, anosmia, muscle pain, sore throat, headache, asthenia, and diarrhea were all associated with positive SARS-CoV-2 antibodies (Table 3). Ageusia and anosmia, reported among 48% of adult participants, had a high positive predictive value for infection: 75.0% and 90.7%, respectively. In children, only asthenia and diarrhea were associated with SARS-CoV-2 antibodies. Only two children with SARS-CoV-2 antibodies experienced anosmia and ageusia, and both were 15 years of age. Among the 139 participants with SARS-CoV-2 antibodies, only two (1.4%, 95% CI = 0.2% - 5.1%), both parents, were hospitalized. There was no death. Across the study period, 9.9% of seropositive adults, and 41.4% of seropositive children, reported no symptoms ($P < 0.001$). Symptoms of respiratory infections – fever, cough, rhinitis- were common among the participants without SARS-CoV-2 antibodies during the study period, with a marked decrease after lockdown was introduced on 1 March 2020 (Figure 2B).

Discussion

This study in one of the first seroepidemiologic investigation on SARS-CoV-2 in the setting of primary schools. Despite three introductions of the virus into three primary schools, there was no further spread of the virus towards other pupils or teaching and non-teaching staff of the schools. In families of infected pupils, the prevalence of antibodies was very high, suggesting intrafamilial clustering of infections. Finally, children experienced mild forms of disease, many of them being asymptomatic.

We can infer from the reported date of symptom onset among seropositive individuals that viral circulation in the study population presumably began around week 5 (27-31 January 2020). Transmission continued to increase up to week 10 (2-6 March), with no effect of school closure for holidays (14 February). Transmission stabilized and then declined after week 13 (23-27 March). Since there was no reported circulation of SARS-CoV-2 during the month of February in the region until the diagnosis of the first local case on 24 February 2020, adherence to any public health or social measures intended to limit the transmission of the virus was likely low, allowing us to study the natural circulation of the virus in the community.

We could identify three symptomatic SARS-CoV-2 infected pupils in three separate schools during the three weeks preceding closure of the school for holidays and then lockdown. There were no secondary cases in pupils, teachers and non-teaching staff of the corresponding schools in the 14 days following these initial cases. These findings are in line with previous studies from Australia[23]. Ireland[24], or France[25]. They differ however from the results of the study performed in the high school of the same city, where 38% of pupils, 43% of teaching staff and 59% of non-teaching staff who participated in the investigation had anti-SARS-CoV-2 antibodies[26]. This latter study would suggest that high school aged children have similar susceptibility to SARS-CoV-2 infection as adults, and can transmit SARS-CoV-2 efficiently. The reasons why the observed onwards transmission from children was lower than in adolescents warrant further investigation. Given that viral load among infected children and adults have been found to be similar[20,21], milder symptoms among children may explain the reduced onward transmission. In families, a different pattern emerged, with high prevalence of antibodies among parents

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and relatives of infected pupils (61% and 44%, respectively). Considering the low onward transmission from pupils in schools, the high prevalence figures observed in families more likely resulted from a contamination of children by their parents rather than the opposite, which has already been suggested by others[17].

In adults, symptoms associated with COVID-19 were fever, cough, shortness of breath, ageusia, anosmia, headache, asthenia, muscle pain, sore throat, and diarrhea, all known features of the disease. Symptoms with highest predictive values for COVID-19 were anosmia and ageusia, as previously reported[31]. Symptoms were less specific in children, with only fatigue and diarrhea being associated with COVID-19. Anosmia and ageusia were rarely seen (1% of children), and only after the age of 15. This study also gave an opportunity to estimate the proportion of asymptomatic forms among infected, showing that they were more common in children than in adults (41.4% vs 9.9%, respectively; $P < 0.001$).

Our results are limited by the short time window for studying the impact of the presence of infected pupils in schools before closure, which happened only two weeks after the first cases of COVID-19 developed in pupils. Still, the absence of well characterized viral spread in the primary school as opposed to what had been observed in the nearby high school at the same time suggests that 6-11 years aged pupils are less contagious than teenager pupils. Another limitation was the incomplete sampling of classes and families, preventing from a full exploration of viral circulation in the schools and households. The clinical findings of our investigation were also limited by the fact that information on symptoms was collected retrospectively, and that other respiratory viruses were circulating concurrently in the study population.

Conclusion

The findings of our investigation are in line with other reports which suggest limited transmission of SARS-CoV-2 in primary schools. These findings suggest that reopening of primary schools can be considered carefully, with continuous monitoring of possible resurgence in infections and strategies to limit transmission such as masks for older children, physical distancing, respiratory etiquette and hand hygiene.

Acknowledgements

We would like to thank the Directorate General for Health for facilitating the initiation of the study, Santé publique France for linking with their investigation team, the Agence Régionale de Santé des Hauts de France, and the Academia of Amiens for their continuous support throughout the realization of the study, especially Ms. Delphine Maskara. We would like to thank the mayor of Crépy-en-Valois, Bruno Fortier and his team, Mrs Sandra Riveros, the local police, and local paramedical staff, Nathalie Bourgeois, Mélissa Mannevy, and Michaël Mannevy, for their help in the implementation of the study. We would like also to thank Nathalie de Parseval, Claire Dugast, Valentine Garaud, Soazic Gardais, Caroline Jannet, Fanny Momboisse, Isabelle Porteret, Hantaniaina Rafanoson, Sandrine Ropars who participated in the organization and the realization of the field investigation. Julian Buchrieser and Rémy Robinot who assisted in the development of serological tests. And finally Nathalie Jolly and Cassandre van Platen, who took care of the regulatory aspects of the study, and Christine Fanaud who informed the participants of their serological status.

Role of the funding source

The study was funded by Institut Pasteur, and several laboratories participating in the study receive funding from the Labex IBEID (ANR-10-LABX-62-IBEID), REACTing and the INCEPTION project (PIA/ANR-16-CONV-0005) for studies focusing on emerging viruses. OS lab is funded by Institut Pasteur, ANRS, Sidaction, the Vaccine Research Institute (ANR- 10-LABX-77), "TIMTAMDEN" ANR-14-CE14-0029, "CHIKV-Viro- Immuno" ANR-14-CE14-0015-01 and the Gilead HIV cure program. LG is supported by the French Ministry of Higher Education, Research and Innovation.

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Tables and Figures

Table 1. Sociodemographic characteristics of the 1340 participants of the SARS-CoV-2, France from 28-30 April 2020

Table 2. Infection attack rate (IAR) according to sociodemographic characteristics

Table 3. IAR (%) by symptoms and type of participant

Figure 1. Flowchart of enrolment of participants

Figure 2. Timeline of symptom onset among (A) 107 symptomatic individuals who were seropositive for anti-SARS-CoV-2 antibodies; (B) 631 symptomatic individuals who were seronegative for anti-SARS-CoV-2 antibodies.

Figure S1. Infection attack rate (IAR) (%) among types of participants

Table 1. Sociodemographic characteristics of the 1340 participants of the SARS-CoV-2, France, 28-30 April 2020

	Teaching staff (n=42)	Non-teaching staff (n=28)	Pupils (n=510)	Parents (n=641)	Relatives (n=119)	Total (n=1340)
Male gender	4 (9.5)	3 (10.7)	259 (50.8)	252 (39.3)	53 (44.5)	571 (42.6)
Age (in years)						
≤ 7	0 (0)	0 (0)	152 (29.8)	0 (0)	9 (7.6)	161 (12.0)
8-9	0 (0)	0 (0)	203 (39.8)	0 (0)	2 (1.7)	205 (15.3)
10-11	0 (0)	0 (0)	155 (30.4)	0 (0)	18 (15.1)	173 (12.9)
12-17	0 (0)	0 (0)	0 (0)	0 (0)	78 (65.6)	78 (5.8)
18-44	19 (45.2)	12 (42.9)	0 (0)	501 (78.2)	10 (8.4)	542 (40.5)
45-64	23 (54.8)	16 (57.1)	0 (0)	138 (21.5)	2 (1.7)	179 (13.4)
≥ 65	0 (0)	0 (0)	0 (0)	2 (0.3)	0 (0)	2 (0.1)
School						
A	5 (11.9)	10 (35.7)	61 (12.0)	67 (10.4)	20 (16.8)	163 (12.2)
B	5 (11.9)	7 (25.0)	90 (17.6)	108 (16.8)	18 (15.1)	228 (17.0)
C	6 (14.3)	4 (14.3)	68 (13.3)	78 (12.2)	15 (12.6)	171 (12.8)
D	8 (19.0)	4 (14.3)	87 (17.1)	116 (18.1)	24 (20.2)	239 (17.8)
E	11 (26.2)	0 (0.0)	117 (22.9)	151 (23.6)	25 (21.0)	304 (22.7)
F	7 (16.7)	3 (10.7)	87 (17.1)	121 (18.9)	17 (14.3)	235 (17.5)

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Table 2. Infection attack rate (IAR) according to sociodemographic characteristics

	N	n (%)	P value
Gender			
Male	571	54 (9.5)	0.34
Female	769	85 (11.1)	
Age (in years)			
≤ 7	161	10 (6.2)	0.36
8-9	205	20 (9.8)	
10-11	173	16 (9.2)	
12-17	78	12 (15.4)	
18-44	542	62 (11.4)	
45-64	179	19 (10.6)	
≥ 65	2	0 (0.0)	
Type of participant			
Pupil	510	45 (8.8)	0.29
Teacher	42	3 (7.1)	
Non-teaching staff	28	1 (3.6)	
All parents	641	76 (11.9)	
Parent of an infected pupil	59	36 (61.0)	
Parent of a non-infected pupil	582	40 (6.9)	
All relatives living in the same household	119	14 (11.8)	
Relatives of an infected pupil	9	4 (44.4)	
Relatives of a non-infected pupil	110	10 (9.1)	

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Table 3. IAR (%) by symptoms and type of participant

Symptoms		Children			Adults			Total		
		N	n (%)	P value	N	n (%)	P value	N	n (%)	P value
Fever										
	Yes	136	16 (11.8)	0.29	152	35 (23.0)	<0.001	288	51 (17.7)	<0.001
	No	481	42 (8.7)		571	46 (8.1)		1052	88 (8.4)	
Cough										
	Yes	145	12 (8.3)	0.60	202	39 (19.3)	<0.001	347	51 (14.7)	0.002
	No	472	46 (9.7)		521	42 (8.1)		993	88 (8.9)	
Dyspnea										
	Yes	30	5 (16.7)	0.16	90	22 (24.4)	<0.001	120	27 (22.5)	<0.001
	No	587	53 (9.0)		633	59 (9.3)		1220	112 (9.2)	
Ageusia										
	Yes	7	2 (28.6)	0.13	52	39 (75.0)	<0.001	59	41 (69.5)	<0.001
	No	610	56 (9.2)		671	42 (6.3)		1281	98 (7.6)	
Anosmia										
	Yes	6	2 (33.3)	0.10	43	39 (90.7)	<0.001	49	41 (83.7)	<0.001

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	No	611	56 (9.2)		680	42 (6.2)		1291	98 (7.6)	
Muscle pain										
	Yes	50	5 (10.0)	0.88	157	36 (22.9)	<0.001	207	41 (19.8)	<0.001
	No	567	53 (9.3)		566	45 (7.9)		1133	98 (8.7)	
Sore throat										
	Yes	108	11 (10.2)	0.76	154	24 (15.6)	0.05	262	35 (13.4)	0.08
	No	509	47 (9.2)		569	57 (10.0)		1078	104 (9.6)	
Rhinorrhea										
	Yes	111	13 (11.7)	0.36	142	21 (14.8)	0.13	253	34 (13.4)	0.08
	No	506	45 (8.9)		581	60 (10.3)		1087	105 (9.7)	
Headache										
	Yes	118	11 (9.3)	0.97	203	39 (19.2)	<0.001	321	50 (15.6)	<0.001
	No	499	47 (9.4)		520	42 (8.1)		1019	89 (8.7)	
Fatigue										
	Yes	97	15 (15.5)	0.03	220	48 (21.8)	<0.001	317	63 (19.9)	<0.001
	No	520	43 (8.3)		503	33 (6.6)		1023	76 (7.4)	
Chest pain										

Exhibit 10

	Yes	0	0 (0.0)	-	6	0 (0.0)	0.99	6	0 (0.0)	0.99
	No	617	58 (9.4)		717	81 (11.3)		1334	139 (10.4)	
Nausea										
	Yes	3	1 (33.3)	0.26	9	3 (33.3)	0.07	12	4 (33.3)	0.01
	No	614	57 (9.3)		714	78 (10.9)		1328	135 (10.2)	
Vomiting										
	Yes	27	2 (7.4)	0.99	17	2 (11.8)	0.99	44	4 (9.1)	0.78
	No	590	56 (9.5)		706	79 (11.2)		1296	135 (10.4)	
Abdominal pain										
	Yes	8	0 (0.0)	0.99	10	2 (20.0)	0.31	18	2 (11.1)	0.92
	No	609	58 (9.5)		713	79 (11.1)		1322	137 (10.4)	
Diarrhea										
	Yes	53	10 (18.9)	0.01	93	16 (17.2)	0.05	146	26 (17.8)	0.002
	No	564	48 (8.5)		630	65 (10.3)		1194	113 (9.5)	
Symptom severity										
	None	307	24 (7.8)		295	8 (2.7)		602	32 (5.3)	
	Minor only	97	9 (9.3)	0.32	129	7 (5.4)	<0.001	226	16 (7.1)	<0.001

Exhibit 10

Major	213	25 (11.7)		299	66 (22.1)		512	91 (17.8)	
Medical consultation*									
Yes	110	9 (8.2)	0.24	155	30 (19.3)	0.36	265	39 (14.7)	0.93
No	199	25 (12.6)		271	43 (15.9)		470	68 (14.5)	
Hospitalization									
Yes	3	0 (0.0)	0.56	6	2 (33.3)	0.08	9	2 (22.2)	0.24
No	614	58 (9.5)		717	79 (11.0)		1331	137 (10.3)	

* Only among participants who declared symptoms

Exhibit 10

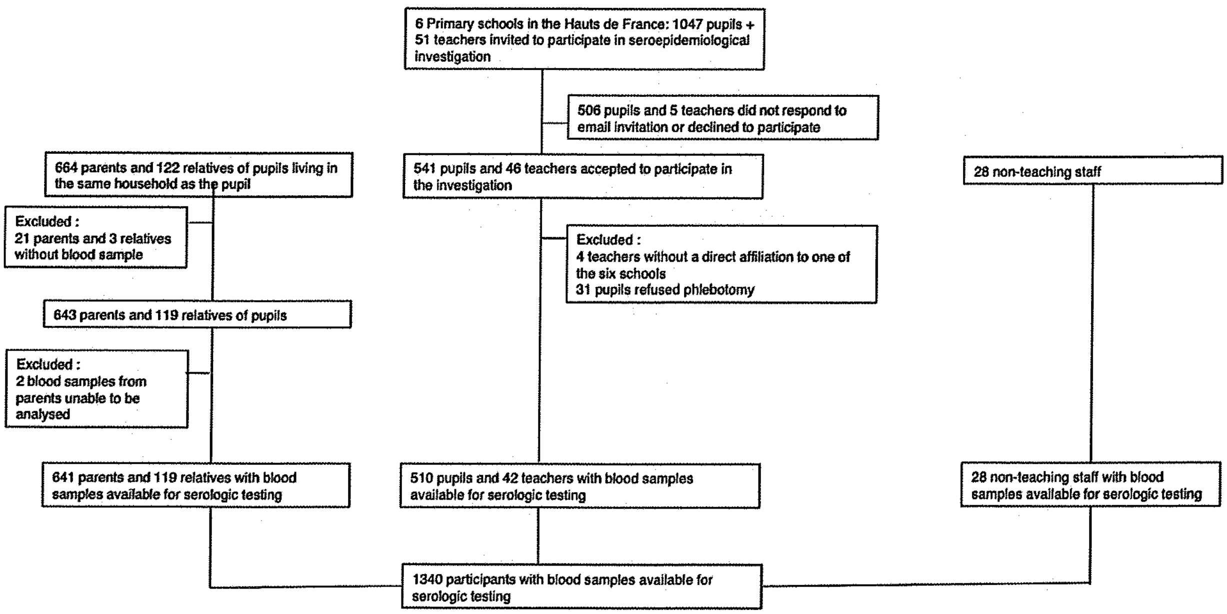

Figure 1. Flowchart of enrolment of participants

Exhibit 10

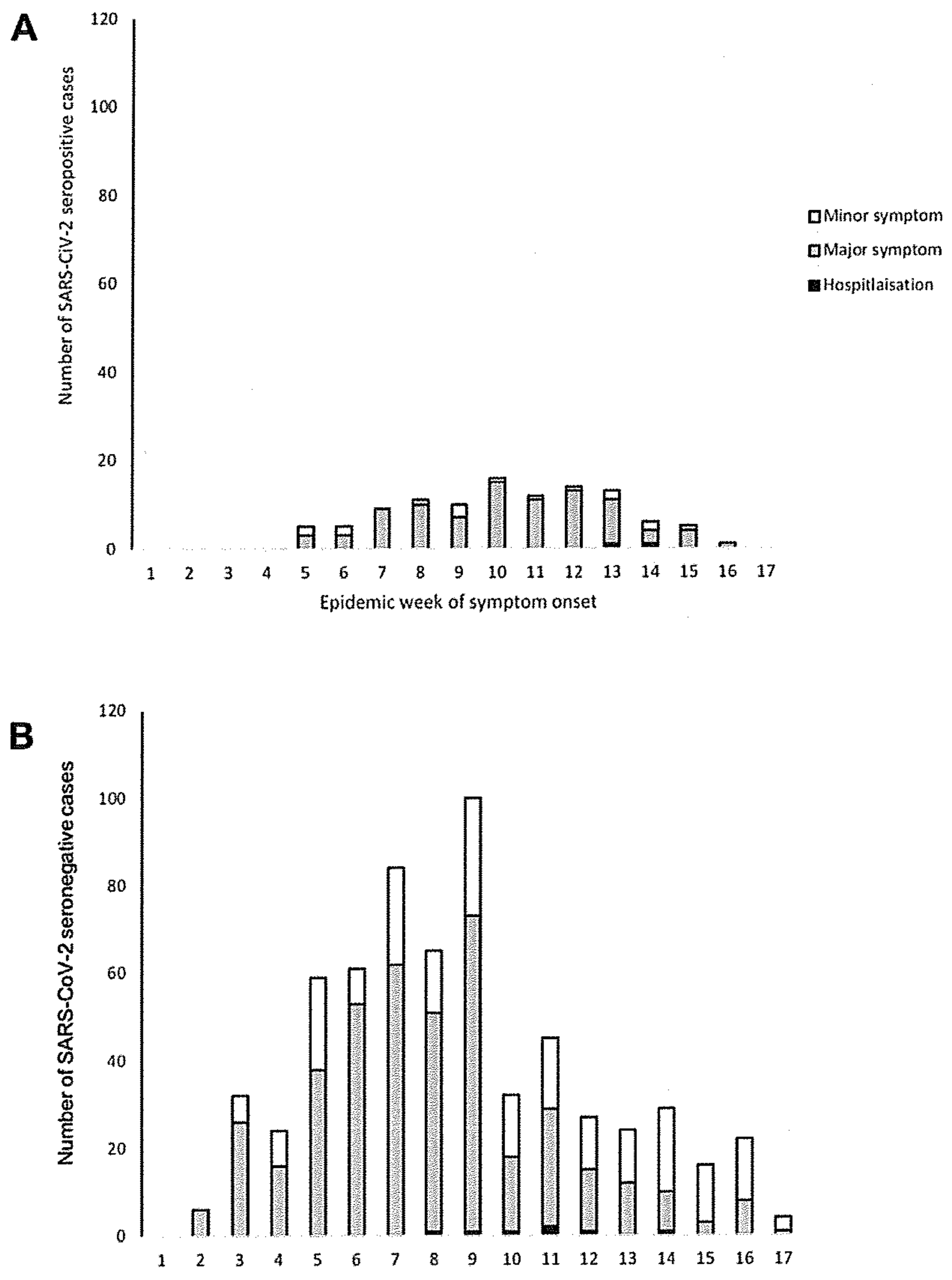

Figure 2. Timeline of symptom onset among (A) 107 symptomatic individuals who were seropositive for anti-SARS-CoV-2 antibodies; (B) 631 symptomatic individuals who were seronegative for anti-SARS-CoV-2 antibodies.

Exhibit 10

SARS-CoV-2 infection in primary schools in northern France: A retrospective cohort study in an area of high transmission

Supplementary Material

Supplementary Material Table S1. Symptoms by adult/child category

	Children (n = 617)	Adults (n = 723)	Total (n = 1340)
Fever	136 (22.0)	152 (21.0)	288 (21.5)
Cough	145 (23.5)	202 (27.9)	347 (25.9)
Dyspnea	30 (4.9)	90 (12.4)	120 (9.0)
Ageusia	7 (1.1)	52 (7.2)	59 (4.4)
Anosmia	6 (1.0)	43 (5.9)	49 (3.7)
Muscle pain	50 (8.1)	157 (21.7)	207 (15.4)
Sore throat	108 (17.5)	154 (21.3)	262 (19.5)
Rhinorrhea	111 (18.0)	142 (19.6)	253 (18.9)
Headache	118 (19.1)	203 (28.1)	321 (24.0)
Fatigue	97 (15.7)	220 (30.4)	317 (23.7)
Chest pain	0 (0.0)	6 (0.8)	6 (0.4)
Nausea	3 (0.5)	9 (1.2)	12 (0.9)
Vomiting	27 (4.4)	17 (2.4)	44 (3.3)
Abdominal pain	8 (1.3)	10 (1.4)	18 (1.3)
Diarrhea	53 (8.6)	93 (12.9)	146 (10.9)
Major symptoms	213 (34.5)	299 (41.4)	512 (38.2)
Minor symptoms	97 (15.7)	129 (17.8)	226 (16.9)
No symptoms reported	307 (49.8)	295 (40.8)	602 (44.9)
Medical consultation	116 (18.8)	160 (22.1)	276 (20.6)
Hospitalisation	3 (0.5)	6 (0.8)	9 (0.7)

Exhibit 10

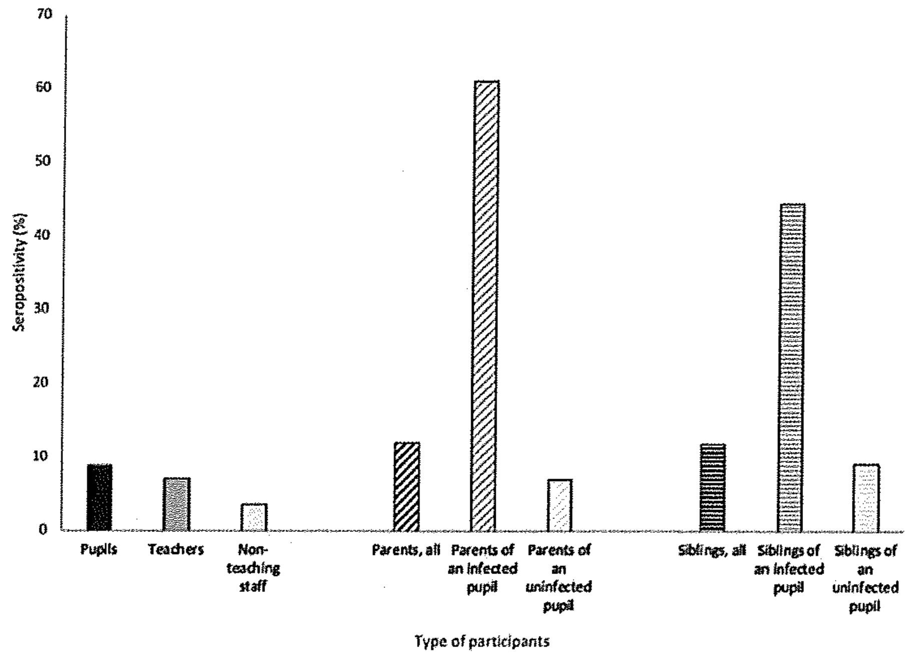

Figure S1. Infection attack rate (IAR) (%) among types of participants

Exhibit 10

EXHIBIT 11

Anti-SARS-CoV-2 IgG antibodies in adolescent students and their teachers in Saxony, Germany (SchoolCoviDD19): very low seropraevalence and transmission rates

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Exhibit 11

Abstract

Background: School closures are part of the SARS-CoV-2 pandemic control measures in many countries, based on the assumption that children play a similar role in transmitting SARS-CoV-2 as they do in transmitting influenza. We therefore performed a SARS-CoV-2 seropraevalence-study in students and teachers to assess their role in the SARS-CoV-2 transmission.

Methods: Students grade 8–11 and their teachers in 13 secondary schools in eastern Saxony, Germany, were invited to participate in the SchoolCoviDD19 study. Blood samples were collected between May 25th and June 30th, 2020. Anti-SARS-CoV-2 IgG were assed using chemiluminescence immunoassay technology and all samples with a positive or equivocal test result were re-tested with two additional serological tests.

Findings: 1538 students and 507 teachers participated in this study. The seropraevalence for SARS-CoV-2 was 0.6%. Even in schools with reported Covid-19 cases before the Lockdown of March 13th no clusters could be identified. 23/24 participants with a household history of COVID-91 were seronegative. By using a combination of three different immunoassays we could exclude 16 participants with a positive or equivocal results after initial testing.

Interpretation: Students and teachers do not play a crucial role in driving the SARS-CoV-2 pandemic in a low prevalence setting. Transmission in families occurs very infrequently, and the number of unreported cases is low in this age group, making school closures not appear appropriate as a strategy in this low prevalence settings.

Funding: This study was supported by a grant from the state of Saxony

Exhibit 11

Manuscript:

Introduction:

Since the identification of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as the cause of COVID-19 in December 2019 [1], the virus spread rapidly around the world, leading to the declaration of a pandemic by the World Health Organization on March 12th 2020. By March 18th 2020, 126 countries—including Germany—had implemented school closures as part of their pandemic control measures, with the number of countries peaking at 194 on April 10th 2020 and more than 90% of the world's student population being affected at this point[2].

These actions were mainly based on the assumption that children play a similar role in transmitting SARS-CoV-2 as they do in transmitting influenza during outbreaks, for which evidence exists that school closures reduce the peak of the outbreak[3]. However, there is reason to believe that children play a less significant role in SARS-CoV-2 transmission compared to influenza, making control measures focused on this age group less effective: Most countries—including Germany—report a much lower proportion of cases in children compared to their population size[4–6]. In addition a recent report from Australia could only identify a very limited spread of COVID-19 in primary schools, with no evidence of children infecting teachers [7].

However, currently available data is insufficient to rule out that children are as likely as adults to be infected by and to transmit SARS-CoV-2, but simply show little to no symptoms of the disease.

We therefore aimed to quantify the proportion of adolescent schoolchildren and teachers in Saxony, one of the eastern Federal States of Germany, that already have developed antibodies against SARS-CoV-2. In Saxony, the infection rates were comparatively low with 139 laboratory-confirmed SARS-CoV-2 infections per 100,000 inhabitants as of 13 July 2020.

Methods:

Study Design

After the reopening of the schools in Saxony on May 18th, 2020 students grade 8–11 and their teachers in 13 secondary schools in eastern Saxony were invited to participate in the SchoolCoviDD19 study. After teachers, students, and their legal guardians provided informed consent, 5 mL of peripheral venous blood were collected from each individual during visits at each participating school between May 25th and June 30th, 2020. In addition, participants were asked to complete a questionnaire on age, household size, previously diagnosed SARS-CoV-2 infections in themselves or their household contacts, comorbidities and regular medication. In addition, students were asked about regular social contacts outside their household or classroom. The SchoolCoviDD19 study was approved by the Ethics Committee of the Technische Universität (TU) Dresden (BO-EK-156042020) and has been assigned clinical trial number DRKS00022455.

Laboratory Analysis

We assessed anti-SARS-CoV-2 IgG antibodies in all samples using a commercially available chemiluminescence immunoassay (CLIA) technology for the quantitative determination of anti-S1 and anti-S2 specific IgG antibodies to SARS-CoV-2 (Diasorin LIAISON® SARS-CoV-2 S1/S2 IgG Assay). Antibody levels > 15.0 AU/ml were considered positive and levels between 12.0 and 15.0 AU/ml were considered equivocal.

Exhibit 11

All samples with a positive or equivocal LIAISON® test result, as well as all samples from participants with a reported personal or household history of a SARS-CoV-2 infection, were re-tested with two additional serological tests: These were a chemiluminescent microparticle immunoassay (CMIA) intended for the qualitative detection of IgG antibodies to the nucleocapsid protein of SARS-CoV-2 (Abbott Diagnostics® ARCHITECT SARS-CoV-2 IgG) (an index (S/C) of < 1.4 was considered negative whereas one >/= 1.4 was considered positive) and an ELISA detecting IgG against the S1 domain of the SARS-CoV-2 spike protein (Euroimmun® Anti-SARS-CoV-2 ELISA) (a ratio < 0.8 was considered negative, 0.8–1.1 equivocal, > 1.1 positive)

Participants whose positive or equivocal LIAISON® test result could be confirmed by a positive test result in at least one additional serological test were considered having antibodies against SARS-CoV-2.

Statistical Analysis

Analyses were performed using IBM SPSS 25.0 and Microsoft Excel 2010. Results for continuous variables are presented as medians with interquartile ranges (IQR) and categorical variables as numbers with percentages, unless stated otherwise.

Role of the funding source

The funder of the study had no role in the study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding authors had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results:

A total of 1538 students and 507 teachers from 13 different schools participated in this study. Demographic data is shown in Table 1.

Table 1

	Students	Teachers
Participants	1538 (75.2%)	507 (24.8%)
Age (median)	15 (14–16)	51 (37–57)
Female	802 (52%)	357 (70%)
Household size	4 (3–5)	2 (2–4)
Participant previously tested positive for SARS-CoV-2 by PCR	5 (0.3%)	0
Household contact of participant previously tested positive for SARS-CoV-2 by PCR	22 (1.4%)	2 (0.4%)
Regular social contacts outside the student's household/classroom	1230 (80%)	NA

The number of participants ranged from 21 to 573 per individual school. Twelve participants—11 students and one teacher—had detectable antibodies against SARS-CoV-2 in at least two different assays and were considered seropositive. In 7/13 schools, seropositive participants could be identified, with four seropositive participants in one school as the maximum. The seroprevalence ranged from 0 to 2.2 per individual school.

Exhibit 11

Table 2	
	Prevalence
All	0.6
Students	0.7
Teacher	0.2

Of all participants with a personal history of a SARS-CoV-2 infection, 4/5 were seropositive, with one participant showing only an equivocal test result in one of the assays. Of all participants with a household history of a SARS-CoV-2 infection, 23/24 were seronegative, with 22/24 showing negative results in all three assays and one showing an equivocal result in only one assay. All assay result combinations and the resulting serostatus of each individual participant are listed in Table 3.

Table 3				
	Diasorin LIAISON®	Abbott Diagnostics®	Euroimmun®	Serostatus per study protocol
Personal COVID-19 History				
4/5 Participants	Positive	Positive	Positive	Positive
1/5 Participants	Negative	Equivocal	Negative	Negative
Household COVID-19 History				
1/24 Participants	Positive	Positive	Positive	Positive
1/24 Participants	Equivocal	Negative	Negative	Negative
22/24 Participants	Negative	Negative	negative	Negative
No known COVID-19 History				
1994/2016 Participants	negative	Not performed		Negative
4/2016 Participants	Positive	Positive	Positive	Positive
1/2016 Participants	Positive	Positive	Negative	Positive
10/2016 Participants	Positive	Negative	Negative	Negative
4/2016 Participants	Equivocal	Negative	Negative	Negative
1/2016 Participants	Equivocal	Equivocal	Negative	Negative
1/2016 Participants	Equivocal	Positive	Negative	Positive
1/2016 Participants	Equivocal	Positive	Positive	Positive

Discussion:

The findings from this unique study in older students and their teachers indicate that the prevalence of IgG antibodies against SARS-CoV-2 remains extremely low after the first wave of the corona pandemic in Germany. While this finding is consistent with local surveillance data[8] that shows a prevalence of PCR-confirmed cases of 0,15%, it clearly indicates that schools did not develop into silent hotspots of SARS-CoV-2 transmission during this first wave of the pandemic. In fact, 5 of the 12 participants with antibodies against SARS-CoV-2 had a personal or household history of COVID-19,

Exhibit 11

yielding a ratio of unidentified to identified cases of 2.4, which is much smaller than that previously assumed by some authors[9]. We could not detect a single cluster of infections in the participating schools, even though at least three schools did have confirmed SARS-CoV-2 cases before the March 13th lockdown in Saxony. This is consistent with findings from the 2003 SARS outbreak [10,11], and calls the effectiveness of transmission control measures focused mainly on the student population into question. This is especially relevant since there are clearly described adverse effects of school closures, as loss of education, loss of social contacts and social control, nutritional problems in children who rely on school meals, increases in harm to child welfare in vulnerable populations, as well as economic harm caused by loss to productivity due to parents being forced from work to childcare[12,13]. Additionally, even with school closures in place, social contacts continue as informal child care and non-school gatherings[14], thereby reducing the potential benefit of school closures further. Our data support this finding this finding since an overwhelming majority of not less than 80% of the participating students in our study reported to have regular social contacts outside their household or classroom.

Close contact with COVID-19 patients—especially in the same household—has been shown to increase viral transmission[15]. However, in our study, only one out of 24 participants with a confirmed SARS-CoV-2 infection in the same household became indeed infected as measured by antibody production. This suggests that either the transmissibility of the virus is lower than previously assumed or that there are certain quarantine and separation measures than can effectively reduce the probability of viral transmission even in close contact situations.

Currently no gold standard serological testing strategy for SARS-CoV-2 exists. Even though immunoassays yield better performance than rapid point-of-care tests[15] and the targeted SARS-CoV-2 S protein and nucleoprotein show a similarity of less than 30% to endemic betacoronaviruses[16], false positive results are still a concern, especially in low-prevalence populations and when interpreting results on a personal rather than a population-based level. By using a combination of three different immunoassays and only regarding participants with at least two positive results as seropositive for SARS-CoV-2, we could exclude ten participants with a positive and six with an equivocal initial test by negative confirmatory testing. In our population a positive predictive value of 42.9% could be observed which was nearby an expected PPV of 45.3% for a prevalence of 0.59% population and the given test characteristics (sensitivity 97.6%, specificity 99.3%). By using this approach, we could reliably identify patients with confirmed seropositivity against SARS-CoV-2 in a low-prevalence population.

Conclusion:

As for now, students and teacher do not seem to play a crucial role in driving the SARS-CoV-2 pandemic in Germany. Transmission in families appears to occur very infrequently, and the number of unreported cases obviously is low in this age group. Therefore, social distancing strategies such as the reduction of students of different classes mixing at school paired with symptom-based screening strategies, contact tracing and quarantine measures for identified cases are likely as effective as full school closures, with less adverse effects on the student population.

For serological testing, a combination of different immunoassays seems to be effective to increase the number of true positive test results.

Exhibit 11

Declaration of interests

All authors declare no conflict of interests

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Exhibit 11

EXHIBIT 12

Centers for Disease Control and Prevention

COVID-19 Pandemic Planning Scenarios
Pandemic Planning Scenarios

Updated Sept. 10, 2020 Print

Summary of Recent Changes

Updated September 10, 2020:

- The Infection Fatality Ratio parameter has been updated to include age-specific estimates
- The parameter for Number of Days from Symptom Onset to Seeking Outpatient Care—which was based on influenza care seeking data—has been replaced with the Median Number of Days from Symptom Onset to SARS-CoV-2 Test among SARS-CoV-2 Positive Patients
- A new parameter for the likelihood of an infection being reported has been added: The Ratio of Estimated Infections to Reported Case Counts

CDC and the Office of the Assistant Secretary for Preparedness and Response (ASPR) have developed five COVID-19 Pandemic Planning Scenarios that are designed to help inform decisions by public health officials who use mathematical modeling, and by mathematical modelers throughout the federal government. Models developed using the data provided in the planning scenario tables can help evaluate the potential effects of different community mitigation strategies (e.g., social distancing). The planning scenarios may also be useful to hospital administrators in assessing resource needs and can be used in conjunction with the COVID-19Surge Tool.

Each scenario is based on a set of numerical values for biological and epidemiological characteristics of COVID-19 illness, which is caused by the SARS-CoV-2 virus. These values—called *parameter values*—can be used in models to estimate the possible effects of COVID-19 in U.S. states and localities. This document was first posted on May 20, 2020, with the understanding that the parameter values in each scenario would be updated and augmented over time, as we learn more about the epidemiology of COVID-19. The September 10 update is based on data received by CDC through August 8, 2020.

In this update, age-specific estimates of Infection Fatality Ratios have been updated, one parameter measuring healthcare usage has been replaced with the median number of days from symptom onset to positive SARS-CoV-2 test, and a new parameter has been included: Ratio of Estimated Infections to Reported Case Counts, which is based on recent serological data from a commercial laboratory survey in the U.S.[1]

New data on COVID-19 are available daily, yet information about the biological aspects of SARS-CoV-2 and epidemiological characteristics of COVID-19 remain limited, and uncertainty remains around nearly all parameter values. For example, current estimates of infection-fatality ratios do not account for time-varying changes in hospital capacity (e.g., in bed capacity, ventilator capacity, or workforce capacity) or for differences in case ascertainment in congregate and community settings or in rates of underlying health conditions that may contribute to a higher frequency of severe illness in those settings. A nursing home, for example, may have a high incidence of infection (due to close contacts among many individuals) and severe disease (due to a high rate of underlying conditions) that does not reflect the frequency or severity of disease in the broader population of older adults. In addition, the practices for testing nursing home residents for SARS-CoV-2 upon identification of a positive resident may be different than testing practices for contacts of confirmed cases in the community. Observed parameter values may also change over time (e.g., the percentage of transmission occurring prior to symptom onset will be influenced by how quickly and effectively both symptomatic people and the contacts of known cases are quarantined).

Exhibit 12

The parameters in the scenarios:

- Are estimates intended to support public health preparedness and planning.
- Are **not** predictions of the expected effects of COVID-19.
- Do not reflect the impact of any behavioral changes, social distancing, or other interventions.

The five COVID-19 Pandemic Planning Scenarios (Box 1) represent a range of possible parameters for COVID-19 in the United States. All parameter values are based on current COVID-19 surveillance data and scientific knowledge.

- Scenarios 1 through 4 are based on parameter values that represent the lower and upper bounds of disease severity and viral transmissibility (moderate to very high severity and transmissibility). The parameter values used in these scenarios are likely to change as we obtain additional data about the upper and lower bounds of disease severity and the transmissibility of SARS-CoV-2, the virus that causes COVID-19.
- Scenario 5 represents a current best estimate about viral transmission and disease severity in the United States, with the same caveat: the parameter values will change as more data become available.

Parameter values that vary among the Pandemic Planning Scenarios are listed in Table 1, while parameter values common to all five scenarios are listed in Table 2. Definitions of the parameters are provided below, and the source of each parameter value is indicated in the Tables.

Parameter values that vary across the five COVID-19 Pandemic Planning Scenarios (Table 1) include measures of viral transmissibility, disease severity, and pre-symptomatic and asymptomatic disease transmission. Age-stratified estimates are provided, where sufficient data are available.

Viral Transmissibility

- **Basic reproduction number (R_0):** The average number of people that one person with SARS-CoV-2 is likely to infect in a population without any immunity (from previous infection) or any interventions. R_0 is an estimate of how transmissible a pathogen is in a population. R_0 estimates vary across populations and are a function of the duration of contagiousness, the likelihood of infection per contact between a susceptible person and an infectious person, and the contact rate.[2]

Disease Severity

- **Infection Fatality Ratio (IFR):** The number of individuals who **die** of the disease among all infected individuals (symptomatic and asymptomatic). This parameter is not necessarily equivalent to the number of reported deaths per reported case because many cases and deaths are never confirmed to be COVID-19, and there is a lag in time between when people are infected and when they die. This parameter also reflects the existing standard of care, which may vary by location and may be affected by the introduction of new therapeutics.

Pre-symptomatic and Asymptomatic Contribution to Disease Transmission

A **pre-symptomatic case** of COVID-19 is an individual infected with SARS-CoV-2, who has not exhibited symptoms at the time of testing, but who later exhibits symptoms during the course of the infection. An **asymptomatic case** is an individual infected with SARS-CoV-2, who does not exhibit symptoms during the course of infection. Parameter values that measure the pre-symptomatic and asymptomatic contribution to disease transmission include:

- **Percentage of infections that are asymptomatic:** The percentage of persons who are infected with SARS-CoV-2 but never show symptoms of disease. Asymptomatic cases are challenging to identify because individuals do not know they are infected unless they are tested over the course of their infection, which is typically only done systematically as a part of a scientific study.
- **Infectiousness of asymptomatic individuals relative to symptomatic individuals:** The contribution to transmission of SARS-CoV-2 from asymptomatic individuals compared to the contribution to transmission of SARS-CoV-2 from symptomatic individuals. For example, a parameter value of 50% means that an asymptomatic individual is half as infectious as a symptomatic individual, whereas a parameter value of 100% means that an asymptomatic individual is just as likely to transmit infection as a symptomatic individual.

Exhibit 12

individual is just as likely to transmit infection as a symptomatic individual.

- **Percentage of transmission occurring prior to symptom onset:** Among symptomatic cases, the percentage of new cases of COVID-19 due to transmission from a person with COVID-19 who infects others before exhibiting symptoms (pre-symptomatic).

Parameter values that do not vary across the five Pandemic Planning Scenarios (Table 2) are:

- **Level of pre-existing immunity to COVID-19 in the community:** The percentage of the U.S. population that had existing immunity to COVID-19 prior to the start of the pandemic beginning in 2019.
- **Ratio of estimated infections to reported case counts:** The estimated number of infections divided by the number of reported cases. The level of case detection likely varies by the age distribution of cases, location, and over time.
- **Time from exposure to symptom onset:** The number of days from the time a person has contact with an infected person that results in COVID-19 infection and the first appearance of symptoms.
- **Time from symptom onset in an individual and symptom onset of a second person infected by that individual:** The number of days from the time a person becomes symptomatic and when the person who they infect becomes symptomatic.

Additional parameter values common to the five COVID-19 Pandemic Planning Scenarios are these ten measures of healthcare usage:

- Median number of days from symptom onset to SARS-CoV-2 test among SARS-CoV-2 positive patients
- Median number of days from symptom onset to hospitalization
- Median number of days of hospitalization among those not admitted to the ICU
- Median number of days of hospitalization among those admitted to the ICU
- Percentage of patients admitted to the ICU among those hospitalized
- Percentage of patients on mechanical ventilation among those hospitalized (includes both non-ICU and ICU admissions)
- Percentage of patients who die among those hospitalized (includes both non-ICU and ICU admissions)
- Median number of days on mechanical ventilation
- Median number of days from symptom onset to death
- Median number of days from death to reporting of that death

These healthcare-related parameters (Table 2) are included to assist in assessment of resource needs as the pandemic progresses.

Box 1 Description of the Five COVID-19 Pandemic Planning Scenarios

For each Pandemic Planning Scenario:

- Parameter value for **viral transmissibility** is the Basic Reproduction Number (R_0)
- Parameter value for **disease severity** is the Infection Fatality Ratio (IFR)
- Parameter values for the **pre-symptomatic and asymptomatic contribution** to disease transmission are:
  - Percentage of transmission occurring prior to symptom onset (from pre-symptomatic individuals)
  - Percentage of infections that are asymptomatic
  - Infectiousness of asymptomatic individuals relative to symptomatic individuals

For Pandemic Scenarios 1-4:

- These scenarios are based on parameter values that represent the lower and upper bounds of disease severity and viral transmissibility (moderate to very high severity and transmissibility). The parameter values used in these scenarios are likely to change as we obtain additional data about the upper and lower bounds of disease severity and viral transmissibility of COVID-19.

For Pandemic Scenario 5:

Exhibit 12

- This scenario represents a current best estimate about viral transmission and disease severity in the United States, with the same caveat: that the parameter values will change as more data become available.

Scenario 1:

- Lower-bound values for virus transmissibility and disease severity
- Lower percentage of transmission prior to onset of symptoms
- Lower percentage of infections that never have symptoms and lower contribution of those cases to transmission

Scenario 2:

- Lower-bound values for virus transmissibility and disease severity
- Higher percentage of transmission prior to onset of symptoms
- Higher percentage of infections that never have symptoms and higher contribution of those cases to transmission

Scenario 3:

- Upper-bound values for virus transmissibility and disease severity
- Lower percentage of transmission prior to onset of symptoms
- Lower percentage of infections that never have symptoms and lower contribution of those cases to transmission

Scenario 4:

- Upper-bound values for virus transmissibility and disease severity
- Higher percentage of transmission prior to onset of symptoms
- Higher percentage of infections that never have symptoms and higher contribution of those cases to transmission

Scenario 5:

- Parameter values for disease severity, viral transmissibility, and pre-symptomatic and asymptomatic disease transmission that represent the best estimate, based on the latest surveillance data and scientific knowledge. Parameter values are based on data received by CDC through August 8, 2020.

Table 1. Parameter Values that vary among the five COVID-19 Pandemic Planning Scenarios. The scenarios are intended to advance public health preparedness and planning. They are **not** predictions or estimates of the expected impact of COVID-19. The parameter values in each scenario will be updated and augmented over time, as we learn more about the epidemiology of COVID-19. Additional parameter values might be added in the future (e.g., population density, household transmission, and/or race and ethnicity).

Parameter	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5: Current Best Estimate
R_0*	2.0		4.0		2.5
Infection Fatality Ratio†	0-19 years: 0.00002 20-49 years: 0.00007 50-69 years: 0.0025 70+ years: 0.028		0-19 years: 0.0001 20-49 years: 0.0003 50-69 years: 0.010 70+ years: 0.093		0-19 years: 0.00003 20-49 years: 0.0002 50-69 years: 0.005 70+ years: 0.054
Percent of infections that are asymptomatic§	10%	70%	10%	70%	40%

Exhibit 12

Parameter	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5: Current Best Estimate
Infectiousness of asymptomatic individuals relative to symptomatic¶	25%	100%	25%	100%	75%
Percentage of transmission occurring prior to symptom onset**	30%	70%	30%	70%	50%

*The best estimate representative of the point estimates of R_0 from the following sources:
Chinazzi M, Davis JT, Ajelli M, et al. The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak. *Science*. 2020;368(6489):395-400; Imai N., Cori, A., Dorigatti, I., Baguelin, M., Donnelly, C. A., Riley, S., Ferguson, N.M. (2020). Report 3: Transmissibility of 2019-nCoV. *Online report*
Li Q, Guan X, Wu P, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. *N Engl J Med*. 2020;382(13):1199-1207
Munayco CV, Tariq A, Rothenberg R, et al. Early transmission dynamics of COVID-19 in a southern hemisphere setting: Lima-Peru: February 29th-March 30th, 2020 [published online ahead of print, 2020 May 12]. *Infect Dis Model*. 2020; 5:338-345

The range of estimates for Scenarios 1-4 represent the upper and lower bound of the widest confidence interval estimates reported in: Li Q, Guan X, Wu P, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. *N Engl J Med*. 2020;382(13):1199-1207.
Substantial uncertainty remains around the R_0 estimate. Notably, Sanche S, Lin YT, Xu C, Romero-Severson E, Hengartner N, Ke R. High Contagiousness and Rapid Spread of Severe Acute Respiratory Syndrome Coronavirus 2. *Emerg Infect Dis*. 2020;26(7):1470-1477 (https://dx.doi.org/10.3201/eid2607.200282) estimated a median R_0 value of 5.7 in Wuhan, China. In an analysis of 8 Europe countries and the US, the same group estimated R_0 of between 4.0 and 7.1 in the pre-print manuscript: Ke R., Sanche S., Romero-Severson, & E., Hengartner, N. (2020). Fast spread of COVID-19 in Europe and the US suggests the necessity of early, strong and comprehensive interventions. *medRxiv.*

† These estimates are based on age-specific estimates of infection fatality ratios from Hauser, A., Counotte, M.J., Margossian, C.C., Konstantinoudis, G., Low, N., Althaus, C.L. and Riou, J., 2020. Estimation of SARS-CoV-2 mortality during the early stages of an epidemic: a modeling study in Hubei, China, and six regions in Europe. *PLoS medicine*, *17*(7), p.e1003189. Hauser et al. produced estimates of IFR for 10-year age bands from 0 to 80+ year old for 6 regions in Europe. Estimates exclude infection fatality ratios from Hubei, China, because we assumed infection and case ascertainment from the 6 European regions are more likely to reflect ascertainment in the U.S. To obtain the best estimate values, the point estimates of IFR by age were averaged to broader age groups for each of the 6 European regions using weights based on the age distribution of reported cases from COVID-19 Case Surveillance Public Use Data (https://data.cdc.gov/Case-Surveillance/COVID-19-Case-Surveillance-Public-Use-Data/vbim-akqf). The estimates for persons ≥70 years old presented here do not include persons ≥80 years old as IFR estimates from Hauser et al., assumed that 100% of infections among persons ≥80 years old were reported. The consolidated age estimates were then averaged across the 6 European regions. The lower bound estimate is the lowest, non-zero point estimate across the six regions, while the upper bound is the highest point estimate across the six regions.

§ The percent of cases that are asymptomatic, i.e. never experience symptoms, remains uncertain. Longitudinal testing of individuals is required to accurately detect the absence of symptoms for the full period of infectiousness. Current peer-reviewed and preprint studies vary widely in follow-up times for re-testing, or do not include re-testing of cases. Additionally, studies vary in the definition of a symptomatic case, which makes it difficult to make direct comparisons between estimates. Furthermore, the percent of cases that are asymptomatic may vary by age, and the age groups reported in studies vary. Given these limitations, the range of estimates for Scenarios 1-4 is wide. The lower bound estimate approximates the lower 95% confidence interval bound estimated from: Byambasuren, O., Cardona, M., Bell, K., Clark, J., McLaws, M. L., & Glasziou, P. (2020). Estimating the extent of true asymptomatic COVID-19 and its potential for community transmission: systematic review and meta-analysis. *Available at SSRN 3586675*. The upper bound estimate approximates the upper 95% confidence interval bound estimated from: Poletti, P., Tirani, M., Cereda, D., Trentini, F., Guzzetta, G., Sabatino, G., Marziano, V., Castrofino, A., Grosso, F., Del Castillo, G. and Piccarreta, R. (2020). Probability of symptoms and critical disease after SARS-CoV-2 infection. *arXiv preprint arXiv:2006.08471*. The best estimate is the midpoint of this range and aligns with estimates from: Oran DP, Topol EJ. Prevalence of Asymptomatic SARS-CoV-2 Infection: A Narrative Review [published online ahead of print, 2020 Jun 3]. *Ann Intern Med*. 2020; M20-3012.

Exhibit 12

¶ The current best estimate is based on multiple assumptions. The relative infectiousness of asymptomatic cases to symptomatic cases remains highly uncertain, as asymptomatic cases are difficult to identify, and transmission is difficult to observe and quantify. The estimates for relative infectiousness are assumptions based on studies of viral shedding dynamics. The upper bound of this estimate reflects studies that have shown similar durations and amounts of viral shedding between symptomatic and asymptomatic cases: Lee, S., Kim, T., Lee, E., Lee, C., Kim, H., Rhee, H., Park, S.Y., Son, H.J., Yu, S., Park, J.W. and Choo, E.J., Clinical Course and Molecular Viral Shedding Among Asymptomatic and Symptomatic Patients With SARS-CoV-2 Infection in a Community Treatment Center in the Republic of Korea. *JAMA Internal Medicine*; Zou L, Ruan F, Huang M, et al. SARS-CoV-2 Viral Load in Upper Respiratory Specimens of Infected Patients. *N Engl J Med*. 2020;382(12):1177-1179; and Zhou R, Li F, Chen F, et al. Viral dynamics in asymptomatic patients with COVID-19. *Int J Infect Dis*. 2020; 96:288-290. The lower bound of this estimate reflects data indicating that viral loads are higher in severe cases relative to mild cases (Liu Y, Yan LM, Wan L, et al. Viral dynamics in mild and severe cases of COVID-19. *Lancet Infect Dis*. 2020;20(6):656-657) and data showing that viral loads and shedding durations are higher among symptomatic cases relative to asymptomatic cases (Noh JY, Yoon JG, Seong H, et al. Asymptomatic infection and atypical manifestations of COVID-19: Comparison of viral shedding duration [published online ahead of print, 2020 May 21]. *J Infect*. 2020; S0163-4453(20)30310-8).

** The lower bound of this parameter is approximated from the lower 95% confidence interval bound from: He, X., Lau, E.H., Wu, P., Deng, X., Wang, J., Hao, X., Lau, Y.C., Wong, J.Y., Guan, Y., Tan, X. and Mo, X. (2020). Temporal dynamics in viral shedding and transmissibility of COVID-19. *Nature medicine*, *26*(5), pp.672-675. The upper bound of this parameter is approximated from the higher estimates of individual studies included in: Casey, M., Griffin, J., McAloon, C.G., Byrne, A.W., Madden, J.M., McEvoy, D., Collins, A.B., Hunt, K., Barber, A., Butler, F. and Lane, E.A. (2020). Estimating pre-symptomatic transmission of COVID-19: a secondary analysis using published data. *medRxiv.*The best estimate is the geometric mean of the point estimates from these two studies.

Table 2. Parameter Values Common to the Five COVID-19 Pandemic Planning Scenarios. The parameter values are likely to change as we obtain additional data about disease severity and viral transmissibility of COVID-19.

Parameter values are based on data received by CDC through August 8, 2020, including COVID-19 Case Surveillance Public Use Data (https://data.cdc.gov/Case-Surveillance/COVID-19-Case-Surveillance-Public-Use-Data/vbim-akqf); data from the Hospitalization Surveillance Network (COVID-NET) (through August 1); and data from Data Collation and Integration for Public Health Event Response (*DCIPHER*).

Pre-existing immunity **Assumption, ASPR and CDC**	No pre-existing immunity before the pandemic began in 2019. It is assumed that all members of the U.S. population were susceptible to infection prior to the pandemic.
Time from exposure to symptom onset*	~6 days (mean)
Time from symptom onset in an individual and symptom onset of a second person infected by that individual†	~6 days (mean)
Mean ratio of estimated infections to reported case counts, Overall (range)§	11 (6, 24)
Parameter Values Related to Healthcare Usage	
Median number of days from symptom onset to SARS-CoV-2 test among SARS-CoV-2 positive patients (interquartile range)¶	Overall: 3 (1, 6) days
Median number of days from symptom onset to hospitalization (interquartile range)**	18-49 years: 6 (3, 10) days 50-64 years: 6 (2, 10) days ≥65 years: 4 (1, 9) days

Exhibit 12

Median number of days of hospitalization among those not admitted to ICU (interquartile range) ††	18-49 years: 3 (2, 5) days 50-64 years: 4 (2, 7) days ≥65 years: 6 (3, 10) days
Median number of days of hospitalization among those admitted to ICU (interquartile range)††,§§	18-49 years: 11 (6, 20) days 50-64 years: 14 (8, 25) days ≥65 years: 12 (6, 20) days
Percent admitted to ICU among those hospitalized††	18-49 years: 23.8% 50-64 years: 36.1% ≥65 years: 35.3%
Percent on mechanical ventilation among those hospitalized. Includes both non-ICU and ICU admissions††	18-49 years: 12.0% 50-64 years: 22.1% ≥65 years: 21.1%
Percent that die among those hospitalized. Includes both non-ICU and ICU admissions††	18-49 years: 2.4% 50-64 years: 10.0% ≥65 years: 26.6%
Median number of days of mechanical ventilation (interquartile range)**	Overall: 6 (2, 12) days
Median number of days from symptom onset to death (interquartile range)**	18-49 years: 15 (9, 25) days 50-64 years: 17 (10, 26) days ≥65 years: 13 (8, 21) days
Median number of days from death to reporting (interquartile range)¶¶	18-49 years: 19 (5, 45) days 50-64 years: 21 (6, 46) days ≥65 years: 19 (5, 44) days

* McAloon, C.G., Collins, A., Hunt, K., Barber, A., Byrne, A., Butler, F., Casey, M., Griffin, J.M., Lane, E., McEvoy, D. and Wall, P. (2020). The incubation period of COVID-19: A rapid systematic review and meta-analysis of observational research. *medRxiv*.

† He, X., Lau, E.H., Wu, P., Deng, X., Wang, J., Hao, X., Lau, Y.C., Wong, J.Y., Guan, Y., Tan, X. and Mo, X. (2020). Temporal dynamics in viral shedding and transmissibility of COVID-19. *Nature medicine*, *26*(5), pp.672-675.

§ The point estimate is the geometric mean of the location specific point estimates of the ratio of estimated infections to reported cases, from Havers, F.P., Reed, C., Lim, T., Montgomery, J.M., Klena, J.D., Hall, A.J., Fry, A.M., Cannon, D.L., Chiang, C.F., Gibbons, A. and Krapiunaya, I., 2020. Seroprevalence of antibodies to SARS-CoV-2 in 10 sites in the United States, March 23-May 12, 2020. *JAMA Internal Medicine*. The lower and upper bounds for this parameter estimate are the lowest and highest point estimates of the ratio of estimated infections to reported cases, respectively, from Havers et al., 2020.

Exhibit 12

¶ Estimates only include symptom onset dates between March 1, 2020 – July 15, 2020. Estimates represent time to obtain SARS-CoV-2 tests among cases who tested positive for SARS-CoV-2. Estimates based on and data from Data Collation and Integration for Public Health Event Response (*DCIPHER*).

** Estimates only include symptom onset dates between March 1, 2020 – July 15, 2020 to ensure cases have had sufficient time to observe the outcome (hospital discharge or death). Data for 17 year olds and under are suppressed due to small sample sizes.

†† Based on data reported to COVID-NET by Aug 1, 2020. Data for 17 year olds and under are suppressed due to small sample sizes. https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html.

§§ Cumulative length of stay for persons admitted to the ICU, inclusive of both ICU and non-ICU days.

¶¶ Estimates only include death dates between March 1, 2020 – July 15, 2020 to ensure sufficient time for reporting. Data for 17 year olds and under are suppressed due to small sample sizes.

References

1. Havers, F.P., Reed, C., Lim, T., Montgomery, J.M., Klena, J.D., Hall, A.J., Fry, A.M., Cannon, D.L., Chiang, C.F., Gibbons, A. and Krapiunaya, I., 2020. Seroprevalence of antibodies to SARS-CoV-2 in 10 sites in the United States, March 23-May 12, 2020. *JAMA Internal Medicine*.
2. Dietz K. The estimation of the basic reproduction number for infectious diseases. Stat Methods Med Res. 1993;2:23–41.

Archive

COVID-19 Pandemic Planning Scenarios – May 20, 2020 [7 pages]

COVID-19 Pandemic Planning Scenarios – July 10, 2020 [9 pages]

Last Updated Sept. 10, 2020

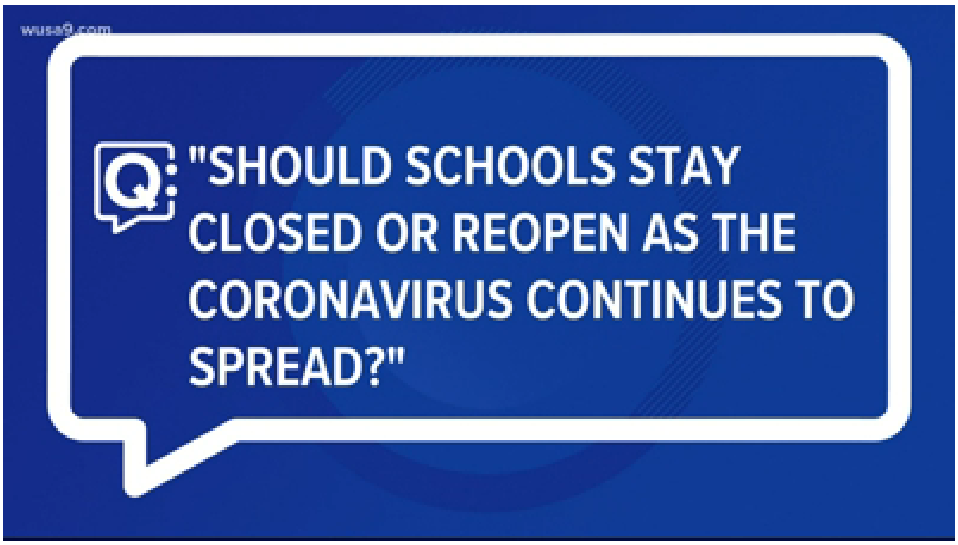
Exhibit 12

EXHIBIT 13

CORONAVIRUS

Schools are 'one of the safest places' for kids during pandemic, CDC director says

CDC Director Robert Redfield made comments regarding the CDC's stance on school closures Thursday that have left some parents confused.



Author: **John Henry**
Published: **8:23 PM EST November 20, 2020**
Updated: **8:23 PM EST November 20, 2020**

WASHINGTON — Parents and teachers are reacting to comments the director of the Centers for Disease Control and Prevention recently made in regard to school closures. CDC Director Dr. Robert Redfield told reporters Thursday his agency never recommended schools close in the spring nor has he recommended they do so now.

“The truth is, for kids K through 12, one of the safest places they can be from our perspective is to remain in school," he said.

RELATED: Gov. Northam should 'recommend' virtual-only learning in Virginia, education association leaders say

Redfield said the CDC has newer data to rely on to help it make such claims.

“Today, there's extensive data that we've gathered over the last two to three months to confirm that K-12 schools can operate with face-to-face learning and they can do it safely and they can do it responsibly,” he said.

Local school systems have taken different approaches to learning in the age of COVID.

Exhibit 13

St. Mary’s County Public Schools recently paused its hybrid model due to a local covid case spike. Montgomery County Public Schools plans to remain fully virtual through January.

However, some parents say they are pleased with Redfield's comments.

> The Coronavirus Task Force and the CDC do not and have never recommended school closures. pic.twitter.com/7rUotXGQ94
>
> — The White House (@WhiteHouse) November 19, 2020

Montgomery County parent Deborah Schoenfeld switched her kids to private school this year due to COVID restrictions in her community.

"Schools are so important that we really need to get these children back for in-person learning," she said. "I think it takes a lot of bravery for someone like Dr. Redfield to be making these statements."

Mike Pereira, another MCPS parent, said his family decided to homeschool their children over the summer because it looked like everything would be limited to virtual learning.

"We didn't want to take a chance on taking our kids to even a private school that could be virtually doing classes," he said.

Pereira said he was also happy to hear what Redfield said Thursday. However, he said it found it heartbreaking because many families are still in a position where their children must learn virtually.

"It's really challenging for a lot of families," he said. "For us, we're sort of in a good spot because my wife is a speech therapist and is involved in our kids' education, as am I, during the course of a normal year. But, I'm not so sure other families around Montgomery County and elsewhere can do the same thing. It's very difficult."

Montgomery County Health Officer Dr. Travis Gayles sent a letter to all private schools in his county Thursday.

It stated current data shows coronavirus cases attributed to exposure in Montgomery schools have been low. However, it also said that per guidance from the Maryland departments of education and health, all schools should strongly consider a return to full virtual learning due to the current COVID case surge.

RELATED: Washington Teachers' Union will not sign agreement to reopen DC Public Schools

Washintgton Teachers' Union President Elizabeth Davis told WUSA9 she thinks it is too early to begin in-person learning in the District.

"The messaging was that we should follow the science, nothing else, the science of what's happening," she said. "And, [the CDC's stance] clearly is suggesting that we should not."

Davis added that not all schools are well-off and have the resources needed to reopen safely. She said the White House still needs to provide funding to help all schools.

"They've basically starved jurisdictions and school districts of the funding they need in order to open schools safely," she said.

Redfield's comments also created some confusion Thursday. On the CDC's website, an old page shows the agency once shared guidelines with the country's schools as to what they should do if they decided to close due to the coronavirus.

RELATED: Fairfax County delays return to in-person learning, as COVID cases rise

Exhibit 13

WUSA9 reached out to DC Public Schools, Fairfax County Public Schools, and Prince George's County Schools for comment regarding the CDC's stance. Those are some of the largest schools in the area that are predominantly virtual during the fall semester. None of them replied as of the publishing of this article.

The Maryland State Department of Education did release a statement regarding the CDC.

"MSDE continues to refer to the existing guidance in the Education Recovery Plan, as well as Covid-19 Guidance for Maryland Schools issued in partnership with the Maryland Department of Health, which support the reopening of schools."

Exhibit 13

EXHIBIT 14

Secondary Navigation

Transcript: Mayor de Blasio Appears Live on CNN's New Day

November 30, 2020

Alisyn Camerota: Okay, big announcement this weekend, New York City's public school system will reopen for in-person learning for elementary school kids next week. The move marks a reversal from just ten days earlier when the Mayor shut down schools and moved to remote learning. So, what changed? Let's ask New York City Mayor Bill de Blasio. Good morning, Mr. Mayor.

Mayor Bill de Blasio: Good morning, Alisyn. How are you doing?

Camerota: I'm doing well. So, just take us inside your thought process. What changed from November 19th when you shut down in-person learning to yesterday, when you announced reopening?

Mayor: Alisyn, we had to reset the equation to create something that would be sustainable for the long haul. We had said back in September, we would open our schools – biggest school system in the country. Most cities weren't opening schools at all. We did, but we also said we'd have really strict standards. And I said, if we hit the three percent positivity, that would be the point where we'd have to do something different. Now we have a different approach. We're adding a lot more testing, weekly testing in every school. Kids will have to have a testing consent form to come to school. This is going to allow us to get back up with our school system next Monday – elementary school, early childhood, special education programs. And we're going to keep building from there. And Alisyn, one of the other things we're going to be able to do now is have five-day-a-week instruction in a lot of schools, because a lot of parents did choose remote learning. Other parents want their kids in the classroom. We now have the ability to give them more days in the classroom, which is going to be really great for those kids.

Exhibit 14

Camerota: Yes, and for the parents. I mean, obviously this is music to the ears of many parents, but just help us understand, did you consult different doctors or different scientists in terms of why was the three percent threshold considered dangerous 11 days ago? But now the city's positivity rate is 3.9 and it's not too dangerous for kids to go back to school.

Mayor: Alisyn, I certainly understand the question. The real question is back in August, September, when we laid down that three percent, we did not have the information we have now. And so, we had put it in place to say to folks, we'd be very stringent, to parents, teachers, staff, we're going to keep them very safe. We put all sorts of measures in place to keep schools safe. Everyone wears a mask, for example, in our schools, kids and adults alike, always. It worked. So, the previous standard proved to be effective, but now it was time for something different. Alisyn, what happened was that that three percent standard, after we had so much experience with the schools, proved to be different than we thought it would be. And then we said, what can we do now to sustain our schools for the long haul, all the way to having the vaccine present? We decided we needed a lot more testing and to make that in every school. That would be the difference maker. That was the new measure we needed. We did consult with the State, with all the stakeholders, and we agreed that was the way.

Camerota: And so, you're going to be testing students every week. Now are these rapid tests?

Mayor: Well, these will be the PCR test, the diagnostic tests. And we'll get results very quickly. Our City has been able to turn around tests typically in a day or two with our public facilities. So, we'll be able to really quickly know what's going on in each school and act accordingly.

Camerota: And so, what's the new threshold now? So, now that, with your new information, you've decided that the three percent is too low, I guess, of a threshold, what's the new threshold now for if you were to have shut it down?

Mayor: It's a different approach now, Alisyn, overall, because what has happened is we've proven the schools could be extraordinarily safe. I mean, the schools are some of the safest places to be right now in New York City, which is a credit to our educators and our staff and our parents. We know it works, but you have to constantly monitor that testing. And if we see multiple cases in the school, we do an immediate investigation with our Test and Trace Corps, and in a lot of cases we will close that school either temporarily or even for a two-week quarantine. So, that ability to school-by-school make those adjustments, that has proven to be the most effective tool. We don't think that the specific number has as much meaning as a single number. That's how we started. That's what we thought was necessary to get the school system started. Now we have a much more comprehensive testing system than we were able to do back then and a strong, what we call our situation room that determines whether a school should stay open or not, each school at a time. Those are the checks and balances we need to keep the school system going all the way to when we have a vaccine. This is going to be a sustainable model now.

Camerota: And so why not apply that model to middle schoolers?

Mayor: Oh, we will, but we're just not ready to do it yet. The amount of testing we need, the sheer capacity requires us to focus on elementary school, special education, and early

Exhibit 14

childhood. Over time we're going to certainly move to middle school and high school as well.

Camerota: And when? What's your target date?

Mayor: Well, it's not going to be the next few weeks. I mean, obviously from now until the Christmas break, the focus will be on the younger kids. But when we come back, especially because we need to fight back this second wave that's bearing down on us now over these next weeks, when we come back, my hope is we can then move quickly to middle school and high school.

Camerota: And so just so I understand in terms of the elementary school, starting on Monday, they'll now – every student will now be tested twice a week?

Mayor: Once a week. It's been once a month up to now. It will now be once a week. Every child is required to either be tested, have a consent form, or have a medical exemption from testing. So, we're going to be comprehensive. We're going to be doing this every week.

Camerota: And then if somebody is positive, does their classroom stay home? Does their grade stay home? Do you have a plan for what happens when there's a positive test?

Mayor: Well, Alisyn, that's what's been working so well these last few months, and that's why we were able to open New York City public schools and keep them safe. We have a very rigorous procedure. Yes, if there's a case in the classroom, the classroom quarantines, it's a kind of pod system so you can just quarantine that classroom. If there's multiple cases in a school, there's a careful investigation to determine whether the school only needs a temporary or a full two-week quarantine. That has worked and it's allowed us to keep the vast majority of our schools open the vast majority of the time. But it's also given us the ability to pinpoint when there's a problem and address it quickly through our Test and Trace Corps.

Camerota: Mayor Bill de Blasio, thank you very much for all of the information. I know that parents are, you know, all ears this morning to see how it's going to work moving forward. We really appreciate it.

Mayor: Thank you, Alisyn.

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EXHIBIT 15

Secondary Navigation

Mayor de Blasio and Chancellor Carranza Announce Plan to Return to In-Person Learning in New York City Schools

November 29, 2020

NEW YORK—Mayor Bill de Blasio and Schools Chancellor Richard A. Carranza today announced a plan to safely reopen New York City school buildings for in-person instruction with more rigorous testing protocols in place. Students in 3-K and Pre-K programs, as well as those in grade k through grade 5 who have opted for in-person learning will return to school buildings on Monday, December 7, and schools serving students with the most significant disabilities, known as District 75, will return on December 10th. Middle and High Schools will remain remote for the time being.

"Reopening our buildings is paramount to our city's recovery from COVID-19," said **Mayor Bill de Blasio**. "That's why we are doubling down on the safety and health measures that work to make in-person learning a reality for so many of our students."

"Getting our kids back in school buildings is one of the single most important things we can do for their wellbeing, and it's so important that we do it right," said **Schools Chancellor Richard A. Carranza.** "The unparalleled value of in-person learning for students has been evident in the first few months of school, and we will do everything we can to keep our schools safe and keep them open for the duration of this pandemic."

By the time students return to buildings on December 7th, a consent form for testing will be required for all students and staff, and every school will participate in weekly random testing for 20 percent of their in-person population. Parents can fill out the consent form online using a New York City Schools Account (NYCSA) at mystudent.nyc or print and sign the form and bring it to school on their first day back to buildings.

Exhibit 15

Our schools are safe, and the most recent positivity rate is 0.28 percent--453 positive cases out of 159,842 tests. The Situation Room will continue to take fast action following established protocol for tracing COVID cases that are reported from both outside and in-school testing.

Schools will also continue to work towards accommodating students in person five days per week. This includes the approximately 300,000 students who have shown up to in-person learning so far, and the 35,000 students who opted-in earlier this month. Superintendents will work with their schools to adjust schedules as needed with the goal of full-time in-person education in the coming weeks for the students who have selected that option.

We will continue to closely monitor transmission in schools and throughout the City, and work closely with public health experts and the latest State guidance to keep our schools safe and open for in-person learning.

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Exhibit 15

EXHIBIT 16

INTERACTION

Responsive Interactions and Instruction in Prekindergarten through 3rd Grade: Building a Strong Foundation for the Common Core Learning Standards

Guidance from

New York State Head Start Collaboration Office, Patty Persell

New York State Association for the Education of Young Children, Kristen Kerr

Exhibit 16

INTERACTION

Photo courtesy of Community Playthings

Responsive Interactions and Instruction in Prekindergarten through 3rd Grade: Building a Strong Foundation for the Common Core Learning Standards

The NYS Early Childhood Advisory Council, NYS Head Start Collaboration Office, and the NYS Association for the Education of Young Children are working to support our youngest students, their families, teachers, and leaders by highlighting key features of high quality early childhood teaching. **We firmly believe that young students can best meet Common Core Learning Standards when they have effective teachers who use intentional, experiential, and developmentally and culturally appropriate practices.** This brief provides helpful strategies related to setting up a classroom environment that will help to put the State's young learners on a path to social and intellectual success as they master the foundational skills to meet the New York Common Core Learning Standards.

To learn more and view the other briefs in this series that address leadership, curriculum, the classroom environment, and assessment, please visit The New York ECAC website at www.nysecac.org or contact Patty Persell at Patricia.persell@ccf.ny.gov

Exhibit 16

Interactions and Instruction in a High-Quality Classroom Help Young Children Learn

Beginning at birth, children learn about themselves and their worlds through their relationships with their families, caregivers, and teachers. When those relationships are sensitive to young children's development and maturation, they put children on the path to lifelong success.

An effective relationship starts with the establishment of trust and an understating of child development. As children develop from birth through the 3rd grade, they move from concrete to abstract and symbolic thinking. At the same time, with thoughtful instruction and practice they gain the ability to regulate their emotions, collaborate with their peers, and understand others' perspectives. Shifts in cognition manifest in all aspects of young children's development, which are deeply interrelated. Indeed, during a child's first eight years "emotional, social, physical, and thinking abilities are intertwined like a multi-fibred weaving. Each strand forms an essential part of the whole."[1]

As children grow, a complex combination of experiences, environment, and family characteristics shape children's learning and development. Appropriate experience at the right stage of development determines the strength of the brain's architecture, which, in turn, determines how well he or she will think and regulate emotions.[2] Positive early development lays the foundation for the full spectrum of skills, attitudes, and knowledge required to succeed in college and beyond. While deprivation undermines development, nurturing and stimulating early learning experiences help our young children thrive.

Because children learn best when they have rich interactions, early childhood teachers and caregivers have a responsibility to build nurturing and stable relationships with each child in their care. To do so, they must have and model empathy, respect, and caring throughout their daily activities. When those strong relationships are established, children will learn when teachers present them with new ideas and abilities that are just beyond their current knowledge base and when they have many hands-on opportunities to practice their new skills. These learning opportunities occur naturally during playful learning in an early childhood education setting and project-based learning in the elementary grades. The learning process is the same – child-driven hands-on opportunities to work with peers as they solve problems, test their ideas, invent, create, and grow.

"...a substantial body of evidence shows that teacher-directed didactic instruction actually limits children's learning, creativity, and curiosity. Further, when young children do not engage in dramatic play at school, behavioral challenges and expulsions increase."

In light of the way that young children learn, a comprehensive approach to early childhood and elementary instruction is intentional, responsive, and builds on children's backgrounds and interests. In fact, a substantial body of evidence shows that teacher-directed didactic instruction actually limits children's learning, creativity, and curiosity. Further, when young children do not engage in dramatic play at school, behavioral challenges and expulsions increase.[3] A high-quality early learning environment strikes a balance between child-initiated play in the presence of engaged teachers and focused experiential learning guided by teachers, depicted by the orange area in Figure 1 (below).[4]

Interactions and instruction include the strategies teachers or caregivers use to engage young learners as they scaffold new knowledge and skills. Teachers build relationships with each student through responsive interactions. When teachers speak in a warm tone and treat every student with respect, they establish a safe and stimulating environment in which children can explore new ideas and abilities. Instruction transpires when teachers approach children as active participants in their learning. They have rich conversations with their students to extend their thinking and present increasingly challenging tasks across all developmental domains. These interactions take place in large group settings, such as a morning meeting or when the teacher facilitates a group discussion about a topic they are investigating. In a high-quality classroom, most instruction occurs in learning centers. Indeed, teachers use small group interactions to differentiate instruction and conduct authentic assessments of children's progress. With the support of a teacher who listens to the children, asks questions, and adds information, the children deepen their understanding of key concepts. As teachers scaffold children's learning, they rely on a variety of instructional techniques, including encouragement, giving specific

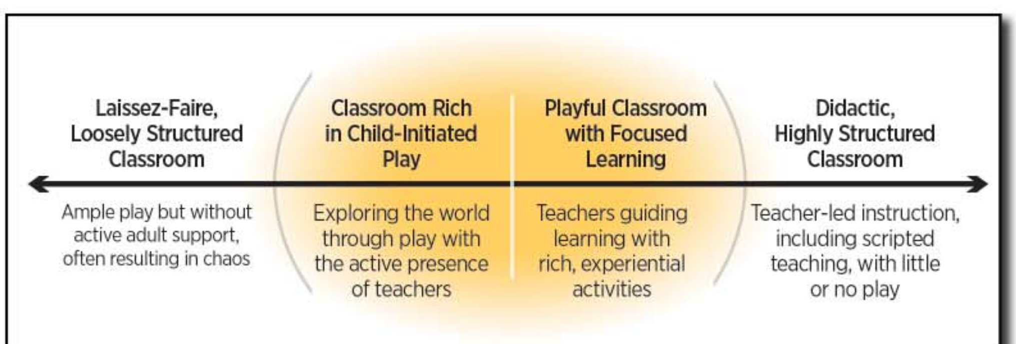

Figure 1. Early Childhood Instructional Continuum[5]
The orange section depicts the "sweet spot" for maximum learning, trust and discovery.

Exhibit 16

feedback, modeling, adding a challenge, offering clues, providing information, and directions.[6]

- **In prekindergarten**, teacher-child interactions are responsive. Through thoughtful interactions, teachers understand and build on students' prior learning, interests, and family experience in order to nurture each child's innate drive to acquire new skills and knowledge. Prekindergarten teachers are sensitive to children's social and emotional development in order to cultivate children's love of school and learning.
- **In kindergarten**, many children have their first experience with public school, which can shape lifelong attitudes toward school. It is especially important for teachers to support children's approaches toward learning: their attention, emotional regulation, flexibility, persistence, interests, and motivation to learn.[7] Children at this age still vary dramatically in their development and there is also a wide age range in many kindergarten classrooms. Thus, effective kindergarten teachers must be highly skilled at individualizing interactions and differentiating instruction.
- **In 1st to 3rd grade**, teachers' interactions and instruction need to focus on dispositions as much as academic goals because children are particularly sensitive to social comparisons and peer acceptance. Excellent teachers plan their lessons to encourage children to do their personal best and motivate children to make progress over time. Teachers encourage young students by acknowledging their critical thinking, persistence, and creativity.

High Quality Interactions and Instruction in Action

In a high-quality kindergarten class, the teacher uses responsive interactions and comprehensive instructional strategies to create a caring learning community so that her students come to school eager to learn. The teacher begins the day with a morning meeting to help cultivate positive relationships among the students and affirm the culture of the classroom. The children greet one another at the beginning of the meeting and the children have a chance to participate in the group discussion, then the teacher introduces new content knowledge and the plan for the day. Then, the children have time to engage in child-initiated choice time in learning centers. The teacher scans the classroom to observe how her students are working together and to ensure they are engaged in appropriate activities. She sees one child who appears tired and is wandering from one center to the next without becoming actively involved. The teacher approaches the child to see how she is feeling. The teacher has a strong and trusting relationship with her student and the student shares that she had a difficult morning. First the teacher sits with the child and listens and then when the child seems ready she encourages the child to go to the reading center where she can sit comfortably and listen to a book on tape with her classmates. The books that the children can choose highlights key literacy constructs the children are developing, such as rhyming. The book also relates to the content they are exploring, such as their community. When the book is finished, the teacher returns to the reading center to engage the students in a discussion about the book and to check in with the child to see that she is feeling more comfortable and engaged. She also encourages the children to explain their opinions based on the story line as well as their personal experiences.

Interactions and Instruction address the Common Core Learning Standards

The Common Core Learning Standards promote college and career readiness by describing the knowledge and skills in math, reading, writing, speaking, listening, and language that students should gain as they advance through the grades. To foster a cohesive approach to instruction in prekindergarten through elementary school, the State Education Department developed the **Prekindergarten Foundation for the Common Core**. This tool addresses five essential early learning domains: approaches to learning, language and literacy, cognition and general knowledge, social and emotional development, and physical health. Like developmentally appropriate practice, the Common Core Learning Standards support interdisciplinary learning, higher order thinking, creativity, and the use of language and literacy skills throughout the day. As students master the standards, they gain seven essential capacities that promote their intellectual development.[8] A high-quality approach to interactions and instruction support each capacity.

Common Core Essential Capacities	Characteristics of High Quality Interactions and Instruction
Demonstrate independence	Provides students with ample opportunity to pursue their interests independently and collaborate with their peers. Teachers respect children's choices during child-initiated learning, which builds students' intrinsic motivation, self-regulation, and independence. Teachers positively acknowledge children's independence and initiative.
Build strong content knowledge	Builds on children's interests and experiences during their interactions. Teachers ask open-ended questions to understand students' knowledge, respond to children's questions, and add additional information that spans subject areas to build a comprehensive knowledge base.
Respond to varying demands of audience, task, purpose, and discipline	Includes rich discussion throughout the day. Teachers model communication strategies and help students to express themselves appropriately with their peers. Young learners' communication skills flourish when they have responsive relationships with their teachers.
Comprehend as well as critique	Promotes curiosity and critical thinking when teachers ask open-ended questions and follow-up questions. Teachers encourage students to ask questions of one another during small group work.
Value evidence	Provides opportunities for students to explain their opinions and statements when they interact with one another in whole group, small group, and individual conversations. They ask children to find evidence in a text to support their thinking, for example, "How do you know Goldilocks was scared? What did she do or say that showed you how she felt?" They encourage children to plan and review their work and to represent what they know in several ways (e.g., verbally and pictorially).
Use technology and digital media strategically and capably	Digital media is used sparingly because young students learn best through interacting with their peers and their teachers and through hands-on learning.
Understand other perspectives and cultures	Recognizes that students' family backgrounds play a significant role in how they approach learning. When teachers interact with young learners, they learn about a child's family to help the child establish a strong sense of self and they learn to value the strengths of every child's family. Teachers' interactions demonstrate and model acceptance, appreciation, and value of diversity.

Strategies For Teachers

- Speak with young students in a warm, caring, and encouraging tone
- Listen to children and encourage them to respectfully listen to one another
- Structure the day so that the majority of time is spent in one-on-one and small group interactions with students
- Use a variety of techniques that are responsive to young students' learning styles, experience, and culture, including encouragement, giving specific feedback, modeling, adding a challenge, offering clues, providing information, and giving directions.

Strategies For Leaders

- Hire teachers with expertise in early and cultural and linguistic competence to teach in prekindergarten to 3rd grade
- Select curricula that foster rich discussion and interactions among teachers and students
- Provide professional development that encourages responsive and appropriate interactions
- Ensure teachers have sufficient time to engage in elaborated authentic interactions with students by limiting class sizes and providing adequate staff support

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Resources

- **PreK-3rd: Getting Literacy Instruction Right**
  Foundation for Child Development, Nonie K. Lesaux
  www.fcd-us.org/resources/prek-3rd-getting-literacy-instruction-right
- **Engaging Interaction and Environments**
  Head Start National Center on Quality Teaching and Learning (NCQTL)
  www.eclkc.ohs.acf.hhs.gov/hslc/tta-system/teaching/practice/engage
- **Classroom Assessment Scoring System**
  Teachstone
  www.teachstone.com/the-class-system/

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[2] National Scientific Council on the Developing Child (2007). The Timing and Quality of Early Experiences Combine to Shape Brain Architecture: Working Paper No. 5. Retrieved from www.developingchild.harvard.edu

[3] Gilliam, W. (2005). Prekindergarteners left behind: Expulsion rates in state prekindergarten systems. New Haven, CT: Yale University Child Study Center.

[4] Miller, E. & Almon, J. (2011). Crisis in the kindergarten: Why children need to play in school. Alliance for Childhood. Retrieved January 14, 2014 from www.allianceforchildhood.org/sites/allianceforchildhood.org/files/file/kindergarten_report.pdf

[5] Miller, Ed. & Almon, J. (2011). Pg. 12

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[7] Tomlinson, H.B. (2009). An overview of development in the kindergarten year. In C. Copple and S. Bredekamp (Eds.). Developmentally Appropriate Practice In Early Childhood Programs Serving Children from Birth Through Age 8 (3rd ed.). Washington, DC: National Association for the Education of Young Children.

[8] New York State Education Department. (2010). New York State P-12 common core learning standards for English language arts and literacy. Retrieved February 27, 2014 from: www.engageny.org/sites/default/files/resource/attachments/nysp12cclsela.pdf

Prepared by Kate Tarrant, Ed.D
September 2014

NYS Early Childhood Advisory Council
nysecac.org

Exhibit 16

EXHIBIT 17

McKinsey & Company

Public Sector Practice

COVID-19 and student learning in the United States: The hurt could last a lifetime

New evidence shows that the shutdowns caused by COVID-19 could exacerbate existing achievement gaps.

by Emma Dorn, Bryan Hancock, Jimmy Sarakatsannis, and Ellen Viruleg

June 2020

Exhibit 17

The US education system was not built to deal with extended shutdowns like those imposed by the COVID-19 pandemic. Teachers, administrators, and parents have worked hard to keep learning alive; nevertheless, these efforts are not likely to provide the quality of education that's delivered in the classroom.

Even more troubling is the context: the persistent achievement disparities across income levels and between white students and students of black and Hispanic heritage. School shutdowns could not only cause disproportionate learning losses for these students—compounding existing gaps—but also lead more of them to drop out. This could have long-term effects on these children's long-term economic well-being and on the US economy as a whole.

Despite the enormous attention devoted to the achievement gap, it has remained a stubborn feature of the US education system. In 2009, we estimated that the gap between white students and black and Hispanic ones deprived the US economy of $310 billion to $525 billion a year in productivity, equivalent to 2 to 4 percent of GDP.[1] The achievement gap between high- and low-income students was even larger, at $400 billion to $670 billion, 3 to 5 percent of GDP. Although we calculate these two gaps separately, we recognize that black and Hispanic students are also more likely to live in poverty. Yet poverty alone cannot account for the gaps in educational performance.[2] Together, they were the equivalent of a permanent economic recession.

Unfortunately, the past decade has seen little progress in narrowing these disparities. The average black or Hispanic student remains roughly two years behind the average white one, and low-income students continue to be underrepresented among top performers.[3] We estimate that if the black and Hispanic student-achievement gap had been closed in 2009, today's US GDP would have been $426 billion to $705 billion higher.[4] If the income-achievement gap had been closed, we estimate that US GDP would have been $332 billion to $550 billion higher (Exhibit 1).

These estimates were made before schools closed and the transition to remote learning began, sometimes chaotically. In this article, we explore the possible long-term damage of COVID-19–related school closures on low-income, black, and Hispanic Americans, and on the US economy.

Learning loss and school closures

To that end, we created statistical models to estimate the potential impact of school closures on learning. The models were based on academic studies of the effectiveness of remote learning relative to traditional classroom instruction for three different kinds of students. We then evaluated this information in the context of three different epidemiological scenarios.

How much learning students lose during school closures varies significantly by access to remote learning, the quality of remote instruction, home support, and the degree of engagement. For simplicity's sake, we have grouped high-school students into three archetypes. First, there are students who experience average-quality remote learning; this group continues to progress, but at a slower pace than if they had remained in school.[5] Second, some students are getting lower-quality

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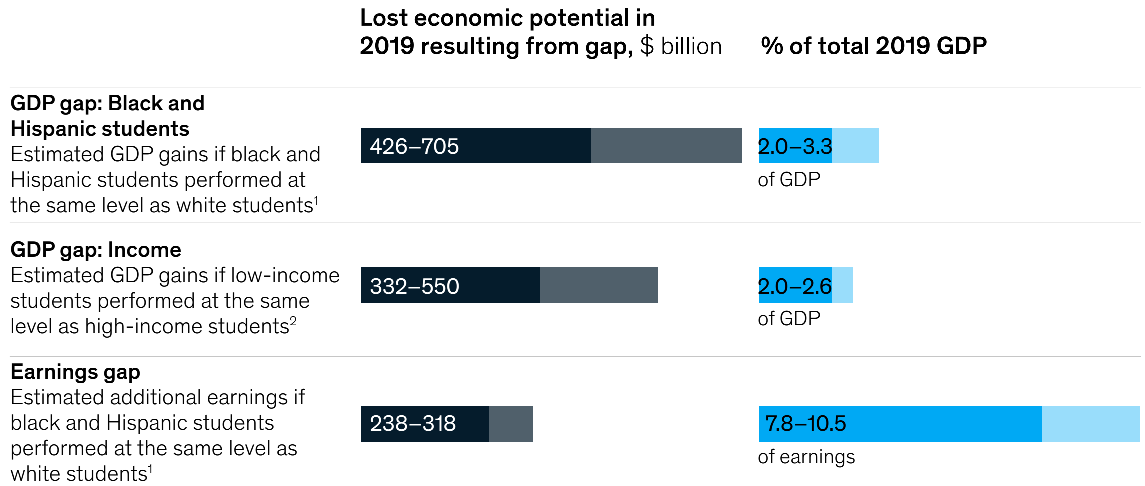
[1] For both 2009 and 2019, we use $25,000 in annual income (in 2009 constant dollars) as the cutoff between low and high income.
[2] For an analysis of the interaction between the racial and ethnic achievement gap and the income achievement gap, see Byron G. Auguste, Bryan Hancock, and Martha Laboissiere, "The economic cost of the US education gap," June 2009, McKinsey.com.
[3] Erik Hanushek, Paul E. Peterson, Laura M. Talpey, and Ludger Woessmann. *Long-run Trends in the U.S. SES-Achievement Gap*, NBER National Bureau of Economic Research, working paper number 26764, February 2020; S. F. Reardon, "The widening academic achievement gap between the rich and the poor: New evidence and possible explanations," in Greg Duncan and Richard Murnane (Eds.), *Whither Opportunity? Rising Inequality and the Uncertain Life Chances of Low-Income Children*, New York: Russell Sage Foundation, 2011.
[4] The learning gap has remained almost the same between 2007 (the year of the latest data when we published our 2009 report) and 2019. Black students scored, on average, 31 points lower than white students did on eighth-grade National Assessment of Education Progress (NAEP) math assessments in 2007; in 2019 they scored 32 points lower. Hispanic students scored, on average, 26 points lower than white students did on eighth-grade NAEP math assessments in 2007; in 2019 they scored 24 points lower. The increase in dollar values is the result of an increase in proportion of black and Hispanic people in the workforce and higher GDP base value in 2019.
[5] High-quality remote-learning programs are typically the result careful planning and deliberate approaches—which were not typical of the COVID-19 transition.

Exhibit 17

Exhibit 1

The US economy would be significantly larger in 2019 if it had closed achievement gaps in 2009.



[1] NAEP 8th-grade math score: comparison of average scores of black and Hispanic students with white students.
[2] NAEP 8th-grade math score: comparison between low-income (eligible for free lunch) students and high-income students.

remote learning; they are generally stagnating at their current grade levels. Then there are students who are not getting any instruction at all; they are probably losing significant ground. Finally, some students drop out of high school altogether.

We also modeled three epidemiological scenarios. In the first—"virus contained"—in-class instruction resumes in fall 2020. In the second—"virus resurgence"— school closures and part-time schedules continue intermittently through the 2020–21 school year, and in-school instruction does not fully resume before January 2021.[6] In the third scenario—"pandemic escalation"—the virus is not controlled until vaccines are available, and schools operate remotely for the entire 2020–21 school year.

In our second scenario (in-class instruction does not resume until January 2021), we estimate that students who remain enrolled could lose three to four months of learning if they receive average remote instruction, seven to 11 months with lower-quality remote instruction, and 12 to 14 months if they do not receive any instruction at all (Exhibit 2).

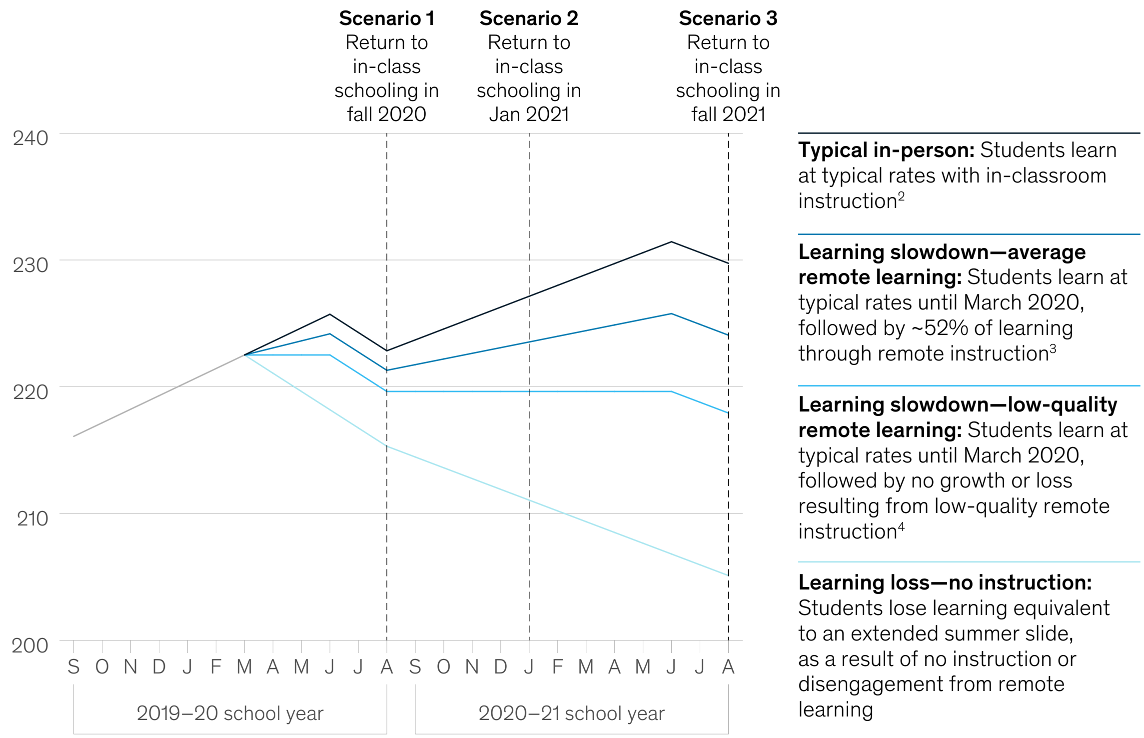
Although students at the best full-time virtual schools can do as well as or better than those at traditional ones,[7] most studies have found that full-time online learning does not deliver the academic results of in-class instruction.[8] Moreover, in 28 states,[9] with around 48 percent of K–12 students, distance learning has not been mandated.[10] As a result, many students may not receive any instruction until schools reopen. Even in places

[6] For simplicity's sake, we have equated this with schools restarting as normal in January 2021, even though the reality is more likely to be a patchwork of different actions.
[7] There is evidence from online-learning providers' internal, peer-reviewed research that some virtual-learning experiences can achieve parity with brick-and-mortar experiences for students, especially those who were struggling academically.
[8] See, for example the 2015 Online Charter School Study of the Center for Research on Education Outcomes (CREDO), credo.stanford.edu.
[9] Alaska, Arkansas, Colorado, Connecticut, Georgia, Hawaii, Illinois, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Missouri, Montana, New Jersey, New York, North Carolina, Ohio, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Virginia, West Virginia, and Wisconsin.
[10] *Politics K–12*, "Coronavirus and learnings: What's happening in each state," blog entry by *Education Week* staff, April 3, 2020, blogs.edweek.org.

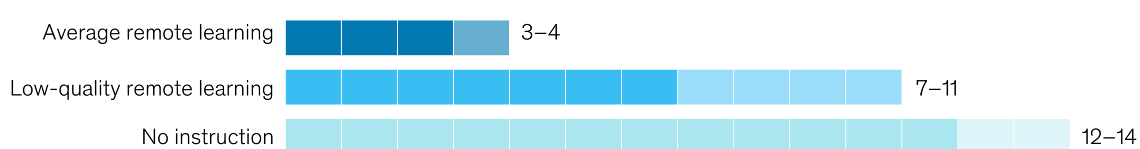
Exhibit 2

In all three scenarios, students are at risk for significant learning loss.

Projected 6th-grade math performance, example, NWEA[1] RIT Scores



Average months of learning lost in scenario 2 compared with typical in-classroom learning



[1] NWEA is a K–12 assessment provider serving over 9,500 schools across the US; their RIT scores are a standardized scaled score that measures student performance and progress.
[2] Normal school year growth rates estimated using NWEA data.
[3] 52% assumed growth for high-quality instruction.
[4] 0% assumed average growth for low-quality instruction. Rates of learning loss may differ by student groups.

Source: Megan Kuhfeld, Dennis Condron, and Doug Downey, *When does inequality grow?*, 2019; Center for Research on Education Outcomes, Online Charter Schools Study, 2015

where distance learning is compulsory, significant numbers of students appear to be unaccounted for.[11] In short, the hastily assembled online education currently available is likely to be both less effective, in general, than traditional schooling and to reach fewer students as well.

Likely effects on low-income, black, and Hispanic students

Learning loss will probably be greatest among low-income, black, and Hispanic students. Lower-income students are less likely to have access to high-quality remote learning or to a conducive

[11] The Curriculum Associates analysis of anonymized data on usage from March to May 2020 of i-Ready software (a personalized learning system typically used as supplemental instruction by classroom teachers), curriculumassociates.com.

Exhibit 17

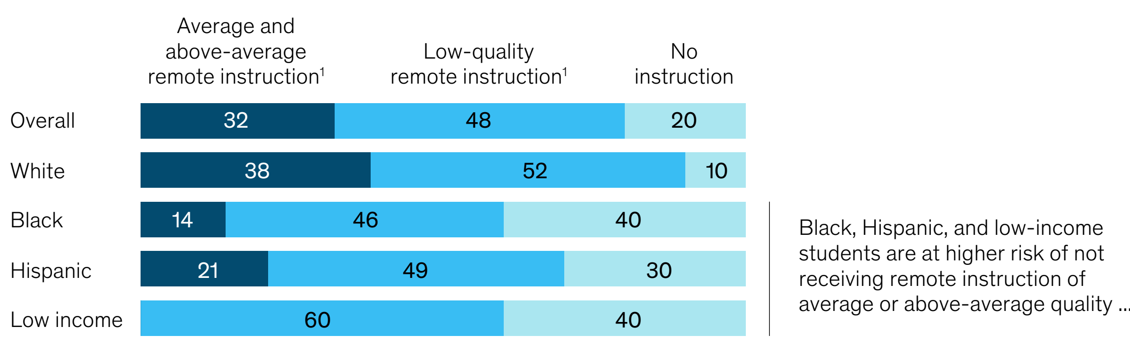
learning environment, such as a quiet space with minimal distractions, devices they do not need to share, high-speed internet, and parental academic supervision.[12] Data from Curriculum Associates, creators of the i-Ready digital-instruction and -assessment software, suggest that only 60 percent of low-income students are regularly logging into online instruction; 90 percent of high-income students do. Engagement rates are also lagging behind in schools serving predominantly black and Hispanic students; just 60 to 70 percent are logging in regularly (Exhibit 3).[13]

These variations translate directly into greater learning loss.[14] The average loss in our middle epidemiological scenario is seven months. But

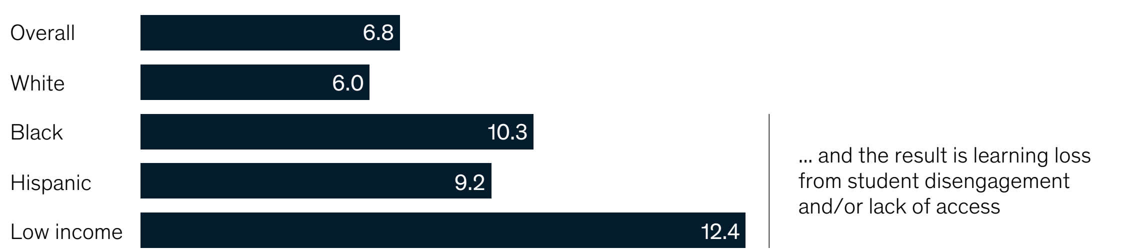
Exhibit 3

Learning loss will probably be greater for low-income, black, and Hispanic students.

Quality level of remote instruction, % of K–12 students



Average months of learning lost in scenario 2 compared with typical in-classroom learning[2]



[1] Estimates based on income quintiles, with assumption that top 2 income quintiles receive high-quality instruction.
[2] Includes 0.05 standard deviation reduction for black, Hispanic, and low-income students to account for recession impacts (~1 month of additional lost learning).

Source: US Census 2018

[12] Many parents continue to work full-time outside their homes, so their children may not have an adult at home to supervise their learning; Brooke Auxier and Monica Anderson, "As schools close due to the coronavirus, some U.S. students face a digital 'homework gap,'" Fact Tank, March 16, 2020, pewresearch.org. Many white-collar workers, however, are able to work remotely and thus provide at least some supervision. Dana Goldstein, Adam Popescu, and Nikole Hannah-Jones, "As school moves online, many students stay logged out, *New York Times*, April 6, 2020, nytimes.com. Also, one in ten public school students in New York City lives in shelter housing, which can mean several children sharing a single room; Anna North, "The shift to online learning could worsen educational inequality," Vox, April 9, 2020, vox.com.

[13] The Curriculum Associates analysis of anonymized data on usage from March to May 2020 of i-Ready software (a personalized learning system typically used as supplemental instruction by classroom teachers), percentage of log-ins as a portion of pre-closure rates on a weekly basis, curriculumassociates.com.

[14] To gauge the proportion of students that may fall into our three learning archetypes by race or ethnicity and by income level, we integrated multiple sources of information, including national surveys of teachers and data on student log-in patterns by race or ethnicity and income estimates to generate the plausibility of the type of instruction that students may receive given the income quintiles of their families. Specifically, "No instruction" estimates based on Curriculum Associates data and press reporting, including Mark Lieberman, "Taking attendance during Coronavirus closures: Is it even worth it?", *Education Week*, May 27, 2020, edweek.org; and Howard Blume and Sonali Kohli, "15,000 LA high-school students are AWOL online, 40,000 fail to check in daily amid coronavirus closures," *Los Angeles Times*, March 30, 2020, latimes.com. High- and low-quality instruction estimates are based on US Census income quintiles (Income Data Tables, US Census Bureau, 2019, census.gov) with the assumption that top two income quintiles receive higher-quality instruction.

These effects—learning loss and higher dropout rates—are not likely to be temporary shocks easily erased in the next academic year.

black students may fall behind by 10.3 months, Hispanic students by 9.2 months, and low-income students by more than a year. We estimate that this would exacerbate existing achievement gaps by 15 to 20 percent.

In addition to learning loss, COVID-19 closures will probably increase high-school drop-out rates (currently 6.5 percent for Hispanic, 5.5 percent for black , and 3.9 percent for white students, respectively). The virus is disrupting many of the supports that can help vulnerable kids stay in school: academic engagement and achievement, strong relationships with caring adults, and supportive home environments. In normal circumstances, students who miss more than ten days of school are 36 percent more likely to drop out.[15] In the wake of school closures following natural disasters, such as Hurricane Katrina (2005) and Hurricane Maria (2017), 14 to 20 percent of students never returned to school.[16] We estimate that an additional 2 to 9 percent of high-school students could drop out as a result of the coronavirus and associated school closures—232,000 ninth-to-11th graders (in the mildest scenario) to 1.1 million (in the worst one).[17]

In addition to the negative effects of learning loss and drop-out rates, other, harder to quantify factors could exacerbate the situation: for example, the crisis is likely to cause social and emotional disruption by increasing social isolation and creating anxiety over the possibility that parents may lose jobs and loved ones could fall ill. Milestones such as graduation ceremonies have been canceled, along with sports and other extracurricular events. These challenges can reduce academic motivation and hurt academic performance and general levels of engagement.[18]

The loss of learning may also extend beyond the pandemic. Given the economic damage, state budgets are already stressed. Cuts to K–12 education are likely to hit low-income and racial- and ethnic-minority students disproportionately, and that could further widen the achievement gap.[19]

The economic impact of learning loss and dropping out

These effects—learning loss and higher dropout rates—are not likely to be temporary shocks easily erased in the next academic year. On the contrary, we believe that they may translate into long-term harm for individuals and society.

Using the middle (virus resurgence) epidemiological scenario, in which large-scale in-class instruction does not resume until January 2021, we estimated the economic impact of the learning disruption. (The results would, of course, be worse in the third scenario and better in the first.) All told, we estimate that the average K–12 student in the United States

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[15] *Research brief: Chronic absenteeism*, Utah Education Policy Center, University of Utah, 2012, uepc.utah.edu.
[16] "Declining Enrollment, Shuttered Schools," *Education Week*, September 19, 2018, edweek.org; "Legacy of Katrina: The Impact of a Flawed Recovery on Vulnerable Children of the Gulf Coast," National Center for Disaster Preparedness, Children's Health Fund, 2010.
[17] To create these estimates, we compared data on the effects on drop-out rates resulting from extended school absences, online-only instruction (which can disrupt engagement and student–teacher relationships), and natural disasters. We focus on grades 9 to 11, as many school districts have relaxed testing and other graduation requirements for current 12th-grade students.
[18] Leah Lessard and Hannah Schacter, "Why the coronavirus crisis hits teenagers particularly hard: Developmental scientists explain," *Education Week*, April 15, 2020, edweek.org.
[19] During the 2008 recession, annual academic gains in US counties that suffered the largest shocks to employment fell 25 percent from prerecession levels. These districts disproportionately served poor and black Americans. K. Shores, K and M. P. Steinberg, *Schooling During the Great Recession: Patterns of School Spending and Student Achievement Using Population Data*, 2019.

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could lose $61,000 to $82,000 in lifetime earnings (in constant 2020 dollars), or the equivalent of a year of full-time work, solely as a result of COVID-19–related learning losses. These costs are significant—and worse for black and Hispanic Americans. While we estimate that white students would earn $1,348 a year less (a 1.6 percent reduction) over a 40-year working life, the figure is $2,186 a year (a 3.3 percent reduction) for black students and $1,809 (3.0 percent) for Hispanic ones.

This translates into an estimated impact of $110 billion annual earnings across the entire current K–12 cohort[20] (Exhibit 4). Of that sum, $98.8 billion would be associated with loss of learning and the rest ($11.2 billion) with the increase in the number of high-school dropouts. This is not just an economic issue. Multiple studies have linked greater educational attainment to improved health, reduced crime and incarceration levels, and increased political participation.

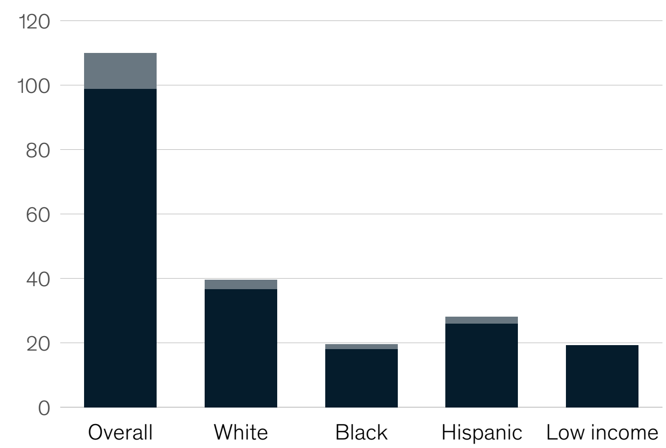
The damage to individuals is consequential, but the consequences could go deeper: the United States as a whole could suffer measurable harm. With lower levels of learning and higher numbers of drop-outs, students affected by COVID-19 will probably be less skilled and therefore less productive than students from generations that did not experience a similar gap in learning.[21] Furthermore, if other countries

Exhibit 4

Loss of learning leads to loss of earning.

Average annualized earnings loss, scenario 2, $ billion

Dropout
Learning loss



	Overall	White	Black	Hispanic	Low income
Estimated effect of learning loss					
Number of students affected, million	55.3	27.1	8.3	14.3	11.8
Average annual earnings lost, $	1,785	1,348	2,186	1,809	1,642
Average lifetime earnings lost, %[1]	2.2	1.6	3.3	3.0	4.0
Estimated effect of higher number of dropouts					
Average number of high-school dropouts, thousand	648	263	114	233	NA
Average annual earnings lost, $[2]	17,218	10,951	11,879	9,280	NA
Average lifetime earnings lost, %[1]	21.2	13.2	18.1	15.2	NA

[1] Assumes 40-year work life with average salary in 2020 dollars, using 2% inflation and 4.4% wage growth rate, average estimate.
[2] Individual earnings on average over a career of 40 years., average estimate.

Source: Bureau of Labor Statistics; Brookings Institute; National Center for Education Statistics; National Center for Children in Poverty

[20] Using projected learning loss onto the National Assessment of Education Progress and its relationship with the country's GDP and earnings. In addition, in all calculations below, we have accounted for the effects of an economic recession on academic outcomes.

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mitigate the impact of lost learning and the United States does not, this will harm US competitiveness. By 2040, most of the current K–12 cohort will be in the workforce. We estimate a GDP loss of $173 billion to $271 billion a year—a 0.8 to 1.3 percent hit (Exhibit 5).[22]

A call to action

These numbers are sobering—but they are not inevitable. If the United States acts quickly and effectively, it may avoid the worst possible outcomes. But if there is a delay or a lack of commitment, COVID-19 could end up worsening existing inequities.

It is therefore urgent to intervene immediately to support vulnerable students. Many students will continue to take advantage of free learning resources, but school systems must also think creatively about how to encourage ongoing learning over the summer. Initiatives might include expanding existing summer-school programs, working with agencies that run summer camps and youth programs so that they add academics to their activities, and enlisting corporations to identify and train volunteer tutors. Tennessee, for example, is recruiting 1,000 college students to tutor kids falling behind. New York will be conducting remote summer school for 177,700 students (compared with 44,000 in 2019). Some districts are making digital summer learning available (though optional) to all students.

The necessity of continued remote learning cannot be an excuse for inaction or indifference. There are examples of high-quality online education, and reaching this level should be the general expectation. While no one knows exactly what level of in-class learning will be possible for the 2020–21 school year, many students will probably need to stay home for at least part of it. Educators need to use the summer to learn how to make instruction more effective, whatever the scenario.

Achieving this goal will make it necessary to provide teachers with resources that show them how they can make virtual engagement and instruction effective and to train them in remote-learning best practices. It will also be necessary to work with parents to help create a good learning environment at home, to call upon social and mental-health services so that students can cope with the pandemic's stresses, and to ensure that all students

Exhibit 5

The educational losses caused by COVID-19 could hurt long-term GDP growth.

Estimated impact, by scenario

	Learning loss, months	**Number of additional high-school dropouts,** thousand	**GDP loss by 2040,** $ billion	**Annual earnings loss,** $ billion
Scenario 1: In-classroom instruction[1] resumes by fall 2020	3.1	232	80–125	44–57
Scenario 2: In-classroom instruction[1] resumes by Jan 2021	6.8	648	173–271	96–124
Scenario 3: In-classroom instruction[1] resumes by fall 2021	12.4	1,100	306–483	169–221

[1] Or instruction as effective as in-classroom instruction.

[21] Similar effects have been noted for other generations that experienced major learning disruptions. For example, several studies have shown long-term earnings implications for students whose learning was disrupted during World War II.
[22] Using Hanushek and Woessman 2008 methodology to map national per capita growth associated with decrease in academic achievement, then adding additional impact of COVID drop-outs on GDP.

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have the infrastructure (such as laptops, tablets, and good broadband) needed for remote learning.

As a blend of remote and in-classroom learning becomes possible, more flexible staffing models will be required, along with a clear understanding of which activities to prioritize for in-classroom instruction, identification of the students who most need it, and the flexibility to switch between different teaching methods. And all this must be done while school systems keep the most vulnerable students top of mind. That may require investment—something that cannot be taken for granted if state and local government budgets are cut.

The US academic-achievement gap was first identified in 1966. Its persistence is troubling. The possibility that COVID-19 could make it worse deserves focused attention. The achievement gap costs the United States hundreds of billions of dollars—and also exacts a long-term cost in social cohesion. This is a moment—and a challenge—that calls for urgency and energy.

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The authors wish to thank Priyanka Agrawal, Justice Tention-Palmer, and Josh Williams for their contributions to this article.

Designed by Global Editorial Services

EXHIBIT 18

Interim Considerations for Testing for K-12 School Administrators and Public Health Officials

Updated Dec. 4, 2020 Print

These interim considerations are based on what is currently known about COVID-19 as of the date of posting, October 11, 2020. These considerations are for testing in school settings and are intended for K-12 school administrators working in collaboration with their state, tribal, local, and territorial (STLT) public health officials. While these considerations were developed with public schools, including charter schools, in mind, private schools may also find these considerations useful.

These considerations are meant to supplement—**not replace**—any federal, state, tribal, territorial, or local health and safety or privacy laws, rules, regulations, and policies with which schools must comply. The decision to implement testing in schools should be guided by what is feasible, practical, and acceptable. If antigen testing is used, it should be tailored to each community's needs.

This considerations document does not dictate the determination of payment decisions or insurance coverage of such testing, except as may be otherwise referenced (or prescribed) by another entity or federal or state agency. U.S. Centers for Disease Control and Prevention (CDC) has no regulatory authority over testing; therefore, this document is intended to assist STLT public health officials and K-12 school officials in making decisions rather than establishing any regulatory requirements.

CDC will update these considerations as needed and as additional information becomes available. Please check CDC website periodically for updated interim guidance.

Summary of Changes

Revisions made on October 21, 2020

- Added links to the updated close contact definition.
- Updated language to align with updated definition.

With the increased availability of tests, these considerations are intended to provide guidance on the appropriate use of testing for SARS-CoV-2 (the virus that causes COVID-19) in K-12 schools for surveillance, diagnosis, screening, or outbreak response. Schools can help protect students and their families, teachers, staff, and the broader community and slow the spread of COVID-19. Testing to diagnose COVID-19 is part of a comprehensive strategy and should be used in conjunction with promoting behaviors that reduce spread (e.g., mask use, social distancing, hand hygiene); maintaining healthy environments (e.g., cleaning and disinfection, ventilation); maintaining healthy operations (e.g., scheduling, virtual learning, class sizes); and preparing for when someone gets sick. If an outbreak occurs, schools should immediately notify STLT public health officials. STLT officials will then work closely with school administrators to scale up testing, identify contacts and initiate contact tracing, and determine who will need to be quarantined and isolated.

Schools should work with STLT public health officials to decide and how to use testing. K-12 schools operated by the federal government (e.g., for Department of Defense Education Activity (DoDEA), which operates K-12 schools for DoD Dependents) should collaborate with federal health officials. In addition to state and local laws, school administrators should follow guidance from the Equal Employment Opportunity Commission when offering testing to faculty, staff, and students who

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are employed by the K-12 school. Schools also should follow guidance from the U.S. Department of Education on the Family Educational Rights and Privacy Act (FERPA) and the Health Insurance Portability and Accountability Act (HIPAA) and FERPA and COVID-19 and their applicability to students and COVID-19 contact tracing and testing.

Types of tests to identify SARS-CoV-2, the virus that causes COVID-19

Table 1 summarizes the main types and characteristics of tests used to diagnose current SARS-CoV-2 infection, the virus that causes COVID-19. Additional information can be found on CDC's SARS-CoV-2 testing pages. Throughout this document, "testing" refers to viral testing for potential infection. Tests used to show past SARS-CoV-2 infection (i.e., antibody tests) are not included in this document. CDC does not currently recommend using antibody testing as the sole basis for diagnosis of current infection. For more information the Food and Drug Administration (FDA) has provided FAQs on testing for COVID-19 .

Table 1: Types of COVID-19 tests currently available to diagnose current infection

	Viral Tests	
	Molecular Tests	Antigen Tests
How is the sample taken?	Nasal or throat swab (most tests); saliva or sputum test (a few tests)	Nasal or throat swab
What does it test?	Diagnose current SARS-CoV-2 infection by detecting viral genetic material (Nucleic acid amplification tests (NAAT), including real-time reverse-transcriptase Polymerase chain reaction (RT-PCR).	Diagnose current SARS-CoV-2 infection by detecting viral proteins.
How are the results used?	Help public health officials identify and recommend isolation for people with active infection in order to minimize COVID-19 transmission.	Help public health officials identify and recommend isolation for people with active infection in order to minimize COVID-19 transmission.
Who administers test?	Nasal or throat swab can be self-collected in the company of a health professional or can be collected by a health professional. Test must be performed by trained staff in a Clinical Laboratory Improvement Amendments (CLIA)-certified laboratory or point-of-care testing site operating under certificate of waiver.	Test must be administered by trained staff associated with CLIA-certified laboratory or point-of-care site that has a certificate of waiver.
Other information	Considered the gold standard for COVID-19 detection and are typically performed in a specialized laboratory. A few molecular tests have been authorized for and have data supporting use in asymptomatic individuals. Some molecular tests can be performed at or near the point of care.	May be more likely to miss a current infection than molecular tests such as RT-PCR. Currently, there are not enough data to know if using antigen tests is effective for people with COVID-19 who do not have symptoms. Performed at or near the point of care.
How long does it take to get results?	1 to 3 days	Approximately 15 minutes

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*Table adapted from U.S Food & Drug Administration Table

School-based testing should NEVER be conducted without consent from a parent or legal guardian (for minor students) or from the individual him or herself (for adults). Assent may also be considered for minor students.

When testing might be performed

Schools can play an important role in assisting public health officials in identifying teachers, staff, or students who have COVID-19 symptoms or who had recent close contact (within 6 feet for a total of 15 minutes or more) with someone with COVID-19. If the school is experiencing an outbreak, the school should immediately notify public health officials and collaborate to facilitate increased testing and contact tracing, as necessary. School administrators working in close collaboration with public health officials might choose to test students, teachers, or staff for purposes of surveillance, diagnosis, screening, or in the context of an outbreak and public health consultation.

- School-based testing may be considered for:
  - People in a school setting who show signs or symptoms consistent with COVID-19 while at school.
  - Schools in a community where public health officials are recommending expanded testing on a voluntary basis including testing of a sample of asymptomatic individuals, especially in areas of moderate to high community transmission.
- Public health officials may consider providing testing for people who, for example:
  - Have a recent known or suspected exposure to a person with laboratory-confirmed COVID-19.
  - Have been asked or referred to get testing by their healthcare provider or health department.
  - Are part of a cohort for whom testing is recommended (e.g., in the context of an outbreak).

When testing is not recommended?

If a school is implementing a testing strategy, testing should be offered on a voluntary basis. It is unethical and illegal to test someone who does not want to be tested, including students whose parents or guardians do not want them to be tested. It is **not** recommended to retest individuals who have tested positive and do not have symptoms for COVID-19 for up to 3 months from their last positive test. Data currently suggest that some individuals test persistently positive due to residual virus material but are unlikely to be infectious. Parents or guardians may request documentation from their health care provider to indicate the date and type of the student's most recent COVID-19 test.

Which schools and persons should be prioritized for school-based testing?

Health departments and school districts can work together to develop a strategy for prioritizing K-12 schools, depending on resources and goals, for school-based testing.

There are three levels of decision-making when it comes to selecting school-based testing:

- Which schools?
- Which persons in those schools?
- Which strategies?

Which schools?

Schools that have opened for any in-person classes (including hybrid, which includes combination of in-person and virtual classes) can benefit from developing a testing strategy. CDC's Indicators for Dynamic School Decision-Making can be used to determine which schools may provide the best settings for school-based testing.

Schools in communities disproportionately affected or that lack access to testing

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Public health officials and school administrators may consider placing a higher priority for testing in schools that serve populations experiencing a disproportionate burden of COVID-19 cases or severe disease. These may include:

- Schools with moderate or large proportions of racial and ethnic groups that have experienced higher rates of COVID-19 cases relative to population size.
- Schools in geographic areas with limited access to testing due to distance or lack of availability of testing.

Schools in communities with moderate, higher, and highest risk of transmission

The decision to initiate a school-based testing strategy among students, teachers, and staff should be made in consultation with the local health department. CDC recommends taking into consideration the level of community transmission and implementation of mitigation strategies when deciding on school-based testing. Testing in schools located in communities at moderate to highest risk may provide the maximum balance of testing efficiency.

Schools with an active outbreak

Classrooms or schools experiencing an active outbreak may temporarily close for in-person learning. The local health department may facilitate testing for students, teachers, and staff who are in schools with an active outbreak. The health department will also conduct contact tracing in these situations. Schools can assist by providing information to identify close contacts (e.g., class rosters, seating charts, and student emergency contact information). Health departments can use a tiered approach (Table 2) in an outbreak setting to determine which close contacts and other potentially exposed persons could be tested and either isolated or quarantined.

Which persons?

Once public health officials determine the school's risk category, public health officials working in collaboration with school administrators can prioritize which staff, teachers, and students should be offered school-based testing. Persons with symptoms for COVID-19 and close contacts of confirmed or probable COVID-19 patients should be considered the priority for testing. Asymptomatic staff, teachers and students who are not close contacts should also be considered for testing in schools where the risk of transmission is moderate to high. Table 2 shows how to prioritize testing for close contacts using a tiered approach. Schools should work collaboratively with public health officials to consider conduct testing and selection of persons for school-based testing in all levels of the suggested hierarchy.

Students, teachers, and staff with symptoms

Individuals showing symptoms of COVID-19 in schools should be prioritized for testing. People with COVID-19 can report a wide range of symptoms ranging from mild symptoms to severe illness. Symptoms may appear 2 to 14 days after exposure to the virus that causes COVID-19. Students, teachers, and staff members are encouraged to monitor themselves for symptoms. According to CDC guidance, symptoms may include:

- fever or chills
- cough
- shortness of breath or difficulty breathing
- muscle or body aches
- headache
- new loss of taste or smell
- sore throat
- congestion or runny nose
- nausea or vomiting or diarrhea

Hierarchy of testing for SARS-CoV-2 testing

Hierarchy for selection of persons for testing in schools can be as follows

1. Persons with symptoms of COVID-19
2. Persons who have had contact with someone with COVID-19 (see Table 2 for defining and identifying contacts)

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3. All students, faculty, and staff with possible exposure in the context of outbreak settings (as described in Table 2)

Defining and identifying close contacts
Table 2 provides an overview strategy for defining and identifying close contacts of individuals of positive COVID-19 cases. It describes tiers of criteria for determining close contacts. In collaboration with local public health officials, the definitions for tiers should be adapted to reflect the specific school setting and to be consistent with the health department's contact tracing strategies.

Tiered approach for SARS-CoV-2 testing of persons with possible exposure in the context of a school Screening for symptoms and testing of symptomatic persons should continue in addition to the additional testing outlined below.

- **Students, teachers, and staff in Tier1 (Table 2)**, who have a known close contact (within 6 feet for a total of 15 minutes or more) with confirmed or probable COVID-19 should be tested and quarantined as soon as possible to reduce the risk of further transmission. All quarantined individuals should follow existing guidance and stay home and monitor their health for 14 days after last contact with a person who has COVID-19. If possible, stay away from others, especially people who are at higher risk for getting very sick from COVID-19. The best way to protect yourself and others is to stay home for 14 days if you think you've been exposed to someone who has COVID-19. Check your local health department's website for information about options in your area to possibly shorten this quarantine period.
- **Students, teachers, and staff in Tier 2 and Tier 3 (Table 2):** Testing may be considered for these individuals based on recommendations from their healthcare provider and assessment of exposure risk or a positive symptom screen from a reputable COVID-19 screener, such as CDC's Coronavirus Self-Checker. Students, teachers, and staff in Tier 2 and Tier 3 should also be considered for testing if during contact tracing an individual is considered as a potential contact or if an individual has symptoms. When determining sequencing for testing of Tier 2 and Tier 3 individuals, schools and public health officials may consider prioritizing teachers and staff over students given the higher risk for severe disease outcomes among adults.

Table 2: Tiered approach and criteria for determination of contacts for testing

Tier 1 **Close contacts** **Highest risk of transmission***	Students, teachers, and staff who were within 6 feet apart from the individual with COVID-19 for a total of 15 minutes or more beginning 2 days before the individual with COVID-19 became symptomatic (or, for asymptomatic individuals, 2 days prior to specimen collection) until the time of isolation.** Schools should consider the following example settings in determining close contacts: • Classrooms • Lunchrooms • Athletic teams and other extracurricular activities • After-school care and other events
Tier 2 **Potential contacts** **Next highest risk of transmission**	Students, teachers, and staff in the same classroom/cohort/pod as the person with COVID-19 who always kept 6 feet distance between persons. For example, this includes individuals in the following scenarios: • Students, teachers, or staff in the same hallway, but not sharing a classroom or bathroom. • Students who took the same bus but were farther than 6 feet apart from other riders at the same time as a person with COVID-19.
Tier 3 **Potentially exposed individuals** **Lowest risk of transmission**	Students, teachers, and staff who shared a common space (e.g., teacher's lounge, library) and were not using the space at the same time as the person with COVID-19, but where short duration exposure to those with confirmed COVID-19 cannot be definitively ruled out. For example, this includes: • Students, teachers, and staff who are in-person at the school on a different schedule and in different rooms than the individual with confirmed COVID-19, but exposure cannot be definitively ruled out.

Which strategies?

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Health departments and school districts can work together to develop a strategy for prioritizing K-12 schools, depending on resources and goals, for school-based testing. Implementation of mitigation strategies (e.g., social distancing, masks, hand hygiene, enhanced cleaning and disinfection) should be implemented with all of the various testing strategies.

Testing people with symptoms: Schools should advise teachers, staff, and students to stay home if they are sick or if they have been exposed to COVID-19. Encourage these individuals to talk to their healthcare provider about getting testing for COVID-19 in a healthcare or public health facility.

If a teacher, staff, or student becomes sick at school or reports a new COVID-19 diagnosis, schools should follow the steps of the new COVID-19 Diagnosis flowchart on what to do next. This includes notifying a student's parent or guardian, and initiating testing strategies.

- In some schools, school-based healthcare professionals (e.g., school nurses) may perform COVID-19 antigen testing in school-based health centers if they receive a Clinical Laboratory Improvement Amendments (CLIA) certificate of waiver . It is important schools-based healthcare professionals have access to, and training on the proper use of personal protective equipment (PPE).
- Not every school or school-based healthcare professional will have the resources or training to conduct testing. Public health officials should work with schools to help link students and their families, teachers, and staff to other opportunities for testing in their community.

Schools can provide options to separate students with COVID-19 symptoms or suspected or confirmed COVID-19 diagnoses by, for example, placing students in isolation room/areas until transportation can be arranged to send them home or seek emergency medical attention.

If a COVID-19 diagnosis is confirmed, schools can assist public health officials in determining which close contacts and other potentially exposed persons could be tested and either isolated for 10 days (if they have COVID-19) or quarantined for 14 days (if they are a close contact without symptoms or a negative test result; see Table 2). The best way to protect yourself and others is to stay home for 14 days if you think you've been exposed to someone who has COVID-19. Check your local health department's website for information about options in your area to possibly shorten this quarantine period.

- Schools should make a communication plan to notify local health officials, staff, and families immediately of any case of COVID-19 while maintaining confidentiality in accordance with the American Disabilities Act (ADA) and Family Educational Rights and Privacy Act (FERPA) or and other applicable laws and regulations.
- School administrators should work with local health officials to assess transmission levels and support contact tracing.

Note: CDC's Coronavirus Self-Checker is an interactive clinical assessment tool that will assist individuals aged 13 years and older, and parents and caregivers of children aged 2 to 12 years, in deciding when to seek testing or medical care if they suspect they or someone they know has contracted COVID-19 or has come into close contact with someone who has COVID-19.

Testing people without symptoms who are close contacts of positive COVID-19 cases: Schools can assist by providing information, where appropriate, to identify close contacts (e.g., class rosters, seating charts, and information to facilitate outreach to contacts). CDC defines close contacts as those within 6 feet of someone with known or suspected COVID-19 for at least 15 minutes, irrespective of whether the contact was wearing a mask or PPE (see Table 3). Additional factors to consider including are proximity, the duration of exposure (longer exposure time likely increases exposure risk), and whether the exposure was to a person with symptoms (e.g., coughing likely increases exposure risk). The local health department will facilitate contact tracing and testing for close contacts in coordination with parents or guardians and schools.

All persons who are identified as close contacts need to quarantine for 14 days, even if screening test results are negative, because they can still develop COVID-19 for up to 14 days after being exposed. Quarantine helps prevent spread of disease that can occur before a person knows they are sick or if they are infected with the virus without feeling symptoms. Close contacts who are in quarantine who develop symptoms should be re-tested.

Testing of persons in an outbreak setting: Classrooms or schools may temporarily suspend in-person instruction when experiencing an active outbreak. The local health department will facilitate contact tracing and testing for schools with an active outbreak. Schools can assist by providing information to identify close contact (e.g., class rosters, seating charts, and information to facilitate outreach to contacts). Persons who are close contacts of anyone confirmed or suspected of having COVID-19 should be quarantined for 14 days from their last contact. The best way to protect yourself and others is to stay

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home for 14 days if you think you've been exposed to someone who has COVID-19. Check your local health department's website for information about options in your area to possibly shorten this quarantine period. Schools in an outbreak setting can use a tiered approach (see Table 3) to determine which close contacts and other potentially exposed persons should be tested and either isolated or quarantined.

Other testing strategies:

- Repeat testing and/or expanded testing of teachers, staff, and students: In schools where the risk of transmission is moderate to high, public health officials working collaboratively with school administrators can determine the appropriateness of offering repeat testing to randomly-selected asymptomatic teachers, staff, and students at the school. Testing teachers and staff should be prioritized over students in any sampling strategy, and older students prioritized over younger students. Persons who have recovered from COVID-19 in the past 3 months should be excluded from random selection. Contact tracing should immediately begin if anyone tests positive for COVID-19. Close contacts of persons with confirmed or probable COVID-19 should be tested and either isolated for 10 days for those with COVID-19, or quarantined for 14 days. The best way to protect yourself and others is to stay home for 14 days if you think you've been exposed to someone who has COVID-19. Check your local health department's website for information about options in your area to possibly shorten this quarantine period.
- Entry testing or universal one-time testing: It is not known if testing of all staff, teachers, and students at one point in time (referred to as entry testing or universal one-time testing) provides any additional reduction in virus transmission above the key mitigation strategies recommended for schools. Currently, CDC does not have specific recommendations for entry testing of all students, teachers, and staff. However, if infrastructure is in place, and resources are available, schools can serve as a venue for health departments to offer community-based testing to teachers, staff, students and potentially their family members.

How should schools report results of school-based testing?

Every COVID-19 testing site is required to report to the appropriate state or local health officials all diagnostic and screening tests performed. Schools that use antigen testing must apply for and receive a Clinical Laboratory Improvement Amendments (CLIA) certificate of waiver, and report test results to state or local public health departments as mandated by the Coronavirus Aid, Relief, and Economic Security (CARES) Act.

In addition, school administrators should notify staff, teachers, families and/or emergency contacts or legal guardians immediately of any case of COVID-19 while maintaining confidentiality in accordance with HIPAA, ADA, FERPA, and other applicable laws and regulations. Notifications should be accessible for all students, faculty and staff, including those with disabilities or- limited English proficiency (e.g., through use of interpreters or translated materials).

Challenges of school-based testing

These challenges must be considered carefully and addressed as part of plans for school-based testing developed in collaboration with public health officials.

- Not every school system will have the resources or training (including the CLIA certificate of waiver mentioned above) to conduct school-based antigen testing. Public health officials should work with schools to help link students and their families, teachers, and staff to other opportunities for testing in their community.
- School-based testing may require a high degree of coordination and information exchange among health departments, schools, and families.
- There may also be legal factors to consider with onsite school-based testing regarding who will administer the tests, how tests will be paid for, and how results will be reported. Such legal factors include local or state laws defining the services school nurses and other school-based health professionals are permitted to provide.
- The benefits of school-based testing need to be weighed against the costs, inconvenience, and feasibility of such programs to both schools and families.
- Antigen tests usually provide results diagnosing an active SARS-CoV-2 infection faster than molecular tests, but antigen tests have a higher chance of missing an active infection even in symptomatic individuals and confirmatory molecular testing may be recommended. Although antigen tests have not be authorized for use in asymptomatic individuals, FDA and Centers for Medicare and Medicaid Services have allowed the use of these tests in situations where a rapid result is needed.

Considerations before starting ANY testing strategy:

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Considerations before starting ANY testing strategy

Before implementing testing in their schools, K-12 administrators should coordinate with public health officials to ensure there is support for this approach from students, parents, teachers, and staff and to put key elements in place:

- Dedicated infrastructure and resources to support school-based testing.
- CLIA certificate of waiver requirements to perform school-based testing.
- Mechanism to report all testing results (both positive and negative) as required by the state or local public health department.
- Plans for ensuring access to confirmatory molecular testing when needed through the state and local health department because sometimes antigen tests can give false positive results that represent errors and not true infections.
- Ways to obtain parental consent for minor students and assent/consent for the students themselves.
- Physical space to conduct testing safely and privately.
- Ability to maintain confidentiality of results and protect student privacy.

If these conditions are not in place, schools may consider a referral-based testing strategy in collaboration with public health officials.

How can schools adequately plan for testing?

School Administrators considering testing should work with public health officials to address questions related to feasibility, logistics, and ethics of school-based testing, such as the ones listed in Table 3 below.

Table 3: Questions to consider for implementing mitigation strategies to reduce transmission of COVID-19

Readiness	• Does a plan for implementing school-based testing and mitigation strategies exist? • Has the school made contact with public health officials and received consultation on the plan? • Have public health official and school administrators identified needs for adequate overall infrastructure to support the activity? • Have public health officials and school administrators ensured the schools obtained a CLIA certificate waiver ? • Who will be responsible for developing a system to report both positive and negative results to the state or local public health department? • How will test results from schools be communicated to state health departments? • How many tests will be needed? • What training is needed for teachers and other school personnel regarding how to have conversations with parents about testing results? • Are school emergency contact lists up to date?
Collection of Specimens	• Who will conduct the swabbing and testing? • Are there enough staff who are sufficiently trained in obtaining and storing specimens, how to protect themselves, and the proper use of personal protective equipment (PPE)? • Where will the specimen collection be performed? • When will specimens be collected? • What additional materials and supplies, including PPE, are needed? What quantities will be needed? • Where will the specimen collection and testing supplies, and collected specimens be stored, and temperature controlled? • What will be the protocols for cleaning and disinfection of the testing area and equipment? • How will used PPE and potential biohazard waste be disposed?

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Ethics and Feasibility	• Who will be tested and how often? • Will a testing rotation be established so that the same people are not tested every time a testing strategy randomly selects teachers, staff, or students? • Based on your supplies, how many tests can be performed over what time period? • When and how often should additional specimen collection supplies, and testing supplies and reagents, be obtained?
Consent and Harm Mitigation	• What special considerations are needed to ensure students are still able to engage in learning while they are in quarantine or isolation? • What special considerations are needed for children with special healthcare needs or are immunocompromised? • What special considerations are needed for individuals with disabilities? • What special considerations are needed for individuals with limited English proficiency? • How will parent, guardian, or caregiver consent be obtained? • How will student consent or assent be obtained? • How and to whom will test results be provided? • Are multiple emergency contacts on file and current for each student? • Who will conduct contact tracing and notify people who are determined to be a close contact? • How will student and teacher privacy be addressed to minimize any potential harm? • How will stigma be addressed for students, teachers, or staff who are identified as having COVID-19 or having been tested for COVID-19? • How will potential stigma be addressed for those who choose not to be tested? • What is the emotional impact of testing on children? • How can fear of or resistance to testing be reduced?

Last Updated Dec. 4, 2020

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EXHIBIT 19

Centers for Disease Control and Prevention

U.S. Public Health Service Syphilis Study at Tuskegee

The Tuskegee Timeline

This page is currently under review by CDC to ensure the content is accurate and verifiable.

The Study Begins

In 1932, the Public Health Service, working with the Tuskegee Institute, began a study to record the natural history of syphilis in hopes of justifying treatment programs for blacks. It was called the "Tuskegee Study of Untreated Syphilis in the Negro Male."

The study initially involved 600 black men – 399 with syphilis, 201 who did not have the disease. The study was conducted without the benefit of patients' informed consent. Researchers told the men they were being treated for "bad blood," a local term used to describe several ailments, including syphilis, anemia, and fatigue. In truth, they did not receive the proper treatment needed to cure their illness. In exchange for taking part in the study, the men received free medical exams, free meals, and burial insurance. Although originally projected to last 6 months, the study actually went on for 40 years.

1895
Booker T. Washington at the Atlanta Cotton Exposition, outlines his dream for black economic development and gains support of northern philanthropists, including Julius Rosenwald (President of Sears, Roebuck and Company).

1900
Tuskegee educational experiment gains widespread support. Rosenwald Fund provides monies to develop schools, factories, businesses, and agriculture.

1915
Booker T. Washington dies; Robert Moton continues work.

1926
Health is seen as inhibiting development and major health initiative is started. Syphilis is seen as major health problem. Prevalence of 35 percent observed in reproductive age population.

1929
Aggressive treatment approach initiated with mercury and bismuth. Cure rate is less than 30 percent; treatment requires months and side effects are toxic, sometimes fatal.

"Wall Street Crash"–economic depression begins.

1931
Rosenwald Fund cuts support to development projects. Clark and Vondelehr decide to follow men left untreated due to lack of funds in order to show need for treatment program.

1932
Follow-up effort organized into study of 399 men with syphilis and 201 without. The men would be given periodic physical assessments and told they were being treated. Moton agrees to support study if "Tuskegee Institute gets its full share of the credit" and black professionals are involved (Dr. Dibble and Nurse Rivers are assigned to study).

1934
First papers suggest health effects of untreated syphilis.

Exhibit 19

What Went Wrong?

In July 1972, an Associated Press story about the Tuskegee Study caused a public outcry that led the Assistant Secretary for Health and Scientific Affairs to appoint an Ad Hoc Advisory Panel to review the study. The panel had nine members from the fields of medicine, law, religion, labor, education, health administration, and public affairs.

The panel found that the men had agreed freely to be examined and treated. However, there was no evidence that researchers had informed them of the study or its real purpose. In fact, the men had been misled and had not been given all the facts required to provide informed consent.

The men were never given adequate treatment for their disease. Even when penicillin became the drug of choice for syphilis in 1947, researchers did not offer it to the subjects. The advisory panel found nothing to show that subjects were ever given the choice of quitting the study, even when this new, highly effective treatment became widely used.

The Study Ends and Reparation Begins

The advisory panel concluded that the Tuskegee Study was "ethically unjustified"–the knowledge gained was sparse when compared with the risks the study posed for its subjects. In October 1972, the panel advised stopping the study at once. A month later, the Assistant Secretary for Health and Scientific Affairs announced the end of the Tuskegee Study.

In the summer of 1973, a class-action lawsuit was filed on behalf of the study participants and their families. In 1974, a $10 million out-of-court settlement was reached. As part of the settlement, the U.S. government promised to give lifetime medical benefits and burial services to all living participants. The Tuskegee Health Benefit Program (THBP) was established to provide these services. In 1975, wives, widows and offspring were added to the program. In 1995, the program was expanded to include health as well as medical benefits. The Centers for Disease Control and Prevention was given responsibility for the program, where it

1936
Major paper published. Study criticized because it is not known if men are being treated. Local physicians asked to assist with study and not to treat men. Decision was made to follow the men until death.

1940
Efforts made to hinder men from getting treatment ordered under the military draft effort.

1945
Penicillin accepted as treatment of choice for syphilis.

1947
USPHS establishes "Rapid Treatment Centers" to treat syphilis; men in study are not treated, but syphilis declines.

1962
Beginning in 1947, 127 black medical students are rotated through unit doing the study.

1968
Concern raised about ethics of study by Peter Buxtun and others.

1969
CDC reaffirms need for study and gains local medical societies' support (AMA and NMA chapters officially support continuation of study).

1972
First news articles condemn studies.

Study ends.

1973
Congress holds hearings and a class-action lawsuit is filed on behalf of the study participants.

1974
A $10 million out-of-court settlement is reached.

The U.S. government also promised to give lifetime medical benefits and burial services to all living participants; the Tuskegee Health Benefit Program (THBP) was established to provide these services.

1975
Wives, widows and offspring were added to the program.

1995
The program was expanded to include health as well as medical benefits.

1997
On May 16th President Clinton apologizes on behalf of the Nation.

Exhibit 19

remains today in the National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention. The last study participant died in January 2004. The last widow receiving THBP benefits died in January 2009. There are 11 offspring currently receiving medical and health benefits.

the Nation.

1999
Tuskegee University National Center for Bioethics in Research and Health Care hosts 1st Annual Commemoration of the Presidential Apology.

2001
President's Council on Bioethics was established.

2004
CDC funds 10 million dollar cooperative agreement to continue work at Tuskegee University National Center for Bioethics in Research and Health Care.

2004
The last U.S. Public Health Service Syphilis Study at Tuskegee participant dies on January 16.

2006
Tuskegee University holds formal opening of Bioethics Center.

2007
CDC hosts Commemorating and Transforming the Legacy of the United States Public Health Service (USPHS) Syphilis Study at Tuskegee.

2009
The last widow receiving THBP benefits dies on January 27.

Exhibit 19

EXHIBIT 20

J Med Virol. 2020 Jul 14 : 10.1002/jmv.26228. PMCID: PMC7361438

doi: 10.1002/jmv.26228 [Epub ahead of print] PMID: 32592498

Should RT-PCR be considered a gold standard in the diagnosis of COVID-19?

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Received 2020 Jun 5; Revised 2020 Jun 24; Accepted 2020 Jun 25.

To the Editor,

In reference to the comments by Dramé et al,[1] that question the possibility of whether the reverse-transcriptase polymerase chain reaction (RT-PCR) for viral load should be considered a gold standard in the diagnosis of coronavirus disease 2019 (COVID-19). They justify this doubt due to its sensitivity, which only reaches 38%, and is certainly no better than luck. However, in the cited publication by Liu et al,[2] Hainan, China, it does not specify RT-PCR sensitivity. The position is remarkably interesting, considering that in one test their ability to make a diagnosis or screen for a condition often varies in prevalence. A change in prevalence from a lower to a higher value corresponds to a change in both

Exhibit 20

sensitivity and specificity, 3 it is also the case in studies by Cassaniti et al, 4 Lombardy, Northern Italy. In neither of these studies is the prevalence reported. In Lombardy, in 18 March 2020, Cassaniti et al 5 study a total of 17 713 people tested positive for the COVID-19. Its prevalence in Italy was 238 833 confirmed cases and 34 675 mortalities as of 23 June 2020, while the prevalence worldwide was 9 289 255 recorded in data obtained from GISAID. 6

It is important to take into consideration that there are asymptomatic carriers, as well as mild, moderate, severe, and critically ill stages of coronavirus disease, COVID-19, 7 each with different clinical signs, no manifestations or manifestations, and also variations in sensitivity, specificity, and prevalence of biomarkers, for example, in patients undergoing nuclear medicine procedures in Brescia, Italy, a region of high prevalence. Imaging studies, 8 such as ^{18}F-fluorodeoxyglucose positron emission tomography/computed tomography (CT) and ^{131}I single-photon emission computed tomography/CT, have been reported to show that asymptomatic subjects evolving to COVID-19 showed a metabolically active pattern of interstitial pneumonia. In SARS-CoV-2 infections, the combination of several methods improves not only the diagnostic efficiency but also the viral carrier as proposed by Lei et al 9 with a negative CT and a positive RT-PCR. In addition, from a total of 173 patients with the SARS-CoV-2 infection studied by Zhao et al, 10 , Guangdong Province, China, 10 1 to 7 days after symptom onset 67% tested positive, and 15 to 39 days after symptom onset, 45% by RNA by RT-PCR. In addition, immunoglobulin M (IgM) antibodies were found in 29% 1 to 7 days after symptom onset and in 94% after 15 to 39 days after symptom onset. The study in the Netherlands used the severity score for community-acquired pneumonia CURB-65, (confusion, urea, respiration, blood pressure, and age), as a way of classifying the clinical stages, as low/medium risk (0-2). CT had a sensitivity of 88.3% and high risk (≥3) had 100% sensitivity, depending on low-/medium-risk pneumonia or severe risk pneumonia. 11 CT has been observed to have a very consistent sensitivity in the pneumonia stage, for example, a sensitivity of 97.2%, while RT-PCR results in 84.6%. 12 This RT-PCR may increase the positivity rate, depending on the number of repetitions of this test. This shows that different tests could be chosen at each stage of the disease. Nevertheless, the idea is that, for patients clinically suspected of COVID-19, chest CT is carried out, specific nucleic acids by RT-PCR, and IgG and IgM antibodies for SARS-CoV-2 due to the variable specificity and sensitivity of these test depending on the clinical stage and prevalence. 13

It is crucial to evaluate diagnostic accuracy studies, analytical validity, and testing for agreement in CT, RT-PCR, and antibodies tests at the different clinical stages. For the moment, whenever possible, it is more useful in clinical practice to evaluate tests by several methods because there is no generally accepted reference standard nor is there a gold test for the diagnosis of COVID-19. 14

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

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Exhibit 20

EXHIBIT 21

Parents' Bill of Rights

Each child's maximum potential can best be achieved through a partnership between parents and the education community. To foster active engagement between parents and schools, parents have certain rights and responsibilities

All Parents Have The Right to:

A Free Public School Education

Parents have the right to a free public school education for their child in a safe and supportive learning environment.

Parents have the right to:

1. a free public school education for their child, from kindergarten until age 21, or receipt of a high school diploma, whichever comes first, as provided by law;
2. an evaluation for their child with a disability and, if found to be in need of special education, receive a free, appropriate education from age 3 through age 21, in accordance with applicable laws and regulations;
3. bilingual education or English as a Second Language services, for their child with limited English proficiency, as required by law and regulations;

Exhibit 21

4. have their child receive his or her full instructional schedule in accordance with the Department of Education school year calendar;
5. have their child learn in a safe and supportive learning environment, free from discrimination, harassment, bullying, and bigotry;
6. have their child receive courtesy and respect from others and equal educational opportunities regardless of actual or perceived race, color, religion, age, creed, ethnicity, national origin, alienage, citizenship status, disability, sexual orientation, gender (sex) or weight;
7. have a child accorded all the rights set forth in the Bill of Student Rights and Responsibilities found within the New York City Department of Education's Citywide Standards of Intervention and Discipline Measures.

Access Information about Their Child

Be Actively Involved and Engaged In the Education of Their Children

File Complaints and/or Appeals Regarding Matters Affecting Their Child's Education

All Parents Are Responsible For

Parents Should Also

Translations

Parents Bill of Rights

Available in

English English

Español Spanish

中文 Chinese

বাংলা Bengali

Русский Russian

اُردُو Urdu

عربي Arabic

Kreyòl Haitian Creole

한국어 Korean

Français French

Exhibit 21

The Parents Bill of Rights is also available in Polish.

Sign the COVID testing consent form using your NYCSA account

Policies for All

Chancellor's Regulations
Discipline Code
Parents' Bill of Rights
Parents' Bill of Rights for Data Privacy and Security
Other Policies

Calendar

Thu, Dec 17, 2020

#NYCOfficeHours Virtual Town Hall

Thu, Dec 24, 2020 - Fri, Jan 01, 2021

Exhibit 21

Winter Recess: Schools Closed

Mon, Jan 04, 2021

Return from Winter Recess

Mon, Jan 18, 2021

Rev. Dr. Martin Luther King Jr. Day: Schools Closed

View Key Dates Calendar

Find a School

Exhibit 21

Transportation

School Meals

Department of Education

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Accessibility Privacy Policy Sitemap

Exhibit 21

EXHIBIT 22

Parents' Bill of Rights for Data Privacy and Security

Both state and federal laws protect the confidentiality of information about your child that identifies him or her. Such information, which includes student-specific data, is known as "personally identifiable information." Under New York state's education law, if you are a parent of a child in the New York City public school district (the DOE), you have the following rights regarding the privacy and security of your child's personally identifiable information and data.

- Your child's personally identifiable information cannot be sold or released for any commercial purposes.
- If your child is under age 18, you have the right to inspect and review the complete contents of your child's education records.
- Safeguards must be in place to protect your child's personally identifiable data when it is stored or transferred. These safeguards must meet industry standards and best practices. Examples of such safeguards include encryption, firewalls and password protection.
- You have the right to make complaints about possible breaches of student data and to have such complaints addressed.

Complaints to the NY State Education Department should be directed in writing to the:

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Chief Privacy Officer
New York State Education Department
89 Washington Avenue, Albany NY 12234
email to CPO@mail.nysed.gov.

Complaints to the DOE should be directed via email to studentprivacy@schools.nyc.gov, or in writing to the:

Office of the Chief Information Officer
Division of Instructional and Information Technology
New York City Department of Education
335 Adams Street, Brooklyn NY 11201

- You have additional rights as a parent, including additional privacy rights under federal law. They are found in the DOE Parents' Bill of Rights.

- You can also find a complete list of all of the types of student data that the New York State Education Department (SED) collects.

You may also obtain a copy of this list by writing to the Office of Information & Reporting Services, New York State Education Department, Room 863 EBA, 89 Washington Avenue, Albany, NY 12234.

Translations

Parents bill of rights data privacy and security

Available in

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Español Spanish
中文 Chinese
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Русский Russian
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