COVID-19 Evidence Update

COVID-19 Update from SAHMRI, Health Translation SA
and the Commission on Excellence and Innovation in Health

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"What is the evidence for transmission of COVID-19 in schools and what is the impact of closing schools on the transmission and the pandemic"

Executive Summary

Evidence on the likely impact of closing schools on the transmission of SARS-CoV-2 and the pandemic of COVID-19 is limited and mixed.

Studies of COVID-19 transmission (mostly peer-reviewed evidence) indicates that children are at a similar risk of infection as the adult population, that they have mostly mild symptoms or are asymptomatic, but can still transmit the virus to others.

Modelling studies (non peer-reviewed, pre-print studies) suggest that school closures may reduce transmission rates in the community, and delay the peak of the epidemic, but may not reduce the height of the peak (cases per 100,000), and that school closures would need to be implemented in conjunction with other strategies for an extended period of time in the absence of a vaccine, or other effective control strategies.

Other considerations (absence of evidence). There are other risks of school closures to be weighed against potential social distancing gains. These include the foreseeable increased demand for supervision of children and the associated impact on the health workforce, the potential impact on transmission and disease of supervision by older persons, and social harms if children are inadequately supervised and cared for.

Context

- 165 countries have closed their schools across the world, in an attempt to minimise the impact of COVID–19 (1).
- Notably: closures are in place in South Korea (for review 23 March) and Hong Kong (for review 20 April), but schools are open in Singapore (with 2 weeks of holidays in March and Taiwan after extended Chinese New Year break).
- Key factors influencing the potential of closing schools to reduce transmission and the pandemic are:
  - The rate of infection of COVID-19 by children, and whether this differs from adults
  - The rates of transmission (i) between children; and (ii) from children to adults, and whether they differ from (iii) adults to adults

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- The impact of school closures on social distancing between (a) children and other children, and (b) children and adults, including vulnerable adults
- The impact of school closures on the workforce, notably essential services such as health care
- The relatively well-established rates of serious illness experienced by children, adults and older adults with COVID-19 (not covered here).

- *Note: we refer to the virus as SARS-CoV-2 and the disease as COVID-19*

Key summary from the evidence

1. Transmission of COVID – 19

- While the evidence is still developing, numerous studies from China indicate that children can have mild and asymptomatic COVID-19 but can be vectors for virus transmission:
  - A study of 2143 paediatric cases patients in China concluded that "children at all ages were sensitive to COVID-19", though much less likely than adults to have severe symptoms (2). In this study, over 90% of paediatric patients were either asymptomatic, mild or moderate in their severity of illness. Exposure history was not collected, however, the authors suggested that children were exposed to the virus through human-to-human transmission.
  - A study of 10 cases of 2019-cCoV infection in children outside of Wuhan indicated evidence of child to parent transmission. This study suggests viral shedding can occur in children even in those with mild symptoms (3). Virus shedding was observed in the respiratory tract and faeces in the convalescent stage, however, there was no evidence of replication-competent virus in faecal swabs (4).
  - Of 1391 children tested in Wuhan's Children's hospital, 171 (12.3%) were confirmed to have SARS-CoV-2 infection; 90.1% of cases were from a family cluster, 1.2% were from contact with another suspected cases, and 8.8% had an unidentified source of infection (5). Of note, only 15.8% of the 171 child cases had an asymptomatic infection.
  - Monitoring and surveillance data from the Shenzhen CDC showed that 14.9% of household contacts contracted COVID-19 from a primary case. Children were as likely to receive a secondary COVID-19 infection as other age groups, but were less likely to have severe symptoms. Note that this area was under strict isolation conditions so the transmission rate was lower than the rate that has been observed in other populations (6).
- Three studies showed that almost all child cases originated from family clusters, but this may have been due to the limited contact children had with the outside world due to school holidays (7-9).
- A narrative review of published studies of SARS-CoV-2 infection in children in China concluded that in the emerging stage of the SARS-CoV-2 outbreak, person-to-person transmission was almost exclusively among adults. However, after mid-January 2020, the virus further spread through intrafamilial transmission, particularly to the elderly and children. Existing data indicate child cases have predominantly belonged to family clusters of cases. The authors argue that if the disease is not contained, it is likely to move to an "explosion stage" characterised by school transmission and wider community spread, with children becoming main transmitters because their infection is usually mild. The authors argue that at this explosion stage, temporary school closure may be necessary to contain the spread of infection (10).

Summary: The evidence presented above suggests that children are at a similar risk of infection as the adult population but have mostly mild symptoms or are asymptomatic but can still transmit the virus to others.

2. The potential impact of school closures on transmission rates across the community - modelling from various countries

(peer reviewed)

- Peer-reviewed modelling from Singapore, published on 23 March in The Lancet (Infectious Diseases) concluded that 'Implementing the combined intervention of quarantining infected individuals and their family members, workplace distancing, and school closure once community transmission has been detected could substantially reduce the number of SARS-CoV-2 infections'. The authors indicate that in the first instance quarantine and workplace distancing should be prioritised over school closure because at the early stage, symptomatic children have higher withdrawal rates from school than do symptomatic adults from work. The authors conclude that all interventions including school closures could and should be implemented rapidly if local secondary transmission is confirmed within Singapore to suppress increases in the national R0 (11).

(non peer reviewed)

- Modelling from Australia evaluating a range of scenarios over a 91-day period showed that case isolation in conjunction with school closures delayed the incidence and prevalence peaks but the magnitude of these peaks was similar to case isolation alone. Note that this model assumed that no social distancing was taking place. When combined with social distancing at a compliance rate of 70%, school closure did correspond with a reduction in incidence compared to social distancing (70% compliance) alone. However, school closure had minimal effect when social distancing was at 80% and 90% compliance. It is important to note that the authors reported that a resurgence of the disease would be possible once the interventions ceased in all scenarios (12).
- Modelling from France indicated that peak incidence of COVID-19 would decrease if schools were closed. Greater effects were predicted when schools were closed for 8 weeks (as opposed to shorter time frames), 25% of adults were teleworking, and the region was in a more advanced phase of the epidemic (13).
- Modelling from the UK indicated that suppression (i.e. reduce the reproduction number to below 1[1]) is the preferred approach to mitigation (i.e. lesser reduction in the rate of spread), because mitigation will not prevent overwhelming health systems. Modelling found that closing schools would be likely to contribute to suppression and that the suppression strategy would need to be maintained for as long as the virus is circulating in the population. Combining all four modelled interventions (social distancing of the entire population, case isolation, household quarantine and school and university closure) is predicted to have the largest impact (14).
- A modelling study by the US investigated which segments of the health workforce would be reduced in the event of a closure due to childcare obligations, and the subsequent impact on mortality rates. The authors argued that school closures would need to reduce cases of COVID-19 by at least 25% in order for closures to have a net reduction in mortality (15).
- A modelling study of 6 social distancing scenarios indicates that 90-day school closures (compared to and in addition to self-distancing and teleworking) may delay the peak of the epidemic substantially. However, it may also increase the height of the peak (cases per 100,000), if social distancing measures are then removed (16).
- Quantifying the effects of the control measures implemented to restrict population contacts in Wuhan, China, showed that school and workplace closures (combined, not modelled independently) drastically reduced the incidence of infection. At the time of the study, it was not known whether children were more or less infectious than adults (with both scenarios

[1] The reproduction number is the average number of secondary cases each new case generates

modelled). The modelled effects varied according to this factor, suggesting that if children were as infectious as adults restrictions would need to be in place longer, and if they were less infectious than adults, restrictions could be relaxed earlier (17).

- A Hong Kong study described the population behavioural measures they implemented and how they appear to have contained COVID-19, and also how these measures positively impacted influenza rates (reduction of transmission by 44% seen over Jan/Feb 2020, whereas 14—16% reduction seen when schools closed in 2010/11 and 2014/15 for influenza). Comparisons with COVID-19 were limited by the rate of transmission of influenza, which was significantly lower than that observed for COVID in other countries, and the unknown nature of its similarity with respect to children's susceptibility and infectiousness (18).

Note: There have also been some commentaries on potential policy approaches (non peer-reviewed), please see the appendix for more details (19-22). There is also a broad literature on school closures in the event of a disease outbreak that is not included in this review due to the evidence currently indicating important differences between these diseases and SARS-CoV2 and COVID-19.

Summary: The modelling evidence available suggests that school closures may reduce transmission rates in the community, and delay the peak of the epidemic, but may not reduce the height of the peak (cases per 100,000), and that school closures would need to be implemented in conjunction with other strategies for an extended period of time in the absence of a vaccine, or other effective control strategies.

Other considerations (evidence not found in this review)

- Closing schools may lessen, but will not eliminate, transfer of the virus between children who socialise together outside the school setting despite the new social distancing requirements. This will be dependent on social distancing in community settings.
- Closing the schools will create demand for supervision of children.
    - The impact of this on the available health workforce (e.g. nurses who may not have the financial resources to pay for home child care), is unknown, but are likely to be substantial and options should be explored.
    - The impact of increase in supervision of children by grandparents is unknown, but likely to increase the risk of exposure and illness to those older individuals and would therefore need to be discouraged.
    - Closing schools may further encourage voluntary working from home and social distancing among parents.
    - There is the potential for increased social harm if children are not adequately supervised and cared for. This is outside the scope of this review.

- Not closing schools has the potential to send mixed messages to the general community about the necessity of social/physical distancing and may undermine social norms and reduce physical distancing at the population level.

Authors: Professor Caroline Miller, Dr Jacqueline Bowden, Jo Dono

Searchers: Nikki May & Dr Ingrid Lensink (Commission on Excellence and Innovation in Health), SAHMRI Health Policy Centre

Expert input: Prof Steve Wesselingh, Prof David Lynn

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APPENDIX

Analysis and summary of studies included:

Evidence from China on Transmission

Epidemiological Characteristics of 2143 Pediatric Patients With 2019 Coronavirus Disease in China. Pediatrics.

Dong, Y., Mo, X., Hu, Y., Qi, X., Jiang, F., Jiang, Z., & Tong, S.

16 March 2020, peer reviewed

Background: A retrospective study on the epidemiological characteristics of 2142 pediatric patients with suspected or confirmed COVID-19 diagnosis, as reported to China CDC.

Key results: All ages from 1 day to 18 years were susceptible, with the median age 7 years (interquartile range: 2 to 13 years). Most were classified as mild cases (50.9%), with a further 38.8% classified as moderate and 4.4% classified as asymptomatic. Within each age group, the proportion of severe and critical cases was as follows: <1year=10.6%, 1-5 years=7.3%, 6-10 years=4.2%; 11-15 years=4.1%, 16-18 years=3%. The median days from illness onset to diagnosis was 2 days (range 0 to 42 days). The results indicate person-to-person transmission as most of the children were likely to have been exposed through family members and/or other children.

Caveats: Based on epidemiological data rather than clinical measurements; did not collect information on the child's exposure history.

A case study of children with 2019 novel coronavirus infection: clinical and epidemiological features. Clinical and Infectious diseases.

Cai et al.

28 February 2020, peer reviewed

Background: This study details 10 cases of 2019-cCoV infection in children, outside of Wuhan. The study includes 10 children with confirmed 2019-nCoV infection admitted to hospital outside of Wuhan between 19 Jan and 3 Feb 2020. Each child had lab confirmed diagnoses. 8/10 children had direct contact with infected adults with travel history to Wuhan. Household exposure occurred in 7 patients, endemic area exposure occurred in 2, and bus travelling exposure in 1. Among the 7 children exposed to adult cases, the number of secondary symptomatic cases (from the infected adult) including the child in this study, ranged from 1 to 4. Interval between exposure and symptom

onset ranged from 2 to 10 days for case exposure, and 1 to 9 days for endemic areas. No patients required oxygen, some (unclear how many - but 5 received antibiotics and 4 had lung opacities detected) had pneumonia, all discharged by 19 Feb after 2nd consecutive negative nasal swab.

Key results: There was evidence of child to parent transmission, and for potential other transmission. “Patient 7” was a 3-month old infant, whose parents developed symptomatic COVID 7 days after they looked after the baby without protection measures. Nasal swabs were undetectable within 6-22 days (mean 12 days) after illness onset. There was a noted high frequency (83.3%) of 2019-nCoV RNA detection in faeces in mild patients at 3-13 days, and prolonged virus RNA shedding in faeces for a least 2 weeks up to one month in 5 patients. Authors also note, by 22 Jan 2020 all notifiable cases of COVID and severe cases were >= 15 yrs old in Wuhan, however, children are also susceptible with mild and atypical cases largely underdiagnosed according to initial screening criteria which focused on suspected pneumonia. This study suggests viral shedding can occur in children even in those with mild symptoms. In addition to respiratory shedding (up to , faecal shedding of the virus was detected for even longer periods. Two parents also caught the infection from their 3-month old baby. Authors note that due to initial criteria used to screen for the disease, they suspect children were underdiagnosed due to being mild or atypical.

Short take out: Viral shedding can occur even in those with mild symptoms. In addition to respiratory shedding, faecal shedding of the virus was detected for even longer periods. Two parents also caught the infection from their 3-month old baby. Authors note that due to initial criteria used to screen for the disease, they suspect children were underdiagnosed due to being mild or atypical.

Caveats: This study was based on only 10 cases/children outside of the Wuhan area.

Epidemiology and Transmission of COVID-19 in Shenzhen China: Analysis of 391 cases and 1,286 of their close contacts. MedRxiv.
Bie et al.
19 March 2020, not peer reviewed (pre-print)

Background: This study used monitoring and surveillance data from the Shenzhen CDC to examine primary cases of COVID-19 (people that had travelled from Hubei) and secondary transmission of COVID-19 to their close contacts.

Key results: 14.9% of household contacts contracted COVID-19 from a primary case. Children were as likely to receive a secondary COVID-19 infection as other age groups, but were less likely to have severe symptoms.

Caveats: Cases in Shenzhen were closely monitored and isolation was strictly enforced, which likely led to a lower transmission rate than has been observed in other populations (R was 0.4 in this region, whereas it is around 2.6 overall).

Visualizing the Novel Coronavirus (COVID-19) in Children: What We Learn from Patients at Wuhan Children's Hospital

Visualizing the Novel Coronavirus (COVID-19) in Children: What We Learn from Patients at Wuhan Children's Hospital. The Lancet.
Ma, H. et al
12 March 2020, not peer reviewed (pre-print)

Background: This study (preprint) looked at 50 children with COVID-19 in Wuhan Children's Hospital from January 21 to February 14 2020.

Key results: Found that none were first-in-family to be infected and pediatric infections were mainly clustered in families - as in, the children were catching it from their families, not outside.

Caveats: Transmission route was not the focus of the study. Single site, small numbers. I believe schools were closed in Wuhan during this period.

The effect of control strategies that reduce social mixing on outcomes of the COVID-19 epidemic in Wuhan, China. medRxiv.
Kiesha Prem, Yang Liu, Timothy W Russell, Adam J Kucharski, Rosalind M Eggo, Nicholas Davies
12 March 2020, not peer reviewed

Background: Modelling on the impact of various social distancing restrictions (school closures and workplace closures) based on the experience of Wuhan.

Key results: School and workplace closures drastically reduce the incidence of infection. Without closures, infection rates for children and older persons vary greatly depending on how infectious children are. Keeping schools and workplaces closed for an extended period (i.e. through March and April) would prevent a secondary peak in cases, but only if children are considered infectious (if less infectious, it would be safe to relax school and work restrictions in April).

Caveats: School closures and workplace closures were modelled simultaneously so it is difficult to determine what the individual impact of school closures is. The true infectiousness of children is also not yet known; therefore it is difficult to quantify the role of children in spread of the virus.

Clinical characteristics of 24 asymptomatic infections with COVID-19 screened among close contacts in Nanjing, China. Science China Life Sciences

Hu et al.

4 March 2020, peer reviewed

Background: This study identified 24 asymptomatic carriers among close contacts of COVID-19 patients in Nanjing, China and describes the clinical characteristics and transmission potential of these asymptomatic infections.

Key results: Ages of asymptomatic carriers ranged from 5 to 95 years old, with median 32.5 years and 21% of cases under 15 years. 5 of the 24 cases developed some symptoms during hospitalisation, although none presented high fever; 50% showed typical findings on a chest CT scan, 21% showed atypical findings, and 29% showed normal images. The 29% of cases that showed normal images and no symptoms were younger than the other cases (median 14 year, p=0.012). The communicable period, defined as the interval from the first day of positive nucleic acid test to the first day of continuous negative tests ranged from 1 to 21 days (median 9.5 days), and there was evidence of transmission from the asymptomatic carrier to other family members in at least one case, with the infected family members developing symptoms (one severe).

Caveats: The small sample size and single study area mean these findings may not generalise. Large-scale multicentre studies are needed to verify findings.

Clinical Characteristics of COVID-19 in Children Compared with Adults Outside of Hubei Province in China. The Lancet.

Du et al.

5 March 2020, not peer reviewed (pre-print)

Background: Article presenting a retrospective analysis of 67 hospitalised cases (including 14 children) with COVID-19 in Jinan and Rizhao (that is, outside of Wuhan and Hubei province) between 23 Jan and 15 Feb.

Key results: This article found that all child cases were family clusters. However it suggested that "The reason why all children are in family clusters is that it is the traditional Chinese New Year holiday, children have less chance to have contact with the outside world, and Chinese families

always attach great importance to the protection of children." Children also had mild clinical signs and symptoms, making it easy to miss diagnosis.

Caveats: Small numbers, just two sites.

Clinical analysis of 31 cases of 2019 novel coronavirus infection in children from six provinces (autonomous region) of northern China. Zhonghua Er Ke Za Zhi
Wang et al.
2 March 2020, peer reviewed

Background: Reports epidemiological history, clinical manifestations, treatment and prognosis of 31 children with COVID-19 from six provinces in northern China. Cases were diagnosed between January 25th and February 21st.

Key results: Found that infections were mainly (90%) family cluster cases, suggesting cases in children in northern China were mainly caused by close family contact.

Caveats: Small numbers. It appears that most schools in China were shut in this period (extending from the Spring Festival break).

MODELLING FROM AUSTRALIA

Modelling transmission and control of the COVID-19 pandemic in Australia

Sheryl L. Chang, Nathan Harding, Cameron Zachreson, Oliver M. Cliff, Prokopenko M.

23 March 2020, not peer reviewed

Background: This study uses individual-based computational modelling, calibrated to key characteristics of COVID-19, to evaluate and compare several mitigation and suppression measures required to control spread in Australia. Intervention strategies that were considered included: case isolation, restriction on international arrivals, social distancing with the population compliance levels varying from no compliance to 100% compliance, and school closures (independent of social distancing).

Key results: Each scenario was traced over time against a baseline model. Assuming that no social distancing is occurring, case isolation delays the epidemic peak by just over one week and reduces the severity of the peak by about 24% (incidence peak) and 22% (prevalence peak). Adding school closures to the case isolation approach delays both peak incidence and prevalence by 15 days, but the magnitude is the same. Neither case isolation or school closures reduce the overall attack rate. With regard to social distancing, 70% compliance for 91 days delays the epidemic peak but the

disease is not controlled and will resume once social distancing measures are lifted. Social distancing with 80% and 90% compliance are more effective at suppressing prevalence and incidence during the 91-day period. Adding school closures to 70% compliance with social distancing reduces incidence, suggesting that it may "compensate" for about 10% lack of social distance compliance, but would require a longer duration than 80% or 90% compliance with social distancing.

Caveats of the study: Simulating disease transmission involved assumptions about local transmission dynamics (characteristics of the population, which was based on census data, and assumed contact rates across different social contexts) and natural disease history model (infectivity profile, which has some uncertainty regarding the reproductive number and infectivity of the asymptomatic and pre-symptomatic individuals, especially children). Modelling of school closures removes both students and teachers from school interactions but increases their interactions within households. School closure modelling is investigated separately from social distancing modelling by setting social distancing to zero, hence it does not forecast changes to possible epidemic dynamics at this stage.

MODELLING FROM FRANCE

Expected impact of school closure and telework to mitigate COVID-19 epidemic in France
Laura Di Domenico1, Giulia Pullano1,2, Pietro Coletti3, Niel Hens3,4, Vittoria Colizza1
Report #8, 14 March 2020, not peer reviewed

Background: Investigation of delaying the peak incidence by modelling various scenarios relating to school closures and teleworking. Modelling was based on three regions in France where there were more than 300 confirmed cases of COVID-19.

Key results: Peak incidence decreased when schools were closed, but there was variation in effect across a range of scenarios. Greater effects were observed when schools were closed for 8 weeks, 25% of adults were teleworking, and the region was in a more advanced phase of the epidemic.

Caveats of the study: Modelling was based on low susceptibility and moderate infectivity of children relative to adults (based on data from China); there were also assumptions made on social contact and case detection. There were differences by region due to differences in age profiles and stage of outbreak, suggesting that the results are not necessarily generalisable to other regions.

MODELLING FOR THE UK

Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. Imperial College, London.

Ferguson, N. M., Laydon, D., Nedjati-Gilani, G., Imai, N., Ainslie, K., Baguelin, M., ... & Dighe, A.

16 March 2020, not peer reviewed

Background: Modelling of different non-pharmaceutical intervention strategies for Great Britain. The two main strategies investigated were 1) suppression (reduce rate of spread to below 1) and 2) mitigation (reduce the rate of spread)

Key results: Suppression is preferred, as mitigation is unlikely to be a viable option without overwhelming health systems. Projections show that closing schools will contribute to suppression, or the reduction in reproduction number to below 1 (i.e. the average number of secondary cases each new case generates). The suppression strategy needs to be maintained for as long as the virus is circulating in the population. Combining all four interventions (social distancing of the entire population, case isolation, household quarantine and school and university closure) is predicted to have the largest impact. Not accounting for the potential adverse effect on ICU capacity due to absenteeism, school and university closure is predicted to be more effective in achieving suppression than household quarantine.

Caveats of the study: Assumed that children transmit as much as adults. Assumption of school closure scenario: Closure of all schools, 25% of universities remain open. Household contact rates for student families increase by 50% during closure. Contacts in the community increase by 25% during closure.

FURTHER MODELLING

Effectiveness of social distancing strategies for protecting a community from a pandemic with a data driven contact network based on census and real-world mobility data

Summary:

Authors: David Martín-Calvo, Alberto Aleta, Alex Pentland, Yamir Moreno, Esteban Moro
Date: March 22, 2020
Publisher: IDSS MIT / University of Zaragoza / UC3M / ISI Foundation
Peer-review: No

Background: Models the impact across against baseline of 6 social distancing scenarios in a population at 100 cases The 6 scenarios were: 1. school closures; 2. self-distancing and tele-working with (i) 50% compliance and (ii) 90% compliance; 3. Self distancing and teleworking plus school closures; 4. Restaurant, nightlife and cultural closures; 5. Non-essential workplace closures; 6. Total confinement (school and non-essential workplace closures. Social distancing scenarios are modelled for different durations of implementation up to 90 days, after which measures are presumed to be lifted. The impact on epidemic trajectory, effective reproductive number, total cases, and distribution of new infections and cases across community, households and schools are all modelled over 180 days.

Key results:90 day school closures in addition to self-distancing and teleworking (Scenario 3) may delay the peak of the epidemic substantially. However, it may also increase the height of the peak, if social instancing measures are removed.

Caveats: The study used an R0 of 1.3 (standard for Influenza like illnesses). Other modelling studies (e.g. Imperial College London used R0: 2.0-2.6. The study did not model testing or contact tracing but acknowledges their importance.

LESSONS FROM SINGAPORE

Interventions to mitigate early spread of SARS-CoV-2 in Singapore: a modelling study
Koo JR, Cook AR, Park M, Sun Y, Sun H, Lim JT, et al.
Peer reviewed
Background: A modelling study estimated the cumulative number of SARS-CoV-2 infections at 80 days, after detection of 100 cases of community transmission in Singapore using 4 scenarios.

Key results: Study authors argue that this study is the first to model the investigate the use of isolation for individuals with COVID-19 and quarantine of family members, school closures, and workplace distancing as interventions for the immediate control of COVID-19 in the event of secondary local transmission. The authors report that using an approach combining quarantine, school closures, and workplace distancing could prevent a national outbreak at low levels of infectivity and reduce the number of total infections considerably at higher levels of infectivity. Authors argue that quarantine and workplace distancing should be prioritised over school closures because symptomatic children have higher withdrawal rates from school than do symptomatic adults from work. Authors suggest that all strategies should be implemented in rapidly if/when second-generation local transmission occurs and also in countries outside of China with evidence of imported cases and evidence of local transmission.

Caveats: This is a modelling study which includes underlying assumptions including the fact that at the time of publication, the epidemiological characteristics (including the transmission and infectivity profile of the virus) were uncertain, so estimates of the time between symptom onset and admission to hospital, how infectious an individual is over time, and the asymptomatic rate were based on SARS-CoV.

Interrupting transmission of COVID-19: lessons from containment efforts in Singapore. Journal of Travel Medicine.
Lee, V. J., Chiew, C. J., & Khong, W. X.
13 March 2020, peer reviewed

Background: From Feb 5th to Feb 18th, Singapore had the highest number of cases of COVID-19 outside of China, though this was in part due to the liberal testing that was part of their containment strategy. Cases now increase steadily but not exponentially as seen in other countries. This article outlines Singapore's containment approach to COVID-19.

Key results: Singapore's aggressive approach to containing COVID-19, in essence, commenced after the SARS 2003 outbreak in preparation for future outbreaks of disease. Comprehensive surveillance and containment measures included: case tracing and quarantine including of close contacts, liberal testing, plus other measures effected in border control, health care, work places and schools, such as mass temperature checks, implementing 800 Public Health Preparedness Clinics, and instructing medical practitioners to give patients with mild respiratory symptoms up to 5 days leave. The authors advise that by enacting these measures they have enabled some normalcy of life, including schools to remain open and not enacting other major social distancing measures. They do not comment explicitly on school transmission except to say that caseness is low among younger people.

Caveats: Schools remain open in Singapore and the authors report they have not implemented other extreme social distancing measures. This has been done in the context of a comprehensive suite of surveillance and containment measures (at the individual level), some of which the authors note are resource intensive and may not be sustainable in the long term. It is unknown whether keeping schools open in isolation of other similar strategies as implemented in Singapore, would have the same outcome.

LESSONS FROM HONG KONG

Impact assessment of non-pharmaceutical interventions against COVID-19 and influenza in Hong Kong: an observational study

Cowling BJ, Ali ST, Ng TWY, Tsang TK, Li JCM, Fong MW, et al.,

16 March, not peer reviewed

Background: This study aimed to quantify population behavioural changes in Hong Kong during outbreak of COVID-19, as well as impact of health changes in public health measures on COVID-19 and Influenza (ILI). They used data on lab confirmed cases of COVID-19 from Centre for Health Protection. They also obtained ILI sentinel surveillance data from 60 general outpatient clinics from the centre for health protection, and lab surveillance data from Public Health laboratory services, including positive tests for influence and type/sub-type. Two random-digit dialling surveys were done of the general community, one 20-23 Jan, and one 11-14 (T1) Feb (T2), regarding preventive/protective behaviours against COVID-19 and attitudes. At T2 parents with school aged children were asked questions regarding child's socialising behaviour as schools were closed at this time.

Key results: As at 11th March 2020, Hong Kong had 129 cases of COVID-19: 39 imported infections, 30 unlinked infections, and 60 linked infections. Out of 129, 15 were asymptomatic, and 114 were COVID-19 confirmed cases. Schools were either on holidays or closed for the duration of this study. The Data indicate limited evidence of local transmission and no evidence of exponential rise over time. Estimated daily reproductive number (Rt) had remained below 1. The authors also looked at the impact COVID-19 restrictions appeared to have on spread of IFI during this period as compared to previous periods when only schools were closed (without other measures). They estimated a reduction in Rt to be 15% for 2010/11 and 14% for 2014/15. For the current period, the Rt was 1.28 before start of school holidays/closure and 0.72 after (estimating reduction in Rt of 44%). The authors suggest it appears the extra COVID-19 measures were having additional positive impact for ILI. Survey data indicated strong compliance with health protection restrictions (wearing face masks when out, avoiding crowded places, washing/sanitising more frequently) which increased from T1 (61-75%) to T2 (90-98%), and at T2, 79% of parents reported their children had no contact with anyone outside their household on preceding day.

Caveats: The authors acknowledge comparisons between COVID and IFI are limited depending on whether COVID-19 transmission occurs through similar modes and routes as ILI. The authors suggest that if R0 exceeds 2.0 as it did in Wuhan, a greater than 44% reduction (as seen in ILI) would be required to avert a local epidemic. But a significant reduction could still flatten the peak. The authors only make comment about the impact of the extra social distancing measures on ILI.

They comment that the role of school closures in COVID-19 would depend on susceptibility of children to infection and their infectiousness, which at the time of the study were not known. Assumptions regarding causal relationships are also limited by the observational nature of the study.

EARLY REPORTS FROM KOREA

Commentary: Are We Ready for Coronavirus Disease 2019 Arriving at Schools? Journal of Korean Medical Science

Choe, Y. J., & Choi, E. H.

23 March 2020, peer reviewed

Background: The Ministry of Education postponed the start of Korea's school year in response to COVID-19 (schools are still closed at this stage). As the number of new cases in Korea decrease, this article discusses whether schools should reopen or not.

Key results: It is challenging to make guidance on school closure because its impact on the outbreak remains unpredictable. Historical findings demonstrate a strong association between early school closure and mitigation of the US 1918-1919 influenza outbreak. Early epidemiological reports show a low frequency of COVID-19 cases and less severity among children. However, similar infection rates have been found among children and adults. Outbreaks are occurring in places where people closely interact with each other and thus transmission is likely to occur when schools open. This would trigger a second wave in the community. Opening schools is also expected to increase contact rates in the community, decreasing the effectiveness of social distancing. Four to eight weeks of school closure may be considered as part of a mitigation strategy (ref 11). Extending school closure is likely to support the overall effectiveness of social distancing and consequently aid in flattening the curve. All policy needs to be balanced between public health benefits and the significant societal consequences.

Caveats: Not independent research (commentary)

Can we contain the COVID-19 outbreak with the same measures as far SARS? The Lancet Infectious Diseases

Wilder-Smith A, Chiew CJ, Lee VJ.

5 March 2020, not peer reviewed, (opinion piece)

Background: This 'Personal View' outlines the similarities and differences between SARS and COVID-19, and argues that whether the public health measures used during SARS will be successful for COVID-19 depends more on the differences than the similarities.

Key results: There are many similarities between SARS and COVID-19 in terms of virus homology, point of origin, disease transmission, receptors, incubation time, progression for patients with severe disease. However, the epidemic trajectory looks different. COVID-19 appears to have higher transmissibility, and many more patients with mild symptoms that may contribute to the spread because these patients are not detected and thus not isolated. Public health measures used during SARS included active case detection, isolation of cases, contact tracing and quarantine of all contacts, social distancing, and community quarantine; these were successful in containing SARS. This article argues that the political and medical community should similarly persist with containment efforts at the time being, with China's efforts suggesting that containment could be feasible, however the article argues that if community transmission becomes widespread, individual-case containment may not be possible in the long-run and countries may need to move to mitigation.

Caveats: opinion piece

Children's COVID-19 risks unique, Chinese studies find.

Van Beusekom, M.

19 March 2020, not peer reviewed (news piece)

Background: This piece is a summary of Dong et al, Lu et al, and a letter not yet on the list (Wu et al, Estimating clinical severity of COVID-19 from the transmission dynamics in Wuhan, China).

Key results: The letter the article summarises outlines that those under 30 are less likely to get a symptomatic infection and less likely to die if they do become infected.

Caveats: New story of other studies

SARS-CoV-2 Infection in Children. The New England Journal of Medicine

Lu, X. et al

18 March 2020, not peer reviewed (correspondence)

Background: Evaluated children infected with SARS-CoV-2 and treated at the Wuhan Children's Hospital. Both symptomatic and asymptomatic children with known contact with persons with

confirmed or suspected SARS-CoV-2 infection were evaluated from Jan 28 to Feb 26, with clinical outcomes monitored up to 8 March 2020.

Key results: Of the 1391 children tested, 171 (12.3%) were confirmed to have SARS-CoV-2 infection. 27 patients (15.8%) did not have any symptoms of infection or radiologic features of pneumonia, and a further 12 had radiologic features but no symptoms. In contrast with infected adults, most infected children appear to have a milder clinical course. 90.1% of cases were from a family cluster, 1.2% were from contact with another suspected cases, and 8.8% had an unidentified source of infection.

Caveats: Descriptive only. Transmission patterns in particular may not generalise outside of Wuhan, where strong quarantine/lockdown measures were in place.

The Impact of School Closure for COVID-19 on the US Healthcare Workforce and the Net Mortality Effects. medRxiv.
Bayham, J., & Fenichel, E. P.
17 March 2020, not peer reviewed

Background: used US population data regarding occupation and childcare obligations to model which segments of the health workforce would be reduced in the event of a closure due to childcare obligations, and what would the subsequent impact be on mortality rates.

Key results: The authors argued that school closures would need to reduce cases of COVID-19 by at least 25% in order for closures to have a net reduction in mortality.

Caveats: the study was conducted in a US context, which has little government support for childcare, and many parameters are not yet known i.e. the transmission rate between children in schools, the transmission rate from children to other family members etc. The authors also did not consider the impact of possible transmission to the elderly by children having to be cared for by an older relative in the event of a closure.

SARS-CoV-2 infection in children: Transmission dynamics and clinical characteristics. Journal of the Formosan Medical Association.
Cao et al.
26 February 2020, peer reviewed

Background: This article provides a narrative review of published studies of SARS-CoV-2 infection in children in China.

Key results: In the emerging stage of the SARS-CoV-2 outbreak, person-to-person transmission was almost exclusively among adults, but after mid-January 2020, the virus further spread through intrafamilial transmission, particularly to the elderly and children. Child cases have predominantly belonged to family clusters of cases. The authors argue that if the disease is not contained, it is likely to move to an "explosion stage" characterised by school transmission and wider community spread, with children becoming main spreaders because their infection is usually mild. The authors argue that at this stage temporary school closure may be necessary to contain the spread of infection.

Caveats: Based on the evidence reviewed, there is little evidence that children have become significant spreaders of COVID-19, so the conclusions are somewhat speculative.