

COVID-19 Science Update

From the Office of the Chief Medical Officer, CDC COVID-19 Response, and the CDC Library, Atlanta, GA.
Intended for use by public health professionals responding to the COVID-19 pandemic.

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Epidemiology

PEER-REVIEWED

Case-fatality rate and characteristics of patients dying in relation to COVID-19 in Italy. Onder *et al.*
JAMA (March 23, 2020; [Correction](#) on April 10, 2020).

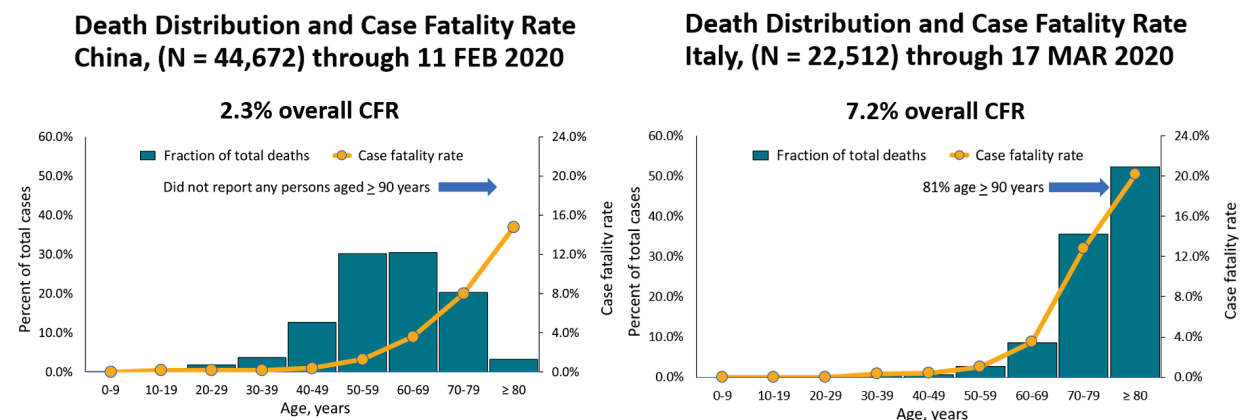
Key findings:

- COVID-19 crude case fatality rates (CFR) were higher in Italy (7.2%) than China (2.3%) (Figure 1).
- Age-stratified CFRs remained higher in Italy among persons aged ≥ 70 years (Figure 2).
- The fraction of deaths among persons aged ≥ 70 years was greater in Italy (38%) than China (12%).
- CFR differences by country:
 - Population age structure.
 - Burden of comorbidities.
 - Definition of COVID-19 deaths (i.e., attribution of death to COVID-19).
 - Testing strategies (e.g., In Italy, testing focused on severely symptomatic patients).

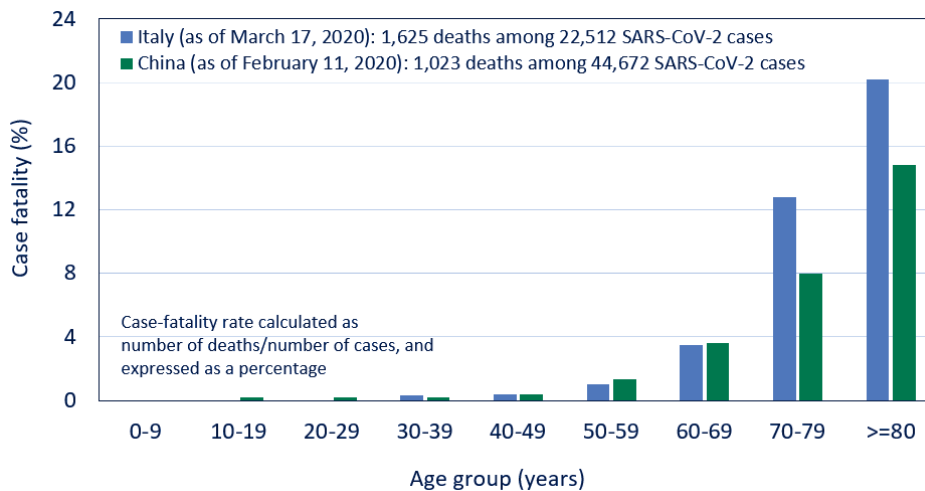
Methods: Comparison of crude and age-stratified CFRs among COVID-19 cases in Italy ($n = 1,625$ deaths through March 17, 2020) and China ($n = 1,023$ deaths through February 11, 2020). **Limitations:** China did not report data for persons ≥ 90 years.

Implications: Population age structure and comorbidities need to be considered when assessing CFRs. Standardized testing and case reporting practices can help increase the utility of CFR comparisons between countries.

Figure 1



Note: Adapted from Zhang *et al.* ([Vital Surveillances: The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases \(COVID-19\) — China, 2020](#); China CDC Weekly Reports) and from Onder *et al.* Reproduced with permission from JAMA doi:10.1001/jama.2020.4683. Copyright©2020 American Medical Association. All rights reserved.

Figure 2

Note: Adapted from Onder *et al.* Case fatality rate by age group in Italy and China. Reproduced with permission from JAMA doi:10.1001/jama.2020.4683. Copyright©2020 American Medical Association. All rights reserved.

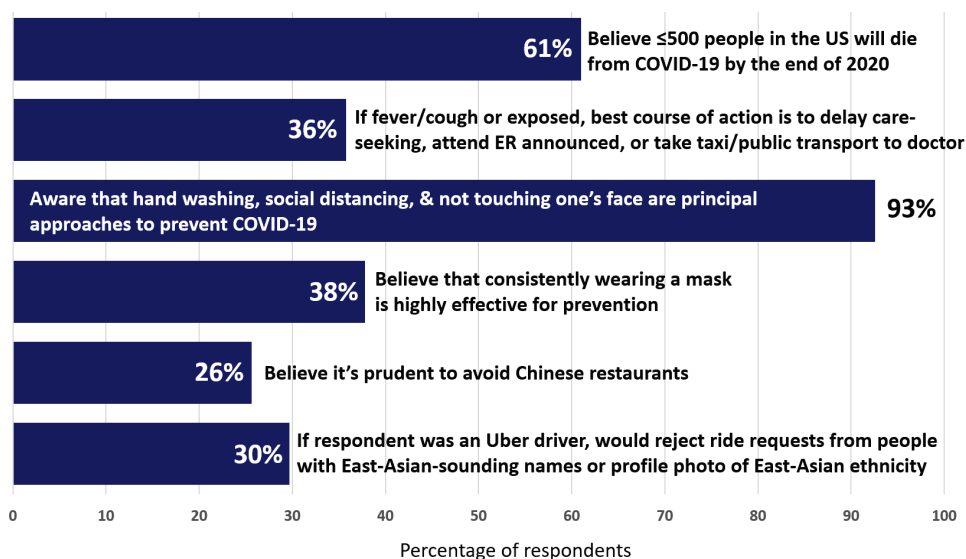
Knowledge and perceptions of COVID-19 among the general public in the United States and United Kingdom: A cross-sectional online survey. Geldsetzer. *Annals of Internal Medicine* (March 20, 2020).

Key findings:

- Underestimation of the death toll: 61% of US respondents thought estimated deaths at ≤500 in 2020.
- Correct identification of prevention approaches: 93% identified washing hands, social distancing, avoiding touching one's face (Figure).
- Some prejudicial beliefs identified: about 30% would avoid Chinese restaurants, or reject Uber customers with East-Asian names or profile pictures

Methods: Cross-sectional online survey among 2,986 US and 2,988 UK adults, February 23 to March 2, 2020.

Implications: US adults have strong understanding of prevention measures, but poor understanding of the likely death toll, which may limit cooperation with restrictions. Efforts to combat biases may be warranted.

Figure:

Note: Adapted from Geldsetzer, P. Available via American College of Physicians Public Health Emergency Collection through PubMed Central.

Modeling & Transmission

PEER-REVIEWED

Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV-2). Li *et al.* Science (March 16, 2020).

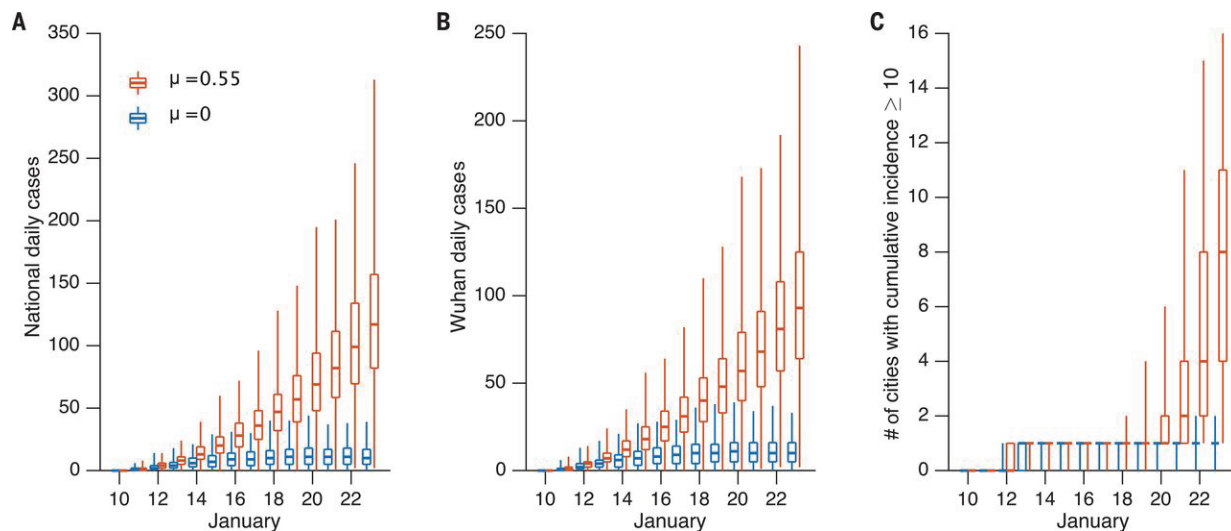
Key Findings:

- Before emplacement of travel restrictions in China on January 23, 2020, model suggests 86% of COVID-19 infections were among “undocumented” (i.e., undiagnosed) persons who were infectious but had very mild or asymptomatic illness and this went unrecognized.
- Modeling suggests asymptotically infected persons were half as contagious as persons with clinical (documented) illness but were the source of 79% of documented cases.
- During travel restrictions, the fraction of undocumented infections declined to 35%.

Methods: Modeled prevalence and contagiousness of undocumented COVID-19 across China. Sensitivity analyses conducted.

Implications: Contagious infections among persons with no or little evident illness facilitated spread of COVID-19 within China, which reinforces the value of testing and social distancing as prevention measures.

Figure:



Note: From Li *et al.* Simulated outbreak spread under two scenarios with differing transmission rates (μ) showing estimated case counts and credible 95% CIs: **RED** evolution of cases in a hypothetical outbreak using estimated per-individual infectiousness for “undocumented” persons with $\mu = 0.55$, and **BLUE** the same hypothetical outbreak but undocumented infections are not contagious with $\mu = 0$. (A) Daily documented cases in all cities. (B) Daily documented cases in Wuhan city. (C) Number of cities with ≥ 10 cumulative documented cases. Licensed under CC-BY 4.0.

Clinical Treatment & Management

PEER-REVIEWED

[Possible vertical transmission of SARS-CoV-2 from an infected mother to her newborn.](#) Dong *et al.* JAMA (March 26, 2020).

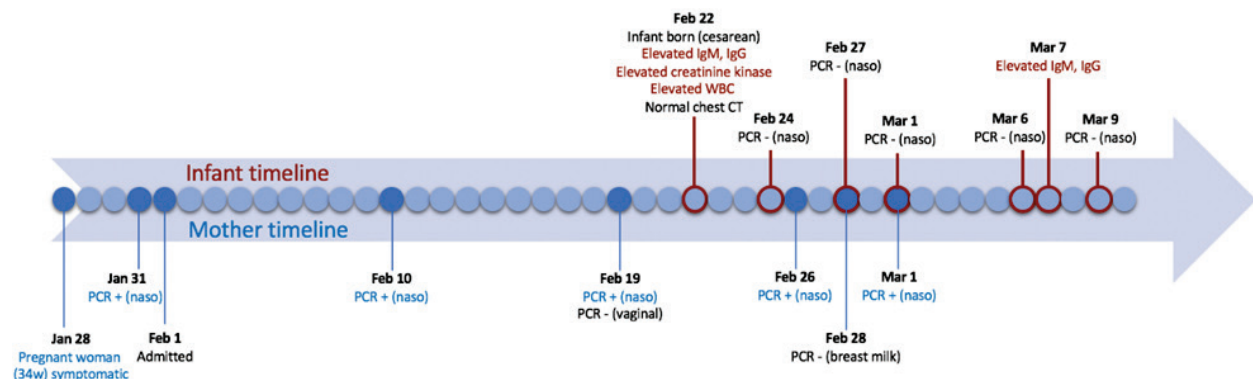
Key Findings:

- An infant born by caesarian section to a mother with COVID-19 exhibited elevated anti-SARS-CoV-2 IgM antibodies (NB: IgM is not transferrable to fetus via placenta) two hours post-delivery (Figure).
- Mother's vaginal secretions at delivery and breast milk were negative for SARS-CoV-2 RNA.
- Infant had serial negative tests for SARS-CoV-2 RNA by NP swabs and a normal chest CT.

Methods: Case report from Renmin Hospital, in Wuhan, China. Mother and infant underwent chest CT. NP swabs tested by RT-PCR. **Limitations:** IgM assays can be falsely positive in infants (IgM values declined in this report seemingly more rapidly than expected, see [commentary](#)).

Implications: Consistent with [existing published data](#), there continues to be no evidence of perinatal SARS-CoV-2 transmission.

Figure:



Note: Adapted from Dong *et al.* Shows a timeline of clinical findings for the mother (bottom, blue) and infant (top, red). Text “naso” refers to nasopharyngeal. Reproduced with permission from JAMA doi:10.1001/jama.2020.4621. Copyright©2020 American Medical Association. All rights reserved.

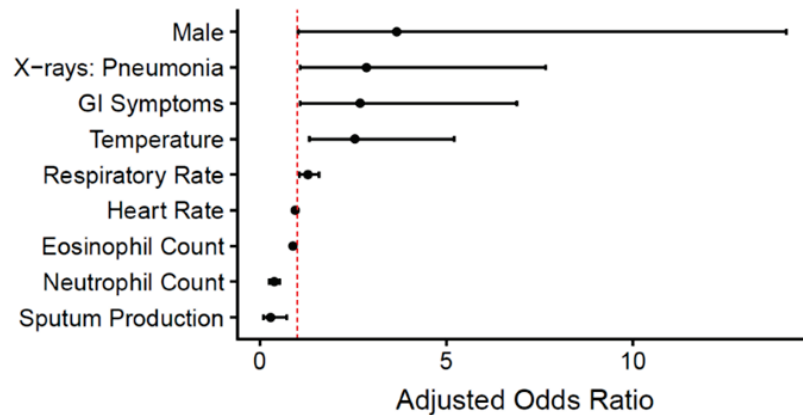
[Epidemiological and clinical predictors of COVID-19.](#) Sun *et al.* Clinical Infectious Diseases (March 25, 2020).

Key Findings:

- Several clinical factors derived from readily available clinical data were associated with lab-confirmed COVID-19 among patients presenting for care (Figure).
- Predictive models performed well (AUC ≥ 0.88) with parsimonious sets of these clinical covariates.

Methods: Multivariable logistic regressions predicted individual risk of SARS-CoV-2 infection in Singapore during January 26 to February 16, 2020 ($n = 788$, with $n = 54$ lab-confirmed COVID-19 cases). **Limitations:** Definitions lacking for “significant” heart rate and respiratory rate; lab values and ranges not described.

Implications: Readily available clinical data may help identify persons with COVID-19 when they present to care and before testing. Further refinement of this approach may improve rapid and accurate triage.

Figure:

Note: Adapted from Sun *et al.* Figure shows AORs with 95% CIs for key covariates of Model 2, which predicted positive COVID-19 cases using only demographic data, clinical findings, and laboratory test results as covariates (AUC 0.88 95% CI, 0.83-0.93).

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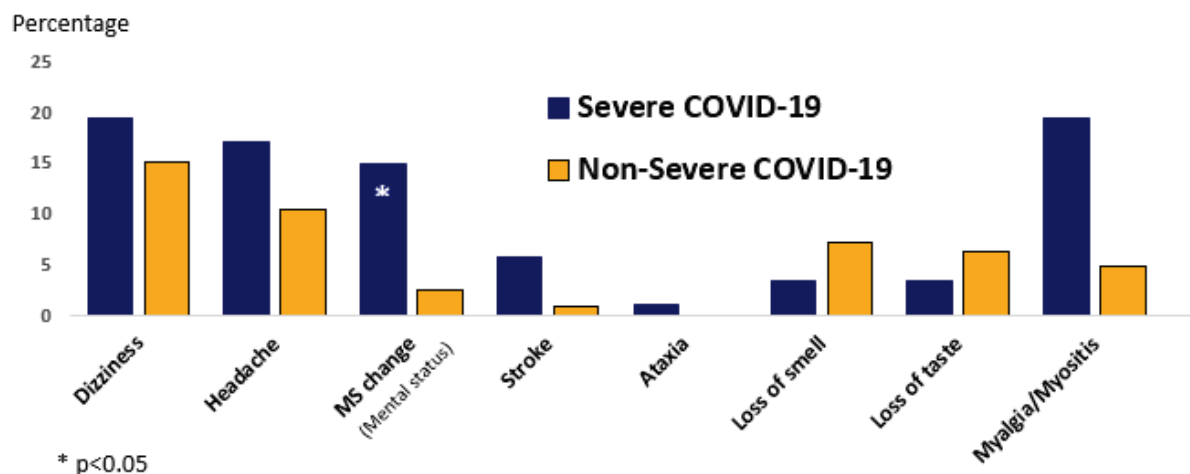
Neurological manifestations of hospitalized patients with COVID-19 in Wuhan, China: A retrospective case series study. Mao *et al.* JAMA Neurology (April 10, 2020).

Key findings:

- Among hospitalized adults with COVID-19, 36% had neurological symptoms or myositis.
- Among those with severe COVID-19, 5%–20% had mental status changes, stroke, or myositis.

Methods: Case series of 214 hospitalized adults with lab-confirmed COVID-19 in three hospitals in Wuhan, China; 41% had severe illness (January 15 to February 19, 2020).

Implications: The high prevalence of neurologic conditions among hospitalized COVID-19 patients may warrant post-hospitalization needs for physical rehabilitation and skilled nursing.

Figure:

Note: Adapted from Mao *et al.* Nervous system symptoms among patients with COVID-19. Reproduced with permission from JAMA Neurol. doi:10.1001/jamaneurol.2020.1127. Copyright©2020 American Medical Association. All rights reserved.

Laboratory Science

PEER-REVIEWED

Temporal profiles of viral load in posterior oropharyngeal saliva samples and serum antibody responses during infection by SARS-CoV-2: An observational cohort study. To *et al.* Lancet Infectious Diseases (March 23, 2020).

Key Findings:

- Patient-collected saliva (“posterior oropharynx”, PO) demonstrated highest viral load (VL) at symptom onset (5.2 log₁₀ copies per mL at presentation) and then declined steadily thereafter (Figure 1).
- RNA was detected in PO samples ≥20 days after symptom onset in one-third of survivors.
- Peak VL levels tended to be higher among older patients (Figure 2).

Methods: 23 patients with lab-confirmed COVID-19 in Hong Kong with self-collected first morning “deep throat” saliva samples by clearing throat and expectorating under nurse supervision.

Implications: Self-collected oropharyngeal saliva samples may be feasible and more acceptable. High VL at illness onset is consistent with other reports. Older persons may be more infectious than younger persons.

Figure 1

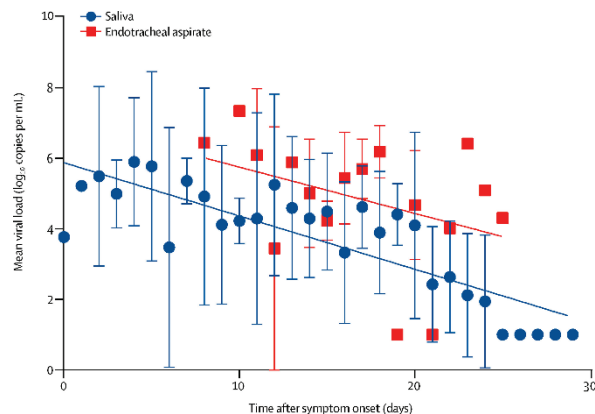
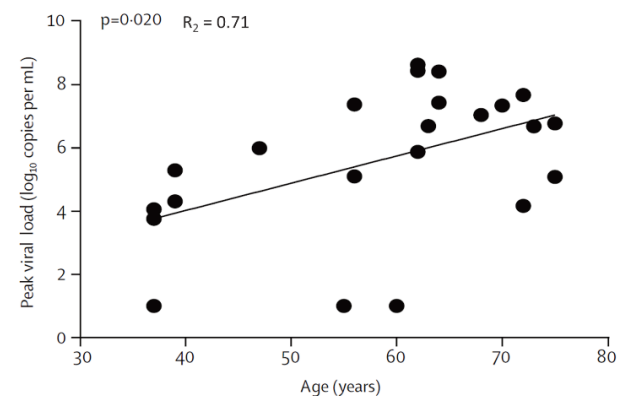


Figure 2



Note: Adapted from To *et al.* **Figure 1.** Temporal profile of serial viral load for all patients (n = 23). **Figure 2.** Correlation between peak viral load and age. This article was published in Lancet Infectious Diseases, Volume 20, Issue 5, To *et al.*, Temporal profiles of viral load in posterior oropharyngeal saliva samples and serum antibody responses during infection by SARS-CoV-2: An observational cohort study, P565-574, Copyright Elsevier 2020. This article is currently available at the Elsevier COVID-19 resource center:

<https://www.elsevier.com/connect/coronavirus-information-center>.

Characteristics of pediatric SARS-CoV-2 infection and potential evidence for persistent fecal viral shedding. Xu *et al.* Nature Medicine (March 13, 2020).

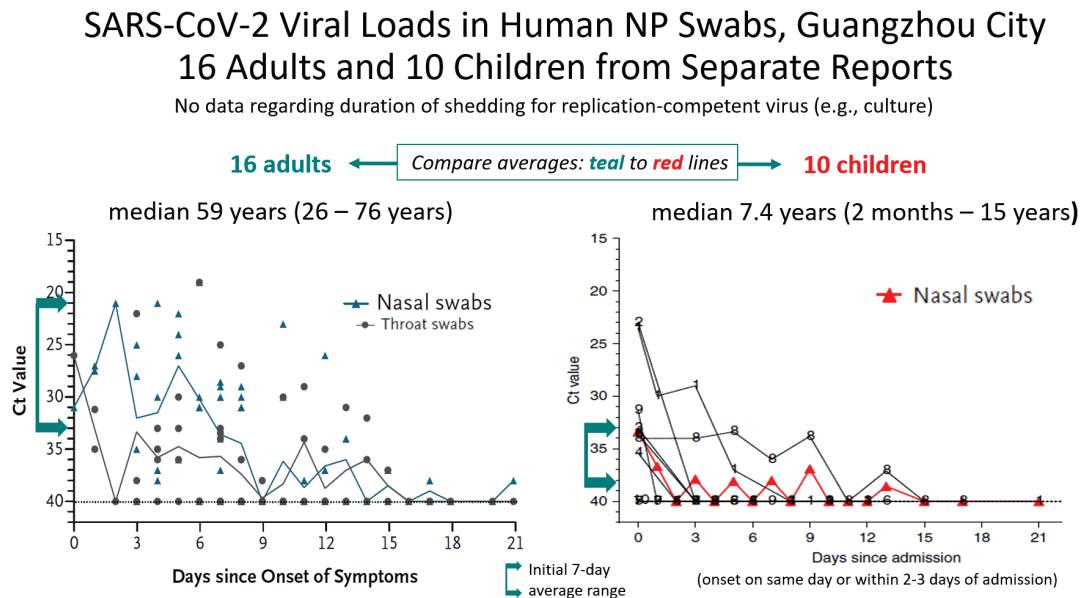
Key findings:

- Among 10 children with lab-confirmed SARS-CoV-2 infection with relatively mild symptoms and few laboratory abnormalities, Ct values in serial NP swabs were lower than among a sample of 16 adult residents from the same city (Guangzhou).

Methods: Case series of hospitalized children identified through screening of contacts. **Limitations:** Small convenience sample; viral cultures not performed.

Implications: Children may have lower SARS-CoV-2 viral burden in nasopharynx after illness onset and during illness, and thereby be less infectious than adults.

Figure:



Note: Adapted from Zou *et al.* ([SARS-CoV-2 viral load in upper respiratory specimens of infected patients](#), NEJM) and Xu *et al.* Zou *et al.* available from NEJM 2020; 382:1177-1179. DOI: 10.1056/NEJMc2001737. Copyright © 2020 Massachusetts Medical Society. Reprinted with permission from Massachusetts Medical Society. Xu *et al.* available via Nature Public Health Emergency Collection through PubMed Central.

In Brief

- Lurie *et al.* [Developing COVID-19 vaccines at pandemic speed](#). NEJM. On developing a vaccine for COVID-19 at “pandemic” speed compared with traditional vaccine development paradigm.
- Dong *et al.* [Public mental health crisis during COVID-19 pandemic, China](#). Emerging Infectious Diseases. On the importance of including emergency psychological crisis interventions during (COVID-19) pandemic preparedness & response.
- Day M. [COVID-19: Identifying and isolating asymptomatic people helped eliminate virus in Italian village](#). BMJ. Universal and repeat testing along with implementation of quarantine/isolation of positive cases (including 50%-75% of asymptomatic persons) reduced transmission in a completely isolated village of 3000 people in northern Italy.

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