



The role of children as amplifiers of COVID-19 transmission

Disclaimer:

This *Quick Response Report* was published on May 4, 2020. Given the rapidly changing nature of the coronavirus pandemic, some of the references included in this report may quickly become out-of-date. We further caution readers that researchers at the Newfoundland & Labrador Centre for Applied Health Research are not experts on infectious diseases and are relaying work produced by others. This report has been produced quickly and it is not exhaustive, nor have the included studies been critically appraised.

Original Inquiry

What is the role of children as amplifiers in the transmission of Covid-19?

Summary

The majority of evidence that we found included guidance documents, other reviews and primary studies. We also found 3 systematic reviews, 5 expert commentaries/editorials and 2 news articles. Our findings are summarized below.

Guidance

ECDC. **Rapid Risk Assessment: Coronavirus disease 2019 (COVID-19) in the EU/EEA and the UK–ninth update** [Internet]. European Centre for Disease Prevention and Control. Apr 23, 2020.

[\(LINK\)](#)

- “...When deciding which measures can be lifted first, choose those measures targeted to specific age groups where evidence shows continued limited disease transmission is less likely to result in major public health impact. So far, this may apply only to children younger than 10 years of age (who are not also members of high-risk groups), although there are still limited data on the role of children in transmitting the disease.”

Johns Hopkins (Paul Auwaeter). **Coronavirus COVID-19 (SARS-CoV-2)**. Johns Hopkins ABX Guide. Updated Apr 27, 2020. [\(LINK\)](#)

- “Children and intrafamilial spread appear to be a growing means of transmission.”

BC Centre for Disease Control. **Caring for children with COVID-19**. April 3, 2020. [\(LINK\)](#)

- “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.”

- “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.”
- “More research is needed to fully characterize infection, transmission and COVID-19 disease in children.”

World Health Organization. **Q&A on coronaviruses (COVID-19)**. April 17, 2020. ([LINK](#))

- Note “This Q&A will be updated as more is known about COVID-19, how it spreads and how it is affecting people worldwide.”
- “Children and adults should follow the same guidance on self-quarantine and self-isolation if there is a risk they have been exposed or are showing symptoms. It is particularly important that children avoid contact with older people and others who are at risk of more severe disease.”

Chen et al. **Returning Chinese school-aged children and adolescents to physical activity in the wake of COVID-19: Actions and precautions**. J Sport Health Sci. Apr 12, 2020 ([LINK](#))

- See section on “What should school administrators and physical educators do?” e.g., “Implement recommended protective measures, including performing daily health checks, wearing masks, conducting temperature checks, and providing designated routes to classrooms.”

CDC COVID-19 Response Team. **Coronavirus Disease in Children - United States, February 12-April 2, 2020**. MMWR Morb Mortal Wkly Rep. April 6, 2020. ([LINK](#))

- “Because persons with asymptomatic and mild disease, including children, are likely playing a role in transmission and spread of COVID-19 in the community, social distancing and everyday preventive behaviors are recommended for persons of all ages to slow the spread of the virus, protect the health care system from being overloaded, and protect older adults and persons of any age with serious underlying medical conditions.”

Government of Canada. **How to care for a child with COVID-19 at home: Advice for caregivers**. April 1, 2020. ([LINK](#))

- “If you are caring for a child who has or may have COVID-19, it is important to follow the steps below to protect yourself and others in the home, as well as those in your community.”

CDC. **Coronavirus Disease 2019 (COVID-19) - Interim Guidance for Administrators of US Childcare Programs and K-12 Schools**. Centers for Disease Control and Prevention. Mar 25, 2020. ([LINK](#))

- “Information about COVID-19 in children is somewhat limited, but the information that is available suggests that children with confirmed COVID-19 generally had mild symptoms. Person-to-person spread from or to children, as among adults, is thought to occur mainly via respiratory droplets produced when an infected person coughs, sneezes, or talks.

Recent studies indicate that people who are infected but do not have symptoms likely also play a role in the spread of COVID-19.”

CDC. **Coronavirus Disease 2019 (COVID-19) - FAQs for Administrators. Centers for Disease Control and Prevention.** March 19, 2020. ([LINK](#))

- “Despite lower risk of serious illness among most children, children with COVID-19-like symptoms should avoid contact with others who might be at higher risk, such as older adults and adults with serious chronic medical conditions.”

World Health Organization. **Q&A: Similarities and differences – COVID-19 and influenza.** March 17, 2020. ([LINK](#))

- “Further preliminary data from household transmission studies in China suggest that children are infected from adults, rather than vice versa.”

Team E editorial. **Updated rapid risk assessment from ECDC on the novel coronavirus disease 2019 (COVID-19) pandemic: increased transmission in the EU/EEA and the UK.** Eurosurveillance. Mar 12, 2020. ([LINK](#))

- A number of social distancing measures are suggested in this report including:
 - “measures in and closure of schools, **taking into consideration the uncertainty in the evidence of children in transmitting the disease**, need for day care for children, impact on nursing staff, potential to increase transmission to vulnerable grandparents”

PHAC. **Public health guidance for schools (K-12) and childcare programs (COVID-19).** Feb 28, 2020. ([LINK](#))

- **Note that this content has been archived “This page is under review and will be updated.”**
- “Virus transmission in the school/childcare setting, as well as in the home and community, is amplified as students/children are generally less compliant with effective hand hygiene and respiratory etiquette practices, they socialize with other students/children in a way that is likely to increase transmission and they can shed the virus up to twice as long as adults.”

Systematic Reviews

Castagnoli et al. **Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infection in Children and Adolescents: A Systematic Review.** JAMA Pediatr. Apr 22, 2020. ([LINK](#))

- “Recently, the group study at Johns Hopkins Bloomberg School of Public Health showed that children are at similar risk of infection as the general population, although they are less likely to have severe symptoms. This finding should be considered in analyses of transmission and control. These preliminary data, coupled with our results, may suggest that children, even when presenting with mild symptoms or are asymptomatic, might be a source of viral transmission. This underscores the importance of extensive preventive strategies that include quarantining and limitation of playing and school activities.

Further studies focused on the pediatric population are needed to confirm this hypothesis.”

Souza de et al. **Clinical Manifestations of Children with COVID-19: a Systematic Review**. medRxiv. Apr 14, 2020. ([LINK](#))

Notes

- “This article is a preprint and has not been peer-reviewed.” Also the authors did not critically appraise included studies.
- “Despite being mild or asymptomatic cases, prolonged viral shedding in stool and nasal secretions made children facilitators of viral transmission.”
- “The role of children in the transmission chain needs to be urgently clarified to establish social and public health policies for the protection of vulnerable populations, such as the elderly and people with comorbidities.”

Ludvigsson JF. **Systematic review of COVID-19 in children shows milder cases and a better prognosis than adults**. Acta Paediatr. March 23, 2020. ([LINK](#))

- The authors of this article did not critically appraisal included studies and “no pre-specified protocol [was conducted] prior to the current review.”
- “COVID-19 is either rare in children or it has not been diagnosed that often because this age group remain asymptomatic. One study suggested that 86% of all early COVID-19 infections in China remained undiagnosed. While undiagnosed (undocumented) cases may have a lower transmission rate, their greater number suggests that they may have been the source of 79% of all early cases. This may have implications if children with few symptoms are cared for by elderly people who constitute a risk group for COVID-19.”

Other Reviews

Lu et al. **SARS-CoV-2 infection in children – Understanding the immune responses and controlling the pandemic**. Pediatric Allergy and Immunology. April 24, 2020. ([LINK](#))

- “This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record.”
- “Although SARS-CoV-2 has strong person-to-person transmission potential between adults, and from adults to children, the transmission potential from children to others is still unclear. In particular, it is important to determine the transmission potential of asymptomatic children to clarify their role in propagating the infection in the community level.”

Dona et al. **Fecal-oral transmission of SARS-CoV-2 in children. Is it time to change our approach?** The Pediatric Infectious Disease Journal. April 16, 2020. ([LINK](#))

- “Droplets are the main human-to-human mechanism of transmission of SARS-CoV-2, but fecal shedding with environmental contamination may play an important role in viral spread.”

- “The clinical pattern of disease presentation among children may have facilitated viral dissemination.”
- “Since gastrointestinal symptoms seem to be more frequently reported in children than adults, and in view of current evidence of fecal shedding, there are implications for every child being admitted or home-isolated, and for household contacts.”

Jeng M-J. **COVID-19 in children: Current status**. Journal of the Chinese Medical Association. April 15, 2020. ([LINK](#))

- “In one report of childhood cases, 94/731 (12.9%) SARS-CoV-2-positive children had no symptoms according to nucleic acid tests, and more than 70% of them were between the ages of 6 and 15 years. The proportion of asymptomatic subjects may be underestimated because many potentially infected people do not receive a SARS-CoV-2 test when they have no symptoms. However, asymptomatic carriers have the potential to transmit the coronavirus that causes COVID-19. It has been proposed that up to 80% of infected people are asymptomatic carriers. Further investigations should be carried out to clarify this issue regarding the prevalence of asymptomatic carriers.”

Choi et al. **Epidemiology and clinical features of coronavirus disease 2019 in children**. Clin Exp Pediatr. Published online Apr 6, 2020. ([LINK](#))

- “In summary, the transmission of SARS-CoV-2 in children primarily occurs through contact with adult patients, mainly through household exposure. In contrast, direct transmission from a child to an adult has not been reported to date. However, the observation of prolonged detection of viral RNA in nasopharyngeal/throat swabs and feces of pediatric patients suggests that children and adolescents may be transmitters in the community.”

Viner, et al. **School closure and management practices during coronavirus outbreaks including COVID-19: a rapid systematic review**. Lancet Child Adolesc Health. April 6, 2020. ([LINK](#))

- “Currently, the evidence to support national closure of schools to combat COVID-19 is very weak and data from influenza outbreaks suggest that school closures could have relatively small effects on a virus with COVID-19's high transmissibility and apparent low clinical effect on school children. At the same time, these data also show that school closures can have profound economic and social consequences.”
- Related News Articles:
 - The Guardian, **Boy with Covid-19 did not transmit disease to more than 170 contacts** Posted April 21, 2020 ([LINK](#))
 - The Guardian, **School closures likely to have little impact on spread of coronavirus, review finds**, Posted April 7, 2020 ([LINK](#))

Li et al. **A Mini Review on Current Clinical and Research Findings for Children Suffering from COVID-19**. medRxiv. Apr 4, 2020. ([LINK](#))

- “The numbers of children with COVID-19 pneumonia infection are small, and most of them come from family aggregation. Symptoms are mainly mild or even asymptomatic, which allow children to be a risk factor for transmission. Thus, strict epidemiological

history screening is needed for early diagnosis and segregation. This holds especially for infants, who are more susceptible to infection than other age groups in pediatric age, but have most likely subtle and unspecific symptoms.”

Health Information and Quality Authority. **Evidence summary for spread of COVID-19 by children.** April 1, 2020 ([LINK](#))

- “To inform national efforts in response to COVID-19, HIQA is developing evidence summaries to answer specific research questions posed by the National Public Health Emergency Team”
- “This evidence summary was developed to address the following research question:
What evidence is available to indicate that children spread COVID-19?
 - “The emerging evidence in the [two] included studies has highlighted child to adult and or family member transmission has the potential to occur, although at extremely low rates”
 - “There is currently limited information on how children contribute to the transmission or spread of COVID-19.”
- Other related Evidence Summaries:
 - “What is the natural history of COVID-19 in children?” ([LINK](#))
 - “What is the viral load over the course of the infection (including any asymptomatic or pre-symptomatic phase), and the duration of infectivity?” ([LINK](#))
 - “What is the evidence for asymptomatic transmission of COVID-19?” ([LINK](#))

Kelvin AA, Halperin S. **COVID-19 in children: the link in the transmission chain.** The Lancet Infectious Diseases. March 25, 2020 ([LINK](#))

- “The most important finding to come from the present analysis is the clear evidence that children are susceptible to SARS-CoV-2 infection, but frequently do not have notable disease, raising the possibility that children could be facilitators of viral transmission. If children are important in viral transmission and amplification, social and public health policies (e.g., avoiding interaction with elderly people) could be established to slow transmission and protect vulnerable populations. There is an urgent need to for further investigation of the role children have in the chain of transmission.”

Zimmermann et al. **Coronavirus Infections in Children Including COVID-19.** Pediatr Infect Dis J. March 12, 2020. ([LINK](#))

- “SARS-CoV, MERS-CoV and SARS-CoV-2 infections seem to affect children less commonly and less severely as compared with adults. This might be because children are less frequently exposed to the main sources of transmission (which until now has been disproportionately nosocomial) or because they are less exposed to animals. However, it could also be that children are less frequently symptomatic or have less severe symptoms and are therefore less often tested, leading to an underestimate of the true numbers infected. In relation to SARS-CoV-2, a study prepublished in early March 2020 suggests that children are just as likely as adults to become infected with this virus but are less likely to be symptomatic or develop severe symptoms. However, the importance of children in transmitting the virus remains uncertain.”

Cao et al. **SARS-CoV-2 infection in children: Transmission dynamics and clinical characteristics.** Journal of the Formosan Medical Association. Mar 1, 2020. ([LINK](#))

- “In conclusion, understanding the role of pediatric population in the transmission dynamics of the outbreak is important, as children may become a significant spreader at the explosion stage of the outbreak. Further studies to unveil why sick children have a milder form of disease may help to the future development of immunotherapy and vaccines for the SARS-CoV-2.”

Expert Opinion

de Niet et al. **The role of children in the transmission of mild SARS-CoV-2 infection.** Acta Paediatrica. April 16, 2020. ([LINK](#))

- “This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record.”
- “Currently, it is not clear if children are important in transmitting SARS-CoV-2, like they are for other respiratory viruses. The main source of transmission involves respiratory droplets or direct contact with (symptomatic and asymptomatic) persons infected with SARS-CoV-2. Thus, infected children might also be an important source of disease transmission. However, the majority of children infected with SARS-CoV-2 thus far, have a documented family cluster outbreak. In these cases, adults often showed symptoms before them, suggesting that children might not play such an important role in disease transmission.”

Vanhems P. **SARS-CoV2 infection and primary school closure.** Eurosurveillance. Apr 16, 2020. ([LINK](#))

- “...at least retrospectively, detailed analysis of inter-individual contact remains a key determinant with viral characteristics in order to understand the dynamic of viral transmission in close environments such as primary schools.”

Goldman RD. **Coronavirus disease 2019 in children: Surprising findings in the midst of a global pandemic.** Can Fam Physician. Apr 15, 2020. ([LINK](#))

- “While children have not been presenting with severe illness, these findings suggest that they have been contracting the illness, likely have SARS-CoV-2 particles in their nasopharyngeal secretions, are very likely to contribute to early transmission to close contacts, and might infect adults who can suffer a serious and life-threatening illness.”

Hagmann SHF. **COVID-19 in children: More than meets the eye.** Travel Med Infect Dis. Published online March 28, 2020. ([LINK](#))

- “The potentially prolonged shedding of the virus in nasal secretions and stool of children and infants has substantial implications for spread of the virus in daycare centers,

schools, and in the home. Consequently, children and infants may play a pivotal role in community-based transmission of SARS-CoV-2.”

- “Much has been learnt about SARS-CoV-2 and COVID-19 in a very short time, yet there is still much that we need to learn about the impact of this virus on children, as well as the impact of children on viral spread.”

Fretheim A. **The role of children in the transmission of SARS-CoV-2-19 – a rapid review**. Norwegian Institute of Public Health. March, 2020. ([LINK](#))

- Key messages:
 - **Q:** “Do children transmit the virus? If so, to whom? Their parents? Other Children?” **A:** “We have found five documented cases of likely spread of disease from children, but as the evidence is sparse, it is too early to say if children may play an important role in the spread of the disease, or not.”
 - “Based on the current evidence, it appears that infected children do not represent a major vector for transmission, but it is too early to draw any conclusions yet as the picture may change as we get more comprehensive data from infection tracking processes.”

Primary Research

Banholzer et al. **The estimated impact of non-pharmaceutical interventions on documented infections with COVID-19: A cross-country analysis**. medRxiv. April 24, 2020. ([LINK](#))

- **This article is a preprint and has not been certified by peer review. It reports new medical research that has yet to be evaluated and so should not be used to guide clinical practice**
- “However, with respect to the ranking of NPIs, we were able to demonstrate that we can be fairly confident that venue closures, gathering bans, border closures, and work bans are among the four most effective NPIs and school closures and lockdowns among the two least effective when applied as a combination of NPIs.”

Xu, et al. **A follow-up study of children infected with SARS-CoV-2 from Western China**. medRxiv. Apr 24, 2020. ([LINK](#))

- **This article is a preprint and has not been peer-reviewed. It reports new medical research that has yet to be evaluated and so should not be used to guide clinical practice.**
- “The mean duration of positive SARS-CoV-2 nucleic acid was 15.4 (SD=7.2) days and similar for both asymptomatic children and children with symptoms or CT abnormalities. We found a significant negative correlation between the lymphocyte count and the duration of positive nucleic acid test.”
- “Children with asymptomatic infection should be quarantined for the same duration as symptomatic patients infected with SARS-CoV-2. The clinical significance and mechanism behind the negative correlation between the number of lymphocytes and the duration of positive SARS-CoV-2 needs further study.”

Danis et al. **Cluster of coronavirus disease 2019 (Covid-19) in the French Alps, 2020.** Clin Infect Dis. April 11, 2020. ([LINK](#))

- “Summary: In this cluster, 12 Covid-19 cases (one asymptomatic) were linked to one single index case. One child, co-infected with other respiratory viruses, attended three schools while symptomatic, but did not transmit the virus, suggesting potential different transmission dynamics in children.”
- Related News Article:
 - The Guardian, **Boy with Covid-19 did not transmit disease to more than 170 contacts** Posted April 21, 2020 ([LINK](#))

Kim et al. **School Opening Delay Effect on Transmission Dynamics of Coronavirus Disease 2019 in Korea: Based on Mathematical Modeling and Simulation Study.** J Korean Med Sci. Apr 6, 2020. ([LINK](#))

- “In conclusion, simulation study though mathematical model showed that school closure is an essential nonpharmacological intervention to prevent or mitigate the COVID-19 epidemic. Especially the third announcement of school opening delay on March 23 for two more weeks could reduce the number of expected cases for children at least 255 assuming the 30 fold increased transmission rate among students.”

Zhu et al. **Children are unlikely to have been the primary source of household SARS-CoV-2 infections.** medRxiv. Mar 30, 2020. ([LINK](#))

- **This article is a preprint and has not been peer-reviewed. It reports new medical research that has yet to be evaluated and so should not be used to guide clinical practice.**
- “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 intrahousehold transmission of SARS-CoV-2.”

Zhang et al. **Detectable SARS-CoV-2 viral RNA in feces of three children during recovery period of COVID-19 pneumonia.** J Med Virol. Mar 29, 2020. ([LINK](#)).

- “However, after being discharged, all three cases were tested SARS-CoV-2 positive in the stool samples within 10 days, in spite of their remained negative nucleic acid in throat swab specimens. Therefore, it is necessary to be aware of the possibility of fecal-oral transmission of SARS-CoV-2 infection, especially for children cases.”
- “Recovered patients might be possible carriers for the viruses, which force us to reevaluate the current criteria of hospital discharge or discontinuation of quarantine and continued patient management. The study was limited to a small number of patients, longitudinal studies on a larger cohort would help to understand the prognosis of the disease.”

Davies et al. **Age-dependent effects in the transmission and control of COVID-19 epidemics.** medRxiv. Mar 27, 2020. ([LINK](#))

- **This article is a preprint and has not been peer-reviewed. It reports new medical research that has yet to be evaluated and so should not be used to guide clinical practice.**

- “Children tend to make more social contacts than adults and hence, all else equal, contribute more to transmission in the community than adults. This is why school closures are considered a key intervention for epidemics of respiratory infections, and without them, one would expect a higher number of infected children.”
- “For COVID-19, school closures are likely to be much less effective than for influenza-like infections where children play a more substantial role in transmission.”

Qiu et al. **Clinical and epidemiological features of 36 children with coronavirus disease 2019 (COVID-19) in Zhejiang, China: an observational cohort study.** Lancet Infect Dis. Mar 25, 2020. ([LINK](#))

- “In conclusion, our study shows that paediatric patients with COVID-19 have a simple transmission mode, either by close contact with infected adults or by exposure to epidemic areas. Although fever, dry cough, and mild pneumonia are common manifestations, nearly half of patients have neither obvious symptoms nor abnormal radiological findings. The proportion of asymptomatic cases indicates the difficulty in identifying paediatric patients without clear epidemiological information. This finding suggests a dangerous situation if community-acquired infections occur.”

Xing et al. **Prolonged presence of SARS-CoV-2 in feces of pediatric patients during the convalescent phase.** medRxiv. Mar 13, 2020. ([LINK](#))

- **This article is a preprint and has not been peer-reviewed. It reports new medical research that has yet to be evaluated and so should not be used to guide clinical practice.**
- “In face of the emerging infectious disease and limited data on pediatric patients, it is unclear what role children play in SARS-CoV-2 transmission or to what extent children are affected by the virus. More attention should be drawn to children, especially for young children who cannot handle their own excretions. Caregivers of these children should avoid direct contact with the stool and close the lid before flushing the toilet. Precautionary measures are needed when conducting aerosol-generating procedures and sewer system should be kept unobstructed.”
- “It is also of vital importance to implement strict hygiene measures after reopening of kindergartens and schools to prevent spreading of the infection among preschool and schoolchildren.”

Cai et al. **A Case Series of children with 2019 novel coronavirus infection: clinical and epidemiological features.** Clinical Infectious Diseases. Feb 28, 2020. ([LINK](#))

- “Most of pediatric cases occurring outside of Wuhan were secondary cases after exposure to adult cases through household contact or travel contact. However, we cannot neglect the potential risk of transmission from the infected child to adult contacts, as shown in patient 7. Thus, personal medical protection is crucial when care providers look after the infected child. The major pattern of transmission was intrafamily transmission.”

News Articles

The Guardian, **Boy with Covid-19 did not transmit disease to more than 170 contacts** Posted April 21, 2020 ([LINK](#))

- “The role of children in spreading the virus remains one of the key mysteries of the coronavirus pandemic and the question of whether those who develop few if any symptoms are carriers is still being debated.”

Ottawa Citizen, **Large study of COVID-19 in children raises concern about infants, transmission,** Posted March 18, 2020. ([LINK](#))

- “U.S. pediatricians Dr. Andrea Cruz and Dr. Steven Zeichner noted that “children may play a major role in community-based viral transmission” since their symptoms often involve the upper respiratory system, making the disease easier to spread through coughing and sneezing.”

Methodology

Newfoundland and Labrador Centre for Applied Health Research (NLCAHR) COVID-19 Quick Response reports are initiated by, and shared with, our partners in the provincial health system, including the four Regional Health Authorities, the Departments of Health and Community Services and Children, Seniors and Social Development, and public health officials.

NLCAHR staff work with topic submitters to clarify the research question. We then search for related systematic reviews, meta-analyses, other reviews, interim and other guidance statements, primary research, expert opinion and health and science reporting.

We use several search strategies, with a focus on the following databases:

- [CADTH](#)
- [Canadian Pharmacists Association](#)
- [Campbell Collaboration](#)
- [Cochrane Collaboration](#)
- [Centre for Disease Control](#) (CDC)
- [Centre for Evidence Based Medicine](#) (CEBM)
- [Evidence for Policy and Practice Information and Co-ordinating Centre](#)
- [European Centre for Disease Prevention and Control](#)
- [Health Canada](#)
- [Joanna Briggs Institute](#)
- [Johns Hopkins](#)
- [MedRxiv](#)
- [National Institutes of Health](#) (NIH)
- [National Institute of Allergy and Infectious Diseases](#) (NIAID)
- [National Library of Medicine](#)
- [Public Health Agency of Canada](#)
- [Trip Database](#)
- [World Health Organization](#)

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