



Vaccine Confidence InfoBulletin

Volume 2 | Issue 4 | April 2022 | Public Health Agency of Canada (PHAC)

Providing credible and timely information on vaccines to health care providers and public health decision makers to support vaccine confidence. Thank you for being a trusted source of vaccine information for individuals and communities across Canada.

Trending topics

Thank you, health care providers

The month of May marks several health care professional appreciation days such as National Nursing Week, National Physicians' Day, and International Day of the Midwife.



These theme days are a great opportunity to reflect on and appreciate the important contributions of these professionals to our healthcare system, the health of our communities, and the furthering of high quality, equitable health care delivery.

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PHAC would like to take this opportunity to thank health care providers who have been on the front lines immunizing, educating about vaccines, treating patients, providing important routine or acute care during the pandemic, delivering public health programs and services and those who have made their impact through policy, planning, and education. Thank you for all that you have done and continue to do!



Have your voice heard! Providing health care providers with engaging, responsive educational materials that meet their needs is a high priority for PHAC. We need your input to provide the best possible resources for your practice.

We would very much appreciate you taking 10 minutes out of your busy schedule to complete [this survey](#) and share it widely within your professional networks. The survey will be available until May 6, 2022.

Guidance on COVID-19 vaccines booster doses

Canada is seeing increases in COVID-19 activity. These increases are expected as protective public health measures are eased and the highly transmissible Omicron variant spreads. The Omicron variant, including the newly emerging Omicron sub-variant BA.2, is partially evasive to previous immunity conferred by COVID-19 vaccines or previous SARS-CoV-2 infection, thus emphasizing the need for booster doses.

The National Advisory Committee on Immunization's (NACI) updated recommendations on boosters are based on current evidence and NACI's expert opinion and are intended to help reduce infections and severe disease.

Initial guidance on a second booster dose of COVID-19 vaccines

On April 5, 2022, PHAC released NACI's initial guidance on the use of second COVID-19 booster doses in Canada.

For a second booster, NACI strongly recommends the prioritization of adults 80 years of age and older living in the community and residents of long-term care or other congregate living settings for seniors because they are at higher risk of experiencing severe outcomes from COVID-19. While the greatest benefit of a second COVID-19 booster dose is expected in adults 80 years of age and older, jurisdictions may also consider offering a second COVID-19 booster dose to adults 70-79 years of age living in the community (discretionary recommendation). A second booster dose may also be

considered for adults younger than 70 years of age in or from First Nations, Métis, and Inuit communities. These decisions should be made by Indigenous leaders in collaboration with health care and public health partners (discretionary NACI recommendation).

For more information, see: [NACI Statement: Initial guidance on a second booster dose of COVID-19 vaccines in Canada.](#)

Updated guidance on a first booster dose of COVID-19 vaccines in Canada

On April 12, 2022, PHAC released updated guidance from NACI on the use of a first booster dose of COVID-19 vaccines in Canada.

NACI now strongly recommends that a first booster of an mRNA COVID-19 vaccine should be offered to adults aged 18-49 years and adolescents aged 12-17 years who are at high risk of severe COVID-19 outcomes, with an interval of at least 6 months after the completion of a primary series (strong NACI recommendation).

All other adolescents 12-17 years of age may be offered a first booster dose of an mRNA COVID-19 vaccine at least 6 months after the completion of the primary series in the context of heightened (ongoing or novel) epidemiological risk (discretionary NACI recommendation).

For more information, see: [NACI statement: Updated guidance on a first booster dose of COVID-19 vaccines in Canada.](#)

Featured article

Q&A with Chief Public Health Officer Dr. Theresa Tam on the state of vaccine confidence in Canada - for National Immunization Awareness Week



National Immunization Awareness Week
April 23-April 30, 2022

1. How do you think the pandemic has affected vaccine confidence or attitudes around vaccines in Canada?

This is quite a complex question that does not have one simple answer. The overwhelming majority of people in Canada have rolled up their sleeves and have received at least two doses of a COVID-19 vaccine. They have done so not only to protect themselves, but also as a tremendous demonstration of solidarity for their loved ones and their communities. I think that given how the pandemic has affected every single individual in Canada, there is a heightened awareness of the importance of vaccines among the general public.

With that said, it's not fully clear yet how the pandemic has affected vaccine confidence in Canada. Canada is a diverse country that includes many communities and populations with different lived

experiences based on their culture, education, religion and history, among other factors. These factors may affect how individuals feel about vaccines, and health system experiences more broadly. In addition, the stigma and racism experienced by Indigenous and racialized communities may contribute to a broader sense of mistrust, including in vaccination.

Despite Canada having some of the highest COVID-19 primary series vaccination rates globally, the COVID-19 pandemic has illuminated and amplified social inequities, including in health, science, and digital literacy, access to health care, as well as vaccine delivery and confidence.

Nonetheless, we will maintain our efforts to better understand the reasons behind pockets of hesitancy in certain populations so that we can better address their unique needs to promote vaccine confidence and uptake, all while combatting the increased mis- and disinformation (MIDI) circulating around vaccines, including the need for boosters.

2. What challenges do you foresee around routine vaccination, for children and adults, post-pandemic?

This is something that we are all very interested in learning more about. The Childhood National Immunization Coverage Survey (CNICS), is conducted every two years by the federal government, and provides important information on vaccine uptake in children, and insights into parents and guardians' knowledge and beliefs about vaccines.

The 2021 CNICS is underway and a module on immunization during the COVID-19 pandemic was added to account for the significant changes in the vaccine and health service access landscape. Results for this latest round should be available in May 2023. Prior to the onset of the pandemic (2017-2019), the CNICS showed stable vaccination rates among Canadian children, with a trend toward increasing positive vaccine sentiment among parents and caregivers.

Early on in the pandemic, studies showed us that some childhood immunizations delivered by clinicians were disrupted, but tended to recover after the first wave. However, it is not known how many of those who missed their scheduled appointments eventually caught up. In contrast, school-based programs delivered to older children have not yet recovered. There were also disruptions to school, adult, and older adult immunization programs.

It is critical to ensure people are aware of any vaccines that they may have missed and to provide them with accessible opportunities to get up-to-date, to ward off a potential resurgence of other vaccine-preventable diseases.



Dr. Theresa Tam
Chief Public Health Officer of Canada

Health care providers are among the most trusted sources of health information, and can play an important role in shaping patients' decisions around vaccination and building understanding of the importance of routine vaccination.

The results of the 2021 CNICS will also be important to identify whether sentiments around vaccines among parents and guardians have shifted during the pandemic. Understanding people's beliefs and attitudes towards vaccination can help us tailor our messages and deliver them in more effective and compelling ways.

3. What are some of the main lessons learned from the pandemic in terms of immunization?



During National Immunization Awareness Week, I think it is especially important to highlight that COVID-19 vaccine roll out constituted this country's largest and most complex vaccination campaign ever. The large majority of people living in Canada (over 85%) have received two doses of COVID-19 vaccine, helping us attain high levels of vaccination.

The development of multiple safe and effective vaccines within a year were remarkable and monumental global achievements. Achievements like this rest on the shoulders of many scientists and health care providers, who toil for years in general and clinical research so that these sort of advancements can happen when we need them most. Thank you for the considerable efforts you have made over the past two years, and for your continued work to protect all people living in Canada. It's been encouraging to see how Canadians have pulled together, to protect their families, communities and others where they live, work, learn and play by getting vaccinated.

Some people still have concerns around the vaccine however, and reasons for this hesitancy are complex and varied. We need to acknowledge and address all of the factors that contribute to vaccine hesitancy, so that the next time there is a health crisis, we can count on a high level of trust in both the scientific community and government officials.

Throughout this pandemic, we have seen how important is it to engage with trusted leaders to reach diverse populations. By working with community leaders and/or health care providers, we can better support people in overcoming access (i.e.: language, finding a vaccine site/booking their appointments, transportation) and other barriers to vaccination.

The vast majority of people in Canada have embraced personal and collective public health practices to protect themselves and those around them, despite the amount of misinformation that we have seen during the pandemic. Moving forward, it will be important to build health literacy skills to support our population as digital citizens who can identify credible, evidence-based information and prevent the spread of mis- and disinformation, which the WHO has dubbed an “Infodemic”.

The pandemic has also resulted in a paradigm shift: Now, conversations about public health and vaccines are at the forefront of our everyday lives. NIAW is a great opportunity to talk to our friends and family about the importance of catching up and getting any missed routine vaccinations, as well as staying up-to-date with COVID-19 vaccines by receiving all doses recommended for them, including booster doses.

Science spotlight

Providing explanations of the science underpinning vaccine guidance and public health response.

Vaccine effectiveness for pediatric COVID-19 vaccines

In this month’s science spotlight, we contextualize some of the considerations for interpreting vaccine effectiveness in children.

Vaccine effectiveness against infection in pediatric populations

Several studies have recently been published demonstrating relatively low real world vaccine effectiveness of COVID-19 vaccines against infection in children.

[Fowlkes et al.](#) [1] In this prospective study from four U.S. states, adjusted two-dose vaccine effectiveness against Omicron infection was higher in those 12 to 15 years of age (59%; 95% CI: 9 to 48% at 14 to 149 days after vaccination) than those 5 to 11 years of age (31%; 95% CI: -28 to 89% at 14 to 82 days after vaccination), although confidence intervals overlapped.

[Dorabawila et al.](#) [2] In this cohort study that has not been peer reviewed, conducted in New York State, vaccine effectiveness against infection declined rapidly for children who had received two 10 mcg Pfizer-BioNTech Comirnaty® doses, with low protection observed one month post-vaccination. In adolescents who had received two 30 mcg Pfizer-BioNTech Comirnaty® doses, protection declined substantially over the study period, although more slowly than in children. In an analysis by single ages, children 11 years of age (who received a 10 mcg dose) had an effectiveness rate against infection of 11% in the last week of the study, while adolescents 12 years of age (who received a 30 mcg dose) had a vaccine effectiveness of 67% (note: 12 year olds had the highest vaccine effectiveness observed among all ages in the study). One possible explanation for this substantial difference in vaccine effectiveness between the 11 and 12 year olds include difference in dosing between the two ages. In addition, the particularly high rate in the 12 year olds may be because they were vaccinated earlier than other age groups.

[Klein et al.](#) [3] In this test-negative design study in the United States, effectiveness of two doses of the Pfizer-BioNTech Comirnaty® vaccine against COVID-19 emergency department and urgent care clinic encounters during the Omicron period was 51% in children 5 to 11 years of age, 45% in adolescents 12 to 15 years of age and 34% in adolescents 16 to 17 years of age in the earliest time periods after vaccination. It declined over time in adolescents (the group where the data over time was available), but was restored to 81% by a booster dose in those 16 to 17 years of age (the only age group with sufficient booster dose data).

Vaccine effectiveness against infection is reduced in all groups in the context of Omicron

The rise of the Omicron variant has presented a challenge both to vaccine confidence and to the containment of the pandemic, due to the reduced effectiveness of vaccines against Omicron infection, a phenomenon which has been noted across all age groups. While preventing infection is not the primary objective of the Canadian COVID-19 immunization program, high initial effectiveness of vaccines against infection from the ancestral strain and earlier variants suggested that these vaccines could prevent infection and transmission. The recent findings of low effectiveness against Omicron infection among children and adults, while disappointing, are not particularly surprising given how different Omicron is from the ancestral strain which was used to develop the vaccines.

For more information on the science behind vaccine effectiveness see the [Science spotlight in the Volume 2, Issue 2, February 2022 issue of the VCIB.](#)

Vaccine effectiveness against hospitalization is higher than against infection

Severe disease and death are rare COVID-19 outcomes for children, therefore assessing efficacy against these outcomes in clinical trials is challenging and may not be possible. It is more feasible using real world data as the sample size is much larger making it possible to detect rarer disease outcomes. However, there are still difficulties in determining vaccine effectiveness. This includes challenges in distinguishing incidental infections from COVID-19 related hospitalization, as inclusion of incidental infections can underestimate vaccine effectiveness against severe disease. Nonetheless, some limited data on severe disease is available. In a nested case control preprint study of children and adolescents (4 to 17 years of age) in Ontario by [Simmons, A et al.](#) [4], two doses of Pfizer-BioNTech Comirnaty® had a vaccine effectiveness of 59% in preventing hospitalization among COVID-19 cases. In the test-negative design study in the United States by [Klein et al.](#) [3], vaccine effectiveness against hospitalization was higher than against emergency department/urgent care clinics, and in adolescents it did not decline substantially over time.


Time since vaccination plays an important role

The time between the last vaccine dose and exposure have a significant impact on the level of protection against infection. Vaccine protection is highest beginning 2 weeks following vaccination, and shortly thereafter, with a subsequent decline over time. For example, in the [Dorabawila et al.](#) study, 5-11 years fell from 65% to no protection at 35 to 41 days from the second dose. The duration of protection may vary by the outcome being measured. For example, effectiveness against asymptomatic infection and symptomatic disease declines more quickly, while the protection against severe disease lasts longer. The closer someone is to their vaccination, the more protection they are likely to have against all of the outcomes.

Vaccine effectiveness against infection among children who received an 8-week interval is unknown


The studies noted above examined children in the United States where the manufacturer's recommended dosing interval of 21 days was primarily used. In Canada, NACI recommends at least an 8-week interval between doses in the primary series in the pediatric population 5-11 years of age.

These longer intervals are recommended in part due to evidence demonstrating lower rates of myocarditis/pericarditis with longer intervals in adolescents and adults, but also because longer intervals yield a stronger immune response and potentially better protection. More data is needed to determine the vaccine effectiveness and duration of protection among children vaccinated with the NACI-recommended interval of at least 8 weeks.



Resources related to vaccination in children

In Practice



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- українська (Ukrainian)
- اُردُو (Urdu)

[A Parent's Guide to Vaccination](#)

Parents/guardians can help protect their children from many serious and potentially deadly diseases by getting them vaccinated on time and keeping their shots up to date. This resource supports parents/guardians in making informed decisions.

[Now available for instant download in 14 languages](#), including [Ukrainian](#), [Arabic](#), [English](#), [French](#), and more. Printed copies are also available by request.

[COVID-19 Vaccines Communications toolkit: Pediatrics, Pregnancy & Boosters](#)

Featuring ready-made content such as social media messaging, images, key messages, and more, this toolkit provides a wide variety of content that you can re-purpose, re-post or customize to reach your patients or audience in ways that will have the most impact.



In Practice

Resources related to vaccination in children continued...

[Webcast - Needle fear, pain and vaccines - Introduction to the CARD™ system as a framework for vaccination delivery](#)

Presented by Dr. Anna Taddio and Dr. Meghan McMurtry

Learn about contributors to stress-related reactions during vaccination and evidence-based strategies to improve the vaccine experience for people receiving vaccines and those who support them.

Vaccine confidence corner

Providing evidence-informed tips, strategies and information in support of vaccine confidence.

How to discuss COVID-19 vaccines with parents in the context of low pediatric vaccine effectiveness

As discussed in this month's [Science spotlight](#), in the context of the Omicron variant, COVID-19 vaccine effectiveness against infection is lower than the efficacy rates found in clinical trials against the ancestral strain. Combined with generally low incidence of severe disease and death amongst kids, many parents may be asking health care providers about the benefits of vaccination and whether they outweigh the risks.



In Practice

Important points to discuss with parents or guardians

Supporting informed decision-making about COVID-19 vaccination in children.

- **Vaccines can prevent serious outcomes in children and adolescents**

Although uncommon, children and adolescents can become seriously ill, be hospitalized, and even die from COVID-19. Children may also experience multisystem inflammatory syndrome in children (MIS-C) and post-COVID syndrome, serious consequences of SARS-CoV-2 infection. Vaccination helps to prevent severe illness and other severe outcomes. A U.S. study reported high vaccine effectiveness of 91% (95% CI: 78 to 97%) of the Pfizer-BioNTech Comirnaty® vaccine in preventing MIS-C in adolescents 12-18 years of age [5].



In Practice

Important points to discuss with parents or guardians continued...

- **More severe variants may emerge, and vaccination now will provide a strong basis for future boosting**

While COVID-19 strains and variants to-date have had low rates of serious illness in children and adolescents, it is possible that a future variant may pose a greater risk. It is not possible to predict future variants and they may emerge quickly and with little warning, as evidenced by the rise of the Omicron variant. Immunity and protection against severe disease take time to build. Beginning a new primary series of vaccination at the time that a wave of a more virulent variant of COVID-19 emerges will not allow sufficient time for robust protection. Having a baseline level of immunity to the ancestral strain of the virus may provide a stronger basis upon which to boost and allow the child's immune system to more quickly mount a strong immune response.

- **COVID-19 vaccines have a good safety profile in children**

The risk of vaccine adverse events in children remains low. Global real world evidence shows that most vaccine side effects in children are mild and last only a few days. NACI has reviewed the safety data and the epidemiology of COVID-19 in children and [strongly recommends a primary series](#) of an mRNA vaccine for children 5 years of age and over.

In the clinic

Providing current recommendations, resources and vaccination best practices for immunizers.

Pfizer-BioNTech Comirnaty® grey cap re-formulation

Pfizer-BioNTech introduced the '**grey vial cap**' formulation of the Comirnaty® COVID-19 vaccine for individuals over 12 years of age. It will become available in Canada in May 2022. This modified formulation, offers improved stability and **no longer requires dilution**, with a change in buffer, which makes handling and administration easier. Unpunctured vials may be stored in the refrigerator between 2°C and 8°C for up to 10 weeks. It uses a Tris-sucrose buffer instead of phosphate-buffered saline (PBS) and excludes potassium chloride. The change in buffer is not considered clinically significant.

Find more detailed information such as the product monograph and the regulatory decision summary, in the [Canadian Immunization Guide](#) and the [Pfizer-BioNTech Comirnaty® vaccine regulatory information on Canada.ca](#).

Table 1. Pfizer-BioNTech- Comirnaty® Covid-19 vaccine product comparison^{a, b, c}

	Pfizer-BioNTech Comirnaty® COVID-19 Vaccine		
Vial cap colour ^d	Orange	Grey	Purple (while supplies last)
Age ^e - Primary series	5 to <12 years	12 years & older	12 years & older
Age ^e - Booster	N/A	18 years & older ^f	18 years & older ^f
Doses per vial	10 doses per vial	6 doses per vial	
Dose volume	0.2 ml (10 mcg) *Not approved for a booster dose	0.3 ml for all doses (30 mcg)	0.3 ml for all doses (30 mcg)
Dilution information	Dilute with 1.3 ml 0.9% sodium chloride injection	DO NOT dilute prior to use	Dilute with 1.8 ml 0.9% sodium chloride injection
Differences in non-medicinal ingredients	<ul style="list-style-type: none"> • Tromethamine • Tromethamine hydrochloride 		<ul style="list-style-type: none"> • Dibasic sodium phosphate dihydrate • Monobasic potassium phosphate • Potassium chloride
Storage	<ul style="list-style-type: none"> • Ultra-frozen until expiry • Do not store vials at -25°C to -15°C. • Refrigerator (2°C to 8°C) for 10 weeks • Room temperature: no more than 12 hours before dilution and no more than 12 hours post dilution 	<ul style="list-style-type: none"> • Ultra frozen until expiry • Do not store vials at -25°C to -15°C. • Refrigerator (2°C to 8°C) for 10 weeks • Room temperature: no more than 12 hours before or after first puncture 	<ul style="list-style-type: none"> • Ultra-frozen until expiry • Frozen (-25°C to -15°C) for 2 weeks • Refrigerator (2°C to 8°C) for 1 month • Room temperature (up to 25°C): undiluted up to 2 hours; 6 hours post-dilution
Usage limit post puncture or dilution	Administer immediately, and no later than 12 hours after dilution	Administer immediately and no later than 12 hours after first puncture	Administer immediately, and no later than 6 hours after dilution

^a [Pfizer-BioNTech Comirnaty COVID-19 vaccine - Canada.ca](#)

^b [COVID-19 vaccine: Canadian Immunization Guide - Canada.ca](#)

^c [COMIRNATY \(COVID-19 Vaccine, mRNA\) Product Monograph](#)

^d Vial cap and label border colour

^e Age indication as per product monograph

^f NACI recommends a booster should be offered at least 6 months from the primary series for all those 18 years of age and over and for 12 to 17 years of age with some [conditions](#). A booster may be offered to all other adolescents 12 to 17 years of age in the context of heightened (ongoing or novel) epidemiological risk.

Community spotlight

Putting the spotlight on innovative projects and best practices from communities across Canada.

**Vaccination, misinformation and digital media:
mobilizing newcomer information practices for effective
COVID-19 communications**



[Refugee 613](#) is an agile and innovative communications hub that informs, connects and inspires people to welcome refugees and build strong communities. With support from PHAC's [Immunization Partnership Fund \(IPF\)](#) and in partnership with the University of Toronto (Faculty of Information), this project will research, develop, and test evidence-based strategies in digital spaces to counter the impact of COVID-19 vaccine misinformation on newcomers to Canada.

The project is generating evidence-based data to understand how vaccine misinformation flows and spreads in newcomer digital spaces, while also providing newcomers with trusted vaccine information through their informal digital networks. Refugee 613 will share the findings of this research on a national scale with the goal of equipping information champions in newcomer digital spaces and other stakeholder groups and organizations with best-practice strategies to communicate fact-based information. This will further efforts to address barriers and overcome vaccine hesitancy among newcomers in Canada.

PHAC webinars and webcasts for health care providers

PHAC, in collaboration with the Canadian Vaccination Evidence Resource and Exchange Centre (CANVax) and the National Collaborating Centre for Infectious Diseases (NCCID), offers expert-led webinars and webcasts focused on providing health care providers with clinical guidance and information related to key vaccine topics.

Webcasts are video resources.

Webinars are live events, with an audience and question & answer period. These live events are recorded and later posted for viewing.

Upcoming webcast in May

New COVID-19 vaccines in Canada: An overview of Novavax Nuvaxovid™ and Medicago Covifenz®
Presented by Iman Abdishukri, RN

The clinical evidence for the Novavax Nuvaxovid™ and Medicago Covifenz® COVID-19 vaccines will be reviewed and the NACI recommendations for the use of Novavax Nuvaxovid™ and Medicago Covifenz® COVID-19 vaccines will be summarized.

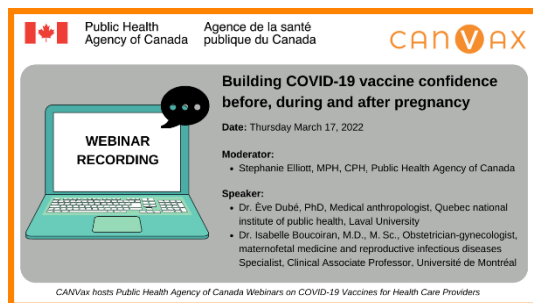
Webinar and webcast watch list

[Webcast - Needle fear, pain and vaccines - introduction to the CARD™ system as a framework for vaccination delivery](#)



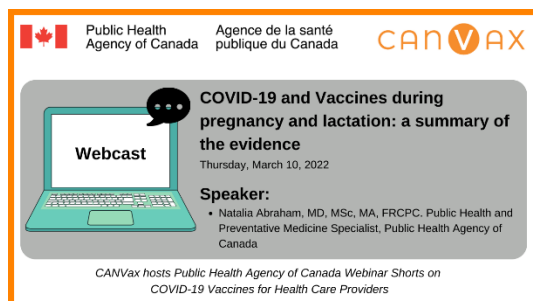
Experts Dr. Anna Taddio and Dr. Meghan McMurtry discuss contributors to stress-related reactions during vaccination and evidence-based strategies to improve the vaccine experience for people receiving vaccines and those who support them.

[Webinar - Building COVID-19 vaccine confidence before, during and after pregnancy: strategies for health care providers](#)



Experts Dr. Ève Dubé and Dr. Isabelle Boucoiran discuss challenges to vaccine confidence before, during, and after pregnancy and provide health care providers with evidence-based strategies to have effective conversations with families. (Recorded live on March 17, 2022).

[Webcast - COVID-19 and vaccines during pregnancy and lactation](#)



Expert Dr. Natalia Abraham shares the latest evidence on the impacts of COVID-19 during pregnancy, and the safety and effectiveness of COVID-19 mRNA vaccines during pregnancy and lactation, and among those planning to become pregnant. (Recorded March 2022).

Contact Vaccine Confidence

[Subscribe](#) to receive the PHAC Vaccine Confidence InfoBulletin directly in your inbox. To explore past issues, see [archived issues on CANVax's website](#).

Have questions or feedback to share? Email us: vaccination@phac-aspc.gc.ca

Please note that any medical questions should be directed to your local health care provider and any urgent medical questions should be directed to 911 or your local emergency department.

Annex

References

- [1] Fowlkes, et al. "Effectiveness of 2-Dose BNT162b2 (Pfizer BioNTech) mRNA Vaccine in Preventing SARS-CoV-2 Infection Among Children Aged 5–11 Years and Adolescents Aged 12–15 Years — PROTECT Cohort," *MMWR Morb Mortal Wkly*, vol. Rep 2022, no. 71, p. 422–428, 2022.
- [2] Dorabawila, et al. "Effectiveness of the BNT162b2 vaccine among children 5-11 and 12-17 years in New York after the Emergence of the Omicron Variant," *medRxiv*, vol. 02, no. 25, pp. 2227-1454, 2022.
- [3] Klein, et al. "Effectiveness of COVID-19 Pfizer-BioNTech BNT162b2 mRNA Vaccination in Preventing COVID-19–Associated Emergency Department and Urgent Care Encounters and Hospitalizations Among Nonimmunocompromised Children and Adolescents Aged 5–17 Years — VISION Network," *MMWR Morb Mortal Wkly Rep*, no. 71, p. 352–358, 2022.
- [4] Simmons, et al., "Vaccine Effectiveness Against Hospitalization Among Adolescent and Pediatric SARS-CoV-2 Cases in Ontario, Canada," *medRxiv*, vol. 03, no. 24, pp. 2227-2919, 2022.
- [5] Zambrano, et al. "Effectiveness of BNT162b2 (Pfizer-BioNTech) mRNA Vaccination Against Multisystem Inflammatory Syndrome in Children Among Persons Aged 12–18 Years — United States, July–December 2021," *MMWR Morb Mortal Wkly Rep*, no. 71, p. 52–58, 2022.