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Canada

Vaccine Confidence InfoBulletin

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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.

In this issue

Trending topics

March 4 is International Human Papillomavirus (HPV) Awareness Day

Find out more about the campaign #OneLessWorry from the International Papillomavirus Society & Immunize Canada, and learn about the HPV vaccine on PHAC's website.

Boosters shown to improve protection

A number of studies and government surveillance reports show that booster doses improve protection against severe disease, including improved protection from death due to the Omicron variant. Compared to two doses alone, a booster dose also appears to provide some improved protection against infection, and therefore transmission. For more information, see the Science spotlight on boosters.

Omicron sub-lineage dominates in some countries

The BA.2 sub-lineage of the Omicron variant has been detected in a number of countries, including Canada. It has become the dominant strain in Denmark and is rising quickly in the United Kingdom. For more information, see the Omicron report.

Go back to page 1

Featured article

Vaccination after infection

Due to the very large recent wave of COVID-19 cases caused by the highly infectious Omicron variant, many in Canada may find themselves having been recently infected with SARS-CoV-2 and wondering how long to wait after infection before receiving a dose of a COVID-19 vaccine. Previous infection does provide some protection against infection, but it is variable from person to person and decreases over time. Vaccination continues to be very important, even for those with a prior SARS-CoV-2 infection. Based on evidence to date, vaccination is expected to offer more robust and longer lasting protection.

On February 4, 2022, the National Advisory Committee on Immunization (NACI) issued updated guidance on the timing of COVID-19 vaccination after SARS-CoV-2 infection. Suggested intervals are intended to serve as a guide and are based on the available evidence on the safety, effectiveness and timing of vaccination following infection; immunological principles; and expert opinion. Suggested intervals between infection and vaccination may change as additional evidence emerges.

Suggested intervals between SARS-CoV-2 infection and COVID-19 immunization

The immunological principles that guide NACI's recommendation for intervals from infection to vaccination are similar to those that informed their recommendation of an optimal interval of 8 weeks between a first and second dose (or at least 8 weeks for those 5-11 years). The rationale is that longer intervals allow for the immune system to produce higher affinity antibodies that are expected to provide better, broader and longer lasting protection. Letting circulating antibodies decline following infection can also prevent immune interference that may disrupt the mounting of a robust immune response.

Numerous reports have documented that the risk of reinfection with Omicron is higher than with previous variants. Omicron infection is expected to generate a good immune response against Omicron for a period of time, allowing for a longer interval to vaccination. However, vaccination remains important, as the duration of such protection is not yet known. Additionally, COVID-19 vaccination with a product based on the ancestral strain is expected to broaden and strengthen the response in order to provide longer protection against current and future variants.

Individuals and their health care providers will want to evaluate their own level of exposure risk and vulnerability to severe outcomes when deciding whether to wait to be vaccinated following an infection with COVID-19. See next page for Table 1, pulled from NACI statement.

Go back to page 1

Table 1. NACI-suggested intervals between previous SARS-CoV-2 infection[a] and COVID-19 vaccination
(Shared from an Advisory Committee Statement (ACS) National Advisory Committee on Immunization (NACI) on February 4, 2022.) [1]

SARS-CoV-2 infection[a] timing relative to COVID-19 vaccination	Population	Suggested interval between SARS-CoV-2 infection[a] and vaccination (clinical discretion is advised)[b,c]
Infection prior to completion or initiation[c] of primary vaccination series	Individuals 5 years of age and older who are not considered moderately to severely immunocompromised and with no previous history of multisystem inflammatory syndrome in children (MIS-C)	Receive the vaccine 8 weeks after symptom onset or positive test (if asymptomatic)[b]
	Individuals 5 years of age and older who are moderately to severely immunocompromised and with no previous history of MIS-C	Receive the vaccine dose 4 to 8 weeks after symptom onset or positive test (if asymptomatic)[d]
	Individuals 5 years of age and older with a previous history of MIS-C (regardless of immunocompromised status)	Receive the vaccine dose when clinical recovery has been achieved or ≥90 days since the onset of MIS-C, whichever is longer
Infection after primary[d] series but before booster dose	Individuals 12 years of age and older currently eligible for a booster dose	3 months after symptom onset or positive test (if asymptomatic)[d] and provided it is at least 6 months from completing the primary series

[a] Previous infection can be defined in different ways based on jurisdictional policies and access to testing. The following suggestion can be considered to define previous infection with SARS-CoV-2:

- Confirmed by a molecular (e.g., PCR) or Health Canada-approved antigen detection-based test; or
- Symptomatic disease compatible with COVID-19 AND household exposure to a confirmed COVID-19 case

[b] These suggested intervals are based on immunological principles and expert opinion, and may change as evidence on COVID-19, variants of concern (VOCs), and COVID-19 vaccines emerge. When considering whether or not to administer vaccine doses following the suggested intervals outlined in this table, biological and social risk factors for exposure (e.g., local epidemiology, circulation of VOCs, living settings) and severe disease should also be taken into account. These intervals are a guide and clinical discretion is advised.

[c] For individuals who have not had any previous doses, they may receive their first dose after acute symptoms of COVID-19 have resolved and they are no longer infectious, or they may follow these suggested intervals. Individual benefit/risk assessment and clinical discretion are advised as per footnote "b". These suggested waiting times are intended to minimize the risk of transmission of COVID-19 at an immunization venue and to enable monitoring for COVID-19 vaccine adverse events without potential confounding from symptoms of COVID-19 or other co-existing illnesses.

[d] The primary series is outlined in the Canadian Immunization Guide. Note that for moderately to severely immunocompromised individuals who were immunized with a primary series that includes one additional dose, a booster dose would be subsequent to that immunocompromised primary series.

Go back to page 1

Vaccine confidence corner

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

Moderna COVID-19 boosters and vaccine hesitancy

While both the Moderna Spikevax™ (50mcg) and the Pfizer-BioNTech Comirnaty® (30mcg) mRNA COVID-19 vaccines have good safety profiles and provide enhanced protection against COVID-19 when offered as a booster dose, media reports have suggested that the Pfizer-BioNTech Comirnaty® booster is being preferred over the Moderna Spikevax™ booster.

In some cases, specific boosters are recommended for specific populations. In order to ensure adequate supply of appropriate boosters for each population, choice in brand for booster doses may not be available. Vaccinators and health care providers should be prepared to address brand specific hesitancy in the clinic.

What does NACI recommend?

The National Advisory Committee in Immunization (NACI) has preferentially recommended the use of the Pfizer-BioNTech Comirnaty® booster dose over the Moderna Spikevax™ booster in people 12 to 29 years of age if a booster dose is recommended.

- Compared to older age groups, adolescents and young adults 12 to 29 years of age have a higher rate of experiencing the rare risk of myocarditis and/or pericarditis after receiving an mRNA COVID-19 vaccine. This risk is lower with the Pfizer-BioNTech Comirnaty® vaccine.

- For adults 30 years of age and older, either Moderna Spikevax™ or Pfizer-BioNTech Comirnaty® vaccines may be used as a booster dose regardless of which COVID-19 vaccine was used in the primary series, given that this age group is at lower risk of vaccine-associated myocarditis/pericarditis.

- If using Moderna Spikevax™ for the booster dose, the 100 mcg dose may be preferred over the 50 mcg dose for those 70 years of age, those living in long term care homes for seniors or other congregate living for seniors or based on clinic discretion for moderately to severely immunocompromised adults.

    - When used as a booster, evidence indicates that Moderna Spikevax™ (100 mcg) induces somewhat higher antibody levels compared to Pfizer-BioNTech Comirnaty® (30 mcg). It is possible that Moderna Spikevax™ (100 mcg) may induce a better immune response than Moderna Spikevax™ (50 mcg). [2] [3]

Go back to page 1

For more detailed information on clinical considerations and product recommendations for COVID-19 boosters, refer to the Canadian Immunization Guide and recent guidance from NACI on boosters for adolescents 12-17 years of age.

Communicating with a vaccine-hesitant patient

When an individual presents for vaccination requesting an alternate vaccine to the one available to them, vaccine providers should non-judgmentally and non-confrontationally ask about their specific concerns about that vaccine. It is important to discuss their perceptions to try to determine if they are based on misinformation or misunderstanding. When correcting misinformation or misunderstanding, highlight the benefit of a booster dose and the safety and effectiveness of the vaccine being offered. Where possible, tailor the discussion to their particular situation, including elements that may be important for their decision, such as the risk of adverse events related to the vaccine versus their risk of complications from COVID-19.

Key messages to discuss with patients

- **A complete COVID-19 vaccine series continues to provide good protection against serious illness for most people, but a booster dose improves this protection.** Either Pfizer-BioNTech Comirnaty® or Moderna Spikevax™ COVID-19 mRNA vaccines are effective as boosters. Your provider will offer you the appropriate product and dose based on your age and medical conditions.
- **You may be offered a different mRNA vaccine for your booster dose than the vaccine product you received for your primary series.** It is fine to use a different vaccine for the primary series and booster dose, keeping in mind the product recommendations based on age and myocarditis/pericarditis risk.
- Evidence suggests vaccine effectiveness against infection with SARS-CoV-2 is decreasing over time following completion of the primary series. With the Omicron variant of concern widespread in Canada, **an mRNA COVID-19 vaccine booster dose will help to increase protection against severe COVID-19 disease.**

Go back to page 1

Mis/disinformation monitor alert

Presenting credible sources to debunk mis- and disinformation.

Misinformation is information that is false or misleading, but presented as fact, regardless of intention.

Disinformation is information which is intentionally created and circulated to deceive or mislead.

Pre-print studies & misinformation

In an effort to communicate emerging science quickly, the practice of publishing findings before peer review has become increasingly common, especially during the COVID-19 pandemic. The peer review process is a critical step for ensuring scientific accuracy, and experts know to view pre-prints with a critical and cautious eye.

During the peer review process other experts in the field dissect the study's methods, ensure that no miscalculations or misinterpretations were made, and that researchers accounted for potential confounding or effect modifying variables in their conclusions.

Scientists rely on this practice to improve their methods and build upon one another's expertise. In some ways, the practice of publishing pre-prints opens researchers up to broader and more public peer review which supports meaningful discourse about a study's methods or results. However, sometimes pre-print findings are reported by the news media or shared on social media without a critical eye —or worse — to seed and fuel the spread of misinformation.

In this month's misinformation monitor we examine two examples of such scenarios.

Example 1

The misinformation

Vaccine skeptics latched onto and made viral the findings of a recent preprint study from Ontario that was first posted on January 1, 2022. In the initial release of the pre-print, findings indicated that three doses of mRNA COVID-19 vaccines were only 37% effective against Omicron infection, while two doses had a **negative effect** on protection. [4] In the weeks following the initial release, over 17,000 Twitter users shared these findings including the group behind a competing viral vector vaccine Sputnik V, who shared the study with over one million of its followers.

Go back to page 1

How it was debunked

Following the release of the results in a pre-print, which were considerably lower than other studies' findings, scrutiny of the study's methods demonstrated some behavioural and methodical issues that were largely responsible for the surprising findings. Researchers have since revised their methods and integrated additional weeks of data. In the second preprint released on January 28, 2022, three doses were in fact found to be 61% effective against Omicron symptomatic disease (97% effective against Delta) and two doses had no effect (but not a negative effect) on protection against symptomatic Omicron infection after 180 days, findings that are consistent with other studies. [4]

How to critically interpret a pre-print

- When a study is cited in an article, **try to find the original study**. Articles will generally indicate whether the article is a pre-print or whether it was peer reviewed.
- **Interpret pre-print findings with caution.** Findings that spark sensational headlines or are dramatically different than those found in other studies should be viewed with caution.
- Where possible, **look for what experts are saying** about the findings.
- **Avoid sharing findings on social media before the study has undergone peer review**, or if sharing a pre-print, state that the findings are not yet peer reviewed and should be considered with caution.
- If a preprint's findings spark your interest, **keep an eye out for the final article and check Retraction Watch** for papers that have been retracted.

Example 2

The misinformation

A pre-print initially released on September 16, 2021, by researchers at the University of Ottawa Heart Institute reported an incidence rate of myocarditis of 1 per 1000 doses of vaccine administered. [5] This pre-print was shared over 15,000 times on Twitter, before being retracted by the authors.

How it was debunked

As in the previous example, the stark difference between their findings and established evidence drew scrutiny from experts. It was quickly identified that the study had used incomplete data on the number of the vaccines administered. The denominator for their rate should have been almost 25x higher than the number they used, which would have resulted in findings consistent with other reports on myocarditis incidence. The authors unanimously agreed to retract their paper.

Go back to page 1

Science spotlight

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

The science of decreasing vaccine effectiveness and boosters

As of February 11, 2022, over 52% of the eligible population in Canada had rolled up their sleeve for a third dose of a COVID-19 vaccine. Many public health experts are concerned that uptake of booster doses is dropping off. Pandemic fatigue, lower vaccine effectiveness against infection due to Omicron, recent SARS-CoV-2 infection and perceptions that are shifting towards 'living with COVID' may all be playing a part in decreasing enthusiasm for another dose. In order to best promote booster doses, it is helpful to understand the benefits of boosting and how it helps to prevent severe disease.

How does the body establish immunity in response to vaccines?

Two types of immune responses are generated towards a pathogen by vaccination or by infection: humoral (antibodies) and cellular (T cells). Long-lived responses are generated by memory B cells (that make antibodies) and memory T cells. Both these types of long-lived immunity are primed by the first exposure and mature over time.

Antibodies can serve several functions to flag and prevent infection, including neutralization of the pathogen before it can enter cells. After the first exposure to an antigen (an immune-priming molecule), the B cells begin to make antibodies and with subsequent exposures antibody levels increase rapidly followed by a slow decline. Following initial exposure, some of the B cells become memory B cells, which quickly recognize the antigen if it re-enters the body and can rapidly divide and become plasma cells to produce high quality and strongly binding (high affinity) antibodies to quickly fight infection. Boosting gives the immune system another opportunity to "see" the antigen and develop better antibodies to prevent infection and help respond to infection if it occurs.

With the cellular immune response, when exposed to an antigen, T cells break into different kinds of effector cells that play a role in fighting an infection. Killer T cells destroy infected cells preventing replication of the virus in the host cell. Helper T cells are even more important as they communicate using chemical signals to strengthen killer T cells as well as antibody producing B-cells. Like memory B cells, memory T cells are created after an exposure and can be rapidly called into action on subsequent exposures. Humoral and cellular compartments of the immune response work together: antibodies may be called to action quickly to try to prevent cells from becoming infected in the first place and cellular immune responses deal with infected cells that slip through antibody defenses. The T cell response can prevent the infection from becoming widespread or severe.

Go back to page 1

While neutralizing antibody responses to the Omicron variant have generally been poorer than against other variants, causing a reduction in vaccine effectiveness against infection, T cell responses against Omicron have generally remained strong, providing protection against more severe disease and offering protection for at least several months after a primary series. T cells responses are also better maintained across different variants, even those that are highly mutated like Omicron, and so T cells are more likely to combat emerging future variants. Just like a booster dose helps to develop better antibodies, it can also generate more robust killer T cells that can respond better to an infection.

Why does vaccine effectiveness decrease over time?

Vaccine effectiveness can refer to several different outcomes, such as effectiveness against any infection, symptomatic disease, severe disease and death. Initially after two doses of vaccine in a primary series, protection against infection and symptomatic illness was high but decreases in protection against infection and symptomatic disease occur as antibodies decline over time, as well as with the emergence of immune evasive variants.

The Omicron variant is genetically quite different from previous variants and from the wild-type strain on which the vaccine is based, and therefore substantial decreases in vaccine effectiveness against infection have been noted since Omicron's arrival in Canada. However, the goal of a vaccination campaign is to minimize harm from a disease, so while infections may still occur, the effectiveness against severe disease and death are the true measures of a vaccine's success.

How do booster doses help?

Booster doses provide a considerable increase in protection against the Omicron variant. [6]

Infection/symptomatic disease: As noted, protection against infection and symptomatic disease from the primary vaccine series decreases over time and is limited against Omicron. With a booster dose, protection against infection and symptomatic Omicron disease increases to about 60% (from almost no protection 6 months following the second dose), though this protection will also likely decrease over time.

However, as noted above, protection against infection and symptomatic disease are not the primary objectives of a vaccination campaign, which is really aimed at preventing serious disease and death.

Severe disease: Two doses of an mRNA vaccine provide good protection against severe Omicron disease (approximately 64% to 86%), which declines over time from the second dose. Protection from severe Omicron disease increases to approximately 90% or more after the booster dose but it is possible that this protection may also decrease over time.

Omicron report & vaccination updates

Omicron variant

During the period of February 11 to 17, 2022, an average of 7,726 new cases were reported daily across Canada. [7] While this is a 25% decrease compared to the week prior, these daily case counts together with other indicators of COVID-19 disease activity, including 13% laboratory test positivity during the the period of February 9 to 15, 2022, indicate persistent widespread activity across the country. [7] As such, maintaining layers of protection remains important to reduce spread, particularly as we continue to spend more time indoors over the winter and as public health measures ease. [7]

Up-to-date vaccination, including a booster dose when eligible, continues to be recommended to provide better protection from severe outcomes, including due to Omicron.

As the SARS-CoV-2 virus continuously evolves, it has the potential to generate new sub-lineages. The Omicron variant of concern currently has four sub-lineages including B.1.1.529, BA.1, BA.2 and BA.3. [8] While BA.1 is the dominant strain globally, BA.2 is quickly increasing in some countries. [8]

Sub-lineage BA.2

As of February 17th, 2022, the BA.2 sub-lineage of Omicron has been detected in 57 countries, including Canada, Denmark, England, India, Qatar, the Philippines and South Africa. It is now dominant over BA.1 in Denmark and it is increasing in England and some other countries.

What do we know so far about the sub-lineage BA.2?

- BA.2 appears to be more transmissible than BA.1 [9] [10] [11]
- BA.2 severity appears similar to BA.1 [9]
- The impact of BA.2 on vaccine effectiveness is still uncertain
    - According to a technical brief from the UK Health Security Agency, there is no evidence of differences in immune escape or vaccine effectiveness (VE) against symptomatic BA.1 and BA.2 based on preliminary evidence from England. [10]

- A household transmission study from Denmark suggested vaccine effectiveness (VE) for BA.2 may be lower than BA.1. [11] The confidence intervals in this study overlap and therefore these differences may not be statistically significant and require verification in additional studies.

- A study on the immune response to BA.1 and BA.2 after vaccination and after infection with BA.1 suggest that the responses are slightly lower for BA.2 but generally similar. [12]

- Additional information on vaccine effectiveness of BA.2 is being monitoring closely.

- It is not yet known if people who have a BA.1 infection can be re-infected with BA.2. This is also being closely watched.

For more information on COVID-19 variants in Canada, refer to the COVID-19 daily epidemiology update page.

Community spotlight

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

The Sickle Cell Awareness Group of Ontario (SCAGO): Improving Vaccination Acceptance within the Sickle Cell Disease/Black Community

Sickle cell disease (SCD) is the most common genetic blood disorder and it disproportionately affects Black communities in Canada. February is Black History Month and, in recognition of its importance, this month's spotlight is on SCAGO's project to improve vaccination acceptance within SCD and Black communities.

There is a high level of hesitancy with respect to COVID-19 vaccination amongst individuals with SCD and Black communities in general. Historically, Black people were unethically treated in research studies where they did not give informed consent, and they were told lies about their treatment. [13]

For example, the Tuskegee syphilis experiment famously withheld treatment from Black men suffering from Syphilis without informing them of the true nature of the disease or treatment options, so that researchers could study the natural course of the disease. This also contributed to burden of disease within the community, as study participants unknowingly passed the disease to their partners.

This is only one example, which illustrates the historic, generational experiences that inform distrust and reluctance to engage with the medical community. Moreover, at present, continued experiences of systemic and interpersonal racism in healthcare settings remain reasons for lack of confidence in vaccines.

With support from PHAC's Immunization Partnership Fund (IPF), the SCAGO, in collaboration with medical and community partners, is utilizing an evidence-based cultural lens, as well as innovative mechanisms, to provide SCD and Black communities with the education and support that they need in order to improve COVID-19 vaccination acceptance and uptake. Their COVID-19 Hub is the cornerstone of this effort. Check out the resources and please share widely with patients and colleagues.

About the SCAGO

The SCAGO is a leading provincial charitable patient organization with a vision to optimize the lives of individuals and families living with sickle cell disease. This is part of a broader vision for every Ontarian with sickle cell disease to have equal and equitable access to comprehensive, standard care regardless of where they reside in the province. SCAGO provides evidence-based support to families with sickle cell disease across all four regions of Ontario. The organization supports clinical research, engages in psychosocial research, health promotion, patient and care provider education, community awareness, and development of best practices guidelines.

About IPF

PHAC's Immunization Partnership Fund (IPF) provides funding for projects that improve access to vaccines and encourage vaccine acceptance and uptake. Funded projects build capacity of health care providers as vaccinators and vaccination promoters; support community-based COVID-19 education, outreach, and vaccine promotion; and build capacity for evidence-based and culturally appropriate vaccine communication.

Go back to page 1

PHAC webinars 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 focused on providing health care providers with clinical guidance related to key vaccine topics.

Upcoming Webinars

- **Thursday, March 17**
  3:30 - 4:40 p.m. EST
  COVID-19 vaccine confidence before, during and after pregnancy: Strategies for health care providers

- **Le vendredi 18 mars**
  12h00- 13h00 HNE
  La confiance envers les vaccins contre la COVID-19 avant, durant et après la grossesse: stratégies pour les fournisseurs de soins de santé

Webinar Watch List

- COVID-19 Vaccine for Pediatric Use in Canada
- Preparing for Pediatric COVID-19 Immunization and Adult Booster Doses
- Revaccination with COVID-19 Vaccines after Anaphylaxis
- Contraindications to COVID-19 Vaccines
- Addressing COVID-19 Vaccine Hesitancy in Clinical Practice

Stay current

- Subscribe to receive this PHAC Vaccine Confidence InfoBulletin directly in your inbox.
- Subscribe to stay up-to-date on the latest guidance and information from the Canadian Immunization Guide (CIG) and/or the National Advisory Committee on Immunization (NACI).
- Subscribe to the CANVax Boost newsletter and NCCID News Alerts to stay up-to-date on upcoming PHAC webinars and more.

Vaccine confidence feedback:

Have questions or practices 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.

Go back to page 1

Annex

Featured resources

CIG COVID-19 chapter

- The COVID-19 vaccine chapter can be found under Part 4: Active Vaccines of the Canadian Immunization Guide.

Child & youth resources

- **Fact sheet**
  - Get the facts: Vaccinating children against COVID-19

- **Ask the expert videos - medical experts answer common questions about COVID-19 vaccines for children 5 to 11 years old**
  - What are the benefits of vaccinating my child against COVID-19?
  - How are children's COVID-19 vaccines monitored for safety and side effects?
  - My child is big for their age or turns 12 soon. Should they wait to receive the dose for ages 12 and up?

- **Social media shareables**
  - Share the facts about COVID-19 vaccines for kids

- **Quick reference guides**
  - Use of COVID-19 vaccines for children (5 to 11 years of age)
  - Use of COVID-19 vaccines for youth and adults (12 years and over)

- **Guidance for parents and guardians**
  - Making COVID-19 vaccination decisions for children 5 to 11 years of age

- **Needle fear support**
  - The CARD™ System for coping with needle fear and anxiety in children

References

[1] National Advisory Committee on Immunization (NACI), "Rapid response: Updated guidance on COVID-19 vaccination timing for individuals previously infected with SARS-CoV-2," 4 February 2022. [Online]. Available: https://www.canada.ca/content/dam/phac-aspc/documents/services/immunization/national-advisory-committee-on-immunization-naci/naci-rapid-response-updated-guidance-covid-19-vaccination-timing-individuals-previously-infected-sars-cov-2.pdf.

[2] R. L. Atmar, K. E. Lyke and e. al., "Pre-Print: Heterologous SARS-CoV-2 Booster Vaccinations – Preliminary Report," medRxiv: the preprint server for health sciences, 2021.

[3] A. Munro, L. Janani and et al., "Safety and immunogenicity of seven COVID-19 vaccines as a third dose (booster) following two doses of ChAdOx1 nCov-19 or BNT162b2 in the UK (COV-BOOST): a blinded, multicentre, randomised, controlled, phase 2 trial," *The Lancet,* vol. 398, no. 10318, pp. 2258-2276, 18 December 2021.

[4] A. Miller, "Canadian COVID-19 vaccine study seized on by anti-vaxxers — highlighting dangers of early research in pandemic," 15 January 2022. [Online]. Available: https://www.cbc.ca/news/health/covid-19-vaccine-study-omicron-anti-vaxxers-1.6315890. [Accessed 8 February 2022].

[5] A. Miller, "A Canadian COVID-19 study that turned out to be wrong has spread like wildfire among anti-vaxxers," 25 September 2021. [Online]. Available: https://www.cbc.ca/news/health/covid-19-vaccine-study-error-anti-vaxxers-1.6188806. [Accessed 8 January 2021].

[6] UK Health Security Agency, "COVID-19 Surveillance Report: Week 4," 27 January 2022. [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1050721/Vaccine-surveillance-report-week-4.pdf.

[7] Government of Canada, "Statement from the Chief Public Health Officer of Canada on February 18, 2022," 18 February 2022. [Online]. Available: https://www.canada.ca/en/public-health/news/2022/02/statement-from-the-chief-public-health-officer-of-canada-on-february-18-2022.html. [Accessed 22 February 2022].

[8] World Health Organization, "Enhancing response to Omicron SARS-CoV-2 variant: Technical brief and priority actions for Member States (Update #6)," 21 January 2022. [Online]. Available: https://www.who.int/publications/m/item/enhancing-readiness-for-omicron-(b.1.1.529)-technical-brief-and-priority-actions-for-member-states. [Accessed 4 February 2022].

[9] Statens Serum Institute, "Despite historically high infection rates, admissions do not follow," 26 January 2022. [Online]. Available: https://www.ssi.dk/aktuelt/nyheder/2022/paa-trods-af-hoeje-smittetal-foelger-indlaeggelserne-ikke-med. [Accessed 4 February 2022].

[10] UK Health Security Agency, "SARS-CoV-2 variants of concern and variants under investigation in England (Technical Briefing 35)," 28 January 2022. [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1050999/Technical-Briefing-35-28January2022.pdf. [Accessed 4 February 2022].

[11] F. P. Lyngse, C. T. Kirkeby, M. Denwood, L. E. Christiansen, K. Mølbak, C. H. Møller, R. L. Skov, T. G. Krause, M. Rasmussen, R. N. Sieber, T. B. Johannesen, T. Lillebaek, J. Fonager, A. Fomsgaard, F. Trier Møller, M. Stegger, M. Overvad, K. Spiess and L. Hvas Mortensen, "Transmission of SARS-CoV-2 Omicron VOC subvariants BA.1 and BA.2: Evidence from Danish Households," *medRxiv,* 30 January 2022.

[12] J. Yu, A.-r. Y. Collier, M. Rowe, F. Mardas, J. D. Ventura, H. Wan, J. Miller, O. Powers, B. Chung, M. Siamatu, N. P. Hachmann, N. Surve, F. Nampanya, A. Chandrashekar and D. H. Barouch, "Comparable Neutralization of the SARS-CoV-2 Omicron BA.1 and BA.2 Variants [preprint]," 2022.

[13] Centers for Disease Control and Prevention (CDC), "The U.S. Public Health Service Syphilis Study at Tuskegee," 22 April 2021. [Online]. Available: https://www.cdc.gov/tuskegee/index.html. [Accessed 7 February 2022].

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