



THE COVID-19 VACCINE AND CANCER: FREQUENTLY ASKED QUESTIONS

The following are frequently asked questions about the COVID-19 vaccine and adult cancer patients. The information is:

- related to the Pfizer and the Moderna COVID-19 vaccines that use mRNA technology
- related to the AstraZeneca COVID-19* and Johnson & Johnson vaccines that use non-replicating viral vectors (adenovirus)
- current as of June 14, 2021

The information below may not be appropriate for all patients. Prescribers must determine whether adopting suggested COVID-19 vaccine information is clinically appropriate for individual patients through a risk-benefit assessment. Consult appropriate clinical prescribing guidelines and local institutional guidance for patient prioritization to inform treatment and vaccination decisions.

Everyone should receive a COVID-19 vaccination, when available, unless contraindicated. There are limitations to the current knowledge around the use of COVID-19 vaccines in the cancer population. The advice below is based on the best available evidence at this time. Guidance will be updated as more real-world evidence becomes available.

Patients should continue to practice recommended public health measures for prevention of COVID-19 infection regardless of vaccination status.

** Note that COVISHIELD (manufactured by Serum Institute of India) and the AstraZeneca COVID-19 vaccine (manufactured by AstraZeneca) are ChAdOx1-S recombinant vaccines developed by AstraZeneca and the University of Oxford. Health Canada has reviewed the manufacturing information for these vaccines and found them to be comparable.*

1. Are all COVID-19 vaccines safe for cancer patients?

COVID-19 vaccine candidates use either conventional or novel mechanisms of action to safely elicit immune responses. Conventional platforms include recombinant viral proteins, live attenuated vaccines and inactivated vaccines, while novel methods include viral vector-based vaccines and mRNA-based vaccines.⁸

The safety of COVID-19 vaccines in cancer patients is currently under investigation. Preliminary data suggests that the Pfizer vaccine is safe for use in cancer patients. In addition, prior experience with other protein-based or inactivated vaccines have not reported unique or major side effects in immunocompromised patients.⁷ The most

frequently reported side effects of COVID-19 vaccine candidates were usually mild or moderate and include pain at the site of injection, fatigue, headache, myalgias and fever (see Question 6 below).

Live attenuated vaccines carry the risk of disease caused by vaccine strains and are not recommended during and after immunosuppressive therapy (such as chemotherapy).³

Currently, these are the vaccines authorized for use in Canada for active immunizations to prevent COVID-19:

- Pfizer COVID-19 mRNA vaccine (Tozinameran or BNT162b2)
- Moderna COVID-19 mRNA vaccine (mRNA-1273 SARS-CoV-2)
- AstraZeneca COVID-19 non-replicating adenovirus vaccine (AZD1222 or ChAdOx1-S recombinant)
- Johnson & Johnson non-replicating adenovirus vaccine (Ad26.COV2.S, recombinant)

The Pfizer vaccine is authorized for use in individuals 12 years of age and older; the Moderna, AstraZeneca and Johnson & Johnson vaccines are authorized for use in individuals 18 years of age and older. Refer to local public health guidance for recommendations on which vaccine to use for specific age groups.

The Johnson & Johnson vaccine is given intramuscularly as a single dose, while the Pfizer, Moderna and AstraZeneca vaccines are administered intramuscularly as a series of two doses. The recommended immunization schedules of the 2-dose COVID-19 vaccines are listed in Table 1.

The following patient groups should receive the COVID-19 vaccine at the dose interval recommended by the manufacturers:¹⁵

- Transplant recipients (including solid organ transplants and hematopoietic stem cell transplants).
- Patients receiving active treatment (chemotherapy, targeted therapies, immunotherapy, excluding individuals receiving solely hormonal therapy or radiation therapy) with:
 - Malignant hematologic disorders
 - Non-hematologic malignant solid tumors

Refer to the latest [NACI](#) and [Ministry of Health](#) recommendations on the use, dosing interval and interchangeability of approved COVID-19 vaccines.

Table 1: Recommended Immunization Schedule of 2-dose COVID-19 Vaccines^{1,4,5,6,12}

Vaccine product (manufacturer)	Clinical trial interval	Minimum interval	Manufacturer authorized interval ^a
Pfizer COVID-19	19-23 days	19 days	21 days
Moderna COVID-19	21-42 days	21 days	28 days
AstraZeneca COVID-19	3-26 weeks	4 weeks	4 to 12 weeks ^b

^aWhile efforts should be made to vaccinate according to the authorized schedules as per individual vaccine product monographs, extended vaccination intervals may be considered in the context of limited vaccine supply; however, they may not be appropriate in certain patient populations, as described above.^{13, 15}

^bA 12-week interval is preferred for the AstraZeneca COVID-19 vaccine based on available ad hoc analyses of the vaccine clinical trial interval data; efficacy may be lower if interval is less than 12 weeks, in the general population.

Both the Moderna and Pfizer vaccines use COVID-19's genetic code in the vaccine, exploiting the host cell to translate the code and make the target spike protein, eliciting both neutralizing antibody and cellular immune responses.⁴ The AstraZeneca and Johnson & Johnson COVID-19 vaccines use replication deficient adenovirus vectors, to deliver the COVID-19 spike protein genetic sequence into the host cell, locally stimulating neutralizing antibody and cellular immune responses.^{11,12, 14} As there is no whole, live or replicating virus involved, the vaccines cannot cause disease and, therefore, may be administered to cancer patients after a risk-benefit assessment by the cancer health care team. It is important to note that immunocompromised persons, including individuals receiving immunosuppressant therapy, may not produce a full antibody response and should therefore continue to follow Public Health guidance to avoid exposure, unless otherwise advised by their health care team.¹⁰

References:

1. Recommendations on the use of COVID-19 Vaccine(s). National Advisory Committee on Immunization (NACI). May 28, 2021.
2. COVID-19 About Vaccines. Ministry of Health. Version 1, December 12, 2020
3. Lopez A, Mariette X, Bachelez H, et al. Vaccination recommendations for the adult immunosuppressed patient: a systematic review and comprehensive field synopsis. *J Autoimmun* 2017;80:10–27.
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5. Pfizer-Biontech COVID-19 Vaccine Product Monograph. December 9, 2020.
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14. Janssen Covid-19 Vaccine Product Monograph. Janssen Inc., April 23, 2021.
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2. Which patient factors require further consideration prior to receiving a COVID-19 vaccine?

Patients with a history of severe allergy (e.g. anaphylaxis) to the COVID-19 vaccine or any of its components, including PEG, polysorbate or tromethamine should be referred to an allergist/immunologist to determine if the vaccine can be safely administered.¹ Refer to question 7: “Can a cancer patient receive the COVID-19 vaccine if they have allergies?” for more information.

Patients who have experienced a previous cerebral venous sinus thrombosis (CVST) with thrombocytopenia or heparin induced thrombocytopenia (HIT) should only receive the adenovirus-based vaccines if the potential benefits outweigh the potential risks.^{2,3} A combination of thrombosis and thrombocytopenia, in some cases accompanied by bleeding, has been observed very rarely following vaccination with adenovirus-based vaccines. Refer to question 6: “What are possible side effects of the vaccination?” for more information.

Patients who have experienced major venous and/or arterial thrombosis with thrombocytopenia following vaccination with a viral vector COVID-19 vaccine should not receive a second dose of a viral vector COVID-19 vaccine.⁴

Patients who have had a hypersensitivity reaction to any other adenovirus-based vaccines should not receive the Johnson & Johnson vaccine.³

References:

1. COVID-19 Vaccination Recommendations for Special Populations (Version 4). Ministry of Health, May 27, 2021.
2. AstraZeneca COVID-19 Vaccine Product Monograph. April 23, 2021.
3. Janssen Covid-19 Vaccine Product Monograph. Janssen Inc., April 23, 2021.
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3. Which cancer patients are at a higher risk of becoming infected with COVID-19 and/or having severe complications with COVID-19?

Cancer patients have a higher risk of contracting COVID-19 and some cancer patients are at higher risk for poorer outcomes with the infection. The following patients are at a higher risk:

- Patients with **hematological cancers**
- Patients with **lung cancer**
- Patients who were **diagnosed with cancer within the last year**
- **Patients who have had a stem cell transplant within the last 6 months**
- Patients with **active cancer**, defined as:
 - **metastatic disease** and/or
 - receiving or recently completed cancer-directed **systemic treatment, radiation therapy, or surgical resection**

Also consider the following patient factors when determining risk:

1. Time since diagnosis:

Patients with a recent diagnosis (within the last year) especially those with a hematologic malignancy have an increased risk of mortality with COVID-19 compared to those with a less recent diagnosis. Patients with a diagnosis 1 to 5 years prior have a higher risk of mortality than patients with a diagnosis beyond 5 years. Patients with hematologic malignancy or following allogeneic stem cell transplant may remain at high risk of infection and mortality even beyond 5 years, as they are often on a prolonged course of treatment or have ongoing significant immunosuppression.

2. Cancer type:

In general, patients with hematologic cancers who are at any stage of treatment (especially those ≥ 60 years of age) and patients with lung cancer have a higher risk of mortality compared to patients with other cancer diagnoses.

3. Treatment type:

There is some evidence to suggest that patients who are currently or recently (within the last 6 months) treated with immune checkpoint inhibitors are at a higher risk of mortality; however, the population-based data are likely to be influenced by a number of confounding factors. Multiple studies were unable to demonstrate whether other systemic treatment types (such as chemotherapy and targeted therapy) increase the risk of mortality from COVID-19. In a population-based study, however, patients with active cancer, particularly those on active treatment, were associated with higher rates of hospitalization, ICU admission, and 30-day mortality. In addition, patients on active treatment may be at an increased risk of neutropenia and development of infections. Patients who have had a stem cell transplant within the last 6 months are also considered to be higher risk.

4. Other factors:

- (a) Older patients (≥ 65) are at higher risk of mortality compared with younger patients.
- (b) Patients who have recently had neutropenia (within 90 days) and patients with lymphopenia at time of COVID-19 diagnosis are at a higher risk of mortality.
- (c) Patients who smoke or have other comorbidities, including obesity, may be at risk for increased hospitalizations and mortality. Follow local public health advice to determine risk based on non-cancer related factors.
- (d) Consideration of COVID-19 vaccination should be given to household or close contacts of cancer patients at higher risk of infection/mortality (based on public health guidance) to reduce the risk of exposure to the virus.

Rationale:

Current available data suggest that COVID-19 mortality is higher in patients with cancer than in the general population.^{1,2,3,4,5,14,15} A pooled analysis of 18,650 found the probability of death to be 25.6% in patients with both a COVID-19 and cancer diagnosis.³ A multivariate analysis of over 10,000 COVID-19 deaths from the UK found that, relative to patients without cancer, patients with nonhematologic malignancy diagnosed within one year prior to a COVID-19 diagnosis had a 1.8-fold higher risk of death, and a hematologic malignancy carried a fourfold higher risk.⁵ The risks were lower for patients diagnosed with cancer 1 to 4.9 years prior to COVID-19 when compared those diagnosed within the preceding year; however, risk was still elevated compared with people without cancer.

Beyond five years, risks for death remained elevated for those with hematologic but not for those with nonhematologic malignancies.⁵

Most studies show a higher risk of mortality among patients with hematologic and lung cancers.^{1,6,7,16} A small Chinese study suggested that lung cancer, metastatic disease, and hematologic malignancy may be associated with higher rates of COVID-19–related death and intensive care unit (ICU) admission.⁶ A larger study of 309 cancer patients with a diagnosis of COVID-19 found that hematologic malignancies were associated with increased COVID-19 severity and patients with lung cancer demonstrated higher rates of severe or critical COVID-19 events.¹ Adults with hematologic cancers are reported to be at high risk for progression to severe disease and death from COVID-19, with an estimated mortality of 36% or greater.¹⁹

An analysis of 536 Italian patients with hematologic malignancy and COVID-19 found that mortality was significantly higher than in the general Italian population with COVID-19, regardless of age.⁷ A large meta-analysis found the risk of death among adults with hematologic malignancies (n = 3240) was 34 percent, and patients ≥60 years of age had a significantly greater risk of dying than did younger patients (relative risk [RR] 1.82, 95% CI 1.45-2.27).⁸

A multi-institutional international registry study including 400 patients with thoracic cancer also diagnosed with COVID-19 showed that many patients were hospitalized (78%), and 36 percent of patients died.^{9,10} Patients who had received chemotherapy within three months had a higher risk of dying from COVID versus patients who did not (hazard ratio 1.7, 95% CI 1.1-2.6); however, in univariate analysis, there were no factors that were identified, including active cancer treatment, as being associated with mortality.¹⁰

Recent active oncologic therapy did not appear to increase the risk of mortality from COVID-19 in some studies. Jee et al reported that cytotoxic chemotherapy was not significantly associated with a severe or critical COVID-19 event and a systemic review indicated that there was no association between receipt of a particular type of oncologic therapy and mortality.⁴ Patients on active immunosuppressive therapy (such as chemotherapy) are, however, more likely to be neutropenic and are at a high risk of developing infection.¹² Robilotti et al analysed 423 patients with cancer and COVID-19 and found that age older than 65 years and treatment with immune checkpoint inhibitors (ICIs) were predictors for hospitalization and severe disease, whereas receipt of chemotherapy and major surgery were not. In this study, treatment with ICI predicted both hospitalization and severe disease, although there was considerable heterogeneity in ICI-treated tumor types, and disease-specific factors could not be individually addressed.¹¹

Garassino reviewed evidence around ICIs and COVID outcomes, which included further analysis of the Robilotti data. It was concluded that there is insufficient evidence at this time to suggest that ICIs worsen complications from COVID-19 and that the population-based registries reporting on the incidence of COVID-19 in patients with cancer receiving ICI therapy compared with patients with cancer not receiving ICI or individuals without cancer, are likely to be plagued by multiple confounding factors.

A recent population-based study with 323 patients enrolled prior to the pandemic (n=67 cancer patients; n= 256 non-cancer patients) compared COVID-19 outcomes. After adjusting for demographics, smoking status, and comorbidities, a diagnosis of cancer was independently associated with higher odds of hospitalization (odds ratio = 2.16, 95% confidence interval = 1.12 to 4.18) and 30-day mortality (odds ratio = 5.67, 95% confidence interval = 1.49 to 21.59). Notably, older age, Black race, and number of comorbidities were statistically significantly associated with increased odds of hospitalization and ICU admission (all P<.05). In addition, exploratory subgroup

analyses were performed to investigate these associations among patients with active cancer (defined as having metastatic disease and/or receiving cancer-directed systemic therapy, radiation therapy, or surgical resection in the 2 months before COVID-19 diagnosis) compared with noncancer patients, as well as those with cancer in remission compared with noncancer patients. The analyses showed that adjusted associations with hospitalization, ICU admission, and 30-day mortality were strongest in the active cancer patient group. The authors concluded that patients with cancer, particularly those receiving active treatment, should be among groups specifically targeted for COVID-19 mitigation and prevention strategies such as vaccination.¹⁴

Lymphopenia at COVID-19 diagnosis was associated with higher rates of severe critical illness.¹ Patients with baseline neutropenia 14-90 days before a COVID-19 diagnosis had worse outcomes.¹ In addition, current literature suggests that the likelihood of a severe illness and death from COVID-19 is higher among adult patients with cancer who have other comorbidities, including obesity.²

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4. When will cancer patients receive immunity (mount an immune response) after the COVID-19 vaccine?

In the general population, individuals may not receive optimal protection until after the vaccine series is completed.^{1,2,7,8,9,10,12} Immunocompromised individuals were excluded in the published Phase 2/3 clinical studies.^{1,2} There is limited research around the safety and efficacy of the COVID-19 vaccine for cancer patients. Most immunocompromised patients, including **cancer patients**, will develop some antibody response to the vaccine; however, it may be diminished.^{11,14} Patients should continue to follow Public Health guidance to avoid exposure to COVID-19, unless otherwise advised by their health care team.^{1,2} Consideration for vaccination should be given to household or close contacts of cancer patients as soon as they are eligible, based on public health criteria in their area.⁴

Patients with hematologic malignancy may be at a significant risk to COVID-19 as a result of both their underlying condition and their treatment that may affect antibody producing B-cells.³ Although immune response may be sub-optimal, inactivated vaccines should be administered to patients with hematologic malignancy according to a risk-benefit assessment by the cancer health care team.^{4,5} COVID-19 vaccination may still offer some protection, and some protection is better than none.⁶

To optimize immune response, individuals on active treatment for malignant hematologic disorders and active treatment for non-hematologic malignant solid tumors, excluding individuals receiving solely hormonal therapy or radiation therapy, should receive the COVID-19 vaccine at the dose interval indicated in the product monograph.¹³

References:

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5. When is the optimal time for cancer patients to receive the COVID-19 vaccine?

Ideally, vaccination should occur at a time when patients are most likely to mount immune responses.²⁶ Clinical trials for COVID-19 vaccines to date have not yet published data on immunocompromised patients, and thus **the optimal timing for COVID-19 vaccination of patients receiving cytotoxic chemotherapy, immunotherapy, targeted therapy and radiation therapy has not yet been established**. Based on experience with other protein-based and inactivated vaccines, inactivated vaccines have been shown to be safe in most immunocompromised patients,^{1,17} although the exact effects of the COVID-19 vaccine in cancer patients is still under investigation. The efficacy, however, will depend on the patient's ability to mount a response to the vaccine.³⁰ Based on experience with the flu vaccine, response rates can be highly variable, and the **effectiveness of the vaccine will depend on underlying disease, the type, and timing of treatment that could hinder a patient's ability to mount an immune response**.^{17,18}

The following guidance on the timing of the COVID-19 vaccine administration, in relation to treatment for cancer patients has been adapted from information pertaining to the inactivated influenza vaccine and will be updated as new evidence emerges.

General guidelines:

- Clinical judgement should be exercised around administration of the complete series of the vaccine prior to initiation of systemic treatment (chemotherapy or immunotherapy). Prioritization of systemic treatment over vaccination, or vice versa, should be determined via risk assessment, considering factors such as patient's age, comorbidities, treatment intent, type of treatment, etc.

- When feasible, vaccines should be administered at least 2 weeks before initiation of systemic treatment to optimize immunogenicity.^{1,2,4,20}
- For COVID-19 vaccines given as a 2-dose series:
 - If the complete series of the vaccine cannot be administered 2 weeks before the start of treatment, the first dose of the vaccine should be administered at least 2 weeks before initiation of systemic treatment, and the second dose within a few days prior to administration of systemic treatment. Although evidence around timing with systemic treatment varies, this can minimize uncertainty around the cause of flu-like symptoms or infusion-related reactions if vaccine is administered around the day of systemic treatment.^{5,6,20,21}
 - If the second dose cannot be administered within a few days of systemic treatment administration, a risk assessment should be conducted around prioritization of either the treatment schedule or vaccination schedule, with consideration for factors such as patient's age, comorbidities, treatment intent, type of treatment, etc.
 - If administration of the second dose of the vaccine is delayed, it should be administered as soon as possible.¹⁹
- Patients receiving vaccine during treatment may have an attenuated or absent response to the vaccine and should continue to exercise precautions when possible (wearing a mask when unable to maintain social distance etc.).^{1,2,4,20}
- Patients who are not on active treatment may receive the vaccine after an appropriate time has passed since their last treatment was completed, depending on the agents used.

Cytotoxic Chemotherapy

- If feasible, allow at least two weeks to pass after the second vaccine dose before starting cytotoxic therapies to allow for memory T cell formation.²²
- During active chemotherapy treatment, both doses of the vaccine should be administered, at minimum, within a few days prior to next chemotherapy cycle, if feasible (i.e. when immunosuppressive effects of cytotoxic chemotherapy are at their lowest and not on the same day of chemotherapy).^{5,6,20}
- Immunization in patients receiving chemotherapy when blood counts are low is discouraged.^{13,14}
- Induction Chemotherapy for Leukemia:
 - Vaccine should be given at least 2 weeks prior to the start of immunosuppressive therapy or when effects of immunosuppressive therapy are at the lowest level.²
 - If the vaccine cannot be given prior to start of induction treatment in acute leukemia, it may be given upon blood count recovery, prior to the start of consolidation treatment.

Targeted therapy

- Vaccine may be administered at any time during treatment for most targeted therapies. Consideration for timing should be taken for targeted treatments that may cause neutropenia or lymphopenias.^{3,20}

Immunotherapy

- Monoclonal antibodies:
 - If feasible, allow at least two weeks to pass after the second vaccine dose before starting B-cell depleting therapies to allow for memory T cell formation.²²
 - Patients receiving maintenance rituximab may receive vaccine at any time during treatment; although there may be a reduced response, extrapolated evidence suggests it is unlikely to cause harm.^{7,20}
- Immune checkpoint inhibitors (ICI):
 - Many trials using ICI do not allow vaccinations due to a concern of increased autoimmune events. However, evidence with inactivated influenza vaccine suggests that patients receiving ICI therapy may not experience an increase in immune-related adverse events when they receive the vaccine within 2 months of treatment.^{9,10} Recent research with mRNA vaccines supports this. Cancer patients treated with ICI who received mRNA vaccine were not likely to develop new immune-related side effects or exacerbation of existing immune-related side effects in the short-term.³¹
 - For patients receiving a combination of ICI, the risk of increased autoimmune events is uncertain and should be weighed against the definite risk of a patient potentially contracting COVID. Experience with vaccinations in this population is mostly with the influenza vaccine and more data will need to be collected before any further recommendations can be made.

Radiation Therapy

- Patients who are receiving radiation therapy alone (not in combination with chemotherapy) may receive vaccine at any time during treatment.²⁰

Stem cell transplant

- If feasible, both doses of the vaccine should be administered at least 2 weeks before initiation of a transplant conditioning regimen, and at least 2 weeks prior to stem cell collection for donors.²
- Post-transplant, the vaccine may be administered as early as 3 months after transplant.^{12,18,22,24}

CAR T-Cell Therapy

- If feasible, both doses of the vaccine should be administered at least 2 weeks before CAR T-cell therapy.¹⁸
- Vaccines should not be administered until at least 3 months after completion of therapy.^{22,25}

Surgery

- Essential urgent surgery should take place, irrespective of vaccination status. Non-urgent elective surgery can also take place soon after vaccination. There is some rationale for separating the date of surgery from vaccination by a few days (at most 1 week) so that any symptoms such as fever might be correctly attributed to the consequences of either vaccination or the operation itself.²³ For surgeries inducing immunosuppression (e.g. splenectomy), a wider window (e.g. 2 weeks) may be recommended.²⁷

Cancer Screening

- Since lymphadenopathy is a potential COVID-19 vaccine side effect, screening exams should be conducted before the first dose of a COVID-19 vaccine or 4–6 weeks after the second dose of a COVID-19 vaccine if feasible, and when it does not unjustifiably interrupt management.^{28,29}

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6. When should the COVID-19 vaccine be given in relation to other vaccinations?

mRNA and non-replicating viral vector vaccines (e.g. Pfizer, Moderna, AstraZeneca, Johnson & Johnson) are not live vaccines and can neither cause infection nor change the host's DNA. There is no data on the co-administration of COVID-19 vaccines with other vaccines. In order to maximize the benefits of COVID-19 vaccines and minimize risks (e.g. immune interference, uncertainty around the cause of side effects), COVID-19 vaccines should not be given simultaneously with other vaccines.^{1,2}

Do not administer any other vaccine until at least 28 days after each vaccine dose of an mRNA or viral vector COVID-19 vaccine, except in the case where another vaccine is required for post-exposure prophylaxis. If the COVID-19 vaccine is given after another vaccine, there should be a wait period of at least 14 days.¹

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7. What are possible side effects of the vaccination?

Side effects of the COVID-19 vaccines were usually mild or moderate and generally resolved in a few days.^{1,4,6,7,10,11,12} Local reactions for the vaccines included pain, rash, redness or swelling at the injection site.^{2,7,11,12,16} Delayed local reactions have been reported.¹⁵ Systemic side effects included fatigue, headache, muscle/joint pain, diarrhea, chills, fever and nausea/vomiting.^{2,7,11,12,16}

Frequencies of systemic effects for the Pfizer and the Moderna vaccines were generally higher after the second dose, and in patients < 56 years of age for the Pfizer vaccine and between 18 to 64 years for the Moderna vaccine.^{2,3,7,8} Local and systemic effects for the Johnson & Johnson vaccine were higher in patients 18-59 years than in older patients.¹⁶ For the AstraZeneca vaccine, fewer and milder adverse reactions were reported after the second dose and reactogenicity reduced with increasing age.^{3,10,11}

Patients should be educated to seek medical attention if the symptoms last longer than 48-72 hours, due to the similarity with symptoms of COVID-19 or other infections.

Cases of lymphadenopathy occurring in the arm and neck region²⁴ have been reported post COVID-19 vaccination, which may mimic metastasis. Based on previous experience with routine vaccinations, vaccine-related lymphadenopathy typically occurs within 7 days of vaccination and generally subsides by 12-14 days. However, vaccine-related lymphadenopathy may persist as far as 4-6 weeks after vaccine administration.^{17,21,22,23,26} Consider timing of vaccination when assessing patients with new or worsening lymphadenopathy.^{2,7,11,12,13,14,23}

Very rare cases of moderate-to-severe thrombocytopenia and thrombotic complications at unusual sites (e.g. abdomen, splanchnic vein, sinus or cerebral vein), called vaccine-induced immune thrombotic thrombocytopenia (VITT), have been reported with the AstraZeneca and Johnson & Johnson vaccines.^{3,12,23,25} In some cases, these have been accompanied by bleeding.¹² VITT typically occurs within 3 weeks following AstraZeneca or Johnson & Johnson vaccine administration.¹² Fatalities have been reported. The exact mechanism is still under investigation but appears to be similar to heparin-induced thrombocytopenia (HIT). It is associated with platelet activating antibodies, which stimulate clot formation and thrombocytopenia. Patients should be advised to seek immediate medical attention if they develop symptoms of thromboembolism accompanied by thrombocytopenia, which becomes clinically apparent approximately 4-28 days after receiving a viral vector COVID-19 vaccine, and should be monitored for symptoms up to 42 days.^{3,12,18-20,23,25}

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8. Can a cancer patient receive the COVID-19 vaccine if they have allergies?

Severe allergic reactions to the vaccine have been reported.^{1,2,4,12,13} A delayed hypersensitivity reaction was reported with the Johnson & Johnson vaccine.¹³

Patients with a history of severe allergy (e.g. anaphylaxis) to any of the components of a COVID-19 vaccine should be referred to an allergist/immunologist to determine if the vaccine can be safely administered.

Patients who have had an allergic reaction within 4 hours of receiving a previous dose of a COVID-19 vaccine should not receive a second dose unless they have been evaluated by an allergist/immunologist and it is determined that the vaccine can be safely administered. Documentation of the discussion with the allergist/immunologist must be provided to the healthcare provider administering the vaccine and it should include a vaccination care plan.¹⁵

Polyethylene glycol (PEG), a water-soluble polymer used as a drug delivery vehicle, is a component of both Pfizer and Moderna vaccines and is known to cause mild to severe hypersensitivity reactions.^{6,7} Patients who have had anaphylactic reactions to PEG should be referred to an allergist/immunologist to determine if any of the vaccines can be safely administered.¹⁵ . Cancer medications containing PEG include (but are not limited to) the following:

1. PEGaspargase (Oncaspar®)
2. Pegfilgrastim (e.g. Neulasta® and others)
3. Liposomal irinotecan (Onivyde®)
4. PEG-liposomal doxorubicin (Caelyx®)

Polysorbate, a surfactant and emulsifier used as an excipient in some drug formulations,⁷ is structurally related and has the potential for cross-reactivity to PEG. It is also a component of the AstraZeneca and Johnson & Johnson vaccines^{12,13}. Patients who have had an anaphylactic reaction to polysorbate should be referred to an allergist/immunologist to determine if any of the vaccines can be safely administered.¹⁵ . Cancer medications containing polysorbate include (but are not limited to) the following:

5. Cabazitaxel
6. Docetaxel
7. Etoposide
8. Fosaprepitant (IV)
9. Rituximab (reactions with rituximab are typically a result of cytokine release syndrome and may not be related to polysorbate)
10. Paclitaxel (contains the excipient, Cremophor EL (polyethoxylated castor oil) which has the potential for cross-reactivity with polysorbate)⁹

Not all medications that contain PEG or polysorbate will cause allergic reactions and many drugs, including oral medications, may contain PEG or polysorbate in various concentrations, depending on the manufacturer.

Tromethamine is a component of the Moderna vaccine and may cause allergic reactions. It is also a component in contrast media and some oral and parenteral medications (e.g. ketorolac).¹⁴

Clinicians should consult individual product monographs for a full list of non-medicinal ingredients if their patients have had a history of anaphylactic reactions to their cancer medications. Patients should be counseled about the risks of developing a severe allergic reaction against the benefits of vaccination.

Refer to Ministry of Health guidance on COVID-19 vaccines and allergies for more information.

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9. Are any trials of COVID-19 being done in immunocompromised populations?

Several vaccine candidates are currently in clinical trials authorized by Health Canada,¹ however, few studies have included immunocompromised patients or patients receiving immunosuppressive therapy. There is emerging evidence that suggests immune response may be lower following the first dose of the Pfizer COVID-19 vaccine in certain cancer populations compared to the general population.^{2,3} Safety data from observational studies suggest comparable frequency and severity of adverse effects following mRNA COVID-19 vaccination in cancer patients, solid organ transplant recipients and those receiving immunosuppressive therapy.⁴ Given the limited number of participants in these studies, and the diversity of cancer patient populations, it is possible that COVID-19 vaccine candidates may differ in their efficacy and safety for these patients.

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If you have any questions regarding the COVID-19 Vaccine and cancer, please email the Drug Formulary team at OH-CCO_DrugFormulary@ontariohealth.ca.

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December 15th, 2020

Date	Updates
June 14, 2021	<ul style="list-style-type: none">• Authorized age for Pfizer vaccine (Q1)• VITT side effect information (Q7)• Allergy guidance (Q8)• Clinical trial information (Q9)
April 30, 2021	<ul style="list-style-type: none">• Information on AstraZeneca and Johnson & Johnson vaccines adverse effects (VIPIT, hypersensitivity) (Q1, Q6, Q7)• Information regarding ICIs (Q4)
April 12, 2021	<ul style="list-style-type: none">• Recommended Immunization Schedule (Q1)• Optimal timing for cytotoxic chemotherapy, surgery and cancer screening (Q4)• Information on adverse effects and rare adverse effect (VIPIT) (Q6)• Information on tromethamine (Q7)• Emerging trials in the cancer population (Q8)
March 8, 2021	<ul style="list-style-type: none">• Information about AstraZeneca and Johnson & Johnson COVID-19 vaccines• Risk factors (Q2)• Adverse effects(Q6)
January 6 th , 2021	<ul style="list-style-type: none">• Information about Moderna vaccine

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