Guideline Resource Unit
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Immunization Guidelines for Cancer Patients

Cancer Care Alberta

Table of Contents

Influenza Immunization

Influenza Immunization for Adult and Pediatric Patients Undergoing Cancer Treatment

Background

Seasonal influenza is an important cause of morbidity and mortality in Canada. It causes an estimated 15,000 hospitalizations each year, and influenza together with pneumonia ranks among the top 10 leading causes of death.[1,2] People at greatest risk of influenza-related complications are children 6 to 59 months of age, pregnant individuals, older adults (65 years and older), residents of congregate living facilities and other chronic care facilities, Indigenous peoples and people with underlying medical conditions.[2] Adult and pediatric patients with cancer are considered immunosuppressed, either as a result of their underlying disease or secondary to their treatment, and are therefore included in this high risk group. Influenza infection not only causes primary illness but also can lead to severe secondary medical complications, including viral pneumonia, secondary bacterial pneumonia, and worsening of underlying medical conditions.

This guideline outlines the recommendations for influenza immunization among adult and pediatric patients with cancer. For the most current Alberta Health Services/Primary Care Alberta information, clinical guidelines, and schedules on influenza immunization for the general population, please visit the Influenza Immunization Information for Health Professionals webpage.

Guideline Questions

1. What are the recommendations for influenza immunization for adult and pediatric patients with solid tumours or hematologic cancers in Alberta?
2. What is the current evidence for response to the influenza vaccine among adult and pediatric patients with cancer receiving chemotherapy or other systemic therapy?
3. What is the best timing for administering the influenza vaccine in relation to the therapy cycle and other vaccines for adult and pediatric patients with cancer?

Search Strategy

The PubMed database was searched according to the strategy outlined in Appendix B. The 2025 search yielded 36 citations, 7 of which met the criteria to be included in the evidence tables, which are summarized in a supporting document. A comprehensive exploration of gray literature encompassed a review of websites from sources such as Alberta Health, Alberta Health Services/Primary Care Alberta, Health Canada, Public Health Agency of Canada, Centers for Disease Control and Prevention, American Academy of Pediatrics, and the World Health Organization. A search for published clinical practice guidelines on oncology websites yielded one updated guideline from the National Comprehensive Cancer Network.[3]

The following recommendations have been adapted from existing practice guidelines, policy documents, and consensus statements, including those from the Alberta BMT Standard Practice

Manual,[4] Alberta Health Services/Primary Care Alberta Immunization Program Standards Manual,[5] Alberta Influenza Immunization Policy,[6] National Advisory Committee on Immunization,[2] the Public Health Agency of Canada,[7] the Centers for Disease Control and Prevention,[8] and the American Academy of Pediatrics.[9]

Target Population

The recommendations outlined in this guideline apply to adult and pediatric patients with solid tumours or hematologic malignancies.

Recommendations

1. The 2025/2026 trivalent inactivated influenza vaccines being used in Alberta contain the following antigenic strains:[6,8,10]

Egg-based (Fluzone®, Fluviral®, FluZone® High-Dose, Fluad® [adjuvanted])	Cell-cultured (Flucelvax®)
• A/Victoria/4897/2022 (H1N1)pdm09-like virus • A/Croatia/10136RV/2023 (H3N2)-like virus • B/Austria/1359417/2021 (B/Victoria lineage)-like virus	• A/Wisconsin/67/2022 (H1N1)pdm09-like virus • A/District of Columbia/27/2023 (H3N2)-like virus • B/Austria/1359417/2021 (B/Victoria lineage)-like virus

2. Annual administration of the **inactivated** influenza vaccine is recommended for most adult and pediatric patients with cancer. The live attenuated influenza vaccine is not recommended for adults or pediatric patients with immune-compromising conditions.[2,8] Patients considered to be the highest priority are those on active treatment.[2,5]
    - Adults with malignant solid tumours who are 3 months post-chemotherapy and whose cancer is in remission are generally no longer considered immunocompromised. Adults with malignant hematologic disorders who are more than 3 years post-therapy and no longer on immunosuppressive medications are considered healthy and should be assessed for immunizations as per the general population.[11]
    - Children with solid tumours and hematologic malignancies who are 6 months post-chemotherapy and whose cancer is in remission are generally no longer considered immunocompromised.[12]

3. The influenza vaccines included in the 2025/2026 provincially funded program include, for individuals who live, work, go to school, or are visiting Alberta:[6]

Product	Trivalent Inactivated Influenza Vaccine[13]			High-Dose Trivalent Inactivated Vaccine[14]	
Influenza Vaccine Name	Fluzone®	Fluviral®	Flucelvax®	Fluzone® High-Dose	Fluad® (adjuvanted)
Dose	0.5 mL			0.5 mL	
Indications for use of provincially funded vaccine	Individuals six months of age and older.			Individuals 18 years and older, including pregnant individuals, who are:	Individuals 65 years of age and older.

		• Hematopoietic stem cell transplant (HSCT) recipients • Chimeric antigen receptor T-cell (CAR T) therapy recipients; or • Solid organ transplant (SOT) candidates or recipients **Note:** Fluzone® High-Dose is the preferred product for all adult SOT, HSCT, and CAR T-cell therapy recipients.	

4. The recommended influenza vaccine schedules by age are:[13,14]
   - Children aged 6 months through 8 years of age who **have never** received the influenza vaccine require 2 doses (0.5 mL per dose) of the **trivalent inactivated** influenza vaccine with a minimum interval of 4 weeks between doses.
   - Children aged 6 months through 8 years of age who **have** previously received the influenza vaccine should receive 1 dose (0.5 mL) of the **trivalent inactivated** influenza vaccine.
   - For children aged 9 years and older, 1 dose (0.5 mL) of the **trivalent inactivated** influenza vaccine should be administered annually.
   - **High-dose** influenza vaccine recommendations:
     - **Fluzone® High-Dose (trivalent inactivated influenza vaccine):** Recommended for individuals 18 years of age and older, including pregnant individuals, who are:
       - Hematopoietic stem cell transplant (HSCT) recipients
       - Chimeric antigen receptor T-cell (CAR T) therapy recipients; or
       - Solid organ transplant (SOT) candidates or recipients.
     - **Fluad® (adjuvanted trivalent inactivated influenza vaccine):** Recommended for adults 65 years of age and older
   - Influenza immunization with currently available vaccines is not recommended for infants younger than 6 months of age.

5. **Timing** of inactivated influenza immunization in relation to the therapy cycle and other vaccines:
   - The inactivated influenza vaccine should *ideally* be administered at least 14 days before initiating immunosuppressive therapy.[11]
   - Adult and pediatric patients treated with immune checkpoint inhibitor therapies (e.g., PD-1, PDL-1, CTLA-4) can receive the inactivated influenza vaccine at any time during therapy.[15,16]
   - Adult and pediatric patients who are treated with B-cell or T-cell depleting antibodies (e.g., rituximab, blinatumomab), should be informed that influenza immunization is unlikely to provide effective protection, and should be encouraged to ensure their household contacts are all immunized.[4,11,17,18]

- Patients treated with CAR T-cell therapy without a prior history of HSCT who received influenza vaccine pre-CAR T-cell therapy are eligible to receive another dose of influenza vaccine as early as 3 months post-CAR T-cell therapy, at the discretion of the transplant physician. If a clearance letter has been received to proceed with inactivated vaccines, consultation with the healthcare team is not required.[17-19]
- Patients on clinical trial protocols should continue to follow instructions based on their specific protocol.
- Influenza vaccines may be administered at the same time as other inactivated or live vaccines.[13,14]

6. For adult and pediatric patients undergoing **Hematopoietic Stem Cell Transplant (HSCT)**, both recipient and donor immunization status prior to transplant affect post-transplant immunity. Immunity established prior to HSCT may increase immune response following transplant.[4,11,17,18,20,21] For detailed guidance regarding adult HSCT and CAR T-cell therapy recipients, please refer to the "Vaccination" chapter of the Alberta BMT Program Standard Practice Manual.[4]
   a. Recipient: the inactivated influenza vaccine should be administered at least 2 weeks prior to transplant conditioning or mobilization chemotherapy. Live vaccines are contraindicated.
   b. Donor: the inactivated influenza vaccine should be administered at least 2 weeks before stem cell harvest. The transplant healthcare team should be consulted.
   c. For adult HSCT recipients, inactivated influenza vaccine should ideally be administered 6 months post-transplant but can be given as early as 3 months post-transplant at the discretion of the transplant physician during the influenza season. High-dose trivalent inactivated influenza vaccine is recommended for patients 18 years of age or older, including pregnant individuals, if available. Once adult HSCT recipients receive clearance for non-live vaccinations (typically between 3-6 months post HSCT), inactivated influenza vaccine can be given in all subsequent years without further clearance needed.
   d. For pediatric HSCT recipients, the trivalent inactivated influenza vaccine may be administered as early as 3 months post-transplant, at the discretion of the transplant physician.[12]
   e. There is no difference in recommended schedules of influenza vaccine administration between autologous or allogeneic recipients.
   f. Adult and pediatric HSCT recipients who are treated with B-cell or T-cell depleting targeted therapies (e.g., rituximab, blinatumomab) should have the inactivated influenza vaccination postponed until at least 6 months after the last dose of medication.
   g. For HSCT recipients, inactivated influenza immunization should be postponed until at least 6 months after the last dose of conditioning chemotherapy to allow immune recovery. Post-transplant maintenance therapies (e.g., lenalidomide) are not a contraindication to influenza immunization and may be continued during immunization.[22]

h. Individuals receiving CAR T-cell therapy are to be reimmunized with inactivated influenza vaccine as per the standard allogeneic HSCT schedule (see recommendations #6c and #6d above).
i. HSCT recipients who have started their post-HSCT vaccine series and then had the series interrupted by CAR T-cell therapy should restart their vaccine series. Immunization will be directed by the transplant centre through patient specific letters.
j. Live influenza vaccine is contraindicated for HSCT patients less than 24 months post-HSCT and not recommended in the later transplant phase. It may be considered on an individual basis in the later transplant phase (greater than 2 years post-transplant).
k. Household contacts and healthcare workers should be up to date for routine immunizations as per the Alberta Immunization Schedule, including annual influenza, to reduce the risk of disease transmission to transplant recipients. Household contacts and healthcare workers who have received the live influenza vaccine (FluMist®) should avoid close association with individuals with severe immunocompromising conditions (e.g., bone marrow transplant recipients requiring protective isolation) for at least 2 weeks following immunization. The live nasal spray influenza vaccine (FluMist®) may be available for purchase in Alberta through community pharmacies.

7. Annual influenza immunization of family members and hospital or clinic staff and volunteers who are in contact with adult and pediatric patients with cancer is strongly recommended. In many cases, this may be more important than immunizing the patients themselves, as some patients may be less likely to respond to the vaccine. Transmission of influenza between infected healthcare workers and their vulnerable patients results in significant morbidity and mortality; therefore, healthcare workers should consider it their responsibility to provide the highest standard of care, which includes receiving the annual inactivated influenza vaccine.[2,23]

8. **Contraindications** for influenza immunization in adult and pediatric patients with cancer include:[2,13,14]

   - Known severe hypersensitivity to any component of the vaccine, except for egg (see precautions below).
   - Anaphylactic or other allergic reactions to a previous dose of influenza vaccine.
   - Development of Guillain Barré Syndrome (GBS) within 6 weeks of a previous dose of influenza vaccine, unless another cause of GBS was found.

9. **Precautions** for influenza immunization (standard or high-dose vaccine) in adult and pediatric patients with cancer include:[2,13,14]

   - Egg-allergic individuals may be immunized using inactivated egg-based influenza vaccine without a prior influenza vaccine skin test and with the full dose of vaccine, irrespective of a

past severe reaction to egg. Egg-allergic vaccine recipients should be kept under observation for 30 minutes following vaccine administration.

- Consult with the Medical Officer of Health to review the risks and benefits of further influenza immunization for individuals with a history of oculorespiratory syndrome (ORS) that included lower respiratory symptoms within 24 hours of receiving influenza vaccine.

As with all vaccine administration, immunizers should have the necessary anaphylaxis equipment and protocols and be prepared to always respond to a vaccine emergency. Vaccine recipients who have had an anaphylactic reaction to *any* agent should be kept under observation for at least 30 minutes post-immunization.

Individuals who report experiencing lower respiratory symptoms (wheeze, chest tightness, difficulty breathing) within 24 hours of influenza immunization, an apparent significant allergic reaction to the vaccine, or other concerning symptoms (e.g., throat constriction or difficulty swallowing) should have a report sent to the Adverse Event Following Immunization Reporting | Alberta Health Services, please follow the reporting requirements laid out on this webpage. Follow up will then occur directly with the patient.

Discussion

Influenza Immunization: Adult Patients with Cancer

Cancer treatments can produce acute and profound immunosuppression, although the degree of immunosuppression varies by therapy type, dose, and duration.[7] Annual administration of the inactivated influenza vaccine is recommended for most adult patients with cancer. However, interpreting vaccine efficacy is challenging due to differences in patient characteristics, cancer types, vaccine strains, and outcome assessments.[24,25]

Evidence in patients with solid tumours. Earle *et al.* analyzed 1,225 patients from the Surveillance, Epidemiology, and End Results (SEER) and Medicare databases and found that patients undergoing chemotherapy for stage IV colorectal cancer who were immunized had lower rates of influenza and pneumonia than those not immunized (1.1% vs. 3.8%, p=0.004), fewer chemotherapy interruptions, and improved survival to the next influenza season (HR=0.88, 95% CI 0.77-0.99).[26] A 2018 Cochrane review similarly reported reduced mortality and infection-related outcomes, although evidence was limited by small numbers of low-quality studies.[27] A more recent Cochrane review (Hirsch 2025) found only one RCT evaluating influenza vaccination in adults with solid tumours. The incidence of influenza was not reported, and evidence for all-cause mortality, any-grade adverse events, and serious adverse events was very uncertain.[28]

Risks of influenza in cancer patients. Patients with cancer who develop influenza are at high risk of complications and death. In a review including 11 studies of adults undergoing chemotherapy or hematopoietic stem cell transplantation (HSCT), case fatality rates ranged from 11% to 33%.[29] In Canadian intensive care units (ICUs) during the 2009-2010 H1N1 outbreak, 8.2% of 168 critically ill patients had major comorbidities, including cancer-related immunosuppression.[30]

Timing of immunization and chemotherapy. Immunization is most effective at least two weeks prior to starting chemotherapy to allow adequate antibody production.[7,31,32] In breast cancer patients, geometric mean titers were lower when immunized on day 16 versus day four of chemotherapy.[33] However, a pilot study of 18 patients immunized one week before or on the first day of chemotherapy found comparable immune response in both groups.[34] If early immunization is not feasible, immunization between cycles is safe and recommended, although efficacy may be reduced.[26,31,35]

Evidence in patients receiving immunotherapy. Emerging evidence supports the safety and efficacy of influenza immunization in patients receiving PD-1, PD-L1, and CTLA-4 inhibitors.[15,36-44] Earlier concerns about increased immunological toxicity have been largely alleviated by systematic reviews demonstrating outcomes comparable to the general population.[15,16,45] BC Cancer recommends that, where feasible, patients receiving combination CTLA-4/PD-1 therapy be immunized prior to beginning treatment, with deferral considered for patients experiencing severe immune-related adverse events.[46] The INVIDIa-2 study reported improved survival and disease control among advanced cancer patients vaccinated during ICI therapy.[44]

Hematologic malignancies. Adult patients with hematologic malignancies are at high infection risk for infections before immune regeneration and generally exhibit weaker vaccine responses.[47,48] Influenza immunization is recommended for all patients with multiple myeloma, including those with monoclonal gammopathy of undetermined significance (MGUS) or smoldering myeloma, and their close contacts.[49] Retrospective data in patients with multiple myeloma (n=71) showed that 63% achieved seroconversion following one or two influenza vaccinations. A prime-boost approach increased antibody titers, particularly in patients with recent high-dose chemotherapy and autologous stem-cell transplantation, although overall responder rates were similar. Complete or very good partial remission and absence of immunoparesis were independent predictors of sufficient serological response.[50] A recent single-blind RCT (n=130) in patients with hematologic malignancies, including multiple myeloma, chronic lymphocytic leukemia (CLL), and non-Hodgkin's lymphoma (NHL) found modest seroconversion rates (20-81% depending on strain and underlying disease), with lower responses in CLL and NHL patients.[51] Adverse events were generally mild and local.

Some guidelines recommend a second dose within four weeks if immune response is inadequate, which is supported by studies showing improved seroconversion with repeated immunization in immunocompromised hosts.[49,52,53] A recent Cochrane review (Zorger 2025) highlighted that evidence from RCTs on influenza immunization in adults with hematologic malignancies is limited.[54] No studies compared influenza vaccine versus placebo or no vaccine, and the effect of two doses of high-dose trivalent inactivated influenza vaccine compared to one dose is very uncertain. Real-world data from a Danish nationwide cohort of 53,249 adults with solid tumours and 22,182 adults with hematologic malignancies receiving chemotherapy found reduced overall mortality associated with immunization, especially in adults less than 65 years with hematologic malignancies (aHR 0.66; 95% CI 0.51-0.87).[55]

HSCT recipients: risks and outcomes. HSCT recipients experience profound, prolonged immunosuppression increasing susceptibility to influenza. Ljungman *et al.* reported a case fatality rate of 23% among over 1,900 European HSCT patients across three influenza seasons.[56] Kumar *et al.* observed that, among 616 HSCT and solid organ transplant (SOT) patients with confirmed influenza, pneumonia incidence ranged from 11.3% to 35.0%, and ICU admission from 8.1% to 14.3%; HSCT patients had higher six-month mortality (13.8% vs 4.8%, $p<0.001$) and higher viral loads.[57]

Lower respiratory tract infection (LRTI) is a common and serious influenza complication, particularly in immunocompromised patients.[58] Intensive chemotherapy in HSCT can cause prolonged lymphopenia, increasing the risk of progression from upper- to lower-respiratory tract involvement. A systematic review and meta-analysis reported an overall viral LRTI of 35.4%, with adults more affected than children (46.1% vs. 19.92, $p<0.001$).[59]

HSCT recipients: immune response. Immune response in HSCT recipients is influenced by time since transplantation, type of transplant, and prior B- or T-cell depleting therapies. Serologic responses within six months post-transplant range from 20% to 40%, increasing to 20% to 72% thereafter, and approaching healthy levels by approximately two years post-transplant.[21] Rituximab and other B-cell-depleting therapies markedly reduce vaccine responsiveness.[17,60-64] In CAR-T recipients, T cell-mediated immune responses to influenza immunization can be elicited pre-CAR-T and maintained post-CAR-T, even in patients with absent antibody responses, demonstrating the potential for protective cellular immunity despite profound B-cell depletion.[65] It is recommended that both recipients and donors (allogeneic transplants) receive inactivated influenza immunization at least two weeks pre-transplant. High-dose trivalent inactivated influenza vaccine is recommended for adults 65 years of age and older and for adults 18 years of age and older who are HSCT recipients, CAR T-cell therapy recipients, or SOT candidates or recipients.[6,58,66] Immunization should not be delayed for GVHD, despite potential prolonged CD4+ recovery.

Close contacts. Annual influenza immunization is recommended for the close contacts of high-risk patients, including family members and healthcare staff. Higher immunization rates among healthcare workers reduce infections in cancer patients.[67] Annual immunization with non-live influenza vaccine is recommended for all caregivers, regardless of the patient's immunization status.[7] For HSCT recipients, it is recommended for close contacts to be immunized pre- and post-transplant.[11,20] If only the live nasal spray is accepted, caregivers should wait at least two weeks post-immunization before providing care.[11,20]

Influenza Immunization: Pediatric Patients with Cancer

Pediatric patients with cancer are highly susceptible to influenza infections and have higher infection rates compared to healthy children.[68] Hospitalization rates for children under five with chronic health conditions are also significantly higher than for healthy peers.[69]

Vaccine response in children receiving chemotherapy. Interpreting influenza vaccine efficacy in pediatric patients with cancer is challenging. Results vary due to differences in patient characteristics,

cancer types, vaccine strains, and outcome assessments. In a meta-analysis of nine controlled trials and one randomized controlled trial including 770 children, Goossen *et al.* reported weaker immune responses in children receiving chemotherapy compared to those who had completed therapy and healthy controls.[70] Response rates also differ by cancer type (solid vs. hematologic) and chemotherapy regimen.[71,72]

In a study of 32 pediatric patients with acute lymphoblastic leukemia (ALL), the trivalent influenza vaccine was well tolerated.[73] Immune responses were acceptable but limited: fourfold increases in antibody titers were observed in 56.2% versus 80% for H1N1 (p=0.04), 40.6% versus 53.3% for H3N2 (p=0.31), and 59.4% versus 83.3% for influenza B (p=0.038) when compared to healthy siblings. Like adults, immunization is most beneficial at least 14 days prior to starting chemotherapy.

HSCT recipients: timing and dosing. Recommendations for pediatric HSCT mirror those for adults.[17,18,56,66] It is recommended that both the recipient and donor (for allogeneic transplants) receive the inactivated influenza vaccine at least two weeks prior to transplant. Immune recovery post-transplant varies depending on therapy and the presence of GVHD. Although inactivated influenza vaccine may begin as early as three months post-HSCT, the Children's Oncology Group (COG) Taskforce recommends all boosters and reimmunizations be administered at six months for better efficacy.[12] Children under nine receiving the influenza vaccine for the first time post-transplant are recommended to receive two doses at least four weeks apart.[13]

Close contacts. Annual influenza immunization is recommended for family members and healthcare workers of pediatric HSCT recipients, who are severely immunocompromised and cannot be immunized for at least three months post-transplant. In this situation, annual influenza vaccine (either inactivated or live) is strongly recommended for close contacts both pre- and post-transplant.[18,66] If only the live nasal spray is accepts, contacts should wait at least two weeks post-immunization before providing care.[66]

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Appendix A: Additional Resources

Canadian Resources

Alberta Health Services/Primary Care Alberta:

- Get Immunized Against Respiratory Illness This Fall
- Immunization Program Standards Manual
- Influenza Immunization Information for Health Professionals
- Alberta Bone Marrow and Blood Cell Transplant Program: Standard Practice Manual

Government of Alberta: Alberta Immunization Policy

Public Health Agency of Canada:

- Canadian Immunization Guide
- An Advisory Committee Statement (ACS) National Advisory Committee on Immunization (NACI). Statement on Seasonal Influenza Vaccine for 2025-2026.

International Resources

American Academy of Pediatrics: Recommendations for Prevention and Control of Influenza in Children, 2025-2026: Policy Statement.

Centers for Disease Control and Prevention:

- Influenza (Flu) 2025-2026 Flu Season
- Prevention and Control of Seasonal Influenza with Vaccines: Recommendations of the Advisory Committee on Immunization Practices - United States, 2025-26 Influenza Season

National Comprehensive Cancer Network. Prevention and Treatment of Cancer-Related Infections, version 1.2025. To access content, registration (free) is required.

World Health Organization: Global Influenza Programme

Appendix B: Search Strategy

Database	Date	Search Strategy	Results
PubMed	October 2, 2025	1. carcinoma[MeSH Terms] 2. neoplasm[MeSH Terms] 3. cancer[Title/Abstract] 4. tumor[Title/Abstract] 5. tumour[Title/Abstract] 6. ((((carcinoma[MeSH Terms]) OR (neoplasm[MeSH Terms])) OR (cancer[Title/Abstract])) OR (tumor[Title/Abstract])) OR (tumour[Title/Abstract]) 7. influenza A virus[MeSH Terms] 8. influenza B virus[MeSH Terms] 9. influenza, human[MeSH Terms] 10. ((influenza A virus[MeSH Terms]) OR (influenza b virus[MeSH Terms])) OR (influenza, human[MeSH Terms]) 11. immunization[MeSH Terms] 12. vaccination[MeSH Terms] 13. immun*[Title/Abstract] 14. vaccin*[Title/Abstract] 15. (((immunization[MeSH Terms]) OR (vaccination[MeSH Terms])) OR (immun*[Title/Abstract])) OR (vaccin*[Title/Abstract]) 16. (((((immunization[MeSH Terms]) OR (vaccination[MeSH Terms])) OR (immun*[Title/Abstract])) OR (vaccin*[Title/Abstract])) AND (((influenza A virus[MeSH Terms]) OR (influenza b virus[MeSH Terms])) OR (influenza, human[MeSH Terms]))) AND (((((carcinoma[MeSH Terms]) OR (neoplasm[MeSH Terms])) OR (cancer[Title/Abstract])) OR (tumor[Title/Abstract])) OR (tumour[Title/Abstract])) 17. Limit #16 to English, from 2023/8/1 – 2024/12/31 18. Excluded case reports, studies w ≤10 patients, duplicates from 2023, covid 19, non-cancer or non-human subjects (i.e., mice, in vitro), vaccine uptake and equity, vaccine design, unrelated to guideline question (i.e., recommendations, response, timing)	779,972 4,159,394 2,513,302 1,615,439 262,183 5,312,048 52,703 4,974 62,166 88,487 227,037 121,681 3,185,061 480,692 3,420,870 1,142 36 7

Please refer to the Literature Review: Influenza Immunization for Adult and Pediatric Patients Undergoing Cancer Treatment (2025) document for a summary of relevant results.

Development and Revision History

This guideline was reviewed and endorsed by the Alberta Provincial Tumour Teams. Members include hematologists, surgical oncologists, radiation oncologists, medical oncologists, pediatric oncologists, nurses, pathologists, and pharmacists. Evidence was selected and reviewed by a working group comprised of members from the Alberta Tumour Teams, external participants identified by the Working Group Lead, and a methodologist from the Guideline Resource Unit. A detailed description of the methodology followed during the guideline development process can be found in the Guideline Resource Unit Handbook.

This guideline was originally developed and posted to the website in November 2009. The guideline was revised and reposted in September 2010, October 2011, October 2012, September 2013, September 2014, October 2015, October 2016, October 2017, October 2018, October 2019, October 2020, October 2021, October 2022, October 2023, and October 2025. In January 2026, the guideline was included as a chapter in the Immunization Guideline.

Maintenance

An annual review of the evidence will be conducted in 2030. This guideline will be revised and updated accordingly at that time unless critical new evidence emerges.

Abbreviations

ACIP, Advisory Committee on Immunization Practices; ALL, acute lymphoblastic leukemia; CAR T, chimeric antigen receptor T-cell therapy; CI, confidence interval; CLL, chronic lymphocytic leukemia; GBS, Guillain-Barre Syndrome; HR, hazard ratio; HSCT, hematopoietic stem cell transplant; ICI, immune checkpoint inhibitor; LRTI, lower respiratory tract infection; NACI, National Advisory Committee on Immunization; NHL, non-Hodgkin's lymphoma; OR, odds ratio; ORS, oculorespiratory syndrome; PHAC, Public Health Agency of Canada; SEER, Surveillance, Epidemiology, and End Results database; SOT, solid organ transplant.

Disclaimer

The recommendations contained in this guideline are a consensus of the Alberta Provincial Tumour Teams and are a synthesis of currently accepted approaches to management, derived from a review of relevant scientific literature. Clinicians applying these guidelines should, in consultation with the patient, use independent medical judgment in the context of individual clinical circumstances to direct care.

Funding Source

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Pneumococcal Immunization

Pneumococcal Immunization in Adult and Pediatric Patients Undergoing Cancer Treatment

Background

Streptococcus pneumoniae is a common cause of pneumonia and invasive pneumococcal disease (IPD). IPD, defined as infection confirmed by isolation of *S. pneumoniae* from a normally sterile site such as blood or cerebrospinal fluid, can manifest as bacteremia, meningitis, or bacteremic pneumonia. These infections are associated with high morbidity, lifelong complications, and mortality, particularly among infants, older adults, and individuals with underlying medical conditions or immunosuppression.[1]

In Canada, the incidence of IPD was 5.6 cases per 100,000 population in 2021, down from a peak of 10.9 per 100,000 in 2018.[2] Between 2018 and 2022, serotypes 4, 9V, and 12F increased significantly in prevalence. Over the same time, the overall proportion of 13-valent pneumococcal conjugate vaccine (PCV13) serotypes rose from 31.2% to 41.5%, while non-vaccine serotypes declined.[2]

Adults aged ≥65 years and immunocompromised individuals, including those with cancer, are at greatest risk for severe pneumococcal disease and death.[1] Immunization is the most effective strategy to prevent IPD, reduce complications, and mitigate the spread of resistant strains. Pneumococcal vaccines are recommended for routine immunization of infants, children, and adults, as well as for those at increased risk of IPD.[1] The influenza season provides an important opportunity to assess vaccine status and offer immunization to eligible individuals.

Patients who may be immunosuppressed due to cancer or its treatment, including those with hematologic or solid tumours, are particularly vulnerable to IPD.

This guideline outlines recommendations for pneumococcal immunization in adult and pediatric patients with solid tumours or hematological malignancies, including leukemia, lymphoma, multiple myeloma, and other cancers.

Guideline Questions

1. What are the current pneumococcal immunization recommendations for adult and pediatric patients with solid tumours or hematologic malignancies in Alberta?
2. What is the evidence on immunogenicity and clinical effectiveness of pneumococcal immunization in adult and pediatric patients with cancer receiving chemotherapy or other systemic therapy?
3. What is the optimal timing for pneumococcal immunization in relation to systemic cancer therapy (e.g., before, during, or after treatment cycles) to maximize immune response and clinical protection?

Search Strategy

The PubMed database was searched according to the strategy outlined in Appendix A. The 2025 search yielded 165 citations, 22 of which met the criteria to be included in the evidence tables, which are summarized in a supporting document. A comprehensive search of gray literature was conducted to identify current documents from relevant federal, provincial, and international public health and oncology organizations.

Target Population

This guideline provides pneumococcal immunization recommendations for children and adults with solid tumours or hematologic malignancies. For immunization recommendations in the general population, please refer to the *Primary Care Alberta Immunization Program Standards Manual.*

Recommendations

The following recommendations have been adapted from existing practice guidelines, policy documents, and consensus statements, including those from the *Alberta Immunization Policy* the *Primary Care Alberta Immunization Program Standards Manual*, the *Public Health Agency of Canada* (PHAC), and the *National Advisory Committee on Immunization* (NACI).[3-13] Evidence from primary studies, including clinical trials and retrospective reviews, was also considered.

Note: Detailed age-specific schedules, dose spacing, and guidance for special populations, are provided in the Alberta Immunization Policy. Clinicians should consult this policy for information on the number of doses required based on age at initiation, minimum intervals between doses, recommendations for completing interrupted or mixed vaccine series, and additional guidance for high-risk individuals.

1. **Vaccine administration:** It is recommended that children (≥6 weeks of age) and adults at increased risk for IPD due to immunocompromising conditions who have not previously received a PCV receive PCV20.

   High-risk conditions include, but are not limited to:

   - Hematopoietic stem cell transplant (HSCT) recipients
   - Chimeric antigen receptor (CAR) T-cell therapy recipients
   - Receipt of immunosuppressive therapy, including long-term use of corticosteroids, chemotherapy, or radiation therapy (ongoing or anticipating)
   - Malignant hematologic disorders (e.g., leukemia, lymphoma, Hodgkin's disease, multiple myeloma)
   - Malignant solid organ tumours (currently or within the past 5 years)
   - Solid organ transplant candidates and recipients.

2. **Referral to Primary Care Alberta:** Per the Alberta Immunization Policy, the following individuals should be referred to Primary Care Alberta for pneumococcal immunization:

   - Children (<18 years)
   - HSCT recipients
   - CAR-T recipients
   - Solid organ transplant candidates and recipients.

3. **Special considerations for HSCT and CAR T-cell therapy recipients:**

   - *Pre-transplant*: Where feasible, the pneumococcal vaccine should be administered at least 2 weeks prior to transplant conditioning, in consultation with the transplant physician.
   - *Post-transplant*: Begin reimmunization approximately 6 months after HSCT. In select cases, PCV20 may be administered as early as 3 months post-transplant at the discretion of the transplant physician.
   - *Series completion / catch-up:* HSCT recipients who started a series with PCV13 or PCV15 should complete their series with PCV20. Previous doses are counted, and the series should not be restarted. HSCT recipients who previously completed a pneumococcal conjugate series and/or received recommended doses of PPSV but have not yet received PCV20 are eligible for 1 dose of PCV20, to be given at least 8 weeks after the last conjugate vaccine and at least 1 year after the last PPSV dose.
   - *Optional PCV21 dose*: Adult HSCT recipients may choose to privately purchase PCV21 (i.e., not publicly funded) as the final (fourth) dose in their pneumococcal series to broaden serotype coverage. These individuals require a comprehensive immunization assessment at Primary Care Alberta Public Health and clearance from their transplant team. A minimum of 6 months between dose 3 and dose 4 is required.
   - *Donor immunization:* Donor immunization status may influence post-transplant immunity. However, additional immunization of donors beyond routinely recommended vaccines is not routinely advised.

4. **Special considerations for SOT recipients:**

   - *Pre-transplant:* Where feasible, pneumococcal immunization should be given at least 2 weeks before transplantation. Shorter timeframes may be requested by pediatric infectious diseases / the transplant team.
   - *Post-transplant:*
     - Children <18 months: Resume age-appropriate pneumococcal immunization once the child is on baseline immunosuppression, usually 6-12 months after transplant, as determined by the child's attending transplant physician. If immunizations were not completed prior to transplant, complete the series for inactivated vaccines as previously indicated.

    - Children ≥18 months and adults: Resume catch-up pneumococcal immunization once the individual is on baseline immunosuppression, usually 6-12 months after transplant, in accordance with the Alberta Immunization Policy. Clearance letters are not required for SOT post-transplant.
- *Series completion / catch-up:*
    - Individuals (children or adults) who started a pneumococcal conjugate vaccine series with PCV13 or PCV15 should complete their series with PCV20. Previous doses are counted, and the series should not be restarted.
    - Individuals who previously completed a pneumococcal conjugate series and/or received recommended doses of PPSV but have not yet received PCV20 are eligible for one dose of PCV20, administered at least 8 weeks after the last conjugate vaccine and at least 1 year after the last PPSV dose.

5. **Timing in relation to other immunosuppressive therapy:**
    - If possible, administer PCV20 at least 14 days before starting immunosuppressive therapy.
    - If immunization cannot precede therapy, delay at least 3 months after cessation of chemotherapy or high-dose steroids.
    - For ongoing or long-term immunosuppression in patients with malignant solid or hematologic cancer, immunize as soon as possible.
    - Minimum spacing between doses may be shortened to 8 weeks if anticipating immunosuppression.

6. **Patients on rituximab or other B-cell-depleting targeted therapies:** All inactivated immunizations should be postponed until at least 6 months after the last dose. A clearance letter from the patient's transplant healthcare team is required before starting immunization.

7. **Contraindications:** Pneumococcal immunizations should not be administered to individuals with a known severe hypersensitivity to any component of PCV20, including diphtheria toxoid, or to those who have experienced an anaphylactic reaction to a previous dose of a pneumococcal-containing vaccine.

8. **Live vaccines**: Pneumococcal vaccines are inactivated and do not contain live bacteria; therefore, they cannot cause pneumococcal infection.

9. **Serologic testing after immunization**: Routine measurement of antibody titers to assess response to pneumococcal immunization is not recommended.

Discussion

Risk of IPD in Cancer Patients

Streptococcus pneumoniae is a leading cause of pneumonia worldwide and is associated with substantial morbidity and mortality.[14,15] IPD mortality remains high, with a 2021 meta-analysis

reporting an overall mortality of 21% (95% CI 17.5-24%).[16] Risk factors for death include older age, nosocomial infection, septic shock, underlying chronic disease, solid organ tumours, immunosuppression, and nursing home residency.

Adults with hematologic malignancies are at markedly increased risk of IPD, particularly those with chronic lymphocytic leukemia and multiple myeloma, with relative risks up to 39-fold in population-based studies.[17] Risk is further heightened in hematopoietic stem cell transplant (HSCT) recipients, especially those with chronic graft-versus-host disease (GVHD).[18] A large population-based study in the Netherlands including 1453 cancer patients with IPD reported incidence rates of 482/100 000 patient-years for hematologic malignancies and 79/100 000 for solid tumours, compared with 15/100 000 in controls. Incidence was highest in multiple myeloma, non-Hodgkin lymphoma, chronic lymphocytic leukemia, pancreatic cancer, and lung cancer, and greatest among patients ≥50 years. Implementation of infant pneumococcal immunization reduced IPD incidence in hematologic malignancies through indirect herd effects, but had no significant effect in solid tumour patients, highlighting the ongoing high disease burden and the need for tailored immunization strategies.[19]

Pediatric oncology patients, particularly those with hematologic malignancies, also remain at markedly increased risk of IPD. A United State (U.S.) surveillance study from 2005-2019 found that, despite reductions in PCV13-type IPD following vaccine introduction, children with hematologic malignancies had incidence rate ratios of 216-241 compared with children without hematologic malignancies, particularly in children <5 years. Newer PCV15 and PCV20 serotypes accounted for a substantial proportion of cases, highlighting the need for continued immunization and monitoring in this population.[20]

Adult Hematology Studies

Newly Diagnosed / Early Hematologic Malignancy: Evidence suggests that pneumococcal immunization is most effective when administered early in the disease course of hematologic malignancies, prior to significant immune compromise or treatment exposure. In a prospective study of patients with newly diagnosed multiple myeloma, pneumococcal immunization induced a significant increase in antibody titers, with 63% achieving seroconversion and no vaccine-preventable pneumococcal infections observed during six months of follow-up, although the study was not powered to assess clinical effectiveness.[21] In chronic lymphocytic leukemia (CLL), a large observational cohort demonstrated that immune responses to PCV13 were uncommon overall (20%) but occurred predominantly in treatment-naïve patients, with prior therapy, hypogammaglobulinemia, older age, and active disease strongly associated with poor response.[22] A randomized trial in previously untreated CLL further showed that PCV13 elicited superior functional and serologic immune responses compared with PPSV23 across most shared serotypes, with responses attenuated in patients with hypogammaglobulinemia or longer disease duration.[23]

HSCT: Recipients of HSCT are at high risk of IPD, particularly in the early post-transplant period. Randomized and prospective data demonstrate that PCVs are safe and immunogenic when initiated 3-6 months after allogeneic HSCT. In a phase 3 randomized trial, the PCV15 showed a safety profile

comparable to PCV13 and induced similar immune responses for shared serotypes, with higher responses for serotypes 22F and 33F, supporting the use of higher-valency PCVs in this population.[24] Prospective cohort data further indicate that multi-dose PCV13-based schedules induce reasonable seroprotection against conjugate vaccine serotypes, although responses are attenuated in patients receiving immunosuppressive therapy and remain suboptimal for PPSV23-unique serotypes, highlighting limitations of polysaccharide vaccines post-HSCT.[25] Real-world effectiveness data demonstrate a marked reduction in IPD and pneumococcal disease burden following the introduction of PCV-based immunization programs in both autologous and allogeneic HSCT recipients compared with prior PPV-based strategies, underscoring the clinical benefit of conjugate vaccines in this setting.[26] In autologous HSCT recipients with multiple myeloma, reimmunization with inactivated vaccines during lenalidomide maintenance, including pneumococcal immunization, has been shown to be safe and immunogenic, supporting re-immunization despite ongoing maintenance therapy.[27]

CAR T-Cell: Evidence on pneumococcal immunization following CAR T-cell therapy is limited and suggests substantially impaired vaccine responsiveness early after treatment. In a single-center retrospective study of 73 CAR T-cell recipients immunized a median of 13 months post-therapy, pneumococcal vaccine response among those not seroprotected at baseline was low (33%), compared with higher response rates for protein-based vaccines such as tetanus and polio.[28] Vaccine responsiveness was associated with immune reconstitution, including higher pre-immunization IgA levels and trends toward higher absolute B-cell counts, highlighting the importance of B-cell recovery post-CAR T. In contrast, an earlier retrospective study of 148 CD19 CAR T-cell recipients demonstrated progressive loss of pneumococcal IgG titers following CAR T therapy, with only 25% meeting criteria for humoral protection at baseline and further declines through day +540.[29] PCV13 immunization administered at day +90 or +180 post-CAR T did not improve seroprotection, and humoral protection against pneumococcus was observed only in a small subset of patients immunized later (>1-year post-therapy) and/or following intravenous immunoglobulin replacement.

Multiple Myeloma (MM): Large prospective observational data from the global INSIGHT MM study demonstrate a strong association between pneumococcal immunization and improved overall survival, with pneumococcal immunization within the prior five years associated with a 49% reduction in mortality risk compared with unimmunized patients (hazard ratio [HR] 0.51, 95% CI 0.42-0.63; $p<0.0001$), as well as a significantly lower proportion of infection-related deaths.[30] Smaller prospective and longitudinal studies confirm that MM patients are capable of mounting humoral responses to pneumococcal immunization including during active treatment, with serologic responses observed in the majority of patients following sequential PCV13 and PPSV23 immunization, although antibody concentrations decline over time and after autologous stem cell transplantation.[31] Clinical effectiveness data further support pneumococcal conjugate immunization in MM patients receiving novel agents, with a prospective controlled study demonstrating a substantial reduction in pneumonia incidence following a three-dose PCV13 regimen administered during therapy (absolute risk reduction 33%; number needed to treat = 3).[32]

Chronic Lymphocytic Leukemia: A large retrospective cohort study of patients with hematologic malignancies receiving immunosuppressive therapy, including a substantial proportion with CLL, demonstrated that receipt of PCV13 prior to therapy initiation was associated with a 45% reduction in hospitalizations due to pneumonia or sepsis within 12 months compared with unimmunized patients (OR 0.45, 95% CI 0.25-0.84; p=0.012), representing the strongest available real-world evidence of clinical benefit.[33] In contrast, multiple immunogenicity studies consistently show poor antibody responses to pneumococcal polysaccharide vaccines in CLL. A prospective study evaluating PPSV23 administered 5 years after PCV7 found that only 10-15% of CLL patients achieved antibody levels considered protective against invasive pneumococcal disease, indicating that PPSV23 does not meaningfully improve serotype-specific immunity even when given after conjugate priming.[34] Mechanistic studies further demonstrate impaired early B-cell and plasmablast responses following pneumococcal reimmunization in CLL patients, particularly among those with hypogammaglobulinemia or prior CLL-directed therapy.[35] However, repeated dosing with conjugate vaccines (PCV13) appears to elicit modest improvements in cellular immune activation compared with polysaccharide vaccines. These findings reinforce expectations of attenuated serologic responses in CLL, while supporting conjugate immunization strategies based on observed reductions in severe infection outcomes.

Adult Solid Tumour Studies

Current evidence on pneumococcal immunization in adults with solid tumours is limited, with few studies published in the last 10 years. In adults with gastric or colorectal cancer receiving chemotherapy (mean age 59 years), a prospective randomized controlled trial of PCV13 (n=87) demonstrated no significant difference in geometric mean concentrations, opsonophagocytic assay titers, seroprotection (>1:64), or seroconversion rates whether the vaccine was administered two weeks before or on the first day of chemotherapy, indicating adequate immunogenicity regardless of timing.[36] In elderly prostate cancer patients (n=4376; 2188 vaccinated, 2188 unvaccinated), a retrospective matched cohort found that PPSV23 immunization was associated with a lower incidence density of all-cause bacterial pneumonia hospitalizations (143 vs 162 per 1000 person-years; adjusted incidence rate ratio [IRR] 0.48, p=0.046) and higher overall survival (OS, 48% vs 42%, p<0.001), with further reduction in pneumonia hospitalization risk among those also immunized against influenza (adjusted IRR 0.45, p<0.001).[37] The cumulative incidence of first pneumonia-related hospitalization was 34.5% in the immunized cohort versus 36.4% in the unimmunized cohort (p=0.178). A single-centre quality improvement study presented at the American Society of Clinical Oncology (ASCO) 2025 Annual Meeting evaluated implementation of PCV20 in adults with cancer receiving systemic therapy.[38] Following adoption of a single-dose PCV20 strategy, complete pneumococcal immunization increased from 21% to 66%. Among 156 immunized patients (63% receiving cytotoxic chemotherapy), pneumonia-related hospitalization occurred in 13.1% of chemotherapy-treated patients and 3.5% of those receiving non-chemotherapy systemic therapy, with intensive care unit (ICU) admission observed in one patient per group. Although the absence of an

unimmunized comparator limits conclusions regarding vaccine effectiveness, ICU admission rates were lower than those reported in prior database studies of cancer-associated pneumonia.

Pediatric Oncology Studies

Children with hematologic malignancies, particularly those with acute lymphoblastic leukemia (ALL), are at high risk of IPD.[39,40] PCV13 immunogenicity is substantially reduced during active chemotherapy, especially during the maintenance phase, with only 12-13% of children achieving protective antibody responses (≥10/12 serotypes with IgG ≥0.35 µg/mL and ≥4-fold rise) at 1 month post-immunization in one study.[41] Protective responses improve markedly after completion of chemotherapy, with 38-44% of children maintaining immunity at 12 months,[40,41] and post-chemotherapy revaccination further enhances seroprotection to 97-100%.[40] A multicenter trial of children 4-12 months post-chemotherapy confirmed that post-chemotherapy immunization with PCV13 and subsequent PPV23 was immunogenic, increased antibody levels against pneumococcal serotypes, and was well tolerated, further supporting structured reimmunization after chemotherapy.[42] PCV13 is generally safe and well tolerated, with mostly mild local or systemic reactions reported.[40,41,43] While direct immunogenicity and safety data in pediatric oncology patients are primarily available for PCV13, higher-valency conjugates such as PCV20 are anticipated to offer comparable safety and broader coverage based on experience in healthy children and other immunocompromised groups. Immunization provides coverage against most serotypes commonly carried by pediatric oncology patients, although responses to serotype 3 may be limited and variable across studies.[39,43] Evidence in the pediatric cancer population remains limited, highlighting the need for further research to refine timing, dosing, and long-term immunogenicity.

Broad Health System Guidance

The PHAC is the national authority on immunization in Canada and provides official guidance on vaccine use, including pneumococcal immunization for adults and children. PHAC recommends that adults and children with immunocompromise due to active malignancy, HSCT, recent chemotherapy, radiation, or immunosuppressive therapy should receive PCV20 (children) or PCV20/PCV21 (adults).[1] Those previously immunized with PCV13, PCV15, or PPSV23 should receive one dose of the appropriate higher-valency vaccine at least 8 weeks after the last dose; if higher-valency vaccines are unavailable, PCV15 plus PPSV23 may be considered. HSCT recipients receive a three-dose primary series starting 3-9 months post-transplant (≥4 weeks apart), followed by a booster 12-18 months later using the higher-valency vaccine not previously given; timing should be individualized with the transplant specialist. Vaccine responses may be reduced; patients should be counseled about ongoing infection risk, and complex cases may warrant specialist consultation. Household contacts should be up to date on vaccines. Other immuno-compromised populations (e.g., solid organ transplant recipients) follow similar principles. In late 2025, the National Advisory Committee on Immunization (NACI) updated its recommendations to strongly support the inclusion of at least one higher-valency conjugate vaccine (PCV20 or PCV21) in adult pneumococcal immunization programs,

with one dose recommended for adults ≥65 years and those at increased IPD risk (including immunocompromising conditions like malignancy), regardless of prior immunization history.[13]

Cancer Specific Immunization Guidance

The National Comprehensive Cancer Network (NCCN) and the ASCO are the only major cancer organizations to have published cancer-specific clinical practice guidelines addressing pneumococcal immunization in adults with cancer within the past 5 years; no equivalent guidelines were identified for pediatric populations.

NCCN (2025) recommends that adults who are pneumococcal vaccine-naïve receive immunization following CDC guidance,[44] with timing individualized for patients at risk of reduced vaccine response, including those who received anti-B-cell therapy within the past six months or intensive induction/consolidation chemotherapy for acute leukemia.[45] For autologous or allogeneic hematopoietic cell transplant recipients, inactivated pneumococcal immunization is recommended beginning 3-6 months post-transplant, with 3-4 doses depending on vaccine formulation. Immunization may be deferred in patients receiving high-dose corticosteroids (>20 mg prednisone equivalent daily).

ASCO (2024) recommends assessing immunization status and administering age- and risk-appropriate vaccines, including pneumococcal, ideally 2-4 weeks before starting treatment.[46] Non-live vaccines may also be given during or after chemotherapy, immunotherapy, hormonal therapy, radiation, or surgery. For adults aged ≥19 years, pneumococcal options include a single dose of PCV20 or PCV15 followed by PPSV23 at least 8 weeks later; patients previously immunized with PCV13 alone may receive PCV20 after at least one year. In HSCT recipients, reimmunization with inactivated vaccines should begin as early as 3 months post-transplant and be completed by 6-12 months, while live vaccines are delayed ≥2 years and only administered in the absence of active GVHD or immunosuppression. Long-term survivors with persistent B-cell dysfunction or hypogammaglobulinemia should receive non-live vaccines despite potentially attenuated responses, and household members or close contacts should be up to date on recommended immunizations.

The Children's Oncology Group (COG, 2021) has published immunization guidance for pediatric cancer survivors.[47] For children who have completed chemotherapy and have not undergone HSCT, inactivated vaccines may be administered as early as 3 months following completion of therapy. However, COG recommends 6 months post-therapy as a standardized timepoint for booster and revaccination doses to simplify implementation across patient groups, including those who have undergone HCT or chemotherapy without high-dose therapy. This single timepoint approach also accommodates patients who received B-cell-depleting therapies while recognizing that earlier vaccination (i.e., 3 months) may be safe in selected non-HSCT patients.

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Appendix A. Search Strategy

Type of Search Evidence Type	Database or Organization	Date	Search Terms	Limits/Filters	Results
Pediatric Oncology Guidelines	Guideline Central, POGO, COG, NCCN	Jan 16, 2026	vacc, infection, immuniz		1
Adult Oncology Guidelines	PubMed	Jan 13, 2026	Vaccines[MeSH Terms]	English, humans, guideline or practice guidelines last 10 yrs.	2/77
	ECRI Guidelines		vaccine	None	4 (including 1 repeat from PubMed)/133
	ASCO, CCO, Cancer Council Australia, ESMO MASCC, NICE, NCCN, SIGN		immunize or vaccine	Last 5 yrs.	2
Primary Research	PubMed		((((((("neoplasms"[MeSH Terms]) OR ("carcinoma"[MeSH Terms])) OR (cancer[Title/Abstract])) OR (tumor[Title/Abstract])) OR (tumour[Title/Abstract])) AND ((("pneumonia, pneumococcal"[MeSH Terms]) OR (pneumonia[Title/Abstract])) OR (pneumococcal[Title/Abstract]))) AND ((immunization[Title/Abstract]) OR (immunization[MeSH Terms]))	In the last 10 years, English, Humans	22/165

Development and Revision History

This guideline was reviewed and endorsed by the Alberta Provincial Tumour Teams. Members include hematologists, surgical oncologists, radiation oncologists, medical oncologists, pediatric oncologists, nurses, pathologists, and pharmacists. Evidence was selected and reviewed by a working group comprised of members from the Alberta Tumour Teams, external participants identified by the Working Group Lead, and a methodologist from the Guideline Resource Unit. A detailed description of the methodology followed during the guideline development process can be found in the Guideline Resource Unit Handbook.

This guideline was originally developed in November 2012 and subsequently revised in August 2016, October 2017, and February 2026.

Maintenance

An annual review of the evidence will be conducted in August 2025. This guideline will be revised and updated accordingly at that time unless critical new evidence emerges.

Abbreviations

AHS, Alberta Health Services; ALL, acute lymphoblastic leukemia; ASCO, American Society of Clinical Oncology; CAR, chimeric antigen receptor; CCA, Cancer Care Alberta; CLL, chronic lymphocytic leukemia; COG, Children's Oncology Group; GVHD, graft-versus-host disease; HR, hazard ratio; HSCT, hematopoietic stem cell transplant; ICU, intensive care unit; IPD, invasive pneumococcal disease; IRR, incidence rate ratio; NACI, National Advisory Committee on Immunization; MM, multiple myeloma; NCCN, National Comprehensive Cancer Network; OS, overall survival; PCV, pneumococcal conjugate vaccine; PHAC, Public Health Agency of Canada; PPSV, pneumococcal polysaccharide vaccine.

Disclaimer

The recommendations contained in this guideline are a consensus of the Alberta Provincial Tumour Teams and are a synthesis of currently accepted approaches to management, derived from a review of relevant scientific literature. Clinicians applying these guidelines should, in consultation with the patient, use independent medical judgment in the context of individual clinical circumstances to direct care.

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All cancer drugs described in the guidelines are funded in accordance with the Outpatient Cancer Drug Benefit Program, at no charge, to eligible residents of Alberta, unless otherwise explicitly stated. For a complete list of funded drugs, specific indications, and approved prescribers, please refer to the *Outpatient Cancer Drug Benefit Program Master List*.

Citation

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Measles Post-Exposure Prophylaxis

Measles Post-Exposure Prophylaxis

Background

Increased measles activity observed across Canada over the past year has highlighted the need for more detailed guidance on measles post-exposure prophylaxis (PEP) for individuals with weakened or impaired immune systems due to disease or therapies.[1]

Current provincial guidelines in Alberta include detailed evidence-based recommendations for routine immunizations following hematopoietic stem cell transplantation (HSCT) and chimeric antigen receptor (CAR) T-cell therapy.[2, 3] However, they do not provide guidance regarding measles post-exposure management in individuals who are immunocompromised. In addition, in the case of an outbreak, vaccination may be considered earlier than recommended in the routine post-transplant schedule.

The 2025 guidance document published by the National Advisory Committee on Immunization includes measles PEP considerations based on immunocompetency, age, birth year, and immunization status.[4] Following this publication, and the subsequent adaptation of these recommendations for immunocompromised individuals by the Ontario Agency for Health Protection and Promotion,[5] the present document provides specific guidance for cancer patients in Alberta. Many patients within this population are already receiving immunoglobulin replacement therapy as part of their routine care, which has implications for measles PEP decision-making. While the content aligns with the aforementioned publications, the format has been adapted to facilitate clinical staff in triaging patient exposure notices.

Guideline Questions

1. What are the recommended strategies for measles post-exposure management in patients with cancer who are immunocompromised due to their cancer or cancer treatments?
2. What is the role of immunoglobulin replacement in patients who have received HSCT, CAR T-cell therapy, or T-cell engaging (TCE) therapy?

Recommendations

The following recommendations have been adapted from publications from Public Health Agency of Canada and Public Health Ontario.[4, 5] Following identification of the appropriate risk group (Table 1), the flowcharts below can be used to determine when measles PEP is recommended.

Table 1. Identification of Measles Susceptibility Risk Group Based on Patient's Treatment

Patient's Received or Completed Treatment	Next Step
Transplant	
Within 12 mo of autologous HSCT [a]	Flowchart 1
Between 12-24 mo of autologous HSCT [a]	Flowchart 2
Within 24 mo of allogeneic HSCT [a]	Flowchart 1

Patient's Received or Completed Treatment	Next Step
>24 mo of autologous or allogeneic HSCT with no chronic GVHD	Flowchart 3
Chronic GVHD	Flowchart 1
CAR T-cell	
Within 12 mo of CAR T-cell therapy	Flowchart 1
>12 mo after CAR T-cell therapy [b]	Flowchart 2
Acute lymphoblastic leukemia	
Receiving chemotherapy	Flowchart 1
Within 3 mo after completion of chemotherapy [a]	Flowchart 1
Receiving B cell depleting therapy	Flowchart 1
Within 12 mo after completion of B cell depleting therapy [a]	Flowchart 1
Malignancy (not included above)	
Lymphoproliferative disease including hematologic cancers [c]	Flowchart 2
Receiving immuno/ targeted / chemo/ radiation therapy	Flowchart 2
Within 3 mo of completing immuno/ targeted / chemo/ radiation therapy	Flowchart 2
Immunodeficiencies	
Primary immunodeficiency or IEI with contraindication live viral vaccines [d, e]	Flowchart 1
Primary immunodeficiency or IEI without contraindication live viral vaccines [f, e]	Flowchart 3
Secondary immunodeficiency (hypogammaglobulinemia)	Flowchart 2
Therapies/medications	
Receiving cyclophosphamide or anti-thymocyte globulin	Flowchart 1
Receiving alemtuzumab or B cell depleting therapy	Flowchart 1
Within 12 mo of completing alemtuzumab or B cell depleting therapy [a]	Flowchart 1
Therapies/medications (not included above)	
Receiving targeted immunosuppressive therapy [g, h]	Flowchart 2
Within 6 mo of completing targeted immunosuppressive therapy [g, h]	Flowchart 2
Receiving immunosuppressive drugs which impair immune pathways [i]	Flowchart 2
Receiving immunosuppressive drugs not impairing immune pathways [j, k]	Flowchart 3
Within 3 mo of completing immunosuppressive drugs which impair immune pathways [i, h]	Flowchart 2
Receiving long-term high-dose corticosteroid therapy [l]	Flowchart 2
Receiving long-term low-dose corticosteroid therapy [l]	Flowchart 3
Within 4 wk of completing long-term high-dose corticosteroid therapy [l]	Flowchart 2
>4 wk after discontinuation of long-term high-dose systemic steroids [l]	Flowchart 3
Immediately after discontinuation of short-term (<14 d) high-dose steroids [l]	Flowchart 3
Tapering after daily long-term high-dose corticosteroid therapy [l]	Flowchart 2

CAR, chimeric antigen receptor; GVHD, graft-versus-host disease; HSCT, hematopoietic stem cell transplant; IEI, inborn error of immunity; Ig, immunoglobulin; IL, interleukin; JAK, Janus kinase; MMR, measles, mumps, rubella; PEP, post-exposure prophylaxis

[a] Immune reconstitution is progressive and may occur sooner than the timeframe indicated. Consultation with the specialist responsible for the clinical care of the individual is recommended

[b] Timeframe for immune reconstitution following CAR T-cell therapy is variable. Consultation with the specialist responsible for the clinical care of the individual is recommended

[c] e.g., indolent lymphoma, leukemia, or plasma cell lymphoma; excluding acute lymphoblastic leukemia

[d] e.g., X-linked agammaglobulinemia, severe combined immunodeficiency, severe antibody deficiency, ataxia-telangiectasia, select defects in intrinsic and innate immunity, etc.) for which live viral vaccines are contraindicated

[e] As per the Canadian Immunization Guide, the MMR vaccine is contraindicated in individuals with: major B cell deficiency, severe combined B and T cell immunodeficiency, severe T cell deficiency, leukocyte adhesion defects, Chediak-Higashi syndrome and other defects in cytotoxic granule release, undefined phagocyte defect, defects in alpha or gamma interferon production, and nuclear factor kappa B defects.

[f] e.g., minor B cell deficiency with intact T cell function not requiring Ig therapy, partial T cell defects, and other primary immune deficiencies or inborn error of immunity for which live viral vaccines are not contraindicated

[g] Including cytokine inhibitors (e.g., tumor necrosis factor, IL-1, IL-12/23, IL-17, IL-23), costimulation modulators, and small molecule inhibitors (e.g., JAK inhibitors), alone or in combination with steroids or other immunosuppressive drugs

[h] Note that interval may vary with the type and intensity of treatment. Period may be shortened for biologics/treatments with a shorter duration of effect.

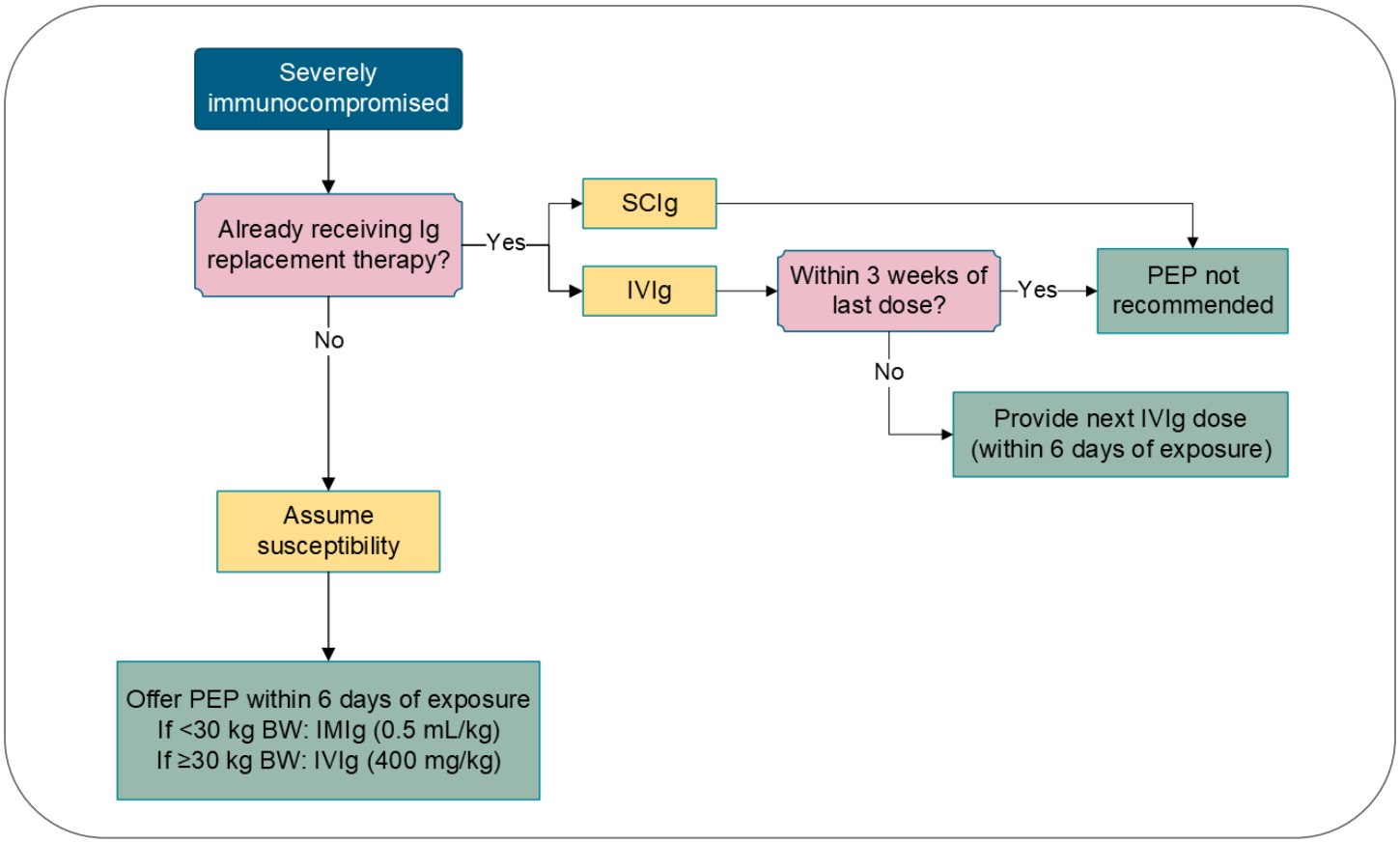
[i] e.g., methotrexate >0.4 mg/kg/week [children: >10 mg/m^2/week; adults: >15 mg/m^2/week], azathioprine >3 mg/kg/day, 6-mercaptopurine >1.5 mg/kg/day, cyclosporine, tacrolimus, sirolimus, mycophenolate mofetil, and small molecule inhibitors.

[j] e.g., IgE blockers, IL-5 inhibitors, IL-5 receptor blockers, IL-4 inhibitors, IL-13 inhibitors (and other cytokine inhibitors; and methotrexate ≤0.4 mg/kg/week (children: ≤10 mg/m^2/week; adults: ≤15 mg/m^2/week), azathioprine ≤3 mg/kg/day, 6-mercaptopurine ≤1.5 mg/kg/day, hydroxychloroquine (any dose)

[k] Individuals on azathioprine exhibiting signs of myelosuppression/myelotoxicity should be assessed for susceptibility and need for Ig PEP, and could be considered as immunocompetent

[l] e.g., high dose is defined as prednisone or equivalent of ≥20 mg/day for ≥14 days for adults, or ≥1 mg/kg/day for ≥14 days children. Note that high-dose prednisone thresholds for children vary across guidelines and range from ≥0.5 mg/kg/day to ≥2 mg/kg/day

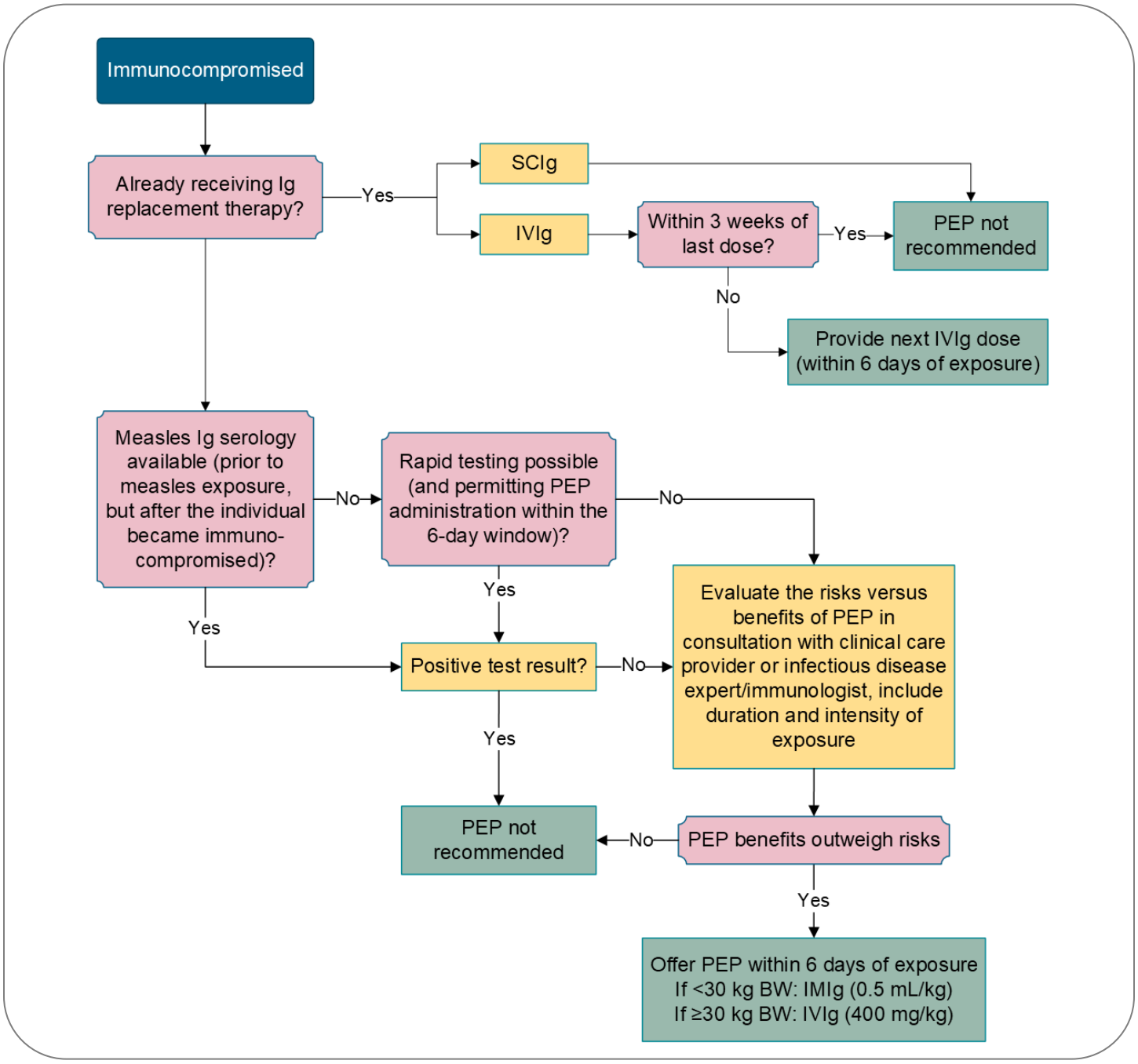
Flowchart 1. Individuals with an absent/near absent immune system, and who therefore are not expected to have sufficient natural/acquired measles antibody-mediated protection, and are known to have a high risk of severe disease*



BW, body weight; Ig; immunoglobulin; IM, intramuscular; IV, intravenous; PEP, post-exposure prophylaxis; SC, subcutaneous

*Allogeneic and autologous HCT recipients may receive MMR as early as 1 year post-transplant (within 72 hours of exposure), rather than waiting 2 years, if their transplant physician determines they are no longer substantially immunocompromised (e.g., ≥3 months off immunosuppressive therapy).

Flowchart 2. Individuals who are immunocompromised, and but may have been able to maintain adequate measles antibody-mediated protection from known previous vaccination or infection†



BW, body weight; Ig; immunoglobulin; IM, intramuscular; IV, intravenous; PEP, post-exposure prophylaxis; SC, subcutaneous

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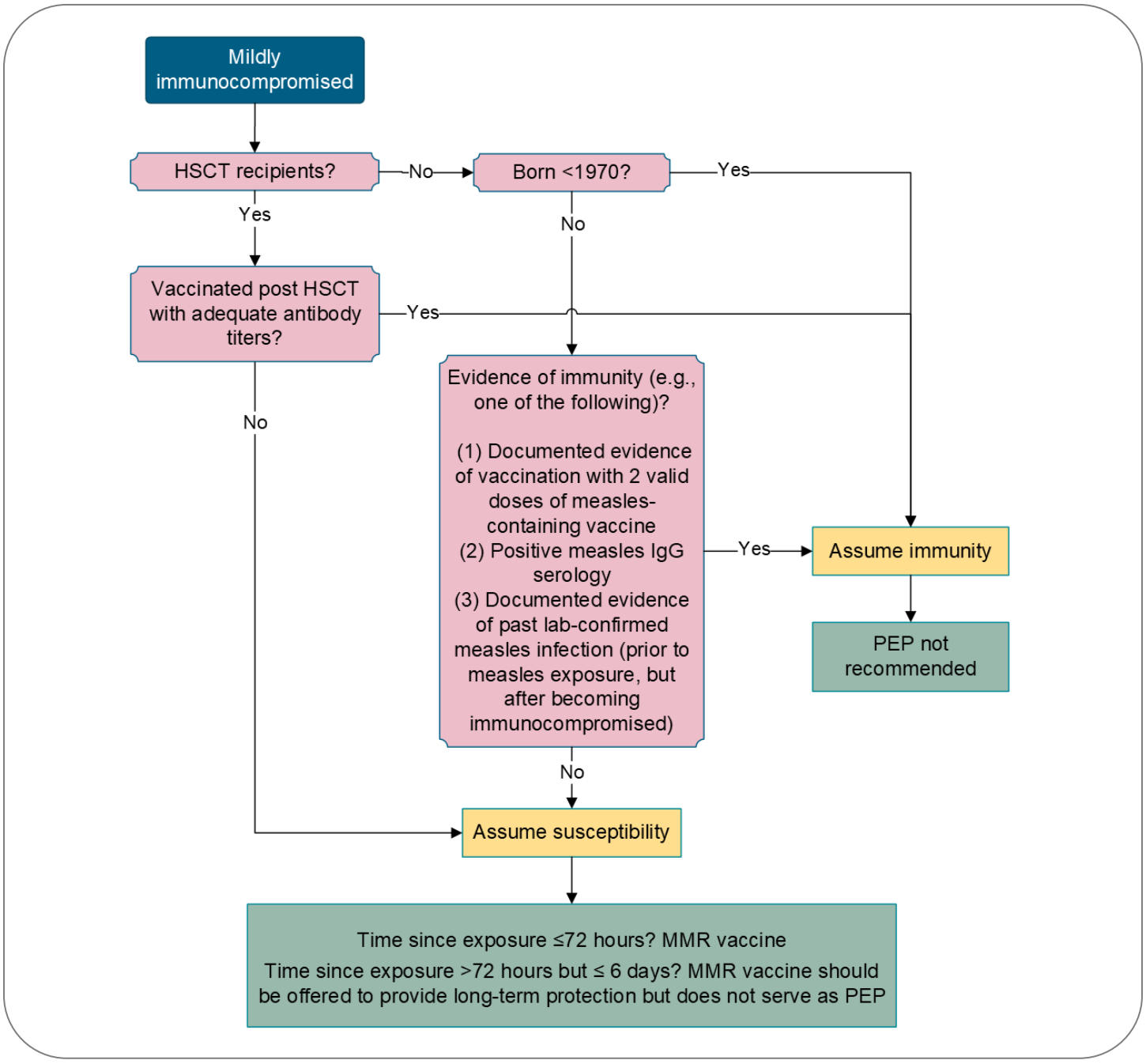
† Allogeneic and autologous HCT recipients may receive MMR as early as 1 year post-transplant (within 72 hours of exposure), rather than waiting 2 years, if their transplant physician determines they are no longer substantially immunocompromised (e.g., ≥3 months off immunosuppressive therapy).

Flowchart 3. Individuals who have low-level immunosuppression or only mild immunocompromising conditions, and who are expected to have measles antibody-mediated protection from known previous infection or vaccination, for whom measles-containing vaccine is not contraindicated



BW, body weight; HSCT, hematopoietic stem cell transplantation; Ig; immunoglobulin; IM, intramuscular; IV, intravenous; MMR, measles, mumps, and rubella; PEP, post-exposure prophylaxis

Special Populations

For HIV-positive individuals, Flowchart 1 should be followed if current CD4 T cell counts are <15% (age 1-13y), <200 cells/mm^3 (age ≥14y), or if the CD4:CD8 ratio is <0.5 (adults). For any asymptomatic individuals, follow Flowchart 3.

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Abbreviations

AHS, Alberta Health Services; BW, body weight; CAR, chimeric antigen receptor; CCA, Cancer Care Alberta; HIV, human immunodeficiency virus; HSCT, hematopoietic stem cell transplantation; IEI, inborn error of immunity; Ig, immunoglobulin; IL, interleukin; IM, intramuscular; IV, intravenous; JAK, Janus kinase; MMR, measles, mumps, rubella; PEP, post-exposure prophylaxis; SC, subcutaneous; TCE, T-cell engaging;

Disclaimer

The recommendations contained in this guideline are a consensus of the Alberta Bone Marrow and Blood Cell Transplant Program and are a synthesis of currently accepted approaches to management, derived from a review of relevant scientific literature. Clinicians applying these guidelines should, in consultation with the patient, use independent medical judgment in the context of individual clinical circumstances to direct care.

This guideline was originally developed in 2026.

Maintenance

A formal review of the guideline will be conducted in 2031. If critical new evidence is brought forward before that time, however, the guideline working group members will revise and update the document accordingly.

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Conflict of Interest Statements

Dr. Irwindeep Sandhu, hematologist and oncologist, reports receiving honoraria from and participating on advisory boards with Johnson and Johnson, Bristol Myers Squibb, Kite/Gilead, Pfizer, Takeda, Amgen, Sanofi, and GSK.
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Appendices

Revision History

Date	Topic Title	Action
Feb 11, 2026	Measles Post-Exposure Prophylaxis	New
Feb 26, 2026	Pneumococcal Immunization In Adult And Pediatric Patients Undergoing Cancer Treatment	Update
Feb 11, 2026	Influenza Immunization for Adult and Pediatric Patients Undergoing Cancer Treatment	Update