doi.org/10.58931/cht.2026.5s0495

About the Authors



Amaris K. Balitsky, MD, MSc, FRCPC

Dr. Amaris Balitsky is a malignant hematologist at Juravinski Hospital and Cancer Centre, specializing in lymphoid malignancies and cellular therapy. Dr. Amaris Balitsky obtained her MD degree from and completed Internal Medicine residency at the University of Toronto. She completed Hematology residency at McMaster University. She went on to complete a 2-year combined clinical and research fellowship, where she developed clinical expertise in lymphoma and cellular therapy at McMaster University and the Juravinski Cancer Centre. She concurrently obtained a Master's degree in Health Research Methods (HRM) in the Department of Health Research Methods Evidence & Evaluation at McMaster University. She also completed requirements for the Clinician Investigator Program (CIP), a Royal College of Physicians and Surgeons of Canada certificate program.

Affiliations: Department of Oncology, McMaster University, Hamilton, ON, Canada
Escarpment Cancer Research Institute, Hamilton, ON, Canada
Hamilton Health Sciences Juravinski Cancer Centre, Hamilton, ON, Canada



Christopher Lemieux, MD, FRCPC, DRCPC

Dr. Christopher Lemieux is a hematologist at CHU de Québec–Université Laval, where he serves as Director of the CAR T-cell therapy program and the Hematology Fellowship Program at Université Laval. He completed advanced fellowship training in transplantation and cellular therapy at Stanford University.

In addition to his clinical and academic leadership roles, Dr. Lemieux is a key member of the Québec Immunocellular Therapy Network, contributing to province-wide initiatives aimed at expanding access to advanced immunotherapies. His research focuses on the clinical integration of novel immunotherapeutic strategies for B-cell malignancies, with a particular emphasis on CAR T-cell therapy and other emerging cell-based treatments.

As both a practicing clinician and active researcher, Dr. Lemieux is dedicated to bridging the gap between innovation and patient care—bringing the latest scientific advances in hematologic oncology to the bedside.

Affiliations: Department of Medicine, Université Laval, Québec, QC, Canada
CHU de Québec-Université Laval, Québec, QC, Canada

A framework for outpatient CAR-T monitoring to support Canadian CAR-T capacity building

Amaris K. Balitsky, MD, MSc, FRCPC[1,2,3] and Christopher Lemieux, MD, FRCPC, DRCPC[4,5]

[1]Department of Oncology, McMaster University, Hamilton, ON, Canada [2]Escarpment Cancer Research Institute, Hamilton, ON, Canada [3]Hamilton Health Sciences Juravinski Cancer Centre, Hamilton, ON, Canada [4]Department of Medicine, Université Laval, Québec, QC, Canada [5]CHU de Québec-Université Laval, Québec, QC, Canada

Introduction: why outpatient CAR-T therapy now in Canada?

Chimeric antigen receptor T cell (CAR-T) therapy has significantly improved outcomes, including sustained remissions and even cures, for patients with refractory or relapsed B-cell non-Hodgkin lymphoma (NHL), B-cell acute lymphoblastic leukemia (ALL), and multiple myeloma (MM).[1-8] CAR-T products differ by antigen target, such as CD19 and B cell maturation antigen (BCMA); and by co-stimulatory domain, which is either CD28 (e.g., axicabtagene ciloleucel, brexucabtagene autoleucel) or 4-1BB (e.g., tisagenlecleucel, lisocabtagene maraleucel, idecabtagene vicleucel). Prior to CAR-T availability, patients with relapsed hematologic malignancies experienced poor outcomes. For example, in patients with relapsed/ refractory large B-cell lymphomas, the median overall survival was 6.2 months. prior to access to CAR-T therapy.[9] These outcomes are balanced by CAR-T therapy-associated toxicities, including cytokine release syndrome (CRS) and immune effector cell-associated neurotoxicity syndrome (ICANS). Despite the substantial clinical benefits observed with CAR T-cell therapy, treatment is associated with distinct immune-mediated toxicities, including cytokine release syndrome (CRS) and immune effector cell-associated neurotoxicity (ICANs). Although these adverse events are generally manageable with established treatment algorithms and are often reversible, severe toxicities, resulting in organ dysfunction and occasionally death, may occur and can necessitate ICU-level care. Enhanced understanding of toxicity kinetics, earlier intervention strategies and the availability of effective management approaches such as tocilizumab and corticosteroids have improved the safety profile of CAR T-cell therapy. Early interventions, such as tocilizumab (anti-IL-6R) and corticosteroids, can attenuate the severity of these toxicities. Given the potential for severe toxicities, CAR-T has traditionally been administered and monitored in an inpatient hospital setting.

Traditionally, CAR T-cell therapy has been delivered in the inpatient setting, with hospitalization for approximately 1 to 3 weeks depending on the product, center practices and patient-specific factors. According to US registry data, the median inpatient length of stay for CAR-T monitoring across cancer types ranges from 12 to 16 days.[10,11] Given the growing experience with CD19 CAR-T for the treatment of LBCL, some centres have successfully transitioned selected patients to outpatient administration and monitoring pathways, reducing reliance on prolonged inpatients hospitalization.[12] For patients who do not develop significant toxicities such as CRS, ICANs or febrile neutropenia, prolonged inpatient hospitalization may not always be necessary. As CAR-T programs continue to evolve, there is growing interest in approaches that can safely minimize time spent in hospital while maintaining appropriate monitoring and support. “Time toxicity” refers to the time patients spend receiving cancer-related care, including hospitalization, clinic visits, testing and management of treatment-related adverse events, rather than time spent at home or engaged in their usual activities.[12] Given the potentially transformative and, for some patients, curative benefit of CAR T-cell therapy, optimizing the patient experience is increasingly recognized as an important component of care. At the same time, not all patients achieve durable disease control, and some may experience early relapse or disease progression. In one analysis looking at outcomes for patients with refractory DLBCL, up to half of patients became refractory or relapsed resulting in shortened survival. For example, the median survival is 1.7 months in patients whose lymphoma progresses prior to day 30 after therapy, and 3 months for those with progression after day 30.[9] In these cases, maximizing quality time outside of healthcare settings may be particularly meaningful. As a result, care models that safely reduce unnecessary hospital time while preserving patient outcomes have become an important area of focus for CAR-T programs and healthcare systems.

In addition to the patient perspective, the Canadian healthcare system faces unique barriers to CAR-T access. Capacity needs are growing as indications for CAR-T therapy expand, and with a finite number of beds, current hospital resources will struggle to keep up with demand. In addition, Canada’s unique expansive geography poses a barrier to CAR-T access. One study conducted in the United States demonstrated that patients living more than 2 hours from a CAR-T centre were 40% less likely to receive CAR-T therapy, and that only 25% of patients eligible for CAR-T actually receive it.[13] Being eligible but not considered for CAR-T therapy has also been associated with reduced survival.[14]

There are currently 20 CAR-T treatment centres across the country (**Figure 1**), with none in the territories, Newfoundland, or Prince Edward Island. Provinces without treatment centres account for 7% of projected hematologic cancer cases in 2024.[15] As a result, patients must travel long

distances, and for some, this means travelling outside their home province to reach their CAR-T centre. While commercial CAR-T patient support programs can help mitigate financial barriers by covering eligible travel, accommodation and meal expenses for patients and caregivers, social, logistical and caregiver-related challenges persist. In fact, in a survey of CAR-T referring providers, 55% reported that travel distance to a treatment centre was a significant barrier.[16]

Driven by the goals of improving patient experience, reducing time toxicity, and optimizing healthcare resource utilization (HCRU), CAR-T delivery models are evolving towards outpatient (OP) administration and monitoring.

There are four Canadian CAR-T centres (Juravinski Cancer Centre, Hôpital Maisonneuve-Rosemont, CHU de Québec–Université Laval, and The Ottawa Hospital) currently offering OP CAR-T administration of CAR-T products with a safer toxicity profile (4-1BB CAR-T products), while ongoing prospective Canadian studies are evaluating outpatient monitoring approaches, with and without remote patient monitoring, for patients receiving either 4-1BB- or CD28-based CAR-T therapies.

Numerous studies have demonstrated the safety and feasibility of administering and monitoring CAR-T therapy recipients in the OP setting, as well as reduced HCRU.[17-28] These single-arm studies used all available CAR-T products in the United States and included patients with different hematologic malignancies, including lymphoma, MM, and ALL. Select studies utilized remote monitoring technology.[23, 24, 27, 29] In addition to demonstrating feasibility, these studies demonstrated fewer hospital admissions and shorter length of hospital stay; for example, in a study administering liso-cel in the OP setting, the length of hospital stay was reduced from 15 days with inpatient monitoring to 6 days with OP monitoring.[19] In addition, a systematic review demonstrated that although there were more unplanned hospitalizations with OP monitoring, the overall hospital length of stay was shorter.[30] Furthermore, there is a potential economic benefit to OP CAR-T monitoring with a 56% reduction in hospitalization costs compared to inpatient monitoring.[31] Together, these studies support OP CAR-T delivery as a safe and feasible strategy that may reduce time toxicity for patients, improve HCRU in a constrained universal healthcare system, and support Canadian CAR-T capacity building as treatment indications continue to expand. In Canada, OP CAR-T models, potentially supported by remote monitoring, could help address geographic and hospital capacity barriers while preserving timely recognition and management of CAR-T-related toxicities.

A US program follows a similar approach, with two notable exceptions. In this program, OP CAR-T monitoring is conducted for both 4-1BB and CD28 products. Grade 1 CRS is treated as an OP with tocilizumab and the patient is only admitted if the fever is refractory to tocilizumab.[28] The program includes a 24-hour clinic equipped to administer OP antibiotics, tocilizumab, chemotherapy, blood products, and immunosuppressive agents. Out of 58 patients who received OP CAR-T monitoring at this centre, 42 (72%) were admitted with a median length of stay of 4 days (range 1-14 days) compared to 12 to 16 days for those receiving inpatient CAR-T monitoring.[10, 11]

Three studies have assessed remote vital sign monitoring of various intensities in CAR-T recipients receiving axicel.[24, 27, 29] A majority of participants across these three studies received prophylactic corticosteroids. In a US multi-centre single-arm study of 30 CAR-T recipients receiving axi-cel, participants provided a complete set of vital signs and neurological assessment once daily and then as needed, with a telemedicine check-in at the end of the day.[24] Median time to hospitalization was 4 days with a median length of stay of 8 days, compared to 16 days in the ZUMA-7 trial.[8] Recognizing the small sample size and low event rate of severe toxicities, there were no grade 3 CRS events and seven grade 3 or 4 ICANS events. In a single-centre study of 20 CAR-T recipients assessing the feasibility of OP CAR-T monitoring, patients receiving axi-cel were seen in an OP clinic daily until day 14, with two telemedicine visits in the afternoons and evenings. Vital signs were monitored remotely via continuous measurements of skin temperature, heart rate, and oxygen saturation, and blood pressure was assessed at specific intervals.[29] Median time to hospitalization was three days with a median length of stay of 5.5 days. Recognizing that this study had a small sample size and a low event rate of severe toxicities, there were only four grade 3 ICANS events, and no grade ≥3 CRS or grade 5 ICANS events. In another single-arm US multi-centre study of 47 CAR-T recipients, participants underwent continuous temperature monitoring, intermittent blood pressure monitoring, and carried a wearable heart rate, respiratory rate, and oxygen saturation monitor.[27] The continuous remote monitoring was conducted in a central clinic staffed by nurses with triage pathways.



CAR-T treatment centres

BRITISH COLUMBIA
1. **Vancouver General Hospital** (Vancouver)
2. **BC Children's Hospital** (Vancouver)

ALBERTA
3. **Cross Cancer Institute** (Edmonton)
4. **Arthur J.E. Child Comprehensive Cancer Centre** (Calgary)
5. **Alberta Children's Hospital** (Calgary)

SASKATCHEWAN
6. **Saskatoon Cancer Centre** (Saskatoon)

MANITOBA
7. **CancerCare Manitoba** (Winnipeg)

NEW BRUNSWICK
8. **Saint John Regional Hospital** (Saint John)

NOVA SCOTIA
9. **QEII Health Sciences Centre** (Halifax)

- Adult CAR-T program
- Pediatric CAR-T program
- Province with a CAR-T centre
- No CAR-T centre

ONTARIO
10. **London Health Sciences Centre** (London)
11. **Juravinski Cancer Centre** (Hamilton)
12. **Princess Margaret Cancer Centre** (Toronto)
13. **SickKids** (Toronto)
14. **Kingston Health Sciences Centre** (Kingston)
15. **The Ottawa Hospital** (Ottawa)

QUEBEC
16. **CHU Sainte-Justine** (Montreal)
17. **McGill University Health Centre** (Montreal)
18. **CHUM** (Montreal)
19. **Hôpital Maisonneuve-Rosemont** (Montreal)
20. **CHU de Québec–Université Laval** (Québec City)

Figure 1. CAR-T therapy centre locations across Canada; Generative AI tools (Claude Opus 5.5, Anthropic) were used to assist in creating Figure 1. The generated visual was reviewed and verified by the authors to ensure scientific accuracy and appropriateness. Responsibility for the content and integrity of this image rests solely with the authors.

There were four grade 3/4 CRS events and three grade 3 ICANS events. These studies demonstrate the feasibility and safety of OP CAR-T monitoring augmented with remote patient monitoring for patients receiving a CD28 CAR-T product. Although hospitalization rates were high, the median length of stay was considerably shorter compared to pivotal trial data.

Definitions and eligibility: what constitutes OP CAR-T?

OP CAR-T treatment is defined as cell infusion with a planned discharge home the same day, supported by structured ambulatory monitoring, distinct from the traditional model of routine admission for one week or more for surveillance and management of CRS and ICANS or any other adverse events.

Eligibility for OP care was initially limited to products with lower toxicity. However, there is now data supporting OP administration of all currently reimbursed products in Canada.[17-28] Patient factors such as disease burden and kinetics, baseline organ function and performance status, prior or active central nervous system involvement, availability of social supports, and distance and transport time to the treating centre are the main considerations in determining eligibility for OP administration.[32] Each centre should develop criteria that align with its infrastructure and capabilities. Although centers should develop selection criteria that reflect the local capabilities, early identification and referral remain critical. Delays in referral may result in disease progression, clinical deterioration, or decline in performance status, potentially limiting eligibility for OP care. Conversely, patients referred earlier are more likely to be suitable candidates for OP CAR-T treatment and monitoring pathways.

Two OP models of care

Model A. Ambulatory OP treatment and monitoring, with admission if needed

The first OP model of care approach uses OP monitoring as the default for all patients, with admission for complications as needed. This has been the model for CAR-T delivery and monitoring in select Canadian centres, including the Juravinski Hospital and Cancer Centre, for 4-1BB CAR-T products since the inception of the program in January 2020. In this centre, patients receive lymphodepleting chemotherapy and CAR-T infusion in an OP Day unit staffed by registered nurses (RNs), nurse practitioners (NPs), and medical doctors (MDs) followed by daily in-person assessments for the first 7-10 days following CAR-T infusion. In this model, no standard prophylaxis (e.g., corticosteroids) is administered. Patients and their caregivers are counselled on the signs/symptoms of CRS/ICANS and infections and are given hematology contact information for when signs and symptoms occur. Hospital beds are reserved on the hematology/oncology ward for all patients who recently received CAR-T therapy.

Table 1. Implementation checklist for OP CAR-T monitoring; courtesy of Amaris Balitsky, MD and Christopher Lemieux, MD

Patient and caregiver
☐ Patient eligibility
☐ Reliable caregiver
☐ Patient and caregiver education
☐ Social worker assessment
☐ Local lodging
☐ **If using remote monitoring technology, technology education and assessment**
Operation
☐ CRS/ICANS pathways
☐ **If using remote monitoring technology, alarm trigger pathways**
☐ Tocilizumab and anakinra available in hospital and ready to be served by pharmacy
☐ Onboarding and ongoing education of program personnel (including on remote monitoring technology if using)
EMR
☐ Standardized order sets for CRS/ICANS management
☐ Standardized templates for documentation
Infrastructure
☐ Adequate nursing staff to support outpatient care
☐ Rapid triage to inpatient (e.g., hold bed agreement, 24/7 nurse line)
☐ 24/7 hematology coverage
☐ Emergency department training and readiness
Quality
☐ Outcomes and metrics

CAR: *chimeric antigen receptor;* ***CRS:*** *cytokine release syndrome;* ***EMR:*** *electronic medical record;* ***ICANS:*** *immune effector cell-associated neurotoxicity syndrome;* ***OP:*** *outpatient.*

Patients are directly admitted to the hematology ward with any grade CRS or ICANS. After the acute phase of CAR-T therapy, CAR-T recipients are seen in the oncology day unit 2-3 times a week until day 30, at which point patients transition to follow-up in clinic with their hematologist. Requirements for this model of care include 24/7 hematologist availability, an oncology day unit that is open daily (including weekends and holidays), direct admission pathways to avoid the emergency department (ED), standardized CRS/ICANS assessment, immediate access to tocilizumab/corticosteroids, and a dedicated, reliable, and educated caregiver (**Table 1**). Patients can be selected for inpatient monitoring as per MD discretion. For patients who live at a significant distance from the CAR-T centre, housing is provided nearby to allow for frequent follow-up and CAR-T-related toxicity care. The authors report positive experiences in their own single centres with ambulatory outpatient treatment and monitoring for CAR-T patients.

Model B. Ambulatory OP monitoring with remote patient monitoring

The approach in Model A can be augmented with remote patient monitoring ranging from clinician telephone check-ins to remote vital sign monitoring. This approach can facilitate early detection and management of CAR-T-related toxicities, improve patient safety, provide peace of mind for clinicians, and support safe care transitions that enable early hospital discharge.[33] Although, outpatient monitoring in Canada is not currently part of the standard of care, specific institutions are in the process of establishing pilot programs for this patient population.

For both OP CAR-T delivery models, we created an implementation checklist (**Table 1**) covering patient, caregiver, operational, electronic medical record, and infrastructure considerations.

Monitoring intensity and "time-at-risk": linking toxicity timing to OP design

OP safety hinges less on the total duration of monitoring than on how well monitoring aligns with the predictable timing of toxicity. The safety of OP CAR-T delivery depends not only on the duration of monitoring but also on ensuring that monitoring intensity is appropriately aligned with periods of highest risk. Across CAR-T products, CRS and ICANS most commonly occur within the first two weeks following infusion, with relatively few new events arising thereafter. In the largest combined analysis of liso-cel clinical trial and Center for International Blood and Marrow Transplant Research (CIBMTR) registry data, approximately 95% to 98% of CRS and ICANS events occurred within the first 15 days after infusion, with late-onset events being uncommon.[34] Similar observations have been reported with axi-cel, where median time to onset was four days for CRS and eight days for ICANS, and only a small proportion of patients experienced a new toxicity event beyond day 14.[35] A parallel CIBMTR-based analysis specifically examining events at and beyond 2 weeks after axi-cel infusion reported a similarly low rate of new-onset toxicity in that later window.[36] These observations provide an opportunity to tailor OP monitoring intensity according to periods of greatest clinical risk, rather than applying a uniform approach throughout follow-up.

The cumulative time patients and caregivers spend in hospital beds, travelling to and attending appointments, being monitored, and seeking urgent care is a burden that OP program design should aim to minimize without compromising safety.[12] Practical program design elements that operationalize this include a daily (or near-daily) early monitoring cadence with structured neurological checks, a defined CRS and ICANS pathway, a direct-to-unit admission process that bypasses the ED when possible, and a single-call escalation line that referring providers and caregivers can use at any hour. Rapid recognition and time-to-treatment metrics matter as much as raw event rates. New-onset CRS and ICANS are rare beyond two weeks post-infusion, supporting more flexible, front-loaded monitoring strategies rather than fixed multi-week observation.[37]

Monitoring requirements across products are evolving as safety data accumulates.

In June 2025, the FDA eliminated the Risk Evaluation and Mitigation Strategy (REMS) requirements for all approved CD19 and BCMA-directed CAR-T therapies. Updated labeling recommends at least two weeks of monitoring after infusion, with daily monitoring during the first week. Driving restrictions were also reduced. In June 2026, based on CIBMTR registry and clinical trial data described above, Health Canada approved an update to the liso-cel product monograph, reducing the recommended duration that patients must remain near a specialized treatment center from 28 to 14 days, with a parallel reduction in driving restrictions from eight weeks to four weeks.[34-36, 38-40]

Evidence synthesis: efficacy comparable; safety differences influence OP feasibility

Adjusted real-world comparisons of axi-cel and liso-cel suggest broadly similar effectiveness, although results vary by cohort and analytic approach. A multicentre real-world comparison reported similar response and survival outcomes for liso-cel and axi-cel.[41] A separate propensity-weighted comparison found an effectiveness advantage favouring axi-cel after adjustment for baseline risk factors.[42] Finally, a third inverse probability of treatment weighting (IPTW) analysis with three years of follow-up did not confirm a statistically significant difference in response rate, progression-free survival, or overall survival between the two products.[43] These analyses are limited by many biases, including differing wait times to infusion and differences in practice patterns between products and centres and should be interpreted with appropriate caution.

Safety and toxicity profiles differ more consistently across these comparative datasets: axi-cel has generally been associated with higher rates of CRS, ICANS, and (in the three-year IPTW analysis) hematologic toxicity than liso-cel, along with more frequent use of tocilizumab and dexamethasone.[41, 43, 44] These differences are directly relevant to OP planning. They affect which patients are reasonable OP candidates, how long intensive monitoring should be maintained, and the likelihood of an unplanned admission. In practice, product-specific toxicity kinetics should be one input, alongside patient-level risk factors, when choosing the OP model and monitoring intensity for a given patient.

HCRU encompasses unplanned and planned inpatient bed-days, ICU transfers and length of stay, ED visits, and unplanned clinic visits. OP CAR-T monitoring can significantly reduce HCRU, with shorter inpatient bed-days despite an increased number of unplanned hospital admissions ,[30] and lower costs, with a 56% reduction in hospital-related costs compared to inpatient costs.[31] OP monitoring is a key lever to address increasing CAR-T indications and constrained inpatient capacity. In addition to reducing time toxicity for the patient, OP monitoring can improve HCRU in a constrained universal healthcare system and help support Canadian CAR-T capacity building.

Conclusion

Moving CAR-T delivery to OP care, with or without remote patient monitoring, requires upfront planning, workflow redesign, and targeted investment in ambulatory and after-hours infrastructure. When aligned with patient risk and site capabilities, OP CAR-T treatment and monitoring can be implemented safely and offer a practical way to sustain and expand treatment capacity in Canada, while optimizing available infrastructure.

There is, deliberately, no single recommended model here. The right choice, or combination of choices across patients and products, depends on each centre's case volume, staffing, distance to patients' homes, existing ambulatory infrastructure, and institutional risk tolerance. Programs should treat the models and evidence summarized here as a framework to be adapted locally and should expect to revisit their choice of model as monitoring requirements continue to evolve and as their CAR-T management experience grows.

Correspondence

Amaris K. Balitsky, MD, MSc, FRCPC
Email: balitsky@hhsc.ca

Christopher Lemieux, MD, FRCPC, DRCPC
Email: christopher.lemieux.med@ssss.gouv.qc.ca

Financial Disclosures

A.K.B.: Consultancy: Kite, BMS, Incyte, AbbVie, Pfizer; Honoraria: Kite, BMS, Incyte, AbbVie, Roche

C.L.: Speaker's bureau: Kite-Gilead, BMS, Roche, AbbVie, Incyte; Consultation: Kite-Gilead, BMS, Roche, AbbVie, Incyte

References

1. Abramson JS, Palomba ML, Gordon LI, Lunning MA, Wang M, Arnason J, et al. Lisocabtagene maraleucel for patients with relapsed or refractory large B-cell lymphomas (TRANSCEND NHL 001): a multicentre seamless design study. Lancet. 2020;396(10254):839-52.
2. Kamdar M, Solomon SR, Arnason J, Johnston PB, Glass B, Bachanova V, et al. Lisocabtagene maraleucel versus standard of care with salvage chemotherapy followed by autologous stem cell transplantation as second-line treatment in patients with relapsed or refractory large B-cell lymphoma (TRANSFORM): results from an interim analysis of an open-label, randomised, phase 3 trial. Lancet. 2022;399(10343):2294-308.
3. Wang M, Munoz J, Goy A, Locke FL, Jacobson CA, Hill BT, et al. KTE-X19 CAR T-cell therapy in relapsed or refractory mantle-cell lymphoma. New Engl J Med. 2020;382(14): 1331-42.
4. Schuster SJ, Bishop MR, Tam CS, Waller EK, Borchmann P, McGuirk JP, et al. Tisagenlecleucel in Adult relapsed or refractory diffuse large B-cell lymphoma. New Engl J Med. 2019;380(1):45-56.
5. Maude SL, Laetsch TW, Buechner J, Rives S, Boyer M, Bittencourt H, et al. Tisagenlecleucel in children and young adults with B-cell lymphoblastic leukemia. New Engl J Med. 2018;378(5):439-48.
6. Jacobson CA, Chavez JC, Sehgal AR, William BM, Munoz J, Salles G, et al. Axicabtagene ciloleucel in relapsed or refractory indolent non-Hodgkin lymphoma (ZUMA-5): a single-arm, multicentre, phase 2 trial. Lancet Oncol. 2022;23(1):91-103.
7. Neelapu SS, Locke FL, Bartlett NL, Lekakis LJ, Miklos DB, Jacobson CA, et al. Axicabtagene ciloleucel CAR T-cell therapy in refractory large B-cell lymphoma. New Engl J Med. 2017;377(26):2531-44.
8. Locke FL, Miklos DB, Jacobson CA, Perales M-A, Kersten M-J, Oluwole OO, et al. Axicabtagene ciloleucel as second-line therapy for large B-cell lymphoma. New Engl J Med. 2022;386(7):640-54.
9. Crump M, Neelapu SS, Farooq U, Van Den Neste E, Kuruvilla J, Westin J, et al. Outcomes in refractory diffuse large B-cell lymphoma: results from the international SCHOLAR-1 study. Blood. 2017;130(16):1800-8.
10. Kish J, Liu R, Pfeffer D, Vennam S, Lussier C, Nayak P. Real-world duration of hospitalization for CAR-T treatment: U.S. patient experience in multiple hematologic malignancies. J Clin Oncol. 2023;41(16_suppl):e18896-e.
11. Bakalov V, Tang A, Helfand AM, Kancharla P, White R, Khattab A, et al. A national inpatient sample analysis for CAR-T cell therapy administration. J Clin Oncol. 2022;40(16_suppl):e19501-e.
12. Gupta A, Eisenhauer EA, Booth CM. The time toxicity of cancer treatment. J Clin Oncol. 2022;40(15):1611-5.
13. Ahmed N, Sun F, Teigland C, Kilgore KM, Mohammadi I, Chambers J, et al. Chimeric Antigen receptor T-cell Access in patients with relapsed/refractory large B-cell lymphoma: association of access with social determinants of health and travel time to treatment centers. Transplant Cell Ther. 2024;30(7):714-25.
14. Buecklein VL, Ayuk FA, Holderried TAW, Mai C, Kievit B, Blisset R, et al. Estimating the impact on survival of not receiving CAR T therapy despite being eligible in relapsed or refractory (R/R) diffuse large B-cell lymphoma (DLBCL) patients in Germany. Blood. 2024;144:5037.
15. Dashboard. CCS. Incidence for selected cancers, by geographic region, and sex [Available from: https://cancerstats.ca/Incidence/Region].
16. Science IIfHD. Strengthening Pathways for cell and gene therapies: current state and future scenarios 2025 [Available from: www.iqviainstitute.org].
17. Simmons GL, Cross S, Pittos EC. Advancing access to CAR T-cell therapy: insights and real-world experience from a community oncology practice. Front Oncol. 2026;16:1712533.
18. Ly A, Sanber K, Tsai H-L, Ondo A, Mooney K, Shedeck A, et al. Outpatient CD19-directed CAR T-cell therapy is feasible in patients of all ages. Br J Haematol. 2023;203(4):688-92.
19. Linhares Y, Freytes CO, Cherry M, Bachier C, Maris M, Hoda D, et al. OUTREACH: phase 2 study of lisocabtagene maraleucel as outpatient or inpatient treatment at community sites for R/R LBCL. Blood Adv. 2024;8(23): 6114-26.
20. Cox T, Carelock T, Zahradka N, Pugmire J, Wilkes M, Campo R, et al. Remote patient monitoring (RPM) technology with centralized virtual nurse monitoring for safe delivery of outpatient chimeric antigen receptor T-cell (CAR-T) Therapy across multiple sarah cannon transplant and cellular therapy network programs. Transplant Cell Ther. 2024;30(2, Supplement):S216-7.
21. Borogovac A, Keruakous A, Bycko M, Holter Chakrabarty J, Ibrahimi S, Khawandanah M, et al. Safety and feasibility of outpatient chimeric antigen receptor (CAR) T-cell therapy:

experience from a tertiary care center. Bone Marrow Transplant. 2022;57(6):1025-7.

22. Ahmed N, Wesson W, Mushtaq MU, Porter DL, Nasta SD, Brower J, et al. Patient Characteristics and outcomes of outpatient tisagenlecleucel recipients for B cell non-Hodgkin lymphoma. Transplant Cell Ther. 2023;29(7): 449.e1-7.

23. Dholaria B, Bhaskar ST, Patel VG, Biltibo E, Jayani R, Sengsayadeth S, et al. Feasibility of axicabtagene ciloleucel in the outpatient setting: primary analysis of prospective trial. Bone Marrow Transplant. 2025;60(6): 769-72.

24. Leslie L, Tees M, Flinn IW, Rodriguez TE, Baird JH, Deol A, et al. ZUMA-24: A phase 2, open-label study of axicabtagene ciloleucel in patients with relapsed/ refractory large B-cell lymphoma given outpatient with corticosteroids. Hematol Oncol. 2023;41(S2):843-5.

25. Ohuabunwa I, Dholaria B, Wanca M, Johnson Mercadante G, Akhom P, Baer B, et al. Feasibility of outpatient administration of ciltacabtagene autoleucel and reduction in healthcare utilization cost: the Vanderbilt experience. Bone Marrow Transplant. 2026;61(3):358-9.

26. Rajeeve S, Wilkes M, Zahradka N, Tomalin L, Quidwai M, Pan D, et al. Detection of cytokine release syndrome using wearables and cytokine profiling following CAR-T therapy for myeloma. JCI Insight. 2026;11(12):e203988.

27. Battiwalla M, Egloff SA, Nadimpalli G, Martin C, Blunk B, Culos K, et al. Outpatient versus inpatient axicabtagene ciloleucel CAR T-cell therapy in non-Hodgkin's lymphoma: insights from a US multicenter transplant and cellular therapy network. Transplant Cell Ther. 2026;32(7): 862.e1-.e14.

28. Furqan F, Bhatlapenumarthi V, Dhakal B, Fenske TS, Farrukh F, Longo W, et al. Outpatient administration of CAR T-cell therapies using a strategy of no remote monitoring and early CRS intervention. Blood Adv. 2024;8(16):4320-9.

29. Dholaria B, Bhaskar ST, Patel VG, Biltibo E, Jayani R, Sengsayadeth S, et al. Feasibility of axicabtagene ciloleucel in the outpatient setting: primary analysis of prospective trial. Bone Marrow Transplant. 2025;60(6): 769-72.

30. Hansen DK, Liu Y-H, Ranjan S, Bhandari H, Potluri R, McFarland L, et al. The Impact of outpatient versus inpatient administration of CAR-T therapies on clinical, economic, and humanistic outcomes in patients with hematological cancer: a systematic literature review. Cancers. 2023;15(24):5746.

31. Lyman GH, Nguyen A, Snyder S, Gitlin M, Chung KC. Economic evaluation of chimeric antigen receptor T-cell therapy by site of care among patients with relapsed or refractory large B-cell lymphoma. JAMA Netw Open. 2020;3(4):e202072-e.

32. Oluwole OO, Dholaria B, Knight TE, Jain T, Locke FL, Ramsdell L, et al. Chimeric antigen receptor T-cell therapy in the outpatient setting: an expert panel opinion from the American Society for Transplantation and Cellular Therapy. Transplant Cell Ther. 2024;30(2):131-42.

33. Majhail NS, Cox T, Larson S, Battiwalla M, Ramakrishnan A, Shaughnessy P, et al. Outpatient administration of chimeric antigen receptor T-cell therapy using remote patient monitoring. JCO Oncol Pract. 2025;21(11):1601-8.

34. Hunter BD, Lunning M, Shadman M, Ahmed S, Abramson JS, Perales MA, et al. CRS or ICANS are rare beyond 2 weeks after lisocabtagene maraleucel infusion: data from clinical trials and the real-world setting. Transplant Cell Ther. 2026;32(2):171 e1- e12.

35. Lemieux C, Kuruvilla J, Shafey M, Davison K, Paulson K, Li SZL, et al. Real-world outcomes of axicabtagene ciloleucel for treatment of relapsed or refractory large B-cell lymphoma in Canada. Curr Oncol. 2026;33(2):85.

36. Kersten MJ, Oluwole OO, Speth K, Song Q, Martin LJ, Shu D, et al. Incidence of cytokine release syndrome and neurological events in patients with relapsed or refractory large B-cell lymphoma at and beyond 2 weeks following axicabtagene ciloleucel infusion. Transplant Cell Ther. 2025;31(2):S230.

37. Ahmed N, Wesson W, Lutfi F, Porter DL, Bachanova V, Nastoupil LJ, et al. Optimizing the post-CAR T monitoring period in recipients of axicabtagene ciloleucel, tisagenlecleucel, and lisocabtagene maraleucel. Blood Adv. 2024;8(20):5346-54.

38. US Food and Drug Administration. FDA expands access to approved CAR T-cell therapies by eliminating REMS. Silver Spring (MD): U.S. Food and Drug Administration; 2025. Available from:

39. https://www.fda.gov/vaccines-blood-biologics/ safety-availability-biologics/fda-eliminates-risk-evaluation-and-mitigation-strategies-rems-autologous-chimeric-antigen-receptor.

40. Bristol Myers Squibb Canada. Breyanzi (lisocabtagene maraleucel) product monograph. Montreal, QC: Bristol Myers Squibb Canada; 2026.

41. Gilead Sciences Canada Inc. YESCARTA (axicabtagene ciloleucel) product monograph. Mississauga, ON: Gilead Sciences Canada, Inc.; 2026.

42. Deschenes-Simard X, Bromberg M, Devlin SM, Gonen M, Beyar-Katz O, Ip A, et al. Comparative real-world outcomes of CD19-directed CAR T-cell therapies in large B-cell lymphoma. Blood Adv. 2025;9(21):5571-84.

43. Portuguese AJ, Huang JJ, Jeon Y, Taheri M, Albittar A, Liang EC, et al. Real-world comparison of lisocabtagene maraleucel and axicabtagene ciloleucel in large B-cell lymphoma: an inverse probability of treatment weighting analysis with 3-year follow-up. Haematologica. 2025;110(9):2040-54.

44. Looka A, Qualls DA, Matthews D, Redd RA, Sakellis C, Duffy C, et al. A real-world comparison of commercial-use axicabtagene ciloleucel and lisocabtagene maraleucel in large B-cell lymphoma. Blood Adv. 2025;9(3):455-62.

Canadian Hematology Today
Science for the Real World

canadianhematologytoday.com

Canadian Hematology Today is published three times per year
in English (ISSN 2816-5152) under the terms of the
Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International
(CC BY-NC-ND 4.0) license by Catalytic Health in Toronto, Ontario, Canada.

© 2026 Canadian Hematology Today.