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# CHIMERIC ANTIGEN RECEPTOR T CELL THERAPY [CAR-T]; A NEW TARGET TO DETECT MYELOMA FOR TREATMENT

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## ABSTRACT

CAR T-cell therapy is primarily used for treating certain types of blood cancers that have been resistant to other treatments, including specific types of leukaemia, lymphoma, and multiple myeloma. A type of treatment in which a patient's T cells (a type of immune system cell) are changed in the laboratory so they will attack cancer cells. T cells are taken from a patient's blood. Then the gene for a special receptor that binds to a certain protein on the patient's cancer cells is added to the T cells in the laboratory. The special receptor is called a chimeric antigen receptor (CAR). Large numbers of the CAR T cells are grown in the laboratory and given to the patient by infusion. CAR T-cell therapy is used to treat certain blood cancers, and it is being studied in the treatment of other types of cancer. Also called chimeric antigen receptor T-cell therapy. It works by genetically engineering a patient's own T-cells in a lab to recognize and attack cancer cells. This immunotherapy can sometimes lead to a cure or significantly extend the lives of patients with these advanced cancers.

Uses of CAR T-cell therapy

- Blood Cancers: It is approved for adults with relapsed or refractory B-cell acute lymphoblastic leukaemia (ALL), chronic lymphocytic leukaemia (CLL), mantle cell lymphoma (MCL), and multiple myeloma.
- Paediatric Cancers: It can be an option for children and adolescents with advanced B-cell ALL who have not responded to other treatments.
- Research: Studies are ongoing to expand its use to other types of blood cancers and to solid tumours.

How it works:

- T-cell extraction: A patient's T-cells are collected from their blood.
- Genetic modification: In a laboratory, scientists insert a new gene that allows the T-cells to produce special receptors called chimeric antigen receptors (CARs).
- Cell growth: The modified CAR T-cells are multiplied into millions.
- Reinfusion: The new CAR T-cells are infused back into the patient's body.
- Targeting cancer: The CAR T-cells can now recognize and bind to a specific antigen on the surface of cancer cells, leading to their destruction.

**KEYWORDS:** CLL, MCL, CAR, NHL

## INTRODUCTION

CAR T stands for Chimeric Antigen Receptor (CAR) T-cell therapy, a type of cancer treatment that uses a patient's own T cells, a type of immune cell, to fight cancer. This process involves genetically engineering the T cells in a lab to express a receptor that targets and attacks cancer cells, before infusing them back into the patient. It is a form of immunotherapy used to treat certain blood cancers, such as some types of leukaemia, lymphoma, and multiple myeloma.

**Collection:** T cells are collected from a patient's blood.[1,2]

**Engineering:** The T cells are genetically modified in a laboratory to create CAR T-cells that can recognize and bind to specific antigens on cancer cells.

**Growth:** The genetically modified cells are then grown in large numbers.

**Infusion:** The CAR T-cells are infused back into the patient's body through an IV drip.

**Targeting:** The CAR T-cells then circulate and attack the cancer cells, essentially turning the patient's own immune cells into a targeted cancer-fighting therapy.

**Immunotherapy:** CAR T-cell therapy is a type of immunotherapy, meaning it uses the body's own immune system to fight disease.

**Targeted therapy:** Unlike chemotherapy, which can affect both cancerous and healthy cells, CAR T-cell therapy is highly targeted to cancer cells that have the specific antigen the CAR recognizes.

**Personalized treatment:** The therapy uses a patient's own cells, making it a personalized form of treatment.

**Uses:** It is used to treat certain blood cancers and is being studied for other cancer types.

**Side effects:** Potential side effects include cytokine release syndrome (CRS) and neurotoxicity, which can cause symptoms like fever, chills, difficulty breathing, and headaches.

The U.S. Food and Drug Administration (FDA) has approved several CAR T-cell therapies, including tisagenlecleucel (Kymriah) for certain paediatric and young adult leukaemia and axicabtagene ciloleucel (Yescarta) for some lymphomas.[3,4]

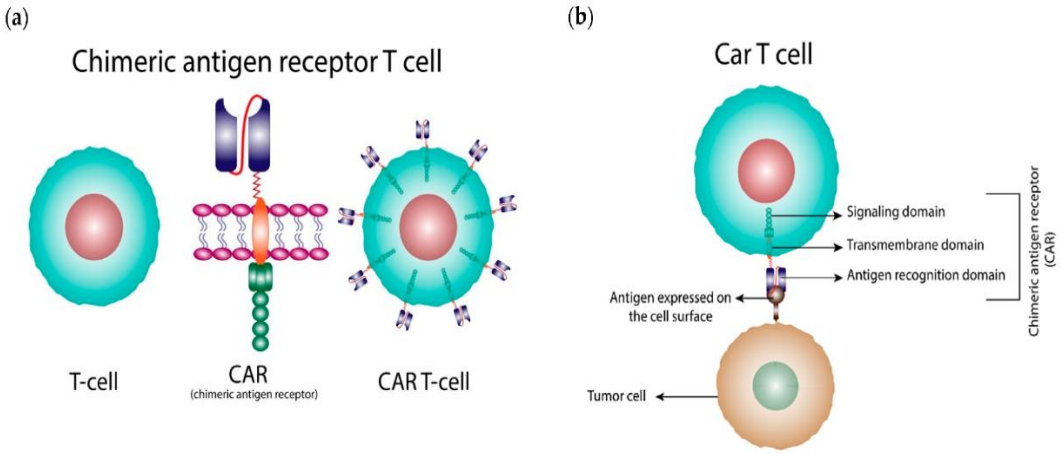


**Figure-1: Chimeric Antigen Receptor-T cell.**

Chemotherapy targets all of the cells in the body that are rapidly dividing, regardless of whether they're cancerous or not. CAR T therapy, on the other hand, targets only cells that possess a specific target. Chimeric antigen receptors (CAR)-T cells are genetically engineered T-lymphocytes redirected with a predefined specificity to any target antigen, in a non-HLA restricted manner, therefore combining antibody-type specificity with effector T-cell function.

CAR T-cell therapy success rates vary by cancer type, but are generally high for certain blood cancers, with remission rates of 80-90% for acute lymphoblastic leukaemia (ALL) and 50-70% long-term remission for certain lymphomas. For multiple myeloma, overall response rates are 73-98%. The therapy is less successful in solid tumours, with response rates as low as 9% in some studies, due to challenges in tumour penetration and suppression.

Success rates by cancer type.

- Acute Lymphoblastic Leukaemia (ALL): 80-90% remission in patients with relapsed or refractory B-cell ALL.
- Non-Hodgkin's Lymphoma (NHL): 50-60% long-term remission in some cases. Over 80% objective remission rate in heavily pre-treated large B-cell lymphoma, with a 5-year survival rate of 42.6% in one study. Approximately 73% complete remission

rate in some studies for different types of aggressive B-cell non-Hodgkin lymphoma.
- Multiple Myeloma: 73-98% overall response rates have been seen in clinical trials for relapsed/refractory multiple myeloma.
- Over 85% overall response rate in one long-term study.
- Solid Tumours: Significantly lower success rates have been observed, with a meta-analysis showing only a 9% response rate in solid tumours.

CAR T-cell therapy is expensive, primarily due to its complex manufacturing, specialized infrastructure, and the high level of personalized care required. Costs can range from $400,000 to over $500,000 in the United States, but are significantly lower in countries like India, where localized manufacturing has helped reduce the price to approximately ₹30 to ₹60 lakh (around $36,000 to $72,000). Efforts are underway in India to further lower these costs to as little as ₹10 to ₹20 lakh in the future.[5,6]

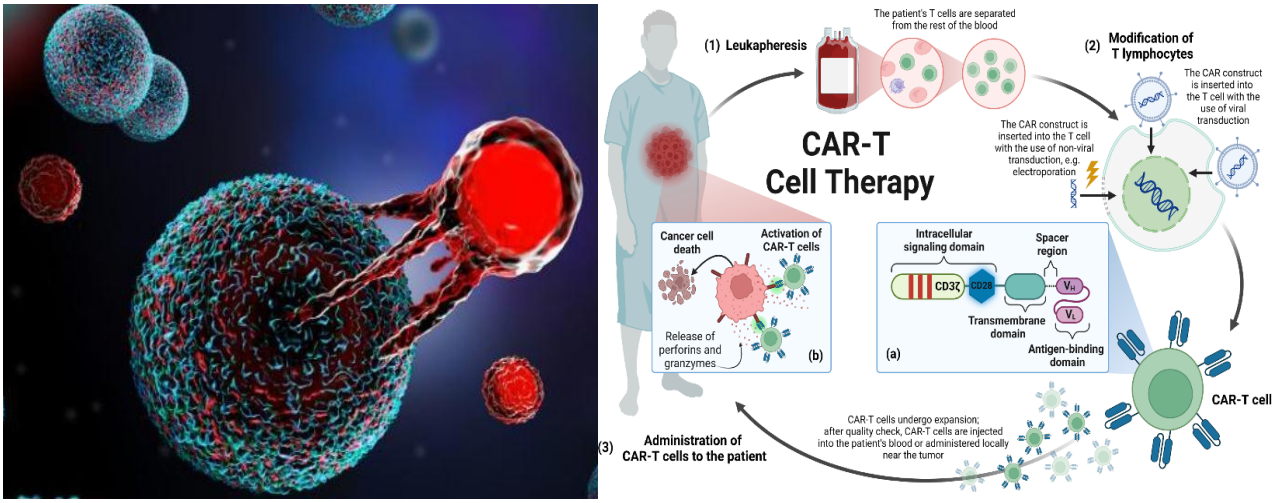


**Figure-2: CAR-T cell therapy.**

**Why CAR T-cell therapy is expensive**
- Complex, personalized process: The therapy involves genetically engineering a patient's own T-cells in a lab, a highly specialized and time-consuming process.
- Specialized infrastructure and expertise: The procedure requires advanced equipment for gene editing and cell culturing, and must be performed by highly trained specialists.
- Strict regulatory compliance: Meeting stringent safety and efficacy standards involves extensive quality control and testing, which adds to the overall cost.
- Limited patient base: Currently, the therapy is approved for specific cancers, and the high development costs must be recouped from a smaller patient population, which drives up the price per treatment.
- Hospital and support costs: Administering CAR T-cell therapy necessitates a hospital stay and a comprehensive support system to manage potential side effects, such as cytokine release syndrome.[7,8]

**Factors that influence cost**
- Country: The cost varies significantly by location. It is generally much cheaper in countries like India compared to the United States.
- Type of cancer: The specific type of cancer being treated can affect the final cost.
- Insurance coverage: A patient's health insurance plan plays a crucial role, and the therapy's cost is influenced by whether it is covered.
- Localized manufacturing: The development of CAR T-cell therapies within a country, such as the NexCAR19 therapy in India, can significantly lower costs by avoiding import and transportation fees.
- Factors influencing success
- Type of cancer: Success rates are highest in blood cancers like ALL, NHL, and multiple myeloma, and lower in solid tumours.
- Progression of the disease: Response rates can vary depending on how advanced the cancer is, although CAR T-cell therapy is often used for patients whose cancer has not responded to standard treatments.
- Individual patient factors: The success of the therapy can be influenced by the patient's overall health and other individual factors.

**CAR T-cell therapy was developed by**

**Dr. Carl June** and his team at the University of Pennsylvania in the early 2000s. Other key contributors include Michel Sadelain, who engineered the CARs, and researchers like **Zelig Eshhar**, who laid early groundwork in the 1980s.

**Dr. Carl H. June:** Led the development of the first FDA-approved CAR T-cell therapy at the University of Pennsylvania and is sometimes called the "Father of CAR T-cell therapy". **Carl H. June** (Born 1953) is an American immunologist and oncologist.

**Figure-3: CAR-T therapy inventors.**

He is currently the Richard W. Vague Professor in Immunotherapy in the Department of Pathology and Laboratory Medicine at the Perelman School of Medicine of the University of Pennsylvania. He is most well-known for his research on T cell therapies for the treatment of several forms of cancers. In 2020 he was elected to the American Philosophical Society.

**Michel Sadelain:** Is credited with engineering the CARs that make the therapy revolutionary, and published a seminal paper in 2002 showing the efficacy of engineered human T cells. Michel Sadelain (born 1960) is a genetic engineer and cell therapist at Columbia University New York, New York. He is the Director of the Columbia Initiative in Cell Engineering and Therapy (CICET). Sadelain also serves as the Director of Columbia University Irving Medical Center's Cancer Cell Therapy Initiative in the Herbert Irving Comprehensive Cancer Center.

**Zelig Eshhar:** As early as 1989, Eshhar and his colleagues in Israel generated similar constructs that showed the potential for using engineered T cells against tumours. Zelig Eshhar (February 25, 1941 – July 3, 2025) was an Israeli immunologist at the Weizmann Institute of Science and the Tel Aviv Sourasky Medical Center. He was Chairman of the Department of Immunology at the Weizmann Institute twice, in the 1990s and 2000s.

CAR T-cell therapy is FDA-approved for patients with relapsed or refractory B-cell acute lymphoblastic leukemia (ALL). Patients are evaluated carefully to determine if this therapy is appropriate for them, and are cared for by a team experienced in CAR T-cell therapy. No cancer is guaranteed to be 100% curable, but several have very high cure rates, especially when detected early. Cancers with nearly 100% cure rates when caught early include thyroid, testicular, cervical, and prostate cancers. Early-stage breast and certain forms of leukaemia are also highly curable.[9,10]

**Cancers with very high cure rates**

- Thyroid cancer: Over 98% survival rate when caught early, often curable with surgery.
- Testicular cancer: Close to 100% cure rate when localized and caught early.
- Cervical cancer: Near 100% curable if found and treated in its precancerous or early stages.
- Prostate cancer: Nearly 100% five-year survival rate when detected early, before it spreads.
- Breast cancer: Nearly 100% cure rate for early-stage detection.
- Hodgkin lymphoma: Has a high cure rate, especially in early stages.
- Basal cell carcinoma: A highly curable form of skin cancer with a 99% cure rate when treated early.

In CAR T-cell therapies, T cells are taken from the patient's blood, genetically engineered to produce the chimeric antigen receptor, and the resultant CAR T-cells are then given back to the patient. The CAR helps the T cells recognise a specific cancer cell antigen and activate the T cells to kill these cancer cells.

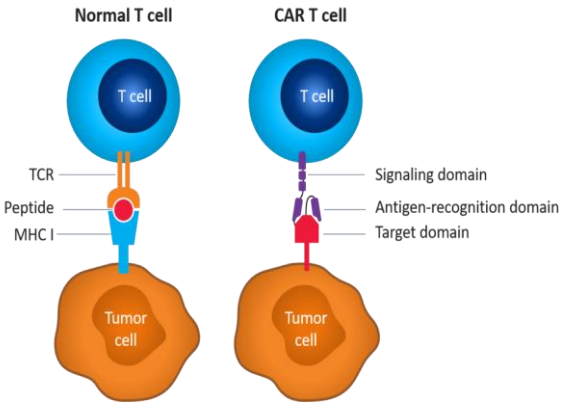


**Figure-4: Normal T cell and CAR-T cell difference.**

Important considerations: The chance of a cure is significantly higher when cancer is found in its initial stages.

Cure vs. remission: Doctors often prefer the term "remission" over "cure," as it means there are no signs of the cancer after treatment. Regular follow-up appointments are essential to monitor for recurrence.
Treatment and survival rates: Survival rates vary based on the specific type and stage of the cancer, as well as the individual's overall health and response to treatment.

The most common side effect of CAR T-cell therapy is called cytokine release syndrome or CRS. It can affect up to 9 in 10 CAR T-Cell patients. It is generally brief, lasting about a week. Many patients liken it to the flu with fever, low energy, and body aches. Patients who undergo CAR T-cell therapy typically do not lose their hair or experience some of the other common side effects of chemotherapy, such as nausea and vomiting. Allergic reactions during the infusion. Abnormal levels of minerals in the blood, such as low potassium, sodium, or phosphorous levels. A weakened immune system, with an increased risk of serious infections. Low blood cell counts, which can increase the risk of infections, fatigue, and bruising or bleeding. The four main types of T cells are helper T cells, cytotoxic T cells, regulatory T cells, and memory T cells, each with distinct functions in the immune response. Helper T cells coordinate other immune cells, cytotoxic T cells directly kill infected cells, regulatory T cells suppress immune responses, and memory T cells provide long-term immunity by remembering previous infections.

**1. Helper T cells (CD4)** Function: These cells act as the "conductors" of the immune response by activating and directing other immune cells, such as B cells and cytotoxic T cells.

**Mechanism:** They release signalling molecules called cytokines to stimulate the other cells, helping them mount an effective response.

**2. Cytotoxic T cells (CD8)** Function: Also known as "killer T cells," these cells are responsible for directly eliminating infected cells and cancer cells.
**Mechanism:** They recognize and kill foreign or compromised cells on contact, preventing the spread of pathogens or tumors.

**3. Regulatory T cells (Treg)** Function: These cells are crucial for maintaining immune tolerance and preventing autoimmune diseases.

**Mechanism:** They suppress immune responses, ensuring that the immune system does not overreact or attack the body's own tissues.

**4. Memory T cells:** Function: This group provides long-term immunity against pathogens encountered in the past. Mechanism: After an infection is cleared, some T cells become memory cells that "remember" the specific antigen. If the same pathogen is encountered again, these memory cells can quickly mount a faster and stronger immune response. After a median follow-up of 12.4 months, the median progression-free survival and OS were 6.0 months (95% confidence interval [CI], 4.7-8.5) and 21.0 months (95% CI, 17.6-32.4). The estimated progression-free survival and OS rates at 12 months were 43.5% and 59.4%, respectively. The FDA-approved conditions for CAR -T cell therapy include: B-cell precursor acute lymphoblastic leukaemia (ALL), in people up to 25 years of age. Depending on the cancer type and stage, as well as the success with other treatments, CAR T-cell therapy may be a better option — and it may even be capable of helping patients reach remission. They have a great deal of training and experience in taking care of CAR T-cell therapy patients. Though every patient is different, most patients are in the hospital for 1 to 3 weeks. The length of your inpatient stay will be determined by how you are feeling, your blood counts, and the side affects you experience.[11,12]

Major hospitals in India offering CAR T-cell therapy include Apollo Cancer Centres, Tata Memorial Centre (TMC), and Fortis Memorial Research Institute. Other hospitals that provide this treatment are HCG Cancer Centre in Bangalore, Amrita Hospital in Kochi, and Cytecare Hospital in Bangalore.

**Hospitals in India offering CAR T-cell therapy**

- **Apollo Cancer Centres:** The first private hospital group in India to successfully complete CAR T-cell therapy and offers the indigenously developed NexCAR19.
- **Tata Memorial Centre (TMC), Mumbai:** A pioneering center in India that was involved in the development of NexCAR19, India's first home-grown CAR-T cell therapy.
- **Fortis Memorial Research Institute (FMRI), Gurugram:** A JCI-accredited hospital offering CAR T-cell therapy for various blood cancers like leukaemia and lymphoma.
- **HCG Cancer Centre, Bangalore:** Offers CAR T-cell therapy and is associated with other HCG Oncology facilities that provide this treatment.
- **Amrita Hospital, Kochi:** The first hospital in Kerala to offer CAR-T cell therapy, in partnership with ImmunoACT.
- **Cytecare Hospital, Bangalore:** Provides CAR-T cell therapy by stimulating the immune system to target cancer cells.
- **Other hospitals:** Other notable hospitals in major cities include Medanta, The Medicity in Gurugram, Max Hospital in Delhi, Apollo Hospital in Delhi, and Kokilaben Dhirubhai Ambani Hospital in Mumbai.

A major hurdle to CAR-T cell therapy is severe toxicities. The most common toxicities following infusion of CAR-T cells are CRS, neurologic toxicity, tumour lysis syndrome (TLS), on-target-off-tumour effects, anaphylaxis, and hematologic toxicities. The CAR T-cell therapy process itself, from cell collection to infusion, takes about 3 to 8 weeks. The therapy starts working once the modified T-cells are infused into the patient's body, where they multiply and begin to attack cancer cells. The full effects are monitored over weeks and months after the infusion.[13,14]

**CAR T-cell therapy timeline**

- T-cell collection (Leukapheresis): This is a one-day procedure to collect a patient's T-cells.
- Cell modification and expansion: In a lab, the T-cells are genetically altered and grown to produce billions of CAR T-cells. This step typically takes about 3 to 6 weeks.
- Lymphodepletion chemotherapy: A few days before the infusion, the patient receives chemotherapy to lower their immune system, which helps the CAR T-cells to expand more effectively.
- Infusion: The CAR T-cells are infused into the patient's bloodstream.
- How and when the therapy takes effect
- Immediate effects: After the infusion, the CAR T-cells begin to multiply and can start attacking cancer cells within the first few weeks.
- Monitoring: Doctors monitor patients closely after the infusion for side effects like cytokine release syndrome (CRS) and neurological issues, which can appear within the first few weeks.
- Long-term effects: Remission and the overall effectiveness of the treatment are evaluated over several months. Some patients may experience relapses, while for others, the response can be long-lasting.
- Of 143 patients from the German Lymphoma Alliance (GLA) who progressed after axi-cel or tisagenlecleucel (tisa-cel), 109 patients (76%) died within 1 year of CAR-T failure while 26 patients (18%) were long-term survivors, defined as living >1 year after post-CAR-T progression.[15-20]

## CONCLUSION

CARs are modular synthetic receptors that consist of four main components: an extracellular target antigen-binding domain, a hinge region, a Trans membrane domain, and one or more intracellular signalling domains. CAR-T cells have revolutionized the treatment of certain haematological malignancies. However, obstacles still remain, which were discussed in this review. Training a workforce to meet the demands of this complex and evolving field is challenging and requires innovative curriculum development. Antigen selection is critical to CAR-T cell function. Tumour cells can down regulate antigens due to the selective pressure of the CAR-T cells. Even with appropriate antigen targeting, on-target off-tumour effects can occur and cause associated toxicity. In solid tumours, getting CAR-T cells to traffic to and infiltrate the tumour is a challenge. This obstacle can be compounded by the immunosuppressive microenvironment of malignancies. Effective treatment also runs the risk of CAR-T cell-associated toxicities such as CRS and neurotoxicity. However, while there are challenges, new strategies and potential solutions continue to evolve and may provide a path forward to more effective and safer future therapies.

## REFERENCES


1. Xin Yu J, Hubbard-Lucey VM, Tang J (2019). "The global pipeline of cell therapies for cancer". Nature Reviews. Drug Discovery, 18(11): 821–822.
2. Jacobson CA, Ritz J (2011). "Time to put the CAR-T before the horse". Blood, 118(18): 4761–4762.
3. Kochenderfer JN, Wilson WH, Janik JE, Dudley ME, Stetler-Stevenson M, Feldman SA, et al. (2010). "Eradication of B-lineage cells and regression of lymphoma in a patient treated with autologous T cells genetically engineered to recognize CD19". Blood, 116(20): 4099–4102.
4. Kochenderfer JN, Dudley ME, Kassim SH, Somerville RP, Carpenter RO, Stetler-Stevenson M, et al. (2015). "Chemotherapy-refractory diffuse large B-cell lymphoma and indolent B-cell malignancies can be effectively treated with autologous T cells expressing an anti-CD19 chimeric antigen receptor". Journal of Clinical Oncology, 33(6): 540–549.
5. Mikkilineni, Lekha (2021). "CAR T cell therapies for patients with multiple myeloma". Nature Reviews. Clinical Oncology, 18(2): 71–84.
6. Carpenter, Robert; Evbuomwan, Moses; Pittaluga, Stefania; Rose, Jeremy; Raffeld, Mark; Yang, Shicheng; Gress, Ronald; Hakim, Frances; Kochenderfer, James (2013). "B-cell Maturation Antigen Is a Promising Target for Adoptive T-cell Therapy of Multiple Myeloma". Clinical Cancer Research, 19(8): 2048–2060.
7. Ali, Syed Abbas; Shi, Victoria; Maric, Irina; Wang, Michael; Stroncek, David; Rose, Jeremy; Brudno, Jennifer; Stetler-Stevenson, Maryalice; Feldman, Steven; Hansen, Brenna; Fellowes, Vicki; Hakim, Frances; Gress, Ronald; Kochenderfer, James (2016). "T cells expressing an anti–B-cell maturation antigen chimeric antigen receptor cause remissions of multiple myeloma". Blood, 128(13): 1688–2300.
8. Raje, Noopur; Berdeja, Jesus; Siegel, David; Jagannath, Sundar; Madduri, Deepu; Liedtke, Michaela; Rosenblatt, Jacalyn; Maus, Marcela; Turka, Ashley; Lam, Lyh-Ping; Morgan, Richard; Friedman, Kevin; Massaro, Monica; Wang, Julie; Russotti, Greg; Yang, Zhihong; Campbell, Timothy; Hege, Kristen; Petrocca, Fabio; M Travis, Quigley; Munshi, Nikhil; Kochenderfer, James (2019). "Anti-BCMA CAR T-Cell Therapy bb2121 in Relapsed or Refractory Multiple Myeloma". The New England Journal of Medicine, 380(18): 1726–1737.
9. Berdeja, Jesus (2021). "Ciltacabtagene autoleucel, a B-cell maturation antigen-directed chimeric antigen receptor T-cell therapy in patients with relapsed or refractory multiple myeloma (CARTITUDE-1): a phase 1b/2 open-label study". The Lancet, 398(10297): 314–324.
10. Choi, Bryan D.; Gerstner, Elizabeth R.; Frigault, Matthew J.; Leick, Mark B.; Mount, Christopher W.; Balaj, Leonora; Nikiforow, Sarah; Carter, Bob S.; Curry, William T.; Gallagher, Kathleen; Maus, Marcela V. (2024). "Intraventricular CARv3-TEAM-

E T Cells in Recurrent Glioblastoma". New England Journal of Medicine, 390(14): 1290–1298.
11. Lim WA, June CH (2017). "The Principles of Engineering Immune Cells to Treat Cancer". Cell, 168(4): 724–740.
12. Li D, Li N, Zhang YF, Fu H, Feng M, Schneider D, et al. (2020). "Persistent Polyfunctional Chimeric Antigen Receptor T Cells That Target Glypican 3 Eliminate Orthotopic Hepatocellular Carcinomas in Mice". Gastroenterology, 158(8): 2250–2265.
13. Sakaguchi S, Yamaguchi T, Nomura T, Ono M (2008). "Regulatory T cells and immune tolerance". Cell, 133(5): 775–787.
14. Mougiakakos D, Krönke G, Völkl S, Kretschmann S, Aigner M, Kharboutli S, et al. (2021). "CD19-Targeted CAR T Cells in Refractory Systemic Lupus Erythematosus". The New England Journal of Medicine, 385(6): 567–569.
15. Chung, James; Brudno, Jennifer; Borie, Dominic; Kochenderfer, James (2024). "Chimeric antigen receptor T cell therapy for autoimmune disease". Nature Reviews Immunology, 24(11): 830–845.
16. Bupha-Intr O, Haeusler G, Chee L, Thursky K, Slavin M, Teh B (2021). "CAR-T cell therapy and infection: a review". Expert Review of Anti-Infective Therapy, 19(6): 749–758.
17. Lee DW, Gardner R, Porter DL, Louis CU, Ahmed N, Jensen M, et al. (2014). "Current concepts in the diagnosis and management of cytokine release syndrome". Blood, 124(2): 188–195.
18. Berg P, Schönefeld S, Ruppert-Seipp G, Funk MB (2022). "Regulatory Measures to Improve the Safety of CAR-T-Cell Treatment". Transfusion Medicine and Hemotherapy, 50(3): 218–225.
19. Gardner RA, Ceppi F, Rivers J, Annesley C, Summers C, Taraseviciute A, et al. (2019). "Preemptive mitigation of CD19 CAR T-cell cytokine release syndrome without attenuation of antileukemic efficacy". Blood, 134(24): 2149–2158.
20. Tan AH, Vinanica N, Campana D (2020). "Chimeric antigen receptor-T cells with cytokine neutralizing capacity". Blood Advances, 4(7): 1419–1431.