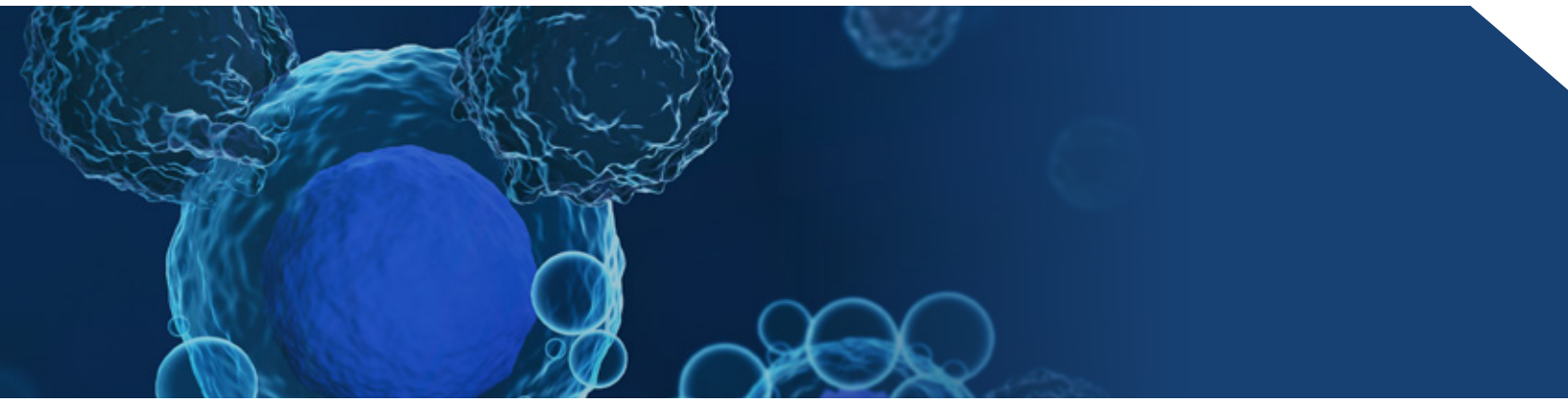
Democratizing CAR T-cell Therapy

A REVOLUTION IN CANCER TREATMENT



MIDI

A Medical Innovation Company

Author
Christopher Montalbano, CEO
MIDI Medical Product Development Corp.
christopherm@midipd.com

MIDI WHITEPAPER

The Overview

Democratizing CAR T-cell Therapy

Notoriously intense and physically taxing, today's common cancer treatments ask a high cost with no guarantee of success. Fortunately, CAR T-cell therapy has emerged as a revolutionary approach to combat cancer, holding immense promise in its ability to target cancerous cells while leaving healthy ones untouched. CAR T-cell therapy is one of the most impressive and promising cancer research and treatment developments. This innovative approach harnesses the body's immune system to fight cancer, offering remarkable precision and efficacy. The therapy involves:

- Extracting T-cells from a patient.
- Genetically engineering them to express Chimeric Antigen Receptors (CARs) which enables T-cells to recognize and attack cancer cells.
- Reintroducing these modified T-cells into the patient's body.

The result is a highly targeted and effective cancer treatment.

One of medicine's youngest and most rapidly advancing fields, this revolutionary technique has grown from a single biopharmaceutical product introduced in 2017 to approximately ten approved therapies already on the market and numerous more in the FDA approval pipeline. However, this groundbreaking therapy has faced significant challenges in achieving adoption and implementation, mainly due to low accessibility and exorbitantly high cost. In this article, we explore the shift from centralized to point-of-care manufacturing and the role of closed system automation in making CAR T-cell therapy accessible to all.

CAR T-cell vs. Conventional Treatments

Democratizing CAR T-cell Therapy

To truly understand the potential impact of CAR T-cell therapy, we must first consider the methods most commonly used today. While those who have cancer now have many treatment options available, the unfortunate fact is that very few of these conventional methods come without significant cost to patients' quality of life and general well-being. At the same time, those that do are far less effective than their more aggressive counterparts.

- **Surgery:** When cancer is localized (i.e., a tumor) in an accessible area of the body and can be removed without a negative impact on overall health, surgery is a popular and effective option for treatment. Allowing for precise targeting of malignant tissues providing immediate results while minimizing the impact on surrounding healthy tissues.
  - Surgery, however, is invasive and can expose patients to significant complications. It also does not guarantee cancer-free status; cancer may reoccur if malignant cells are left within the surgical site's margin.
- **Radiation:** When cancer is localized but cannot be accessed through surgery, radiation therapy provides a non-invasive option.
  - The cost of this non-invasive treatment often causes damage to surrounding healthy tissues. It also requires numerous treatment sessions over several weeks, often highly taxing to the patient.
- **Chemotherapy:** This treatment option is employed when cancer is systemic, meaning it has spread throughout the body and may be found in the blood, lymph nodes, and other non-specific areas.
  - Chemotherapy is not at all targeted, killing healthy cells alongside cancerous ones. Because of this, patients undergoing treatment will experience compromised immune systems alongside several other ill effects, including

hair and weight loss, anemia, fatigue, nausea, and reduction of platelets. In some cases, fertility may be impacted. Like radiation, it also requires numerous challenging treatment sessions.

- **Stem Cell Transplants:** Also known as a bone marrow transplant, this treatment is also used to address systemic cancers and is often paired with chemotherapy. In this treatment, stem cells are derived either from a donor **(allogeneic)** or from the patient via an apheresis machine **(autologous)** and transplanted via intravenous injection following chemotherapy. Once in the bloodstream, their contact with bone marrow stimulates the production of healthy blood cells and, thus, the reconstruction of the immune system (i.e., white cells and other key cell types). Allogeneic transplants can even provide additional defense against cancer, as donor cells may be able to recognize and target remaining malignant cells more effectively than the patients'.
    - Unfortunately, allogeneic transplants contain the genuine risk of causing Graft-vs-Host Disease if donor cells attack healthy tissues in their host, the side effects of which range from mild to life-threatening. Meanwhile, receiving a transplant can be a significant challenge, as suitable and willing donors are often difficult to locate, particularly for patients with rare tissue types or of certain ethnicities. No matter their source, stem cell transplants have a long and challenging recovery period including months if not years of ongoing fatigue, weakness, and other side effects.

In each of these cases, patients and physicians must carefully weigh the cost of treating cancer against the consequences of leaving it unchecked, with treatment often bringing considerable health and quality of life declines.

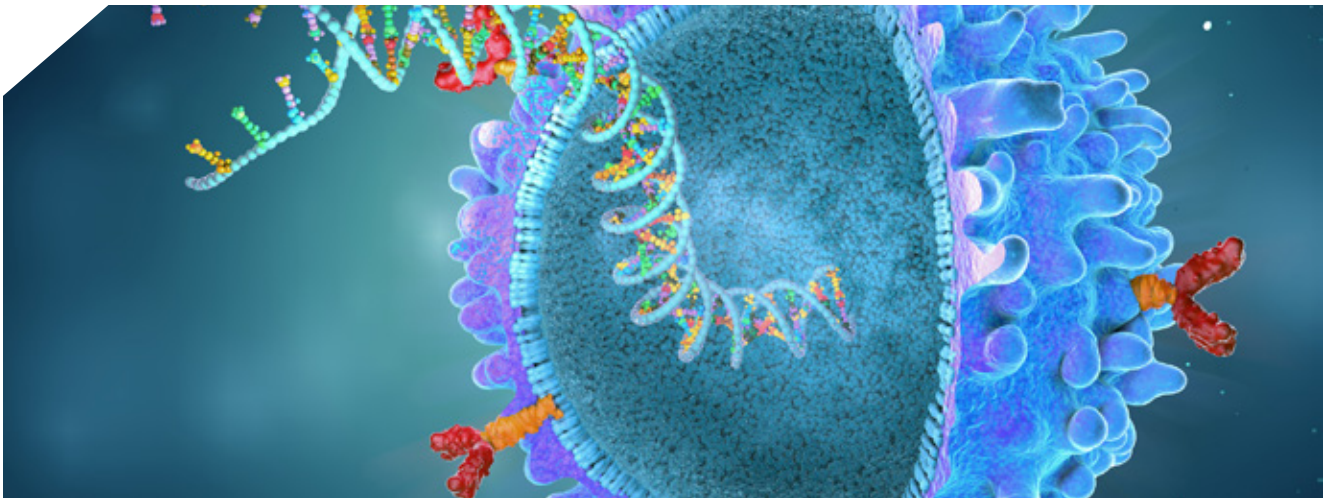
A Primer on CAR T-cell Therapy

Democratizing CAR T-cell Therapy

With the unique capability to specifically target cancer cells, CAR T-cell therapy offers a treatment option that is highly effective against cancer without significant cost to the patient. But how does this revolutionary method manage to outperform its predecessors effectively? The answer lies in our very own immune mechanisms.

At the foundation of CAR T-cell therapy is, as the name suggests, T-cells— white blood cells comprising a class known as lymphocytes that, as part of the natural adaptive immune system, provide highly specific and durable protection against viruses, bacteria, and other microbes the body may come into contact with. While there are many T-cell varieties, each operates with the same molecular machinery, part of which is the T-cell receptor (TCR). Residing on the cell membrane's outer surface, TCRs detect specific antigens. These markers are typically protein-based, on the surface of invading cells, and provide signals that trigger T-cells to latch on and destroy such threats.

Though identical to their naturally occurring brethren, CAR T-cells are unique. They are explicitly engineered and trained to target cancer cells by expressing CARs on their outer membrane, forming a "living drug".



There are two main formats of CAR T-cell therapy: **In-vivo** and **ex-vivo**. A nascent approach still in development, the in-vivo format, involves the creation of CAR T-cells inside the patient's body using a viral vector that delivers genetic information directly to T-cells, instructing them in the expression of CAR receptors.

While still a nascent approach, the in-vivo format offers all of the efficacy benefits of autologous CAR T-cell therapy while retaining the reduced logistical complexity of allogeneic therapies fabrication. Before it can do this, however, it must overcome some significant complications:

+ Lymphodepletion cannot be performed in the case of In-vivo treatments. This is because any immune system depletion would eliminate the very cells targeted by the In-vivo therapy.
+ Off-target: In-vivo therapies must be very carefully developed, with a vehicle for delivering genetic material that is highly selective, to ensure that only T-cells are being targeted. Otherwise, the treatment may cause off-target cells to undergo unwanted gene modifications, a complication that can have an untold negative impact.

Meanwhile, The ex-vivo format refers to therapies in which CAR T-cells are created outside of the body and included within two distinct subcategories: **autologous** and **allogeneic**. Autologous therapies utilize T-cells collected from the patient. Those that are allogeneic use donor blood or stem cells, which may be collected from the bone marrow or blood of the umbilical cord.

From a collection, production and treatment perspective, we may look to the high-level workflow of autologous T-cell therapy, one of the method's most common iterations, to get an idea of what this process looks like. It is as follows:

1. T-cells are collected from the patient's whole blood at a hospital or cancer treatment center.

2. The T-cells are frozen for transport to a separate centralized laboratory, where genetic manipulation methods and cell expansion will be used to produce CAR T-cells in a large enough quantity to administer as treatment. Cell expansion is a mechanism by which cells are encouraged to multiply into volumes sufficient to work with.

3. The resulting CAR T-cells are frozen, transported back to the hospital or treatment facility of origin, thawed and then administered to the patient. This occurs through intravenous infusion and typically only requires one session to provide significant, immediate benefit to the patient.

4. CAR T-cells then reside in the body for several months, destroying cancer cells and preventing relapse.

Varieties of Cancer and CAR T-cell Treatment Efficacy

While CAR T-cell therapy is effective against a multitude of cancer types, it is more effective against hematological malignancies, such as lymphoma and leukemia, than it is against solid-state tumors. This is mainly due to the simple nature of hematological

malignancies; because they arise from blood-forming cells, they are far more easily accessible to CAR T-cells and may be more quickly destroyed. In contrast, solid-state tumors, embedded within healthy tissues are much harder to reach from the bloodstream, causing issues with **trafficking and infiltration.**

These tumors also often cause **hostile microenvironments** within the body that inhibit the function of CAR T-cells, making it more difficult for them to take effect. This effect originates from cell types that support tumor growth, such as Tregs, MDSCs, and TAMs.

Further, because solid tumors are often heterogeneous, containing different types of cancerous cells that vary in antigen expression, this **creates recognition issues** when attempting CAR T-cell targeting. This is in sharp contrast to hematological malignancies, which are commonly homogeneous and easily targeted via their specific antigen. Because of these drawbacks, CAR T-cell therapy in the case of solid-state tumors is far more likely to cause **off-target effects**, causing damage to surrounding healthy tissues. Thus, CAR T-cell therapy is currently better suited to treating systemic cancer types than those occurring at a single site.

With that said, CAR T-cell does have applications against solid-state tumors, and researchers are working actively to increase its viability and efficacy against these malignancies. Some strategies currently under investigation include:

+ **Enhancing recognition** by engineering the CAR T-cell to express more than one CAR receptor, making it more able to combat heterogeneous tumor types.
+ **Enhancing trafficking and infiltration** of CAR T-cells by adjusting chemokines, engineering them to express chemokine-specific receptors.

- Modifying T-cells to enhance their ability to **withstand hostile microenvironments**. Several methods of achieving this are currently under investigation, including increasing the expression of potassium, which boosts T-cell performance, and using **suppressor antibodies, in tandem with genetic manipulation**, to eliminate cell types that support tumor growth before treatment (i.e., Tregs and MDSCs).
- Using alternate delivery methods to target solid-state tumors more precisely in a regional manner. This includes:
  - Performing **regional intraventricular delivery** (i.e., "within a vein") within the tumor location (e.g., brain).
  - Combining surgical removal of tumors with post-procedure localized application of CAR T-cells directly to the surgical margin. One study at Penn Medicine found this approach, using a special T-cell-infused fibrin gel, to eliminate residual cancer cells and provide long-term survival in nineteen of twenty studied mice cases.

Thus, although CAR T-cell therapy may not presently be able to eliminate solid-state tumors alone, there is still much potential to improve our treatment of these tumors by applying the therapy in various unique ways.

Advantages and Disadvantages

Easily, the most significant advantage of CAR T-cell therapy is its unique ability to specifically target cancerous cells while leaving healthy tissues untouched. This ability allows it to effectively treat cancer with few of the collateral damage characteristics seen in current popular treatment methods such as chemotherapy. Its advantages, however, do not stop there. This method also boasts the ability to provide significant lifestyle benefits to the patient after only a single session, a stark contrast to the often long and arduous processes involved with other methods.

Autologous CAR T-cell therapy, because it is produced with patient's cells and on a bespoke basis, patients need not worry about biological mismatches. Meanwhile, allogeneic CAR T-cell therapy is more immediately available, not requiring the bespoke production process of autologous therapies. Because of this, it is considered an "off-the-shelf" version of the treatment that is naturally more scalable than its counterpart. From a single manufacturing run, using the biomaterial of a single donor, allogeneic CAR T-cell therapies may treat as many as one hundred patients.

Common advantages for both autologous and allogeneic CAR T-cell therapy is that they continue to be effective for months following treatment, as the cells continue to live in the body, fighting cancer and preventing relapse. Additionally, the therapy session is often one-time, providing benefits to the patient's lifestyle because it's a "living drug".

Nothing, however, is without its disadvantages. CAR T-cell therapies of any type have a chance to cause the following:

+ **Cytokine Release Syndrome:** Triggered by the multiplication of CAR T-cells in the body, causing an overproduction of cytokines, chemicals that assist T-cell function. This surplus in cytokines may result in a syndrome causing severe flu-like symptoms, including high fever, delirium, kidney failure, low blood pressure, rapid heart rate, and possible cardiac arrest. Mild forms of this syndrome may be effectively managed through standard supportive treatments, such as steroids.
+ **Immune Effector Cell-Associated Neurotoxicity Syndrome:** A syndrome influencing brain function. Symptoms can include irritability, confusion, seizures, and brain swelling. This may also be managed with steroid therapy.
+ **"On-target/Off-tumor" Toxicity** refers to complications that occur as a result of CAR T-cells attacking non-cancerous cells, which may arise if those cells produce the same target antigen as those cancerous.
+ **Anaphylaxis** refers to a severe allergic reaction in which the body becomes hypersensitive and may be life-threatening.

The Autologous Ex-Vivo CAR T-cell therapies also have their own logistical disadvantages. The most significant of these is the long "vein-to-vein" turnaround time required for production, which can take several weeks. This is largely due to the centralized manufacturing methods currently in use, which require multiple instances of frozen biomaterial transport. Additionally, autologous therapies have extremely limited production slots at any given time, again due to the use of a centralized manufacturing location. Unfortunately, many patients do not have time to spare waiting for such treatments to be produced.

Meanwhile, allogeneic therapies may not suffer logistical production and distribution disadvantages. Still, they can put the patient at risk of side effects if there is an immunological mismatch between their cells and the donor. This can cause several health problems, including:

+ **Graft-versus-Host Disease:** A common life-threatening complication when dealing with donor material, this may result in tissue cell death most often in the skin, gastrointestinal tract and liver.
+ **Immune-Mediated Rejection:** When the recipient's immune system reacts against the allogeneic product, this can cause total rejection of cell therapy, thus limiting therapeutic effects. In these cases, CAR T-cell longevity is compromised and will not allow for proper in-vivo expansion, possibly allowing cancer to return. The risk of experiencing this side effect may be reduced by deploying immunosuppressive treatment regimens before treatment; however, this induced lymphodepletion will expose the patient to a far greater risk of contracting opportunistic infections.

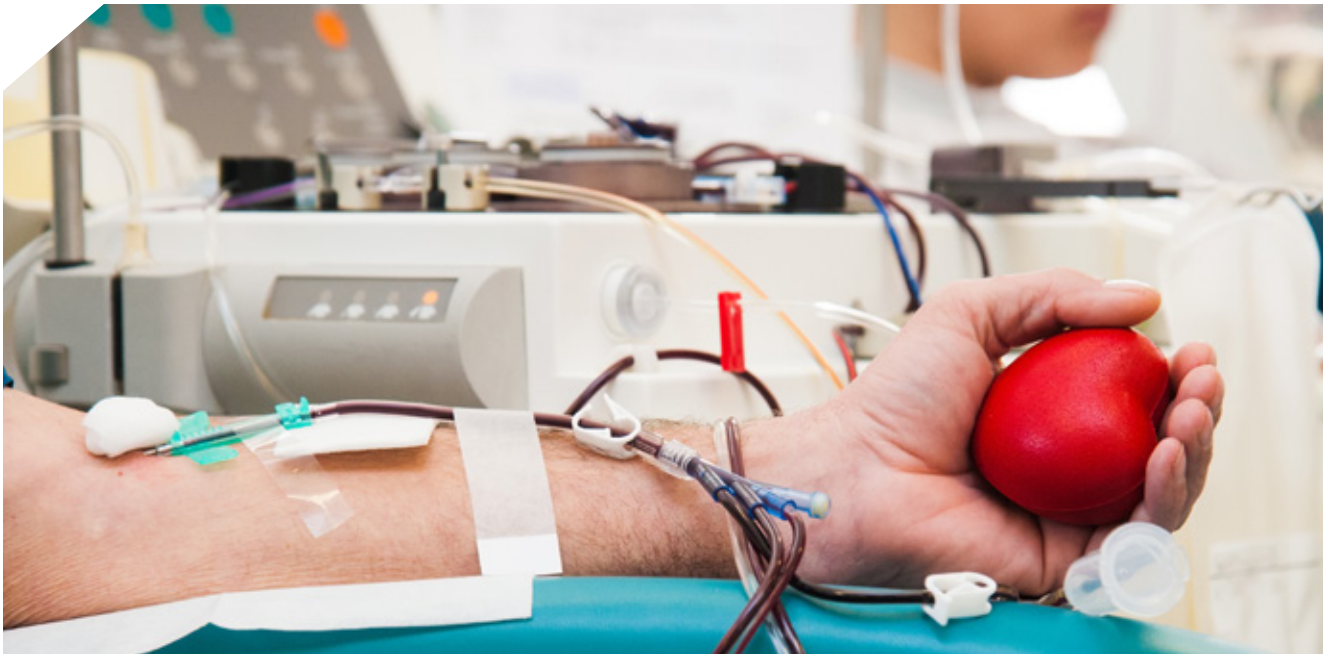
Beyond these, allogeneic CAR T-cell therapy also suffers disadvantages in production, making it more difficult to guarantee quality and efficacy. In producing allogeneic therapies:

+ **T-cell** exhaustion, in which the T-cell loses its effector function and memory potential, can occur after extended periods of cell expansion, an activity necessary to produce many therapies from a single donor sample. This results in a far less effective therapy than would otherwise be provided.
+ Further, because the critical quality attributes of CAR T-cells still need to be fully understood, it can be challenging to qualify incoming materials and thus manage **batch-to-batch variability**.

Current Autologous CAR T-cell Production Workflow

Centralized manufacturing, distributed amongst only approximately 100+ laboratory centers, is currently the method by which autologous CAR T-cell therapies are produced and the source of much of its inefficiencies. This approach contains several drawbacks contributing significantly to the inaccessibility of CAR T-cell therapy.

Given the time-sensitive nature of cancer diagnoses and treatment, the shortcomings of autologous CAR T-cell manufacturing outlined on page 7 may seem immediately apparent. It is a highly time-consuming bespoke production method, taking significant time to prepare. Yet, this observation merely scratches the surface of centralized manufacturing's true drawbacks when employed in the production of CAR T-cell therapy.



The Challenge of Accessibility

While the potential of CAR T-cell therapy to revolutionize cancer treatment is evident, it remains largely out of reach for many patients. While the ideal would be to provide bespoke, autologous therapies to all in need, this effort is severely hindered because these therapies must currently be produced via centralized manufacturing. This process involves collecting a patient's T-cells at a hospital or treatment facility, shipping them to a centralized laboratory for genetic engineering and expansion, and then returning the CAR T-cells to the patient's care site for treatment. This approach presents several significant challenges:

+ **Limited Production Capacity:** With each step of its process highly manual and time-consuming, centralized manufacturing has a limited clean room production capacity, with only a certain number of slots available per year. As this limitation leads to scarce available treatments, many eligible patients face the heart-wrenching reality of not receiving treatment in time. As a reference point, it's estimated a mere 5,000 commercial doses are administered per 500,000 qualified patients.
+ **Higher prices due to low production:** This bespoke, centralized manufacturing process results in a low yearly production count, prices are driven even higher to provide a return on investment for involved manufacturers. Fees for this therapy currently range from $350k to over $3M.
+ **Inability to Scale:** The existing manufacturing methods are complex and labor-intensive, making it challenging to scale production to meet the increasing demand for CAR T-cell therapy. Each patient's therapy requires extensive manual processing steps (up to 50) and a multitude of specialized instrumentation (with their disposables). Producing hundreds of thousands of treatments per year is not feasible.

+ **Challenges with batch contamination:** To mitigate the contamination of CAR T-cells, during particular processing steps and open manipulations, all workers must be outfitted with full bodysuits, and labs must be equipped with proper cleanroom facilities. These requirements constitute significant costs to manufacturers but are critical to ensuring production success. Each time a cell therapy batch is handled, opportunities exist for accidental contamination, which may prevent the successful creation of CAR T-cells. Some manufacturers have reported process failure rates as high as 15%.

+ **Increased risk of manufacturing errors:** Being complex and labor intensive, the production process is far more susceptible to human errors than a simplified, more streamlined approach would be.

+ **Potential for reduced quality:** In the case of centralized CAR T-cell manufacturing, both the manufacturing input (patient T-cells) and its output (therapy) must be frozen for transport and thawed for use. This can negatively impact the quality and quantity of input cells, potentially resulting in less effective treatment.

+ **Patient access challenges:** Hospitals and treatment facilities where CAR T-cell therapy is currently offered are based in urban areas and major metropolises. Unfortunately, this means patients in rural areas must temporarily relocate to receive treatment, often for as long as two weeks. This presents time and cost burdens to the patient and their family and caregivers.

Given these drawbacks, it is clear that manufacturing methodologies must be significantly reconsidered if CAR T-cell therapy is to be delivered to patients in need promptly and at a price the market can bear. To further compound matters, new forms of treatment are being developed and approved at an exponential rate, with around one thousand currently in the FDA pipeline therefore production advancements are in great need.

Recognizing the need to address these challenges, a paradigm shift is underway. The solution is transitioning from centralized manufacturing to a point-of-care approach, where CAR T-cell therapy is produced and administered at the patient's care site. But how can the manufacturing capabilities of an entire laboratory be captured in such an approach? Here, automation provides an answer.

The Role of Closed System Automation

Closed system automation is the key to enabling point-of-care manufacturing and democratizing CAR T-cell therapy with the entire vein-to-vein journey occurring in the patients treatment center. This approach replicates the cleanroom environments found in centralized labs by operating within a closed-loop system that utilizes a disposable kit to prevent contamination, meanwhile replacing the need for expensive professional laboratory teams using a multitude of instruments with advanced automation. In doing so, closed system automation eliminates the need for transportation of materials and the involved freeze/thaw cycles, thus reducing production times significantly. Yet, it offers a significant number of benefits beyond this as well.

Benefits of Closed System Automation:

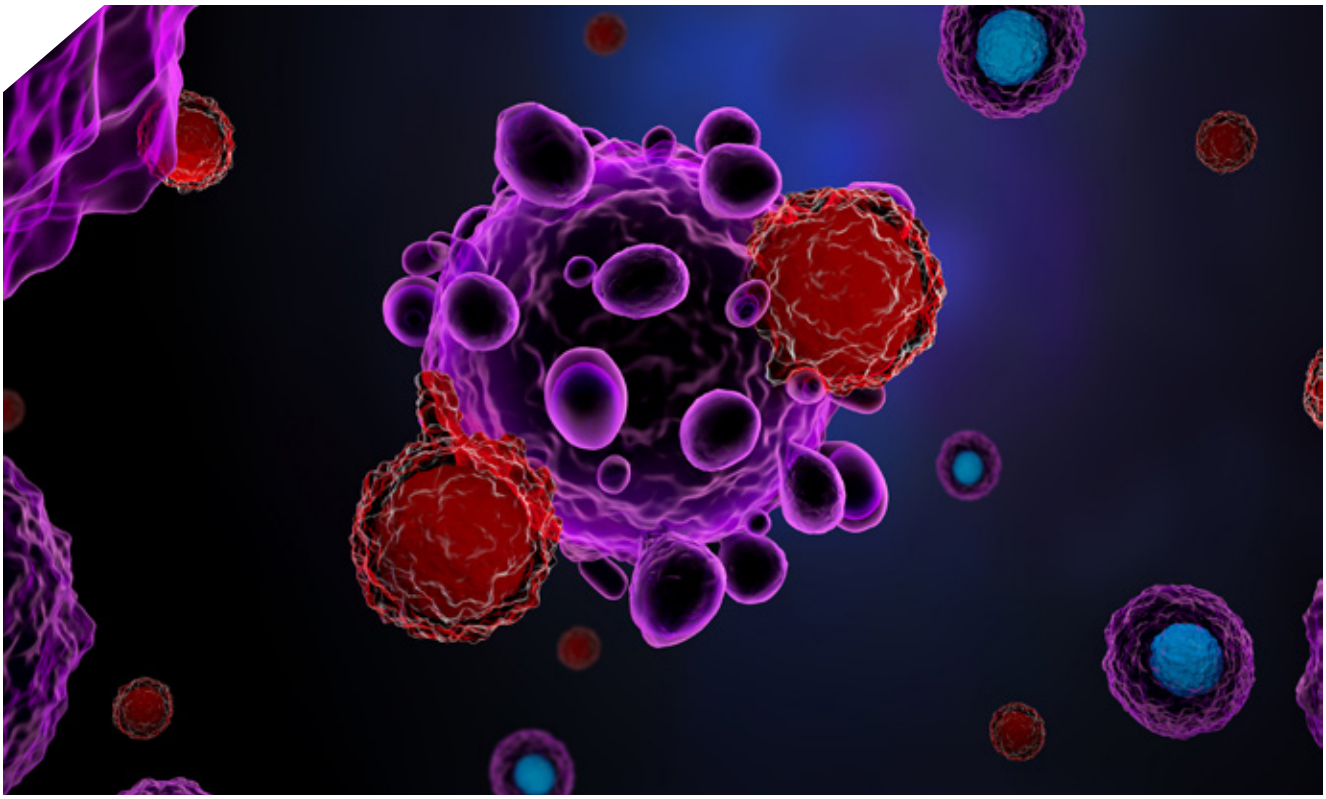
+ **Commercial-Scale Production:** Automation significantly increases production output by reducing manual labor and human interaction. If treatment facilities install multiple automated systems, manufacturing can scale efficiently to serve many patients simultaneously while maintaining stringent quality controls.
+ **Activating Economies of Scale:** Higher production volumes translate to lower production costs, enabling more affordable therapies. This shift from low-volume, high-priced therapies to high-volume, lower-priced treatments benefits both patients and manufacturers. Manufacturers will receive higher return on investment with the significant increase in production volume.
+ **Lower Direct Costs:** Reducing manual labor and eliminating the need for off-site cleanrooms leads to overall cost reductions. Increased yield and reduced waste translate to savings that can be passed on to patients.
+ **Shortened Manufacturing Timelines:** The closed system automation eliminates the need for freezing, thawing, and transportation, streamlining the entire process. The automation also consolidates all the normal processes previously required into a streamlined, automated workflow, resulting in shortened production timelines. This acceleration is crucial in cancer treatment, where time is often of the essence.
+ **Reduced Need for Skilled Labor:** Automation simplifies the workflow, reducing the reliance on highly trained professionals. This not only lowers costs but also ensures greater consistency and quality.
+ **Minimized Contamination and Errors:** With limited human intervention and a closed, controlled environment, closed system automation minimizes contamination and processing errors. This results in a higher yield of CAR T-cells and enhanced safety.

A New Horizon: Point-of-Care Manufacturing

Democratizing CAR T-cell Therapy

+ **Improved Cell Quality:** Using fresh, never-frozen T-cells collected onsite preserves cell viability and function, resulting in higher-quality therapies.
+ **Eliminating the Need for Patient Travel:** Point-of-care closed system automation eliminates patients' need to travel to centralized therapy centers. Outpatient methods can be deployed, improving the quality of life for patients and saving them and their caregivers time, money, and effort.

Implemented correctly, the closed system automation provides scalability, enabling millions of therapies to be produced each year at a fraction of the cost and effort it takes to produce even a single therapy today.



The Automated Workflow

To understand this automated system further, we should consider how its workflow compares to that of centralized manufacturing. While both processes begin with the same basic procedure, collecting T-Cells from patients, centralized manufacturing requires at multiple instances steps that must be performed to maintain sample integrity and prevent contamination during this manually intensive fabrication process with materials needing to be transported from treatment facility to production lab and vice versa. The automated workflow, meanwhile, requires none of these tertiary human interactions and processes as biomaterials never actually leave the closed environment of the system until treatment is fully prepared and administered, resulting in a far more streamlined manufacturing process overall. At a high level, an example workflow for automated autologous CAR T-Cell fabrication is as follows:

1. **Leukapheresis:** This is the process by which white cells, including T-Cells, are collected from the patient. Usually taking two to three hours, it includes extracting the patient's whole blood, harvesting white cells from the sample, and reinfusing red cells back into the patient in real time.

2. **Isolation of T-Cells:** To isolate T-Cells within the sample, it then undergoes a process known as Immunomagnetic Negative Selection. In this process, any unwanted white cells are marked with magnetic particles while T-Cells are left untouched. Tagged cells are then filtered from the sample, typically within as little as ten minutes.

3. **Activation:** Before genetic engineering can occur, T-Cells must be "activated" or made receptive to receiving foreign genetic materials. This is achieved by stimulating the T-Cells with recombinant antibodies and is usually complete within one day.

4. **Genetic Engineering:** Referring to the process of introducing foreign DNA or RNA into the T-Cell, this step typically takes one to two days and can be performed via one of two methods:

    + **Transduction**, in which a viral vector is used to introduce foreign DNA into the T-Cell. Once in contact with the T-Cell, the foreign genetic material will instruct it to express CAR (Chimeric Antigen Receptors) on its surface which, when infused into the patient, will attach to proteins on cancerous cells and allow the T-Cell to identify and eliminate them.

    + Or **Transfection**, a process by which foreign DNA or RNA is introduced into the T-Cell via non-viral methods. There are two major approaches to transfection.

        - Electroporation, in which high-voltage electric pulses are used to open the cell membrane pores of T-Cells, allowing for the introduction of foreign DNA.

        - Ionizable Lipid Nanoparticles, in which ionizable lipids are synthesized into nanoparticles containing mRNA (messenger RNA), which is taken into the cell during regular cellular uptake.

5. **Expansion:** With T-Cells appropriately modified into CAR T-Cells, they must now be multiplied into a volume large enough to be usable in treatment. To achieve this, T-Cells will be placed into a bioreactor with spinner and, over the course of five to nine days, exposed to a cell culture medium which will support growth.

6. **Harvesting, Washing, and Concentrating:** Having now reached a much larger volume, of up to five liters, the cell culture must now be harvested, washed, and concentrated in preparation for infusion into the patient. While there are several methods for doing so, the most common involves the use of counterflow centrifugal elutriation, a process in which cells are sorted by size and density allowing for removal of dead cells. This step is key to improving cell viability and thus ensuring high quality in the final product. The sample may now be properly considered CAR T-Cell therapy and administered accordingly to the patient, intravenously in a single session.

Challenges to Implementation

With increased production output, the current astronomical price per therapy would decrease dramatically, thus allowing more patients than ever to receive treatment. But this transition would not only benefit patients; with improved production and significantly higher distribution volume, manufacturers would see vastly improved returns on investment providing an incentive for even further development of CAR T-cell therapy.

In developing and implementing point-of-care manufacturing for CAR T-cell therapy, the most significant concern is ensuring the standard of safety and quality of product remains uniform with current CAR T-cell therapies produced in a centralized lab. It also includes complying with relevant FDA guidance that may assist in this endeavor. In the case of centralized manufacturing, regulatory guidance includes GMP regulations for CAR T-cell therapy as well as the requirement for any biopharmaceuticals working with human subjects to submit an Investigational New Drug application (IND), which must be approved.

While products manufactured at point-of-care must follow these guidelines as well, they must also pay attention to more recent publications by the FDA that seek to ensure uniform quality and safety in treatments produced at different care sites. Namely, draft guidance for the manufacture of CAR T-cell products published in March 2022 must be followed, as well as a discussion paper on point-of-care manufacturing published in October of the same year. In these documents, the FDA states point-of-care manufacturing should clearly demonstrate comparable analytical methods across production sites, and INDs for such products should accurately report on any differences in manufacturing processes that may occur across sites. It is highly recommended that the same standard operating procedures, reagents, and equipment are used across point-of-care sites, as well as that standard materials and practices are set for the calibration of equipment. Considering the sheer number of variables that differ from one hospital or treatment facility to the next, these requirements seem daunting.

Yet, the closed system automation proposed by MIDI effortlessly ensures uniformity in production methods and environment, even at the most unique point-of-care site. Involving an instrument and disposable set developed under an ISO-13485 quality management system framework, it is the ideal solution to enable widespread point-of-care CAR T-cell therapy manufacturing.

The Democratization

Democratizing CAR T-cell Therapy

CAR T-cell therapy can potentially change the landscape of cancer treatment, offering an exact and practical approach that minimizes, if not eliminates, the collateral damage caused to the patient. However, its adoption has been severely limited due to centralized manufacturing challenges, resulting in high costs and limited accessibility. The transition to point-of-care manufacturing, facilitated by closed system automation, promises to address these challenges and make CAR T-cell therapy more widely available. This shift not only improves accessibility but also reduces costs, minimizes errors, and enhances the quality of CAR T-cell therapies, ultimately bringing us closer to a future where this groundbreaking treatment is accessible to all in need. The successful democratization of CAR T-cell therapy would mark a significant step forward in the fight against cancer, potentially transforming cancer treatment as we know it from an arduous, “lesser of two evils” process to one in which even the deadliest and most challenging forms of this pervasive disease may be simply and promptly eradicated.

Click on the MIDI Innovation Vault Podcast microphone link to listen to details on the above topics covered in NexGen CAR T-cell Therapy; Democratization via Advanced Point-of-Care Production and Applications.

About the Author

Christopher Montalbano is the Co-Founder and CEO at MIDI's Innovation Center Headquarters. With over 30 years' experience in medical device innovation and development, Chris' areas of expertise are multidisciplinary ranging from technology development and commercialization to regulatory planning and control.

EMAIL

Need help with Medical Device Innovation?

LEARN MORE

MIDI welcomes the opportunity to hear from you and discuss your company's device development needs. We work together with our clients embracing development challenges and creating innovative marketable device solutions. Our door is open to discuss project opportunities and/or to further outline for you who we are and what we do.

Please feel free to call, email, or schedule a consultation with MIDI.

About MIDI

MIDI is an Expert in Medical Innovation.

MIDI is an award-winning strategic turnkey, FDA and ISO compliant device development consulting firm with over 50 years' experience servicing domestic and international clientele representing medical, life sciences, and home healthcare markets.

Our multi-disciplined, talented group achieves innovative results within rapid timelines under stringent regulatory constraints. MIDI's dedicated teams of research, design and engineering professionals offer a unique combination of talent and experience, consisting of key personnel working together with a record of outstanding achievement in developing Class I, II and III devices.

Our proprietary DevelopmentDNA™ approach to device development provides clients with a distinguished thoroughness in securing device results that answer market needs and increase sales as well as market share.

From the first idea to the last detail, we balance technical information with strong orientation toward user-driven design solutions. Our disciplines blend all technical/IP and human requirements. This combination is maintained with a proper balance of research methods, design, engineering, cost-effective implementation, manufacturing knowledge, DFX, regulatory compliance, and the wherewithal to use the disciplines in concert.

Our prime goal is total satisfaction for the clients we serve. We consider our clients true partners.

MIDI
(631) 467-8686
innovation@midipd.com

MIDI Innovation Fueled by DevelopmentDNA™

CONNECT