EDITION
2025

BIOPROCESSWATCH
CELL-BASED THERAPIES

mabdesign
THE BIOTHERAPY EXPERT

ABOUT **MABDESIGN**

MabDesign, the French Association of the Biotherapy Industry

MabDesign, the French biotherapy industrial association, aims to support, federate and increase the visibility of the biopharmaceutical industry, foster exchanges, promote the development and competitiveness of companies, and stimulate innovation by encouraging the emergence of start-ups from academic research.

In order to carry out its development strategy and to adapt to changes in the industrial ecosystem, MabDesign's governance has evolved to meet the specific needs of the various companies working in the biotherapy industrial sector. Therefore, the Board of Directors of MabDesign already composed of DBV Technologies, Pierre Fabre and Sanofi, has been strengthened with the arrival of Oxford Biomedica, BioMérieux, LFB Biomanufacturing, TreeFrog Therapeutics, Thermofisher Scientific and Institut Pasteur as well as four Qualified Persons with Nicola Beltramineli (Innate Pharma), Hervé Broly (Merck), Maité Durrenbach (Sanofi) and Stéphane Legastelois (33 California). Their arrival to the Board of Directors reinforces MabDesign global vision of the current challenges and opportunities of the biopharmaceutical industry.

Moreover, to achieve its goals MabDesign sets up a coherent set of actions promoting exchanges, collaborations and skills development. In this dynamic MabDesign has developed a **national directory** that brings together industrial and academic players in biotherapy and allows to identify online the know-how available in France. MabDesign organizes high-level **international scientific events**, in collaboration with key ecosystem players, to highlight innovation and stimulate exchanges between companies in the sector. With the help of its Scientific Committee (**COSSF**), MabDesign writes summary reports (**ImmunoWatch and BioprocessWatch**) for the biotherapy industry. MabDesign offers specialized and **innovative continuous professional training** solutions to enable companies to adapt their skills to the market evolution and maintain their competitiveness. Finally, MabDesign offers its members a **wide range of services** to help companies of all sizes to optimize their positioning, protect and enhance their innovations, conquer new markets and raise public funds.

Operational since September 2015, MabDesign currently has over **280 member companies** and its diversity is its strength. MabDesign's dynamic network includes pharmaceutical and biotech companies, service providers (eg. CROs, CDMOs, etc), professional training actors, high-tech equipment suppliers and specialized consultants.

Bât. L'Initial
17, rue Crépet
69007 Lyon
Tel. 04 78 02 39 88
contact@mabdesign.fr
www.mabdesign.fr

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INTRODUCTION

For several years now, MabDesign has been actively participating in national and regional programmes and organising scientific events and gatherings focusing on bioprocessing. In parallel, we have also been providing strategic consultancy services together with various training opportunities to key actors of this field, including academia, public bodies, SMEs and biotech and pharmaceutical companies, that are involved in the shaping of the bioprocessing industry in France through their R&D, innovation, technologies, services and products. In line with these past and current actions and to further our commitment and support to the French bioprocessing industry, MabDesign has launched in 2021 a second information-monitoring letter, the BioprocessWatch series.

Each edition of BioprocessWatch will focus on current challenges, a critical step or a recent innovation linked to the manufacturing of a specific biopharmaceutical product or affecting the whole field. BioprocessWatch will feature invited scientific contributions from academia and/or the industry, the most recent pipeline, economic and financial data (where applicable), insights into the intellectual property related to the theme and opinion articles and interviews from one or two experts working in the field.

Finally, we would like to acknowledge the continued support and strategic oversight provided by MabDesign's Comité d'Orientation Stratégique et Scientifique de Filière (COSSF) for their significant contribution to the quality and relevance of each edition of BioprocessWatch.

Editorial

Camille BACHELET
Scientific Innovation and Partnership Manager
CELLforCURE By Seqens

Hélène NEGRE
Pharmaceutical Affairs Director
CELLforCURE By Seqens

Over the past decade, cell-based therapies have evolved from experimental concepts to clinically approved treatments, offering unprecedented hope in the field of cancer treatments, rare genetic disorders, or autoimmune diseases. Yet the road from bench to approved and commercial treatments is far from linear and becomes significantly more complex when the goal is to produce thousands of batches.

One of the most underestimated challenges in cell therapy development is the disconnect between early discovery and industrial manufacturing. Promising therapeutic candidates are often developed in academic or small-scale settings, with limited foresight into how they will scale. Processes that work at laboratory scale may not translate efficiently into GMP-compliant, large-scale production. As therapies progress into late-stage development, this gap can become a major bottleneck. To overcome it, manufacturability must be considered from the outset: choosing scalable processes, simplifying and standardizing culture conditions, anticipating closed-system integration, and ensuring automation compatibility. The earlier manufacturing realities are addressed, the smoother and faster the path to industrialization.

Early-phase clinical trials are typically supported by academic institutions and small-scale manufacturing facilities. These settings are well-suited to proof-of-concept studies and early phases. However, as therapies move toward phase II, III trials and commercial launch, they face new challenges: scalability, consistency, cost-efficiency, and regulatory compliance at industrial levels. This is where large-scale CDMOs (Contract Development and Manufacturing Organization) play a critical role, ensuring not only a smooth transition to GMP-compliant, industrial-scale production, but also driving cost reduction through process optimization, standardization, and platform-based approaches. By enabling a single, integrated technology transfer that supports all clinical phases, large-scale CDMOs streamline the industrialization process, reducing both timelines and costs while ensuring continuity and regulatory compliance.

CELLforCURE by SEQENS, based near Paris, is one of Europe's leading industrial CDMOs dedicated to Advanced Therapy Medicinal Products (ATMPs). Specializing in both autologous and allogeneic cell and gene therapies, the company brings over 15 years of expertise and a proven track record in supporting clients from early clinical phases through to commercial manufacturing.

The cutting-edge "one-stop-shop" facility spans 10,000 m², including 3,200 m² of GMP-certified areas with 7 independent manufacturing lines, each equipped with 8 cleanrooms, ensuring maximum safety and compliance for every product.

CELLforCURE's unique blend of CDMO heritage and proven commercial manufacturing expertise, is an ideal partner to help bring your innovative therapies to life, transforming groundbreaking ideas into commercial success.

Acknowledgments to Mabdesign for inviting us to contribute to this issue. We are pleased to share our industrial perspective on cell and gene therapy manufacturing.

EDITORIAL

Clémentine Gamonet
*Responsable CIM-BP et PIBT**
EFS BFC

Bringing a new biotherapy to market, particularly an Advanced Therapy Medicinal Product (ATMP), is a real challenge not only because of the scientific and technical complexity involved, but also because of the strict regulatory requirements and high production costs. So, despite the immense hope offered by these treatments for rare, serious or even incurable diseases, many of these scientific innovations will never see the light of day, as they fail to overcome the countless pitfalls along the road to commercialization. Worse still, some will never even be evaluated in humans. The development phase, which consists in transforming an initial proof-of-concept into an effective and safe biotherapy, is a critical stage, often undervalued by project leaders. This phase is characterized by high levels of uncertainty (scientific, technological and regulatory), and its success depends on a delicate balance between innovation, regulatory compliance and financial viability.

Among the major difficulties encountered by project sponsors, the need for high initial investments is clearly identified: cost of preclinical studies, production of scale batches using pharmaceutical-grade reagents, acquisition of automated production equipment, setting up investigator centers, regulatory advice among others examples. This requires investments of several (tens of) million euros, even though the risks of failure in the early phases of clinical trials are undeniable: possibility of serious adverse events, difficulty in obtaining proof of efficacy in often rare indications, limited efficacy, production costs too high. In order to meet this challenge, several ideas have been put forward: increase public/private partnerships, find innovative financing mechanisms for the early stages of development, make regulations clearer for all stakeholders. But it appears very important to also anticipate and decrease operational risks: Understand the mechanisms of action of the final product as clearly and comprehensively as possible, develop a robust and cost-effective manufacturing process that is adapted to the clinical strategy, anticipate exchanges with regulatory agencies. This requires the support of expert and agile teams, able to assist each project leader: the network of Biotherapy Bioproduction integrators has been set up to meet these objectives. These 8 expert and complementary public entities have been accredited by the French government with the aim of promoting technology transfer for biomanufacturing projects, but also to provide an environment conducive to start-up development and access to cutting-edge equipment.

The partnership with an industrial integrator should enable us to accelerate the development phase while limiting risks, in order to reduce failures upstream of the early clinical trial phases and thus maximize the chances of marketing these innovative therapies for the benefit of patients.

**Cellule Interface et Maturation en Bioproduction (CIM-BP)*
**Pôle Innovation en Bio-Thérapies (PIBT)*

EDITORIAL

Béatrice Clémenceau
*Responsable adjointe et scientifique UTCG**
CHU Nantes

Florence Vrignaud
*Responsable UTCG**
*Pharmacien délégué biothérapie CIC1413***
CHU Nantes

Facilities for the manufacturing of Advanced Therapy Medicinal Products (ATMPs) are essential for the production of biomedicines. The Join4ATMP project has identified 180 ATMP production sites in 9 european countries (https://atmp.n3m.in/). These sites may belong to different identities : biotech companies, Contract Development Manufacturing Organisations - CDMOs, pharmaceutical companies, university hospitals. In France, among the 21 sites identified, 9 are hospital sites.

Since the implementation of regulations on ATMPs in Europe, followed by the marketing of CAR-T cells, the issue of the positioning of hospital bioproduction sites has become more significant. Until then, cellular therapy had been marginal, clinical production were limited to early-stage clinical trials. This activity is however continuing with strong involvement of hospital sites: after transferring production processes developed by academic research units, they validate the processes for clinical use and then, after regulatory authorities approval, produce experimental ATMPs for early-phase clinical trials.

This issue of positioning has intensified over the past two years within the context of the France 2030 plan, with the creation of France Biolead in December 2002, an organization dedicated to accelerating the development of the French biopharmaceutical manufacturing sector. Moreover, in summer 2025, the French Ministry of Health (DGOS) has commissioned the National Cancer Institute (INCa) to conduct a review of access to CAR-T cells treatments, notably by sending a questionnaire to the relevant hospitals and cancer centers. The aim is to identify any limitations to the accessibility of CAR-T cells linked to centralized production, such as logistical complexity and prohibitive costs, and propose solutions.

This topic is also a key concern for UNITC, a French consortium conducting research into cell and gene therapies for cancer. Accredited by the French National Cancer Institute (INCa) in 2024, it brings together French players in this field. It aims to meet the challenge of providing patients with access to innovative therapies. One of its working groups is developing guidelines for the production of CAR-T cells by academic institutions under the hospital exemption defined by European Regulation EC No. 1394/2007.

Hospital bioproduction sites enable academic teams that have developed innovative projects in the field of tissue engineering, regenerative medicine, cell or gene therapy to proceed to clinical trials. They have acquired significant expertise in cell engineering techniques, for selection and amplification of different cell types, made possible by their high adaptability due to the small size of the structures.

These sites may also be authorized for routine processes of ATMPs whose commercial development is of no interest to industrials due to lack of profitability or logistical difficulties. Two models are then possible: for rare clinical indications, a centralized production by one or a few expert units is rational; for broader indications or a drug product with short stability, decentralized production is preferable, allowing for the set up of point-of-care facilities covering the territory.

This dual positioning can make their economic model sustainable, these activities being subject to different fluctuations in demand and are financed differently: the former by clinical research and the latter by the healthcare system. In both cases, funders will need to focus on financing particularly expensive equipments, such as bioreactors, or reagents, such as lentiviral vectors for the production of CAR-T cells. A fully academic network could be established through the development of academic production of reagents, pooled orders, or support for the development of less expensive alternative processes or reagents.

Thus, the future of personalized cell-based medicinal products may lie not only in international pharmaceutical companies, but also in our own local hospitals.

** Unité de Thérapie Cellulaire et Génique (UTCG)*

*** Centre d'Investigation Clinique (CIC)*

CELL-BASED THERAPIES: SCIENTIFIC ADVANCES AND MARKET OUTLOOK

By MabDesign

Cell -based therapies can be divided into two main categories: conventional cell therapies (without any genetic modification) and gene-modified cell therapies. Within cell therapies, we can distinguish on one hand stem cells, which include induced pluripotent stem cells (iPS), embryonic stem cells, hematopoietic stem cells, and non-hematopoietic stem cells; and on the other hand differentiated cells, such as immune and non-immune cells. Gene-modified cell therapies include approaches based on chimeric antigen receptors (CARs) applied to different cell types (T lymphocytes, NK cells, other immune cells), as well as other types of genetic modifications applied to various cells . Finally, it is important to distinguish between autologous therapies, which use the patient's own cells, and allogeneic therapies, which rely on donor-derived cells. While the former reduces the risk of immune rejection but are more complex to manufacture on a personalized basis, the latter allow for an "off-the-shelf" production but require careful management of alloreactivity risks.

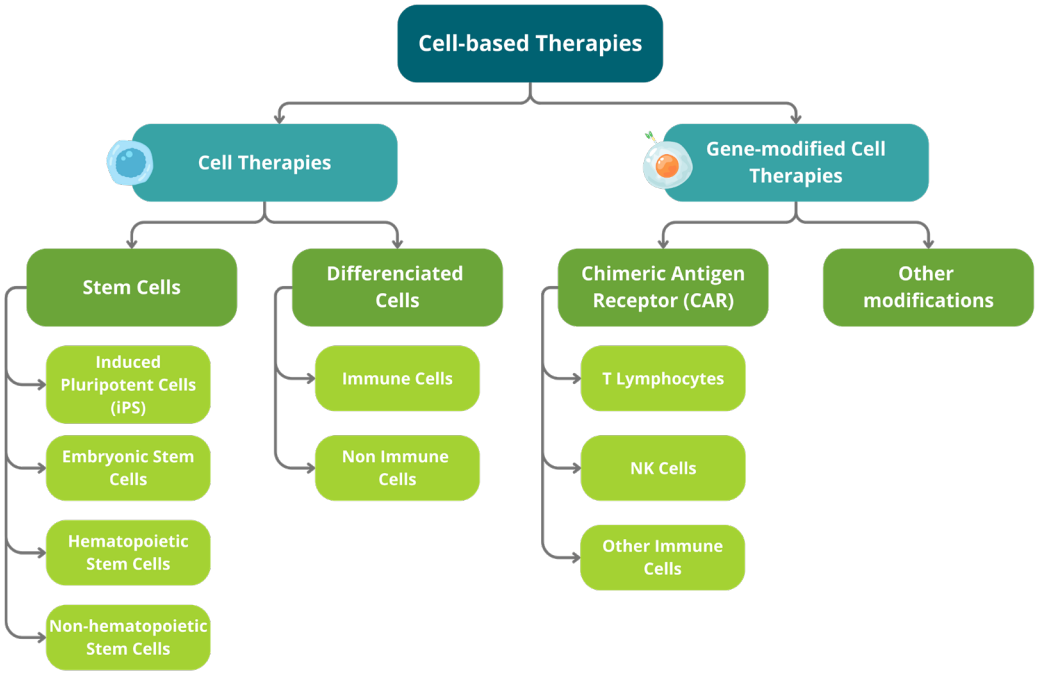
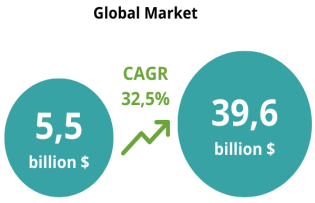


Figure 1 : Cell-based Therapies

In 2025, more than 5 800 clinical trials of cell-based therapies are ongoing worldwide, and the global cell therapy market is estimated ato reach USD 5.5 billion, with an annual growth rate exceeding 30%. Oncology dominates the therapeutic landscape, but applications in autoimmune diseases and regenerative medicine are accelerating.

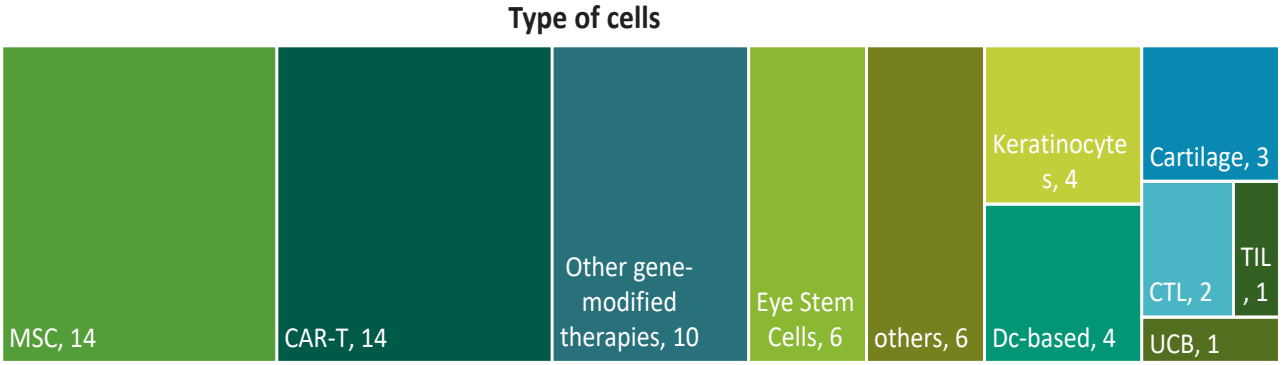


Adoptive cell therapies are experiencing major acceleration. To date, **14** autologous **CAR-T products have been approved** for hematologic indications (acute lymphoblastic leukemia, B-cell lymphomas, multiple myeloma), with the approval of **Aucatzyl (obecabtagene autoleucel) in 2024** marking a broadening of therapeutic options (Alliance for Cancer Gene Therapy, FDA).

The indication of **Carvykti (ciltacel, Janssen/Legend Biotech)** was expanded in April 2024 to the second-line treatment of multiple myeloma, thereby opening access to a much larger number of patients (JNJ.com, Business Wire). Finally, the market remains dominated by a few players. In 2025, Carvykti, Yescarta, and Breyanzi alone account for more than 70% of the global T-cell immunotherapy market (GlobalData).

On the regulatory side, a significant change occurred in **June 2025** where: the FDA removed the REMS (Risk Evaluation and Mitigation Strategy) program for already approved CAR-T therapies, thus reducing access constraints and broadening the availability of these treatments (Reuters).

In parallel, in **February 2024** the FDA granted the first approval for a TIL-based therapy (Amtagvi/lifileucel) in advanced melanoma, marking an important milestone for adoptive therapies beyond CAR-T (FDA). This approval illustrates that other populations of cytotoxic lymphocytes can also be harnessed for therapeutic purposes.



MSC: Mesenchymal Stem/stromal Cells, DC: Dendritic cells, CTL: Cytotoxic T cells, TIL: Tumor Infiltrating T cells, UCB: Umbilical cord stem cells

Figure 2: Marketed Cell-based therapies

Cell-based Therapies in Development

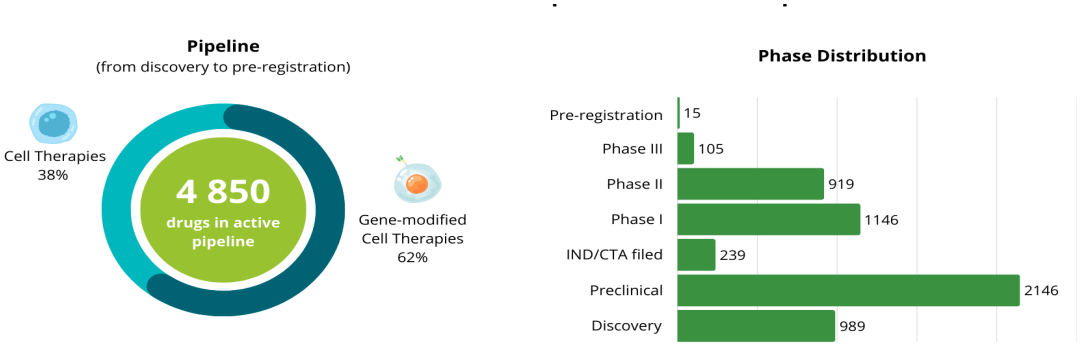


Figure 3 : Pipeline of Cell-based Therapies

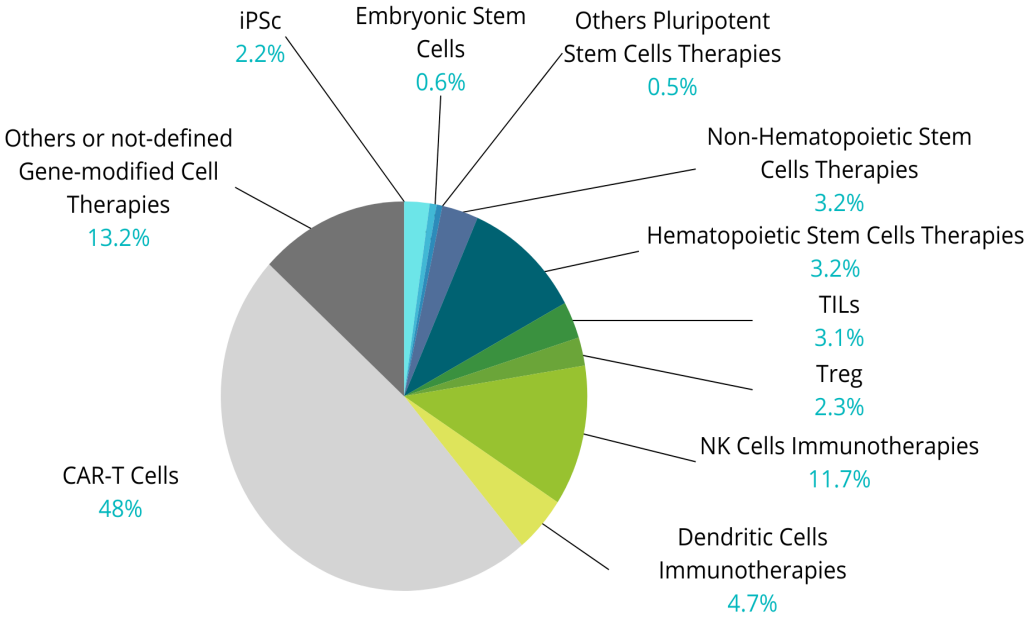


Figure 4 : Type of Therapies in Development

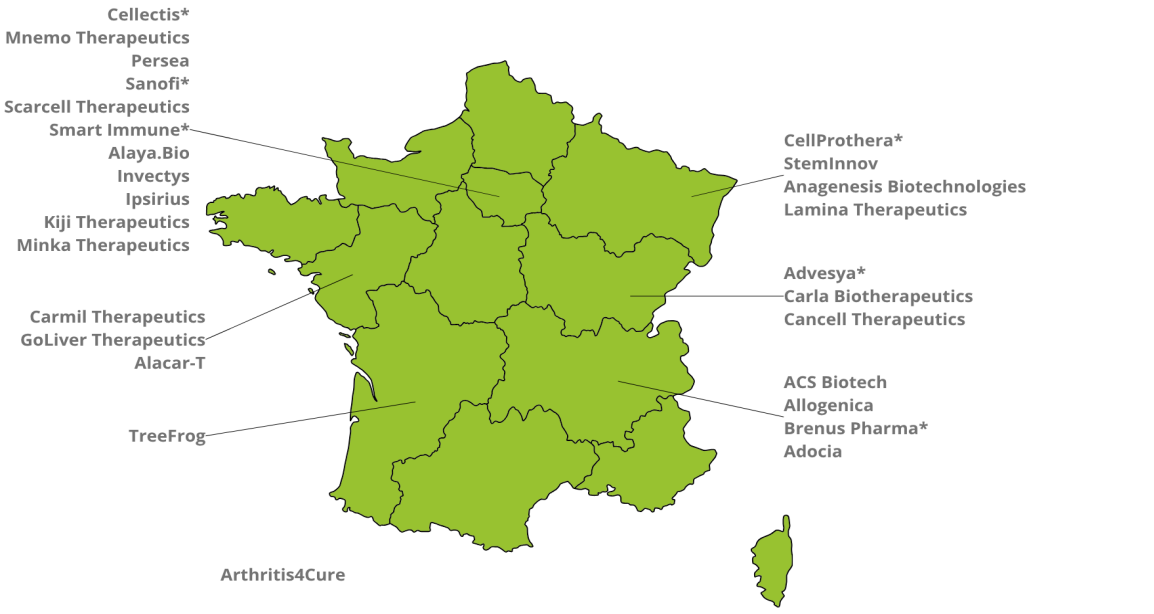
Cell therapies are rapidly diversifying beyond Hemato-oncology indications.

CAR-Ts in autoimmune diseases are opening an entirely new therapeutic field. Results published in the NEJM (2023–2024) showed that anti-CD19 CAR-T cells could induce prolonged remissions in lupus, myositis, or scleroderma. These advances are being pursued in several clinical trials in 2025, conducted by **Cabaletta Bio** (United States) and **Kyverna Therapeutics,** but also by European academic centers such as the **University of Würzburg** (Germany) and **Lausanne University Hospital** (CHUV, Switzerland), which are also evaluating academic CAR-Ts in autoimmune indications.

In parallel, **allogeneic and iPSC-derived** approaches are progressing too. In the United States, **Fate Therapeutics** and **Century Therapeutics** are leading the way, but Europe is also present with **Cellistic** (Belgium), specialized in iPSC lines for immunotherapies, and **TreeFrog Therapeutics** (France), which is developing large-scale iPSC production technologies. These platforms aim to deliver "off-the-shelf" products, i.e immediately available and therefore more accessible than autologous products.

Mesenchymal stem/stromal cells (MSCs) continue to be explored, particularly in regenerative medicine and inflammatory diseases. In Europe, companies such as **Bone Therapeutics/Biologics** (Belgium) or **MediTiss** (Germany) are developing applications in orthopedics and bone regeneration, while in France, several academic trials are investigating MSC use for treatingin inflammatory or neurological diseases.

Finally, **regulatory T cells** (**Tregs**) represent an innovative approach to restoring immune tolerance after transplantation or in autoimmune diseases. Clinical programs are being conducted by S**angamo Therapeutics** (formerly TxCell, France) on using genetically modified Tregs, as well as by **Quell Therapeutics** (United Kingdom), which is now considered a global leader in this field.



*Companies with products in clinical phases; where applicable, the company is at the R&D or preclinical stage

Figure 5 : Mapping of French Player Developing Cell-based Therapies

Cell-based Therapies Manufacturing

The bioproduction bioprocessing of cell-based therapies is now a critical link in their development and patient access. It faces several major challenges. The first lies in the biological variability of the starting cells, which makes reproducibility and batch standardization difficult. Working with living cells also brings specific constraints, with significant losses in viability during selection, modification, or preservation steps.

Added to this are issues of industrialization and scale-up: most processes remain artisanal, relying on manual, costly, and poorly automated steps, which limits the capacity for large-scale production. At the same time, quality and safety must be ensured under strict GMP standards, requiring stronger in-process controls and traceability. Finally, logistics represent a challenge in themselves, with the need to cryopreserve and transport products while maintaining their cell integrity and therapeutic efficacy.

These constraints explain the high costs of current cell therapies and the reliance on a limited number of production sites and specialized CDMOs. To address these challenges, the field must move toward greater standardization and automation, integrate closed industrial platforms, and develop sovereign GMP infrastructures to secure access and strengthen competitiveness against the massive investments being made in the United States and China.

In France, the academic and hospital ecosystem is dynamic (AP-HP, Toulouse, Nantes, Marseille), but industrial capacity remains limited. Existing players — CellforCure, EFS, Clean Cells — are strategic, but insufficient to meet future demand.In France, the bioprocessing ecosystem is dynamic with a network of academic institutions and hospitals (AP-HP, Toulouse, Nantes, Marseille) as well as key strategic industrial players- CellforCure, EFS, Clean Cells

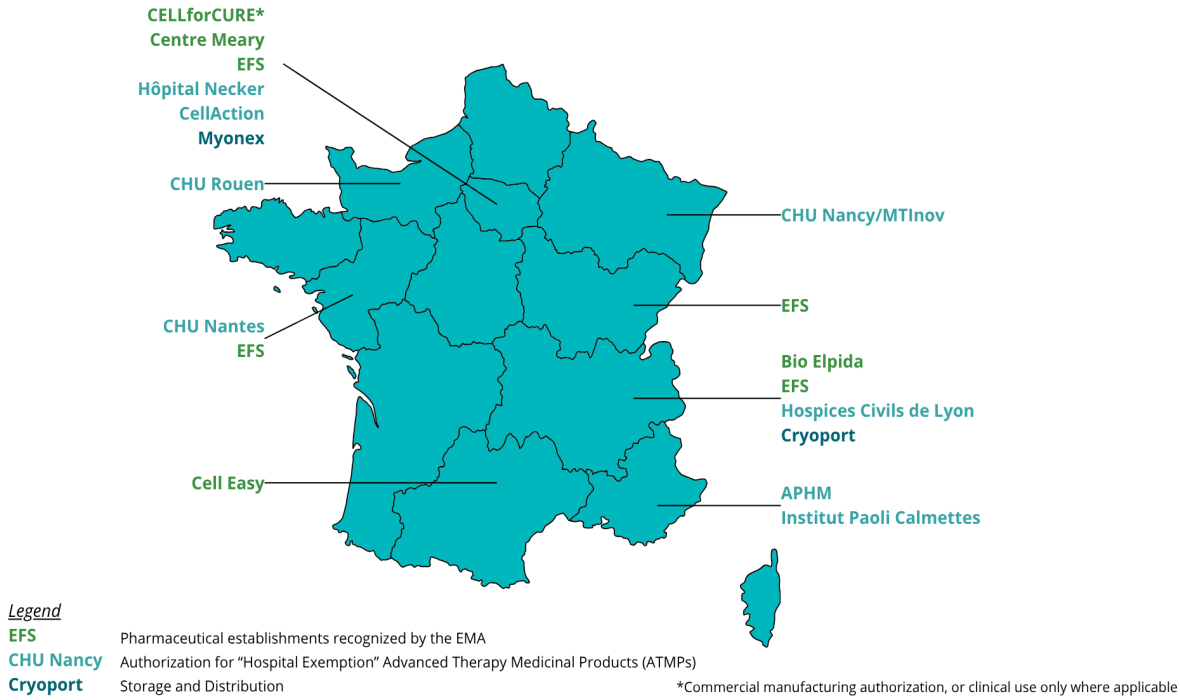


Figure 6 : Mapping of French Players in the Production of Cell-based Therapies

Sources:

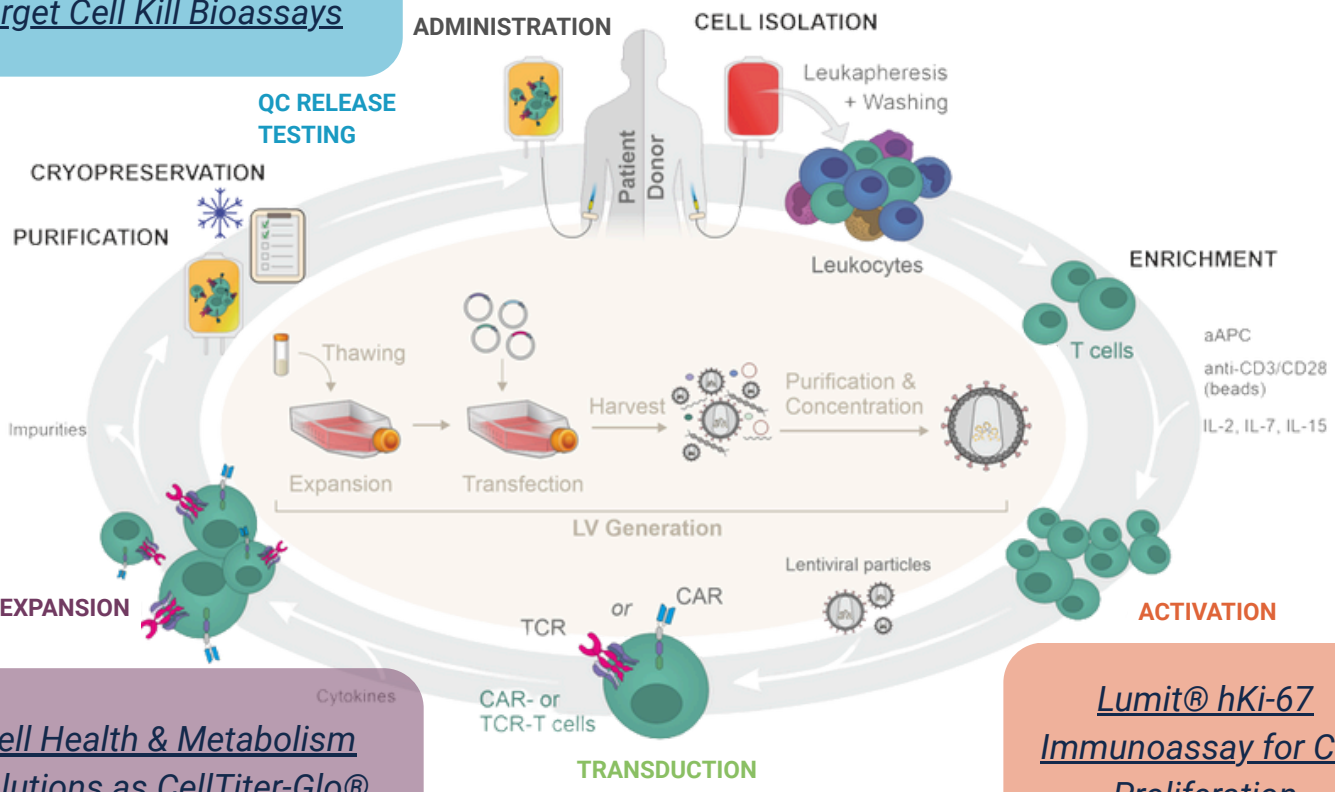
- *MabDesign expertise*
- *GlobalData 2025*
- *Alliance for Cancer Gene Therapy*
- *FDA*
- *Reuters*

Promega

Solutions to facilitate standardization and quality control in the development and production of cellular ATMPs

In the manufacture of cell therapy products, biological variability, process control, and functional characterization remain the main challenges. Promega offers robust, validated tools to support at critical steps, from development to clinical release control.

Potency and Functional Assays as Lumit® Cytokine and HiBiT Target Cell Kill Bioassays



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WHY, WHEN, AND HOW TO PARTNER WITH A CLINICAL & COMMERCIAL CDMO: UNDERSTANDING THE KEY MILESTONES

By CELLforCURE

As cell and gene therapies or advanced therapy medicinal product (ATMP) progress from research to commercialization, choosing the right Contract Development and Manufacturing Organization (CDMO) to partner with becomes a necessity. These partnerships help biotech & biopharma companies navigate the complexities of scaling up manufacturing, ensuring regulatory compliance (FDA, EMA), and optimizing costs. Understanding why, when, and how to engage a CDMO is essential for success.

Why Partner with a CDMO?

Internalization of the manufacturing will provide full control over processes and manufacturing strategies, but it might require a heavy investment with significant capital expenditure (CAPEX) for infrastructure, equipment, and personnel. It needs to be prepared early: the construction, authorization and Good Manufacturing Practices (GMP) certification will take years.

In the other hand, outsourcing will allow a faster deployment as the infrastructure is already existing allowing a quicker clinical and commercial production. More than an infrastructure, a CDMO will help with advanced technical expertise and regulatory knowledge. Finally, outsourcing will help reduce financial risk while maintaining scalability.

Small CDMOs or local academic cell factories offer advantages such as proximity, cost-effectiveness, and flexibility. However, it is difficult to dispel the illusion created by academic structures that only reflect a part of the true manufacturing costs. Indeed, infrastructure and equipment, often funded by taxpayer money, distort the perception of the costs required to produce on a larger scale.

As a result, some biotech companies face difficulties when they realize that industrial manufacturing conditions at a CDMO involve significantly higher costs. Transitioning to large-scale production requires not only appropriate technical and human resources but also a full awareness of the economic realities of the sector. Moreover, involving multiple CDMO players will require multiple technology transfers. In contrast, a CDMO with clinical and commercial capabilities represents a long-term investment that enables a unique technology transfer. Thanks to their real-world experience in clinical and commercial manufacturing, commercial CDMOs can support scaling up and optimizing production costs.

When Partner with a CDMO?

Biotech & Biopharma companies must address issues related to cost optimization, regulatory compliance, and scalability by speaking with a CDMO as early as possible in the product development cycle.

Preclinical and Early Clinical Phases: Laying the Foundation

At a preclinical development stage, there are major questions that should be considered:

- Is my ATMP commercially viable?
- Is my process fully scalable?
- Are cost of goods (COGs) manageable?

At this stage, a CDMO will help answer these questions with their experience. Having an answer to these questions will allow to derisk the project from an industrial and financial perspective but also give responses to the key assumptions from investors. When developing a new therapy, reimbursement and sustainability within healthcare systems are critical considerations. A cell and gene therapy must not only demonstrate clinical efficacy but also provide economic value compared to the existing standard

Clinical Trials (Phase I/II/III): Ensuring GMP Compliance and Scale-Up

As an ATMP enters Phase I, the need for GMP compliant production becomes critical. Choosing a CDMO with the right capacity and expertise ensures that manufacturing can scale efficiently while meeting strict regulatory requirements. During clinical phase I/II, one needs to select a CDMO partner who can navigate multiple challenges: here is a checklist of what should be considered while selecting a CDMO partner:

- Regulatory authorization / compliance (EMA, FDA)
- Capacity for next steps (including commercial)
- Real-life manufacturing experience (Clinical & commercial)
- Localization (needs to be strategical, central and closed to international airports)
- Expertise (does the CDMO have experience with similar cell therapy)
- Flexibility
- Supply chain capacities
- GMP area organization Vs workflow needed for my ATMP
- Access to cutting-edge technologies (Manufacturing, QC, Paper-free)
- Internal Quality Control (QC) of raw material, in-process control, Environmental Monitoring and sterility testing for a fast batch release
- Cyber Security
- Most important: Culture fit with the CDMO partner

Commercialization: Capacity, Execution, and Cost Efficiency

A CDMO with large scale capacities and commercial experience will provide the necessary manufacturing capacity to meet growing market demand while maintaining efficient execution of production processes. Low batch failure rate, consistent product quality, delivery on-time and regulatory compliance are key

A CDMO with real-life commercial experience understands the complexities of large-scale operations, minimizing risks, streamlining supply chains, while offering cost optimization at production volumes. Experience with real-life manufacturing and management of supply chain issue or Out of Specification (OOS) are part of the CDMO journey and needs to be managed properly.

For biotech & Biopharma companies looking to expand into new markets, a CDMO with connections in the USA or Europe can facilitate market expansion, ensuring compliance with regional regulatory requirements and optimizing distribution strategies.

How to Successfully Partner with a CDMO?

A well-structured partnership requires careful planning, clear expectations, and day-to-day collaboration between partners

A critical step is to clearly define the needs and goals. Understanding the specific expertise, production capacity and regulatory support required for a therapy helps align expectations from the outset.

Companies should establish precise criteria regarding timelines, quality standards, and deliverables to ensure both parties share the same vision.

Next, conducting thorough audits and challenging the CDMO is essential. Performing in-depth due diligence, including site visits and compliance audits, provides critical insights into the CDMO's capabilities. During this phase, it is important to assess the CDMO ability to manage deviations and scale-up challenges. Challenging the CDMO's problem-solving approach ensures they have the resilience and technical depth needed for long-term success.

Beyond technical capabilities, a compatible culture and vision play a crucial role in a successful collaboration. A strong partnership requires more than just technical alignment, it also depends on shared values, effective communication, and a mutual commitment to long-term success. Selecting a CDMO that prioritizes partnership over a transactional relationship helps foster trust and efficiency throughout the development and commercialization process.

Transparent communication and governance are key to maintaining alignment. Regular meetings, structured progress reviews, and clearly defined roles and responsibilities ensure that potential challenges are identified and addressed proactively. Establishing clear escalation pathways can also prevent delays and miscommunications.

Biotech & biopharma companies should also leverage CDMO's expertise and flexibility. Being open to process optimization and innovation proposed by the CDMO can enhance efficiency and cost-effectiveness. Process scalability must be addressed early in time to prevent scale-up bottleneck and COGs issues later. A successful partner should be able to adapt to evolving needs, supporting a seamless transition from early clinical phases to full commercialization.

Ensuring regulatory and quality alignment is another critical factor. The CDMO must comply with global regulatory standards, including those set by the FDA and EMA. A shared understanding of quality management systems and compliance expectations minimizes risks and facilitates regulatory approval processes.

Finally, planning for scalability and long-term success is essential. As a cell therapy product candidate progresses clinical phases, production demands increase, and geographic expansion may become necessary. Assessing a CDMO's ability to scale operations to meet future demand and to ensure supply

Conclusion

Challenges of ATMP manufacturing, scalability, COGs for proper market access must be carefully anticipated with a long-term vision to execute manufacturing at large scale while offering cost effectiveness compatible with market access.

Selecting the right CDMO partner involves more than just assessing technical capabilities: it requires time and thorough evaluation of capacities, ability to drive continuous process improvement, and cultural compatibility.

A successful collaboration is built on trust, transparency, and a shared commitment to long-term success. Since CDMO partnerships extend beyond individual development phases, choosing a partner who can scale with the needs and adapt to evolving challenges is essential. . In this long-term journey, the CDMO is not just a service provider but a strategic ally in bringing potent and safe innovative therapies to market efficiently and reliably.

CELLforCURE by SEQENS, based near Paris, is a leader in the manufacturing of ATMPs, specialized in both autologous and allogeneic cell and gene therapy solutions. With over 15 years of expertise, the company offers comprehensive end-to-end services, from Phase I clinical trials to full-scale commercial production.

The cutting-edge “one-stop-shop” facility spans 10,000 m2, including 2,200 m2 of GMP-certified production areas and 7 independent manufacturing lines, each equipped with 8 cleanrooms, ensuring maximum safety and compliance for every product.

As a trusted comprehensive solution provider, CELLforCURE facilitates seamless project development, leveraging in-house Quality Control capacities to deliver drug products.

CELLforCURE’s unique blend of CDMO heritage and proven commercial manufacturing expertise, it is an ideal partner to help bring your innovative therapies to life, transforming groundbreaking ideas into commercial success.

CELLforCURE
by SEQENS

End-to-end ATMP CDMO

FOR CLINICAL & COMMERCIAL CELL & GENE THERAPY MANUFACTURING

LARGE SCALE CAPACITIES

- +3,000 m² GMP area
- 48 cleanrooms Grade B / C
  Across 7 independent, customizable GMP manufacturing lines
- EMA-Authorized / FDA-Compliant

CENTRAL LOCATION IN EUROPE	+25 TECH TRANSFERS	+10,000 ALLOGENEIC CAR-T	+600 AUTOLOGOUS CAR-T	+15 YEARS EXPERTISE
Paris area, France	Clinical & Commercial Autologous & Allogeneic	Clinical vials	Commercial doses	CAR-T, NK, Tregs, TILs, iPSCs, MSCs, HSCs

ONE-STOP-SHOP CDMO

Tech Transfer → Process & Analytical Development → GMP Manufacturing → Quality Control → Product Release

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OPTIMIZED, CONTROLLED AND FULLY GMP-COMPLIANT, BIOPROCESS MANUFACTURING OF ARMED NATURAL KILLER CELLS TO SPECIFICALLY TARGET DELETERIOUS CELL POPULATIONS

Emilie Rigal [1],, Hortense Courot[1],*, Marc Criton1, Alan Cookson[2]*
Bénédicte Fauvel[1], and Jessy Presumey [1]

1 CYTEA BIO, Montpellier, France
2 MedXCell, Montreux, Suisse
* HC and ER contributed equally

A. INTRODUCTION

The Pin™ platform consists in the introduction of few specific mutations in the Fc region of monoclonal antibodies (mAbs) enabling their persistent loading or 'arming' onto the CD16 receptor (natural low-affinity receptor for Immunoglobulin G) of immune cells, to generate CAR-like products. These Fc mutations were incorporated into various mAbs' backbone targeting antigens such as CD20, CD19, HER2, EGFR and others. The Pin™ platform has initially been successfully applied by arming those various Fc-engineered mAbs on Natural Killer (NK) cells. NK cells were selected as the most appropriate first innate immune effector cells to make the proof of concept of the platform. Indeed, adoptive allogeneic NK cells therapies are safe (with no serious adverse reactions and no graft-vs-host disease or graft rejection) and have demonstrated preliminary efficacy data in cancer patients with promising clinical data (Page et al. 2024; Berrien-Elliott, Jacobs, and Fehniger 2023). In order to produce large amounts of NK cells, necessary for patients treatment, we decided to expand NK cells from umbilical cord blood (UCB). UCB is a readily available and ethical source of progenitor cells with high proliferative capacities and immature phenotype (Verneris and Miller 2009). These progenitor cell populations can be expanded and activated to produce consistent and homogeneous batches of NK cells. Therefore, UCB is an optimal starting material for "Off-the-shelf" products (Zhao et al. 2020). We optimized the expansion bioprocess from UCB to produce high number and highly functional NK cells. When NK cells were armed with Fc-engineered mAbs targeting antigens expressed by B cells populations, they exhibited significant and specific in vitro and in vivo cytotoxicity against B cells.

B. RESULTS

a. Bioprocess Manufacturing of Armed UCB-derived NK cells

1- UCB-derived NK cells

The first step of manufacturing (Figure 1) consists in the expansion of human NK cells from umbilical cord blood (eNK). Fresh umbilical cord blood (UCB) units for research purposes were obtained from the French Blood Transfusion Center Cord Blood Bank (Cell and Tissue Engineering Activity, EFS, Besançon,

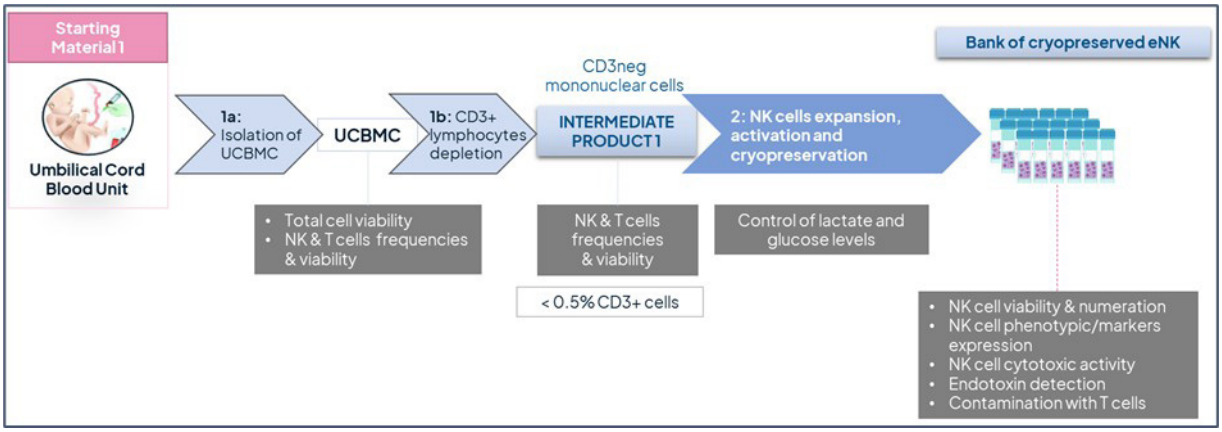

Figure 1: CYTEA BIO's UCB-derived expanded NK cells (eNK)

The bioprocess of UCB-derived expanded NK cells (named eNK cells) is based on the initial know-how (under license) of an academic research team (IRMB, Montpellier). It has been optimized thanks to the intensive efforts made by CYTEA BIO since its creation. CYTEA BIO has worked on over 130 units of cord blood (UCB, supplied by EFS) to expand eNK cells. Over 100 qualified batches of NK cells have thus been obtained. Numerous experimental conditions were tested (over twenty), varying different parameters and reagents. The validated bioprocess was transferred to EFS Besançon, which conducted several pilot expansions and demonstrated 1- its ability to perform expansions with yields similar to those obtained by CYTEA BIO and 2-the feasibility of bioproduction meeting the required specifications and complying with GMP (Good Manufacturing Practice). Moreover, with the support of Scale Ready and Wilson Wolf teams, through the G-Rex Grant program, the scale-up of UCB-derived NK cells using the G-Rex GMP-compliant closed-system is currently under investigation. Overall, three years of optimization of the manufacturing process profoundly improved our production yield (Figure 2), leading to the generation of eNK cells batches large enough for clinical testing.

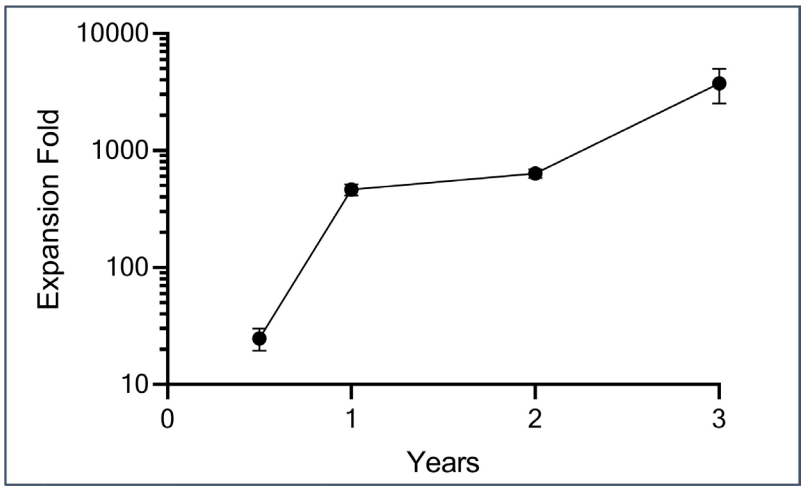

Figure 2: eNK manufacturing optimization led to expansion

2- Arming of eNK cells

In parallel of eNK cells expansion, the Fc-engineered PinTM antibody (Pin-mAbs) is manufactured according to the classical processes of antibody production in mammalian cells. The mAb is fully characterized to ensure patient's safety (implementation of qualifications, quality controls and analytical methods appropriate to prove the mAb is sufficiently safe).

The final stage of the manufacturing (Figure 3) consists in assembling the cells with the antibody. The day before the product will be used, NK cells are thawed and co-incubated with the antibody. The cells thus "armed" are then washed to remove the free (not attached to the cells) antibody, formulated and ready for injection.

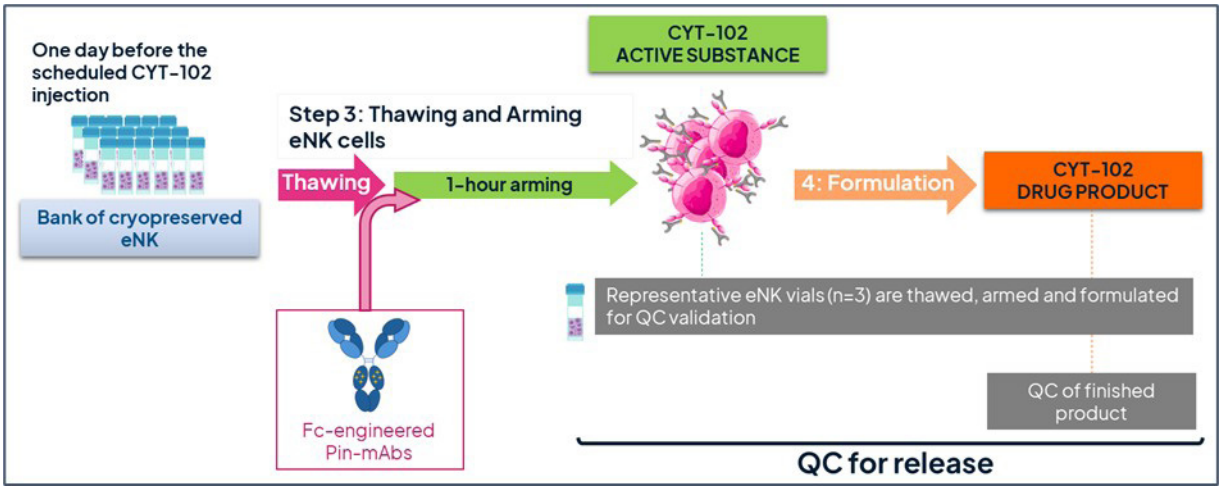

Figure 3: Final stage of the bioproduction of CYTEA BIO's products

b. Targeting B cells with UCB-derived eNK

We applied the platform to the rituximab (anti-CD20) and the blinatumomab (anti-CD19) backbone (Fc-Engineered-Rituximab, Pin-CD20 and Fc-Enginereed-Blinatumomab, Pin-CD19) (Coënon et al. 2024).

Significant and specific in vitro and ex vivo cytotoxicity against CD20- and CD19-positive cells (cancer cell lines and primary cancer cells from patients) have been demonstrated with both MXNK-101 (UCB-derived eNK cells armed with Pin-CD20) and MXNK-102 (UCB-derived eNK cells armed with Pin-CD19) (Figure 5). This data showed the added value of arming eNK cells, as compared to the natural cytotoxicity of unarmed eNK cells, and confirmed the potential of MXNK-101 and MXNK-102 on hematological B cells tumors.

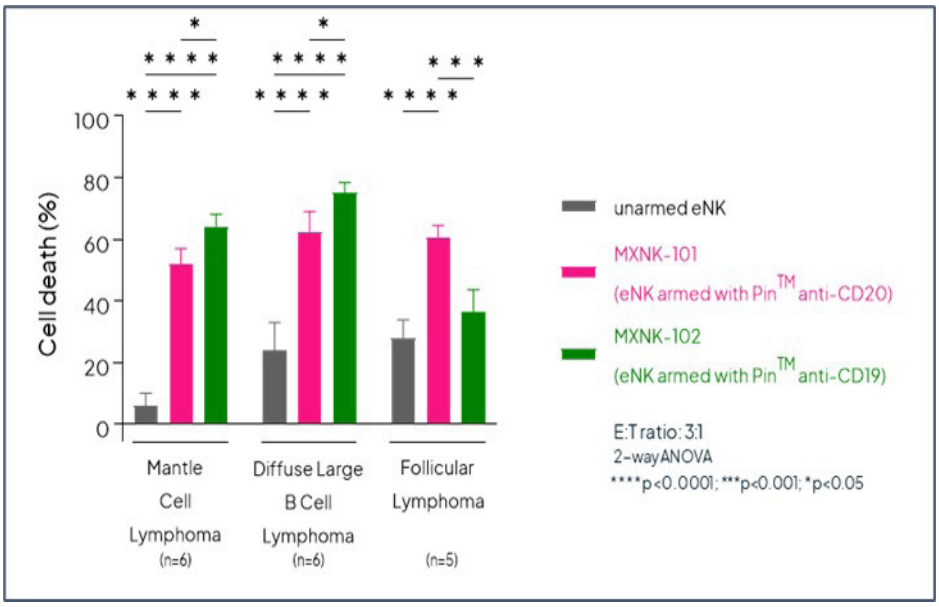

Figure 5: ex vivo killing of primary CD20 & CD19 B tumor cells.
*eNK cells were armed with Fc-Engineered mAbs (Pin-CD20 or Pin-CD19) or incubated with PBS to prepare MXNK-101, MXNK-102 and unarmed eNK and incubated with B-lymphoma primary cells from mantle lymphoma patients (n=6), DLBCL patients (n=6), follicular lymphoma patients (n=5) at ratio E:T 3:1 for 16h. Flow cytometry was used to determine the frequency of target cells death (2-4 eNK donors were tested). Bars represent mean ± SEM. Two-way ANOVA with Tukey's test and mean ± s.e.m. are shown. * = p ≤ 0.05; *** = p ≤ 0.001; **** = p ≤ 0.0001.*

The specific targeting of B cells with MXNK-101 as a new approach against auto-immune diseases was also validated ex vivo on healthy blood cells (Figure 6A) and in vivo (Figure 6B). in vitro cytotoxicity assay on human PBMC from healthy donors showed that only CD20+ B cells but no other immune cell population were killed by MXNK-101, whereas unarmed eNK had no cytotoxic effect (Figure 6A). These in vitro observations were confirmed in animal using humanized mice. 7 days after a single eNK or MXNK-101 intravenous injection, close to 50% of B cells were depleted by MXNK-101 compared to unarmed eNK while no effect was observed on the T cell population (Figure 6B). This data showed the added value of arming eNK cells, as compared to the natural cytotoxicity of unarmed eNK cells, and confirmed their potential as B cells depletion therapies not only in B-cell lymphoproliferative disorders but also in autoimmune diseases.

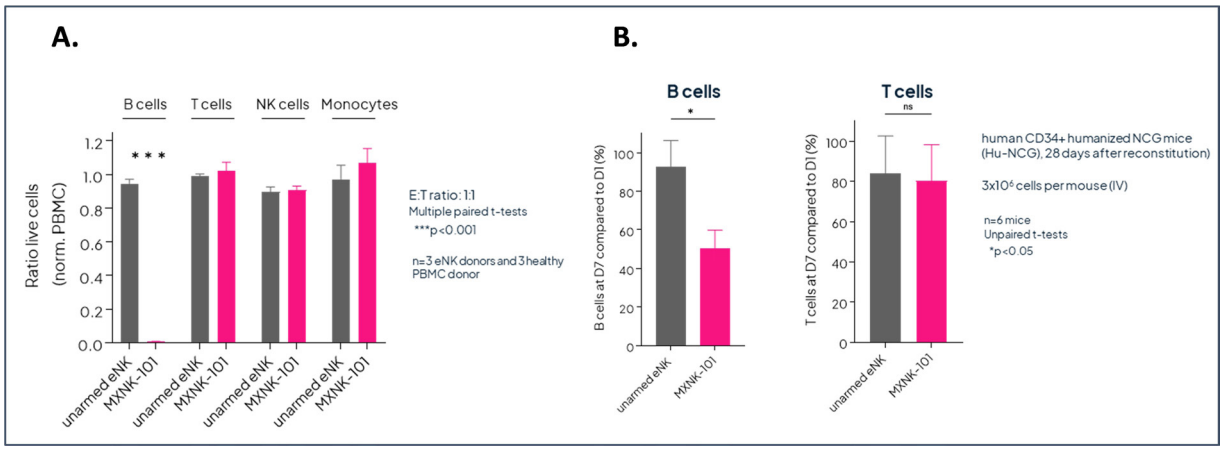

Figure 6: ex vivo (A) and in vivo (B) killing of primary CD20 B cells. A. eNK cells were armed with Fc-Engineered mAbs Pin-CD20 or incubated with PBS to prepare MXNK-101 and unarmed eNK and incubated with PBMC from healthy donors during 16h at E:T ratio 1:1. PBMCs populations were then assessed by flow cytometry. n= 6 samples (2 experiments: 1 eNK donor tested on 1 PBMC donor and 2 eNK donors tested on 2 PBMC donors). Multiple paired T tests and mean ± s.e.m. are shown. B. 3x106 eNK or MXNK-101 were injected intravenously (IV) into human CD34+ reconstituted humanized NCG mice (Hu-NCG, 28 days after reconstitution). Relative percentage difference of human peripheral blood CD20+ B cells (left) and human CD3+ T cells (right) number at D7 compared to D1 was assessed by flow cytometry. eNK, n= 6 mice; MXNK-101, n= 6 mice. Unpaired T tests and mean ± s.e.m. are shown.

C. OUTLOOK

With its modular nature, the Pin™ Platform can be adapted to:

- Other targeting ligand structures (recombinant protein with an Fc region, Fc-peptides, etc.)
- Other targets (tumor-specific and tumor-associated antigen, I&I targets, etc.)
- Multi-targeting (bi/multi-specific constructs, mix of antigen-targeting effector cells subpopulations, etc.)
- Other CD16-positive effector cells (□□ T cells, myeloid cells, CD16-engineered T cells, etc.)

To prove this platform's potential, internal data were generated using broad spectrum of effector cells and different targeting ligands (Table 1).

Effector cells	
NK cells	UCB-derived eNK cells
	PBMC-derived NK cells
T cells	CD16-expressing T cells
	γδ T cells
Myeloid cells	Monocytes
	Macrophages

Targets	
B cells depletion	CD20
	CD19
Solid tumors	EGFR
	HER2
I&I	undisclosed

Table 1: Type of effector cells and targets selected and tested to validate the Pin™ Platform versatility

Most of these data have not been published yet, with the exception of the in vitro characterization of UCB-derived eNK cells armed with Fc-engineered anti-EGFR (Courot et al. 2025).

D.Conclusion

We have optimized the expansion protocol to derive large numbers of highly functional NK cells from fresh umbilical cord blood units. We have shown that these eNK cells, when armed with Fc-engineered targeting mAb, may have the potential to become an important part of the repertoire of therapeutic interventions in many diseases, including hematological and solid tumors and auto-immune conditions. Thanks to the modular nature of the product concept, second-generation developments (multitargeting, target switching and/or effector cells change) to address unmet medical needs, tumor evasion and escape, autoimmunity, inflammation or infectious diseases, are straightforward to implement.

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We would like to express our gratitude to our academic partners (Martin Villalba, Christian Jorgensen, Guillaume Cartron (IRMB, Montpellier, France), Pierre Martineau, Bruno Robert (IRCM, Montpellier, France)). This research was funded by CYTEA BIO and MedXCell supported by the SATT AxLR technology transfer office, the BpiFrance and the G-Rex Grant program. We thank other partners that help us to accelerate our development: MabDesign, Eurobiomed, Paris Saclay Cancer Cluster, Montpellier Hospital, the University of Montpellier, Occitanie region, Montpellier Mediterranée Metropole and BIO (Biotherapy Innovation Occitanie).

ABOUT CYTEA BIO (Under liquidation proceedings)

CYTEA BIO is a preclinical-stage biotech dedicated to the development of innovative cell immunotherapies. Founded in 2020, CYTEA BIO leverages team's expertise from pharmaceutical industries, start-ups, and academic labs. Central to CYTEA BIO's approach is its proprietary Pin™ Platform, which introduces specific mutations in the Fc region of monoclonal antibodies (mAbs) to enhance their binding to CD16. This modification enables stable, long-term noncovalent anchoring of these Fc-engineered constructs onto CD16-expressing cells -allowing the ex vivo preparation of "armed", CAR-like, effector cells without genetic modification. The platform's modularity allows for the attachment of various ligand-binding regions to create a broad portfolio targeting multiple therapeutic indications, including oncohematology, solid tumors, and I&I diseases. Furthermore, with the modular nature of the product concept, second generation developments including multi-targeting and target switching will be straightforward to implement. Finally, this approach enables the development of CYTEA BIO's own product portfolio, but also to create partnerships, utilizing third party effector cells or ligands.

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DEVELOPMENT OF A MIXED LYMPHOCYTE REACTION ASSAY FOR EVALUATING THE ALLOGENICITY OF CELL THERAPY PRODUCTS

Florian Visée, Fabian Vandermeers, Pedro Alves and Arnaud Delobel.
Quality Assistance SA, Belgium

1. Introduction

Cell therapies constitute a promising category of treatments with the potential to address numerous incurable diseases through their distinctive and potent mechanisms of action. In contrast to autologous cell therapies, which utilize cells derived from the patient, allogeneic cell therapies present significant promise as off-the-shelf treatments. These therapies, encompassing induced pluripotent stem cells (iPSCs), mesenchymal stem cells (MSCs), and CAR-T cell therapy, can be produced from a single or limited number of donors, thereby making them accessible to multiple recipient patients. Nevertheless, the application of allogeneic products necessitates HLA-compatible donors and immune suppression, and it may be associated with considerable risks, such as graft-versus-host disease (Kawamoto and Masuda 2024). Consequently, both the FDA and EMA mandate specific tests to demonstrate the allo-compatibility of the treatment for all allogeneic products.

The Mixed Lymphocyte Reaction (MLR) is an in vitro assay employed to detect and quantify allogeneic responses through cell proliferation and cytokine production. This assay facilitates the identification and measurement of non-self-recognition between genetically distinct individuals. The allogeneic response is mediated by the recognition of the Major Histocompatibility Complex (MHC) peptide complex by T cell lymphocytes, as well as the interaction between antigen-presenting cells and T lymphocytes during in vitro co-culture.

Allogeneic reactions can be detected and quantified through various methodologies. Notably, cellular proliferation or cytokine release in culture supernatants has been frequently documented (Stempels, de Wit et al. 2022). This study introduces a non-radioactive flow cytometry technique for effectively evaluating lymphocyte proliferation following non-specific T cell stimulation and allogeneic recognition between randomly selected PBMCs from healthy donors. Additionally, as an orthogonal approach, cytokines secreted during co-culture were quantified using three distinct immunoassay platforms: ELISA, Luminex, and Gyrolab. As a proof-of-concept, we characterized the allogeneic recognition of a cell therapy product, utilized as a regenerative therapy, by co-culturing it with PBMCs from various healthy donors.

2. Method

To distinguish proliferation among PBMC donors, each donor's cells were alternately treated with Mitomycin C or stained with CellTrace Violet. Mitomycin C inhibits cell division in treated cells (stimulating cells), whereas CellTrace Violet (CTV) enables the detection of proliferating cells (responding cells). Additionally, the stimulating cells were stained with CellTrace Yellow (CTY) to allow gating out of this treated population from the CTV-stained cells, thereby improving the detection of proliferating cells.

2.1 CellTrace staining

CellTrace reagent (ThermoFisher) is a cell-permeant, non-fluorescent staining agent that enters cells through passive diffusion across the plasma membrane. Once inside the cell, the non-fluorescent molecule is converted into a fluorescent derivative by cellular esterases and remains in the cytoplasm by covalently binding to cellular amines. During cell division, the amount of CellTrace decreases proportionally with each subsequent division (Figure 1). CellTrace positivity can be monitored via multicolor flow cytometry and is compatible with the use of viability dyes and the detection of other lineage or phenotypic biomarkers.

Practically, after cell counting on ViCeLL XR (Beckman Coulter), $1x10^6$ PBMCs were stained with 2 µM CellTrace reagent. Incubation was performed in PBS for 20 min at room temperature in the dark. After cell staining, several washes were performed with a wash buffer containing FBS to remove excess CellTrace reagent.

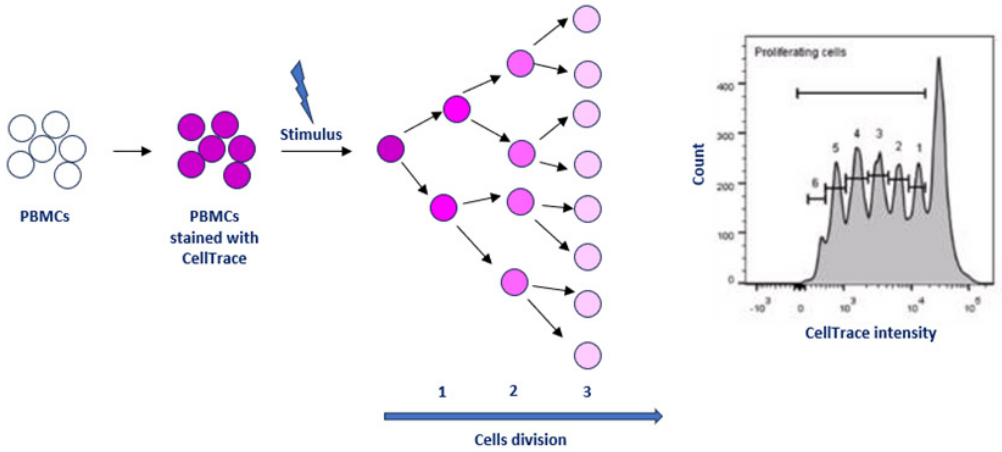

Figure 1: CellTrace principle.

2.2 Mitomycin C treatment

Several parameters were monitored to obtain optimal mitomycin C treatment: incubation time with cells, concentration of mitomycin C, and post-treatment cell viability. Moreover, cell washing conditions were assessed to ensure that any residual mitomycin C did not affect the proliferation of the responding cells. Treatment at 37°C with 10 µg/ml of mitomycin C for 2 h was determined to be optimal for blocking cell division and maintaining good viability. Two additional washes were performed after mitomycin treatment to remove residual mitomycin.

2.3 Mixed Lymphocyte Reaction with PBMCs donors

Based on assay optimization, 5×10^4 CTV-stained cells were co-cultured with 5×10^4 non-proliferating, treated cells (with mitomycin and CellTrace Yellow staining). The in vitro culture was conducted in 96-well U-bottom plates for 5 days at 37 ± 2°C in a humidified incubator with 5 ± 1% CO_2.

For each donor, various controls were implemented to ensure accurate interpretation of the allogeneic response: a negative control (culture medium only), an autologous control (PBMCs from the same donor), and a positive control where PBMCs were exposed to the non-specific inducer phytohemagglutinin (PHA) at a final concentration of 5 µg/mL.

After 5 days of culture, cell proliferation was assessed by flow cytometry using the following gating strategy: first, cell doublets were excluded using sequential gating on FSC-A vs. FSC-H, followed by SSC-A vs. SSC-H. Dead cells were excluded using Viakrome 808 staining (Beckman Coulter). Viable lymphocytes were gated using an anti-CD3-FITC antibody (Becton Dickinson). Proliferation was measured by analyzing CTV fluorescence after the exclusion of CTY-positive cells (Figure 2).

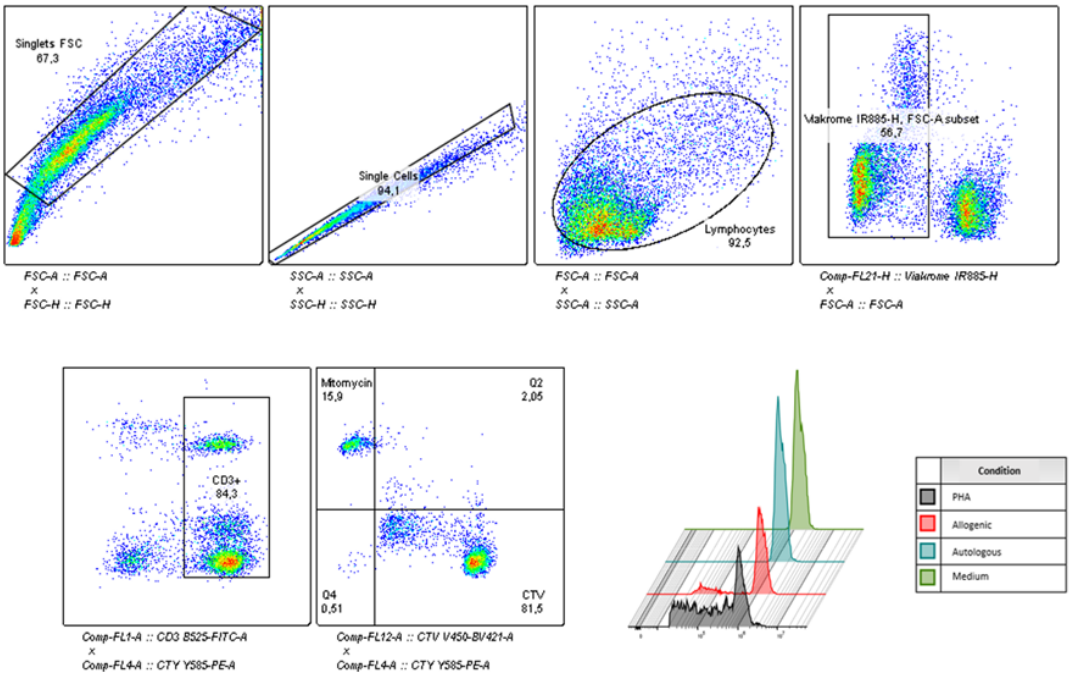

Figure 2: Gating strategy.

The negative control was used to establish gating parameters for distinguishing between proliferating and non-proliferating cells. A minimal proportion of cells proliferated in the presence of the culture medium, likely due to the presence of FBS in the medium (Figure 3). However, the contribution of basal proliferation to the overall allogeneic response is negligible.

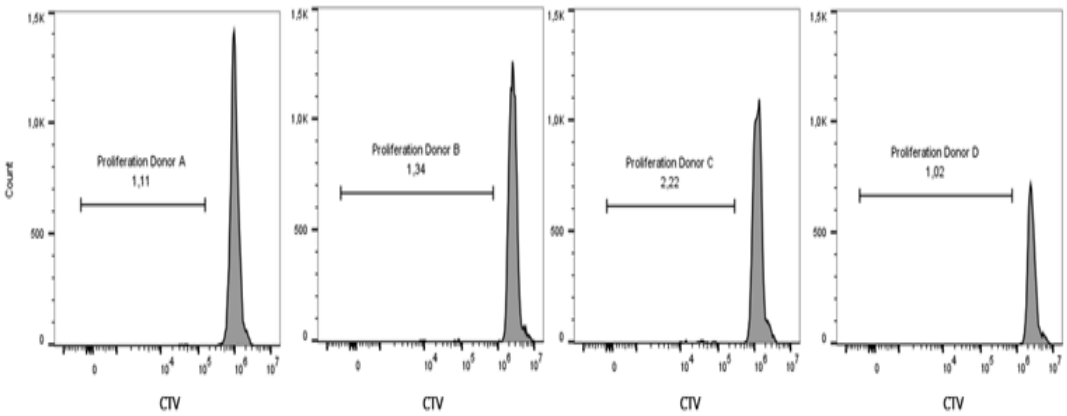

Figure 3: Gate positioning of the negative control.

For each donor, the proliferative response was normalized to the PHA-positive control condition. Accordingly, the proliferation index was calculated for the other test conditions as follows:

Proliferation Index=((%)Proliferation of cells in test condition)/((%)PHA Proliferation)

Allogeneic responses are defined as experimental results in which the observed proliferation index is significantly higher than that in the autologous test condition. If the proliferation index is similar to that of

the negative control and autologous conditions, we can conclude the absence of an allogeneic response.

2.4 Cytokine quantification

As orthogonal methods, the cytokines secreted during co-culture were quantified using three different immunoassays, including ELISA, Gyrolab, and Luminex platforms. In this study, we measured IL-6 and IFNγ concentrations in cell culture supernatants after 1, 2, 3, and 4 days of co-culture.

2.4.1. ELISA

Cytokine quantification was performed using two commercial kits from R&D Systems: Human IL-6 Quantikine and Human IFNγ Quantikine ELISA kits. These sandwich assays employed a monoclonal antibody pre-coated onto a microplate. After incubation with either the supernatant or the standards, an HRP-coupled monoclonal antibody was added. A substrate solution was then applied to induce color development proportional to the amount of IL-6 or IFNγ captured. After stopping the reaction, the absorbance was measured using a SpectraMax microplate reader (Molecular Devices). The concentrations of IL-6 or IFNγ in the supernatants were determined from their absorbance values using a calibration curve.

2.4.2. Gyrolab

The Gyrolab xPlore system (Gyros Protein Technologies) allows automated immunoassays at the nanoliter scale. Analyses were conducted within CD microcapillary structures containing an affinity column pre-filled with 15 nL of streptavidin-coated particles. Biotinylated anti-IL-6 or anti-IFNγ antibodies were captured on the column. After the addition of either the supernatant or the standards, an Alexa Fluor 647-labeled anti-IL-6 or anti-IFNγ antibody was added as the detection reagent. Finally, the measured fluorescence was proportional to the amount of cytokine present in each sample.

2.4.3. Luminex

The Luminex system utilizes a sandwich bead-based immunoassay that enables the simultaneous measurement of multiple analytes within the same solution. Each magnetic microbead is internally dyed with varying proportions of red and infrared fluorophores for identification and coated with a specific capture antibody. Detection is performed using a specific secondary antibody labeled with phycoerythrin (PE). The MAGPIX analyzer (R&D Systems) simultaneously distinguishes the different bead populations and quantifies the cytokines present in the sample. In this study, a duplex IL-6/IFNγ assay was used to quantify cytokine secretion in cell supernatants.

3. Results

3.1 Flow cytometry

In this study, we evaluated allogeneic recognition among PBMCs from four randomly selected healthy donors. Figure 4 presents examples of responses between each pair of donors (labeled A, B, C and D). As observed in the figure, no or few proliferations were detected in the culture medium and autologous controls. In contrast, positive PHA controls showed a high percentage of proliferating cells.

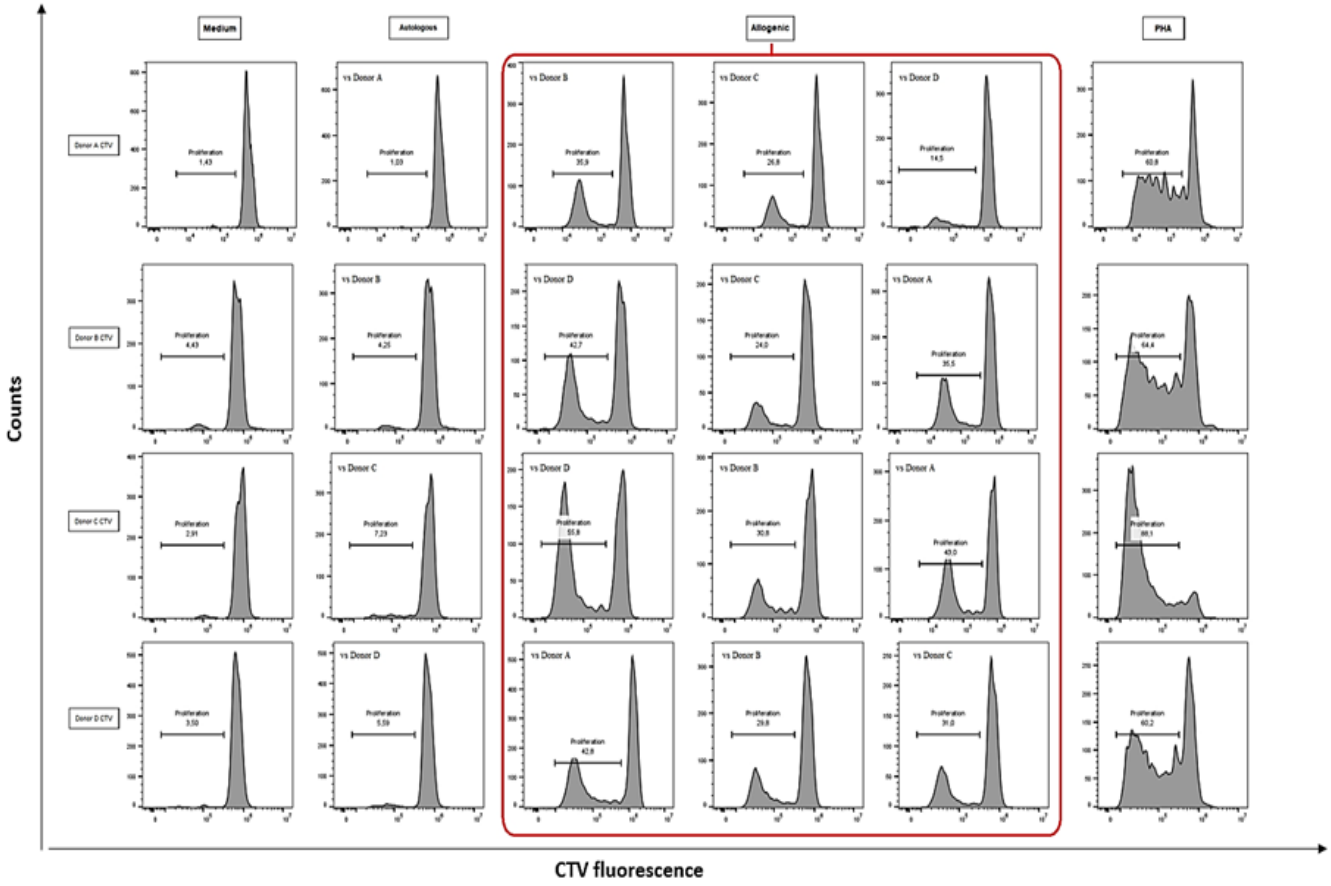

Figure 4: MLR assay performed on co-culture with four different donors.

Figure 5 summarizes the results obtained from a total of six independent analyses. Although varying levels of allogeneic response were observed between donors, all cross-donor conditions exhibited an allogeneic response with a significantly greater proliferation index than that of the autologous control condition. Each colored dot represents an independent run. The histograms represent the mean values of the six runs, and the error bars indicate the standard deviation.

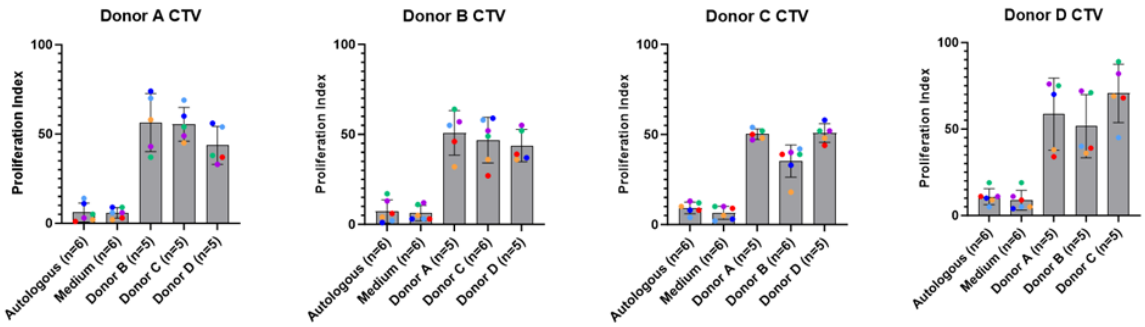

Figure 5 : Variability in MLR assay

In summary, our findings demonstrate that the MLR assay using CellTrace as a readout is sufficiently sensitive and specific to effectively discriminate between autologous and allogeneic reactions in donors.

3.2 Cytokine quantification

To determine the optimal time point for cytokine production, supernatants were collected at one, two, three, and four days of co-culture between two different donors. The supernatants were then analyzed using the three methods in parallel (ELISA, Gyrolab, and Luminex). The results for IL-6 and IFNγ quantitation are presented in Figure 6 and Figure 7, respectively.

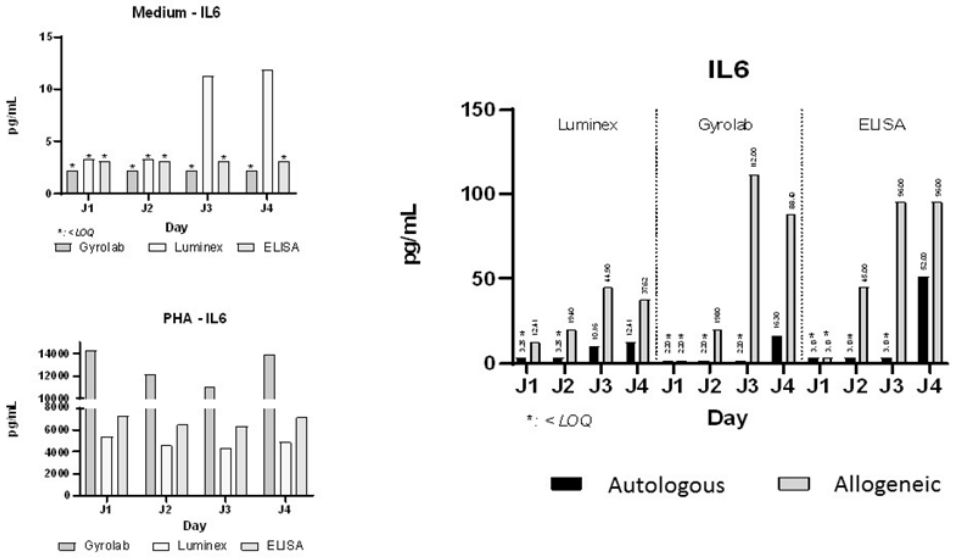

Figure 6: IL-6 quantification.

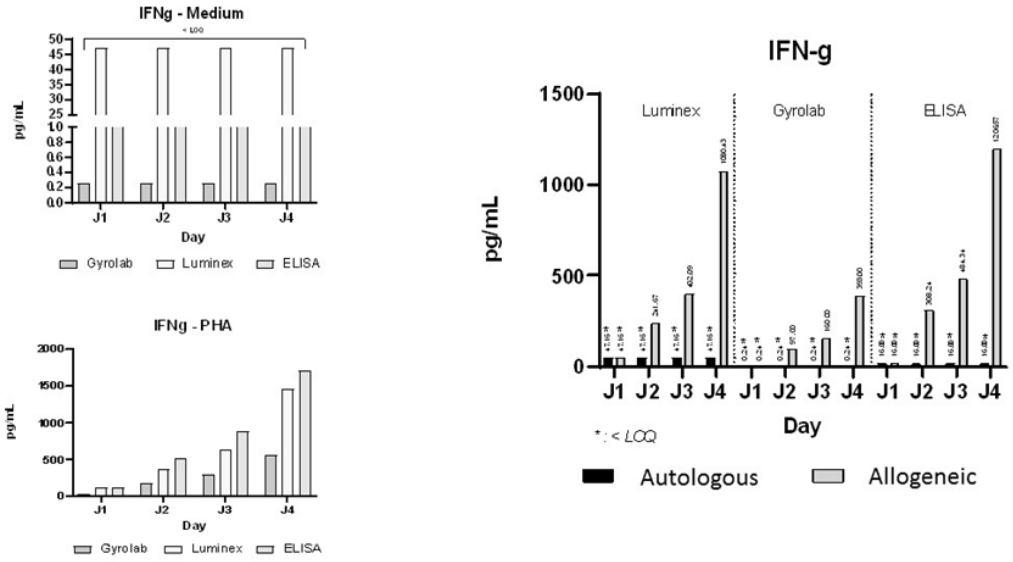

Figure 7: IFN-γ quantification.

We concluded that allogeneic reactions were detectable as early as two days of culture, with a significant increase in cytokine secretion. These observations were confirmed and became more pronounced on days three and four. Notably, IFNγ concentrations under allogeneic conditions were comparable to those measured in the PHA positive control. In contrast, IL-6 concentrations were higher under PHA stimulation than under allogeneic conditions. Differences in the absolute concentrations were observed between the platforms, suggesting variations in the method sensitivity.

3.3 Case study of a cell therapy product

In this case study, a cellular therapy product (CTP) currently under development for the treatment of osteoarthritis was used. This cellular product can produce anti-inflammatory cytokines to counteract IL-1β pro-inflammatory effect. As this therapy is an allogeneic treatment, allogenicity must be assessed to avoid immunogenicity, which could lead to severe side effects.

To this end, an MLR assay was performed using a co-culture of CTP and CTV-stained PBMCs from several unrelated, non-HLA-matched healthy donors. Given that CTP are adherent cells, the protocol required some adaptations. Indeed, during the first analyses, the assay was conducted in flat-bottom plates to allow for cell adhesion. However, the proliferation level was too weak in the positive controls (PHA and allogeneic reactions between different donors), indicating the need for close cell-to-cell contact to effectively assess allogeneic reactions in this model. After optimization, the allogeneic immunogenicity of CTP was assessed using V-bottom plates, including a low-speed centrifugation step to seed and concentrate the cells at the bottom of the well when mixing the cells. CTP was labeled with CTY to enhance the detection of proliferating cells.

Using this optimized methodology, CTP was co-cultured with each CTV-labeled donor PBMCs, alongside allogeneic, autologous, positive (PHA), and negative (culture medium) control conditions. Figure 8 presents the results for each condition across donors in duplicate. Three different CTP/PBMC ratios were tested: 1:1, 2:1, and 3:1. Despite testing three different ratios, the proliferation indices obtained with CTP were similar to those under autologous PBMC conditions and significantly lower than those observed under allogeneic conditions.

These results suggest the absence of an allogeneic reaction between the three donors and the CTP.

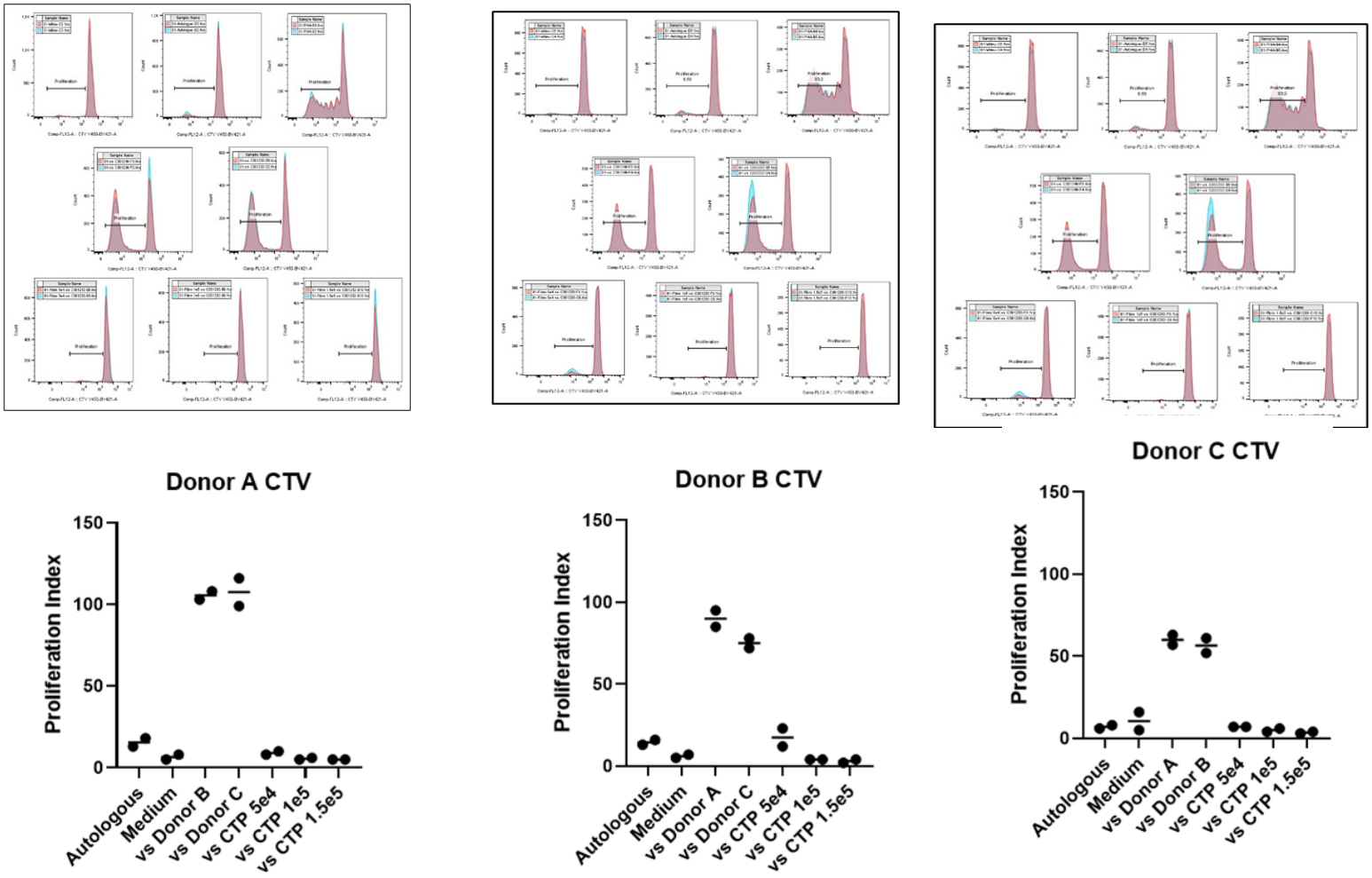

Figure 8: MLR assay using CTP.

4. Conclusion

The MLR assay offers essential insights into the immunological interactions between T cells from unrelated, non-HLA-matched donors, facilitating the detection of allogeneic responses. While the mechanisms and dynamics underlying allogeneic responses are still being explored, the assay has substantially enhanced our comprehension of the extent of allogeneic recognition in cells exposed to immune effector cells from immunocompetent donors. This evaluation is particularly pertinent for allogeneic cell-based therapies or in addressing inquiries related to the immunomodulatory potential of a drug, whether it activates or suppresses, the efficacy of T cell effector functions, or the assessment of external factors (e.g., medium supplements, cytokines, cell density, immunomodulatory factors or cells, growth factors) on T cell effector functions using allogeneic recognition as a metric. Notably, the MLR assay can yield critical information on immunological reactivity, which is vital for assessing the safety of allogeneic cell-based products.

The CellTrace reagent facilitates the labeling and differentiation of the initially stimulated cell population from the stimulating cells, further enabling the identification of cells that undergo division due to the periodic reduction in staining intensity. In our experiments, we applied a second CellTrace reagent to the stimulating cells, which were treated with Mitomycin C. This methodology effectively resolved the ambiguity in identifying the responding cells and allowed for the detection of additional cell divisions near the background fluorescence level. This dual CellTrace labeling strategy enhanced the robustness of detecting proliferating cells.

As an orthogonal approach, we quantified pro-inflammatory cytokines to detect cell proliferation induced by allogeneic recognition. Activation resulting from allogeneic recognition is linked to the secretion of numerous factors that precede cell division, potentially facilitating the earlier detection of allogeneic reactions. Our assessment of IFNγ revealed indications of allogeneic recognition between unrelated donors as early as day 2 post-incubation, potentially reducing the time to readout. We also evaluated IL-6; however, other inflammatory cytokines may exhibit earlier and more dynamic responses. This could be further investigated using cytokine screening on the Luminex platform, which accommodates small sample volumes.

In conclusion, as a proof of concept, we assessed the immunogenicity of a cell therapy product intended for the treatment of osteoarthrosis. To this end, three PBMC donors were evaluated in co-culture with the CTP and compared under autologous and allogeneic test conditions among PBMCs. Although significant proliferation or cytokine production was not observed, it is recommended to extend this study to a larger cohort of donors.

5. About Quality Assistance

Quality Assistance is a leading European contract research organization that provides the pharmaceutical industry with all the analytical services required by EMA and FDA regulations for the development and marketing of innovative human medicinal products.

Quality Assistance holds a unique position in the market, with all its laboratories on one site in Belgium, 270 highly qualified professionals, and over 40 years of expertise at the forefront of analytical sciences.

The company assists its clients from candidate selection through non-clinical and clinical studies to marketing authorization, using state-of-the-art, product-dedicated expertise in analytical sciences. Quality Assistance designs customized solutions, defines analytical protocols, develops and validates specific new analytical methods, and performs characterization, stability, pharmacokinetic, biomarker, and immunogenicity studies, as well as batch release testing, to evaluate the Quality, Safety and Efficacy of the given drugs.

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THE CELL AND GENE THERAPY UNIT AT NANTES UNIVERSITY HOSPITAL, A FRENCH ACADEMIC FACILITY AT THE FOREFRONT OF CELL ENGINEERING FOR THE PRODUCTION OF EXPERIMENTAL ADVANCED THERAPY MEDICINAL PRODUCTS (ATMPS)

Béatrice Clémenceau [1], Florence Vrignaud [1, 2]

1 Unité de Thérapie Cellulaire et Génique (cell and gene therapy unit), CHU de Nantes

2 CIC1413 (Clinical investigation centre), Nantes

The Cell and Gene Therapy Unit (UTCG) was created in 1994 at the Nantes University Hospital Center in France to perform *ex vivo* cell manipulations. Since then, the UTCG is still leading the way in cell engineering while adapting to new quality and regulatory requirements. This is what makes this hospital unit a facility dedicated to the bioproduction of Advanced Therapy Medicinal Products (ATMPs) in early-stage clinical trials.

Whether in the framework of academic or industrial partnerships, the UTCG's mission is to adapt and transfer innovative production processes developed by research units or start-ups to a level of production compatible with clinical use. The UTCG is authorized by the French National Agency for Medicines and Health Products Safety (ANSM) to ensure the clinical production of experimental ATMPs or of hospital-exemption and to manage their quality control. Its activity is governed by an ISO 9001 quality management system that guarantees the quality and safety of the products manufactured, as well as the complete traceability of operations. UTCG is equipped with a 330m² controlled atmosphere area with 3 independant grade B suite comprising each 2 culture rooms that can support production processes in class A + B environment in compliance with Good Manufacturing Practices (GMP). One of the 3 grade B suite is specifically dedicated to the production of *ex vivo* gene therapy products, as class 2 genetically modified organisms (GMOs) can be handled there.

In order to provide innovative products for clinical care in fields such as oncology, autoimmunity, and regenerative medicine, the UTCG has in-depth expertise in cellular engineering processes that include one or more of the following steps:

- Cell selection: cell sorting by immunomagnetic methods or flow cytometry,
- Cell amplification on a small scale in culture plates and flasks, medium scale in culture bags or multi-layer flask, or large scale in bioreactors,
- Genetic transformation by transduction using viral vector,
- Freezing and or thawing cells.

These different techniques form the basis of cell engineering and can be applied to a variety of cell types in numerous clinical applications such as :

Cell Types	clinical applications	References/ Clinical trial
T Lymphocytes		
Tumor-infiltrating lymphocytes (TILs)	Stage III and/or metastatic melanoma	Dréno B et al., 2002 ; Khammari A et al., 2014 NCT00200577, Khammari et al., *Cancer Immunol Immunother.* 2020 NCT04217473, Monberg TJ et al., *Cell Rep Med.* 2025
Anti-EBV CTL - Allogeneic - Autologous	-EBV-associated lymphoma - Auto-immune diseases : SLE and MS	NCT01823718 , Gallot G, et al. J Immunotherapy. 2014 NCT02677688, NCT02912897
Suicide Gene-transduced Anti-HLA-DPB1*0401 CD4+ T Cell Clone	HLA-DPB1*04:01 Positive Tumor Recipients Receiving an Allotransplant From a HLA-DPB1*04:01 Negative Donor	NCT04180059 Vivien R, et al. Cytotherapy. 2018
Anti-CD19 CAR-T cells	Pedriatric ALL-B	NCT 01195480 ; Rossig C, et al. Leukemia. 2017
CD8+ regulatory T lymphocytes	Kidney transplantation	NCT06777719 Bézie S, et al. Front Immunol. 2018
Dendritic cells (DC)		
Leukemic apoptotic corpse-pulsed DC	Elderly AML patients	NCT01146262 Chevallier P, et al. *Hum Vaccin Immunother.* 2021
Autologous DC loaded with specific peptides of AFP	Hepatocellular carcinoma	NCT01128803
Regulatory DC	Kidney transplantation	NCT02252055 Sawitzki B et al, *Lancet.* 2020
Others		
Fetal fibroblasts and keratinocytes	Immunosuppressive properties for allogeneic cell-based wound therapy	NCT 03334656 Zuliani T et al., *PLoS One.* 2013
Stromal vascular fraction (SVF) derived from adipose tissue	Tissue regeneration in particular for the treatment of refractory perianal fistula in Crohn's disease	Pilot batches in progress Serrero M. et al., *Gastroenterology.* 2019
Mesenchymal Stem Cells	Chronic Ischemic Cardiomyopathy	NCT02462330 Guijarro D, et al. *Int J Cardiol.* 2016

EBV: Epstein-Barr virus, CTL : cytotoxic T lymphocyte, SLE: systemic lupus erythematosus, MS: multiple sclerosis, ALL : acute lymphoblastic leukemia, AML : acute myeloid leukemia

Among these different applications, two examples of ATMPs manufactured by UTCG are detailed in the following paragraphs.

Tumor-infiltrating lymphocytes (TILs)

Adoptive cell therapy (ACT) of tumor infiltrating lymphocytes has shown promise for treatment of refractory melanoma and other solid malignancies. The UTCG began manufacturing TILs more than 20 years ago and has produced TILs for five clinical trials.

One of these trial was a phase I/II clinical trial about ACT of TILs as adjuvant therapy for stage III melanoma for which the 88 TIL expansions (two expansions for each of the 44 patients) were all performed by UTCG. The results published in 2002 (Dréno B et al., 2002), showing a correlation between the injection of TILs and prolonged relapse-free survival in the subgroup of patients with only one invaded lymph node at the time of inclusion, were maintained after 17 years of patient follow-up (Khammari A et al., 2014). However, these results were not confirmed in a phase III clinical study published in 2020 (ClinicalTrials.gov identifier: NCT00200577, Khammari et al., 2020), temporarily halting the possibility of applying for a hospital exemption to produce TILs. The most recently published clinical trial concerns the production of TILs for the French center in a clinical trial evaluating TILs in combination with an oncolytic adenovirus producing interleukin-2 (IL-2) and tumor necrosis factor (TNF) upon replication (TUNINTIL, ClinicalTrials.gov identifier: NCT04217473, Monberg TJ et al., 2025).

TIL therapy faces many challenges in clinical use, including patient selection, cell preparation, expansion, and treatment standardization, all of which require greater precision. At the meantime, it is crucial to ramp up clinical research efforts by increasing sample sizes and encompassing a broader range of tumor types. This approach will play a key role in accurately evaluating the efficacy and safety of TIL therapy (Betof Warner A et al., 2024; Hu J et al., 2025).

Chimeric antigen receptor T lymphocytes (CAR-T cells)

CAR-T cells revolutionized the treatment of relapse/refractory hematological malignancies (acute lymphoblastic leukemia, non-Hodgkin's B-cell lymphoma, and multiple myeloma) in 2018.

In 2012, UTCG was one of the first CAR-T bioproduction units in Europe for clinical use, carrying out production as part of the CD19-CAR Immunotherapy for Childhood Acute Lymphoblastic Leukemia (CD19TPALL) clinical trial, sponsored by University College, London (ClinicalTrials.gov identifier: NCT01195480). For this trial, UTCG produced 12 anti-CD19 CAR CTLs between 2012 and 2015 by transducing donor Epstein Barr virus-specific T-cells (EBV CTL) with a first-generation anti-CD19 CAR. In Europe, this was the first multi-center study of CAR T-cell therapy and demonstrated the feasibility of delivering this novel therapeutic approach with central manufacture and administration across multiple centers (Rossig C et al., 2017).

Since then, other generations of CARs have been developed around the world, leading to the commercialization of CAR-T cells by various companies. While CAR construction has evolved, the principle of viral transduction and culture of modified cells has remained the same, allowing UTCG to maintain its position as a CAR-T cell production center. The place of an academic production unit is subject to positioning, not only at the UTCG level (Le Guen C et al., 2024) but also at the level of the French consortium for research on cell and gene therapies called UNITC, certified by the French National Cancer Institute (INCa)and created in 2024. The academic players in the French ecosystem of cell and gene therapies in oncology have thus identified the conditions and minimum requirements necessary for the release of autologous fresh CAR T-cell products under hospital exemption (Boyer O et al., 2025).

Adaptation of a manufacturing process for human use

Adaptation of a manufacturing process for clinical use is the final step in the development of a process. It includes transfer of the process from a research unit to a biomanufacturing unit such as UTCG. It includes:

- Verification that the selected raw materials and reagents are compatible with clinical use (Good Manufacturing Practice (GMP) grade),

- Scale-up compared with initial small-scale production,

- Risk analysis of the various stages of the process developed, in order to position the appropriate quality controls.

In addition to adapting and transferring the process, a quality control strategy is thus being developed. This strategy will have to take into account various factors such as the origin of raw materials, applicable regulatory texts, the phase of clinical development (early or not) and the process steps. This strategy may lead to the validation of an analytical method specific to the ATMP being developed, for potency assays for example.

The development of the production process and control strategy is traced at every stage, and concludes with the performance of validation tests to guarantee the robustness of the process developed. All data obtained will be included in the clinical trial authorization application file.

Less complex processes, without substantial modification of the cells and intended to be used for the same essential function in the recipient as in the donor, allow the manufacturing of products under the regulatory status of cell therapy products rather than ATMPs.

The authorization procedure for routine use is simpler in this case. Thus, with 6 other centers in France, the UTCG realizes positive immunoselection of CD34+ hematopoietic progenitors (Lefèvre K et al, 2024). This cell therapy product is used to improve hematopoietic reconstitution in allogeneic hematopoietic cell transplant patients while limiting the risk of graft-versus-host disease (GvHD).

Finally, expertise in cell engineering allows academic cell therapy units such as UTCG to be able to produce and supply cell reagents that are used in the manufacturing process of cellular products developed by other structures. Indeed, UTCG can supply :

- HLA-typed B-EBV lines (EBV-LCL) that can be used for the selection of anti-EBV T lymphocytes or NK cells,

- Research-grade or clinical-grade cell banks (specific T lymphocytes, HEK-293…)

- EBV infectivity testing on permissive cells.

Integration into the French Health Innovation 2030 plan

The French Health Innovation 2030 plan aims to accelerate French innovation in the field of health by supporting promising research projects. The acceleration strategy “biotherapies and bioproduction of innovative therapies” that is part of this plan should enable France to become a leader in biotherapies and bioproduction of innovative therapies. One of the main objectives of this strategy is to produce 10 biomedicines in France for the treatment of cancer and chronic diseases and to position France as a leader in biotherapies and the bioproduction of innovative therapies (https://www.economie.gouv.fr/france-2030). In this context, academic bioproduction units are one of the major players in the bioproduction sector, acting as a crucial link in bringing innovations in cell or gene therapy from research laboratories to first-in-human administration.

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ACCELERATING THE TRANSFER OF BIOPROCESSES: THE MISSION OF THE PIBT /EFS INTEGRATOR

Clémentine Gamonet 1, Anne TAILHADES 2, Célia Mercier 2, Sophie Derenne 2

1 : Etablissement Français du Sang, PIBT integrator, Besançon, France
2 : Etablissement Français du Sang, La Plaine Saint Denis, Saint-Denis, France.

Integrators in Biotherapy & Bioproduction and their missions

The EFS Integrator called PIBT (for Pole of Innovation in BioTherapy) is part of the 8 public entities certified by the French government as "Integrator Biotherapy & Bioproduction".

This program is intended to speed up project transfer toward industrial steps to give patients access to innovative therapies. With the help of specific resources, expertises and specialized infrastructures, these integrators secure key stages in the development of biotherapies and bio-processes

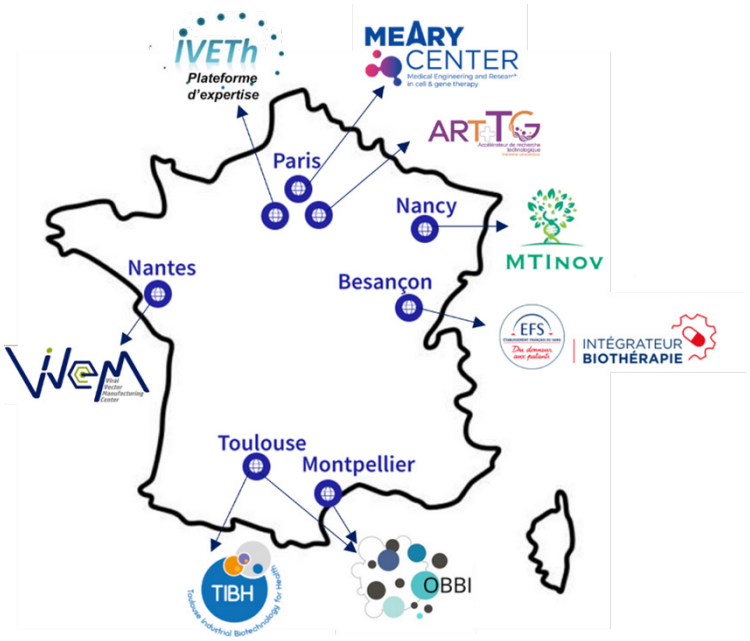


Figure 1: 8 Integrators in Biotherapy & Bioproduction in France

Integrators in Biotherapy Bioproduction and their missions

Located in Besançon, France, the PIBT is specialized in biotherapies development, as well as in innovation technology evaluation and implementation in bioproduction processes. This integrator benefits from a local ecosystem that is particularly conducive to the emergence of innovative technologies, with its wealth of experts in microtechnology, healthcare and innovation. It can also rely on a strong dynamic of local stakholders, fully committed at structuring and strengthening bioproduction sector by bringing together all the forces involved (companies, research teams, universities, healthcare centers, competitiveness clusters and many others). During the development of a new biotherapy, several major steps separate proof-of-concept from pharmaceutical-grade production required for administration in humans. These steps aim to demonstrate the process robustness, reliability, safety and also its regulatory compliance. They also contribute to generate data that will be essential to the subsequent production and regulatory stages.

An early partnership with the PIBT maximizes the chances of success in this key phase: the skills and expertise of the EFS team will enable us to support Each project holder during its development, in order to deliver a GMP-compatible process at optimized costs. In order to consider administering an innovative therapy to humans, a therapy developer must demonstrate not only that its product is likely to have a favourable benefit/risk balance for the patient, but also that the manufacturing process is robust, reproducible, reliable and scalable. It must also ensure the project's financial viability as early as possible.

PIBT, a partner to accelerate the maturation phase of innovative biotherapies

Before the operational start of the development phase with tests and experiments dedicated to the optimization phase, PIBT offers project sponsors to perform a "gap analysis" to assess the project's degree of maturity. This stage involves identifying the critical quality attributes of the final product and the analysis of key stages of manufacturing. An understanding of the drug's expected mechanism of action is also essential to define project the quality control plan to be implemented.

This analysis must take into account the clinical strategy: the indication, the type of clinical trial, the starting raw materials), the doses and administration methods, the prospective investigator centers (etc.) are all parameters to be taken into consideration when defining the manufacturing methods.

The PIBT’s multi-disciplinary skills enable us to draw up a complete analysis of the project, taking into account scientific, financial and regulatory considerations. The analysis as a whole will help identify the gaps that need to be filled to achieve the project owner's objective, and define the development plan that will enable these gaps to be filled.

Based on the gap analysis, the development plan can be drawn up, jointly by the PIBT and the sponsor's team. This will define the various phases to be carried out: the development or comparison of manufacturing processes, the identification and testing of new raw materials in line with pharmaceutical requirements, scale-up, confirmation of the chosen process and the associated quality control plan are just some examples.

The challenge of this structuring is to identify the milestones to be reached as exhaustively as possible, the necessary timetables and the associated budgets: this helps project leaders to define and adopt the best financial strategy (search for public grants, fund-raising, start-up creation or not...). The further development progresses, the higher the cost of a batch and the greater the impact of the changes to be integrated. It is essential to anticipate the objective of each batch produced, in order to generate a maximum of data and take the most advantage of it.

Once this analysis has been carried out and the development plan defined, the process development can begin.

One of the critical points in this phase is the choice of manufacturing process. In order to offer the most appropriate strategy for the project, PIBT is committed to learning about and testing the latest technologies available on the market, as well as innovations under development.

To achieve this, the PIBT works in close collaboration with suppliers of device and system currently on the market or under development, to carry out tests on these equipments: evaluation of performance, ergonomics of use, development potential, compatibility with regulations among others. This enables us to optimize our knowledge of existing systems, and to guide project developers towards the proper technology. This applies not only on process and quality control tools, but also on reagents and consumables.

The PIBT also works in close collaboration with technological innovators, so as to integrate as soon as possible technological breakthroughs that bring cost savings, greater efficiency or safety. Based on the gap analysis, the development plan can be drawn up, jointly by the PIBT and the sponsor's team Development batches will then be produced in a dedicated laboratory, equipped to manufacture cellular products from research grade to "GMP-like" grade. Theses batches can be prepared with GMP-grade reagents,

According to each project requirements, the PIBT team, made up of engineers and technicians with expertise in process development, process automation, immunology, cellular engineering and analytical methods, will carry out all the tests needed to develop a manufacturing process that meets regulatory expectations.

- The first step will be to compare or evaluate different production methods: reagent tests, bioreactor comparisons, critical stage modifications, choice of formulation method, etc. At this stage, the specific analytical methods of the project will also be developed, to ensure the robustness of the results generated during development.

- Once a process has been selected, the feasibility of the "scaled-up" process will be verified, while confirming GMP compatibility. For this, the PIBT will draw on the skills of the production teams at the EFS pharmaceutical establishment, one of which is located in Besançon. This proximity enables early alignment of regulatory prerequisites, and supervision by regulatory experts of the choices made throughout the project.

At the end of this phase, the sponsor disposes of a GMP-compliant manufacturing process for its drug, including a robust quality control plan. The sponsor will have cell batches representative of the final product as well as characterization data to enhance its knowledge of the product and process.

This will enable the sponsor to transfer its project to a pharmaceutical establishment, which will validate the process with a view to applying for production authorization to conduct a clinical trial.

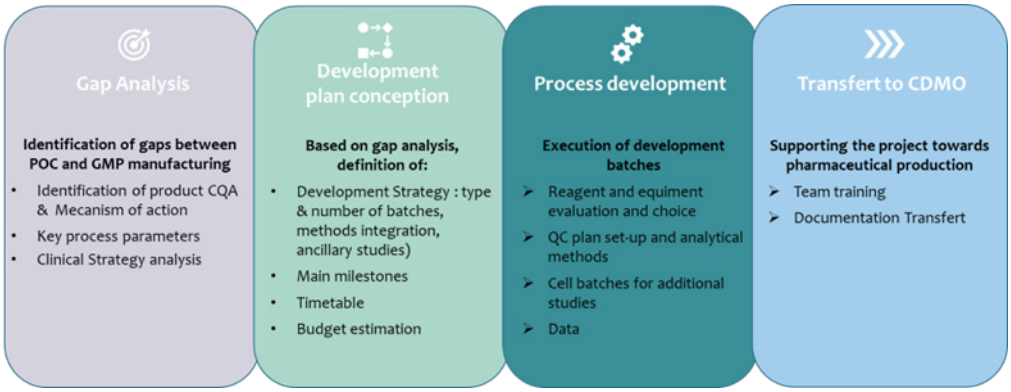


Figure 2 : Overview of the main development phases leading to pharmaceutical production

Facilitate transfer to CDMOs

As PIBT is part of EFS bioproduction activity, therefore a transfer to the EFS's pharmaceutical establishment (authorized to produce advanced therapy medicinal products) will be facilitated by the proximity, knowledge of the teams and complementary of the equipments and methods used. The EFS pharmaceutical establishment comprises 4 production platforms located in Besançon, Créteil, Nantes and St-Ismier. EFS is a long-standing partner of hospitals, making it easier to recruit investigators for single- or multi-centers clinical trials. However, regardless of the establishment to which the PIBT will transfer the manufacturing process, the traceability set-up from the start of development and the anticipation of risks encountered during process or method validation will ensure a transfer at the best conditions. Collaboration with the other integrators of the Biotherapy Bioproduction Integrators (IBB) network is also a relevant support: the complementary skills and knowledge of the other structures will enable us to quickly refer to or call on another integrator to provide a necessary skill. PIBT's expertise enables us to anticipate and master many challenges on new biotherapy development, ensuring robust, reproducible transfer in line with pharmaceutical quality requirements. The agility of our partnerships enables PIBT to support academic and industrial projects, in collaboration or as a service provider, according to the specific needs of each project.

By taking into account the technical, scientific, financial and regulatory issues involved, PIBT is able to accelerate and de-risk project sponsors in their development of new biotherapies. This helps them keep costs down and control the project schedule. This up-to-date and multi-disciplinary team gives project sponsors early access to innovative technologies, so that they can adapt the process to the biotherapy proposed, and rationalize costs wherever possible.All this helps to reassure investors and funders by demonstrating large-scale feasibility as early as possible, and by adopting robust, reliable, adapted and optimized processes.

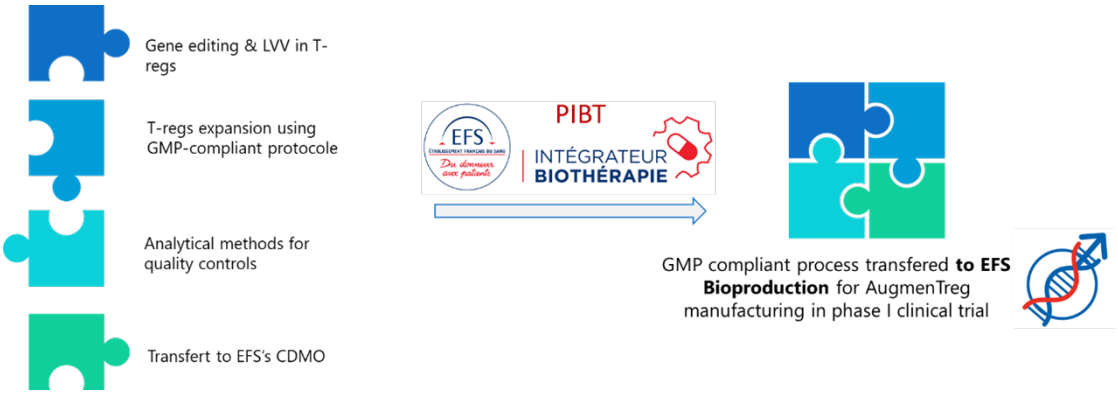
Focus: PIBT and RHU Program « AugmenTreg »

The "AugmenTreg" Project is a collaborative project funded by the ANR RHU Program (university-hospital research) and led by AP-HP, Inserm- Muséum National d'Histoire Naturelle, the University of Lyon Equipe-MeLiS, Asfalia Biologics, Ariana, Sorbonne University and EFS. The aim of this ambitious project is to develop an innovative therapy based on regulatory T lymphocytes, the safety and efficacy of which will be enhanced by genetic modification. This cell therapy will be aimed at patients receiving organ transplants, in order to prevent graft rejection while reducing the use of immunosuppressive drugs. Three types of genetic modification will be implemented: the inactivation of inflammatory genes by CRISPR-Cas9, the overexpression of genes enabling the proper functioning of Tregs, and the insertion of a suicide cassette to destroy the injected cells in the event of an unforeseen adverse event. The final objective of the project is to evaluate the safety of this new cell therapy product in a Phase I clinical trial in patients undergoing liver transplantation.

The missions of the PIBT within this consortium fully illustrate the role of our teams:

- Transpose technology bricks from a research stage (gene editing, LVV for gain of function, innovative suicide gene) to a GMP-compliant grade.
- Integrate these bricks into a GMP-grade sorting & culture process previously developed by another integrator (MEARY Center, AP-HP): knowledge of GMP, choice of technologies, use of appropriate equipment.
- Test the full-scale process to confirm the process and supply consortium with pre-GMP cell batches.
- Develop analytical methods for optimized QC.
- Transfer to the EFS Pharmaceutical Establishment, which will validate the process, perform analytical methods and production.

To achieve these steps, PIBT will use its expertise in cell therapy and genetic modification, its knowledge in GMP processes and equipment to define the most optimized process possible. The project will also benefit from the proximity of the EFS GMP production team to transfer knowledge and train production teams as effectively as possible.



UPCOMING MABDESIGN EVENTS

Join us at our next scientific and networking events in 2025-2026

Immunotherapies & Innovations for Infectious Diseases

9th Edition– 13 & 14 November 2025 - Lyon, France

TRACKS

Alternatives to current Antibiotics · Immunotherapies & new biotherapeutics · Latest developments in Vaccines · Diagnostic Prognostic and theragnostic Biomarkers

KEY FIGURES OF 2024 EDITION

280+ Attendees

29 High-profile speakers

20 Sponsors & Exhibitors

250+ B2B meetings

ICGT Innovations for Cell and Gene Therapies

27-28 May 2026, Sanofi Campus Gentilly, France

TRACKS

Pioneering Research and Applications in iPS cells · Target Optimization of Viral and Non-Viral Vectors · Exploring the Future of CARs & TILs · CRISPR: Innovations, Challenges, and Applications

KEY FIGURES OF 2025 EDITION

180+ Attendees

20 High-profile speakers

17 Sponsors & Exhibitors

100+ B2B meetings

14TH AIS 2026 Antibody Industrial Symposium

MAbImprove

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JUNE 30-JULY 1, 2026
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TRACKS

Antibody Engineering – Clinical Antibody Therapies – Updates on clinical trials of novel antibody therapies (oncology, infection, neurology) – Antibody Delivery Approaches – New 3D Cancer Models for Antibody Therapeutic Screening – Next-Generation Antibody Conjugates – Antibody Therapy and Biomarkers – Antibodies in Women's Health

KEY FIGURES OF 2025 EDITION

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60 High-profile speakers

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by mabdesign THE BIOTHERAPY EXPERT & build tomorrow

TRACKS

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600+ B2B meetings

5 Workshops

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BIO-HUB

MABDESIGN'S RESOURCE CENTER

Launched in 2024, MabDesign's Bio-hub houses a collection of pillar articles, insights from our in-house analysts, experts & KOL interviews and monthly biopharmaceutical pipeline analysis together with a dedicated section for our famous Immunowatch and BioprocessWatch editions. Check out our extensive content in the field of biopharmaceuticals and bioprocessing here: **https://mabdesign.fr/en/bio-hub-mabdesign/**

Next on Watch

- **2025 : Immunowatch Non-Viral Vectors, Immunowatch Infectious Diseases, BioprocessWatch USP & DSP of cell-based therapies**

- **2026 : To be announced in December**

We are currently looking for scientific contributions and sponsors for these various editions. Reach out to Gavin Vuddamalay, our Head of Scientific Affairs **gavin.vuddamalay@mabdesign.fr**, to learn about the available opportunities and deadlines.

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Disclaimer: *While MabDesign cannot guarantee that this Immunowatch edition is error-free due to the non-exhaustiveness of our various databases and sources, we will do our best to correct any omission or errors brought to our attention. Every amended version will be archived on our website.*

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@Mabdesign_fr
MabDesign

Bât. L'Initial
17 , rue Crépet
69007 Lyon
Tél. 04 78 02 39 88
contact@mabdesign.fr
www.mabdesign.fr