UNDERSTANDING THE WEBINARS: A NON-TECHNICAL SUMMARY

This summary presents a **simplified overview of the webinar's scientific content,** making complex concepts easier to understand and apply.

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WEBINAR 1

"UNLOCKING LIFE'S CODE: INTRODUCTION TO GENE THERAPY" BY DR. SELAMI DEMIRCI

He is a Staff Scientist at the NHLBI, NIH, specializing in gene therapy for sickle cell disease. His work uses CRISPR, base, and prime editing, with key studies in rhesus macaques and mouse models.

He has over 50 publications and patents, advancing curative therapies for genetic blood disorders through innovative gene delivery and stem cell research.

Gene therapy is one of the most exciting advances in modern medicine. Instead of just managing the symptoms of disease, gene therapy works by targeting the root cause — our genes. By correcting or modifying the instructions inside our cells, gene therapy offers the potential for long-lasting or even permanent cures.

At its core, gene therapy can take several forms:

- Gene addition, where a healthy copy of a gene is introduced to make up for one that isn't working properly.
- Gene editing, using tools like CRISPR or base editors, which can precisely change specific letters in our DNA code to fix harmful mutations.
- Gene silencing, where genes that are overactive or causing damage are turned down or off.

Most current treatments involve collecting a patient's own stem cells from the blood or bone marrow, making the genetic changes in a laboratory, and then returning the corrected cells to the patient. These modified cells can then repopulate the body and carry out their new, healthier instructions.

Gene therapy has already shown success in treating several serious diseases, especially rare genetic disorders that were previously considered untreatable. What's more, the technology is rapidly advancing. Scientists are now developing in vivo approaches, where gene therapy components are delivered directly into the body — potentially through a simple injection — without needing to handle cells outside the body at all. This opens the door for simpler, more accessible treatments that don't require hospitalization or specialized labs.

These breakthroughs raise important questions about access and cost, especially as treatments can currently be very expensive. However, with ongoing research and innovation, gene therapy is expected to become more scalable and affordable, offering hope to millions of people around the world.

In just a few decades, gene therapy has grown from a scientific idea to a medical reality. It holds the potential not only to treat disease, but to truly transform the way we think about healthcare — shifting from lifelong symptom management to one-time, curative interventions.

WEBINAR 2

OUR GENES, OUR HEALTH: THE BASICS OF GENETICS", BY PROF. JENNIFER ADAIR

She pioneers global access to gene and cell therapies, translating groundbreaking treatments for cancer, anemia, HIV, and immunodeficiencies, while developing innovative, low-cost technologies to expand equitable therapeutic access worldwide.

The basis for all life is DNA, the instructions for each living thing in our universe. What makes us human is our specific DNA blueprint. Since the first human blueprint (called a genome) was sequenced in 2001, we have been learning more about how our instructions (genes) function, and also how changes to the blueprint can cause disease in ourselves and the children who we pass our genes onto. The study of our blueprint is called genetics. Our genes can tell us a lot, but our environment and our behavior can also contribute to our health. Our genes are not always our destiny, but they can provide us with knowledge about risks of disease for ourselves and our children. Learning about our genes is called genetic testing.

New tools to understand how genes contribute to disease (functional genomics), how to integrate information about our genes, our environment and our behavior to better predict and diagnose disease (polygenic risk assessment), and how to fix broken genes or rewrite the blueprint for health (gene therapy) are all being studied right now.

There are ethical and moral discussions about who owns genetic information, what it will be used for, how to protect it from discrimination, and also how to consider the psychological and social impacts of genetic information on families. There is also a need to consider a lack of diversity in the genetic information being used to shape medicine today, and how it will impact human health globally.

As of the early 2000's, 86% of all genetic data in the world comes from Europeans, and only 1.1% came from Africans, yet Africans are the oldest population of humans on the planet. There is a strong need to increase genetic diversity to better understand human health globally and to ensure that genetics closes gaps in health disparities instead of widening them.

The ultimate goal would be globally equitable access to personalized medicine, where a person's genetics, environment and specific disease condition were all used to provide a robust treatment plan to achieve health.

WEBINAR 3

INSIDE THE LAB: HOW GENE THERAPY WORKS" BY PROF. RIMAS ORENTAS

Gene therapy begins with the selection of the vector, which determines how the therapeutic nucleic acid will be delivered into the target cell. Lentiviral vectors are a well-established technology for gene therapy, commonly used to modify T lymphocytes or hematopoietic stem cells.

They form the basis of CAR-T cell therapies and gene addition approaches for sickle cell disease (e.g correcting the beta globin gene). Lentiviral vectors can be engineered with different surface proteins (envelope protein, ENV) which influence the types of cells targeted for transduction.
The field is rapidly evolving towards direct in vivo delivery using viral and non-viral approaches. Lipid nanoparticles (LNPs) are one such non-viral platform, capable of delivering gene-editing tools such as CRISPR/Cas9 and base editors.

While regulation is essential for safety, excessive regulation can increase costs. Policy decisions and the design of vector and cell manufacturing facilities should remain patient-centered, keeping the ultimate goal—accessible and effective therapies—in mind. These advances in technology are already benefiting patients, providing new, life-changing treatment options.

He is an Associate Professor at the Faculty of Pharmacy, University of Coimbra. He coordinates CNC-UC, CIBB, and the new GeneT – Gene Therapy Center of Excellence. Active in gene therapy since 1998, he has led over 40 projects. He serves on scientific and strategic boards, with research focused on brain diseases like Machado-Joseph disease.

WEBINAR 4

THE FUTURE IS NOW: INNOVATIONS IN GENE THERAPY" BY DR. KEVIN DOXZEN

Gene therapy is evolving from a futuristic concept into a transformative reality for medicine. The latest advances are helping to overcome technical hurdles that have challenged the field, while new approaches are pushing gene therapy beyond rare genetic disorders and opening possibilities for treating widespread conditions.

This talk, "The Future is Now: Innovations in Gene Therapy," will introduce the ground-breaking tools and strategies shaping the field. We will begin with next-generation editing technologies, such as base editing and prime editing, which allow scientists to correct single DNA letters with remarkable precision, potentially offering safer and more accurate therapies. Beyond DNA, researchers are developing methods for epigenetic and RNA-level editing, which can fine-tune how genes are switched on or off—without making permanent changes to the genome.

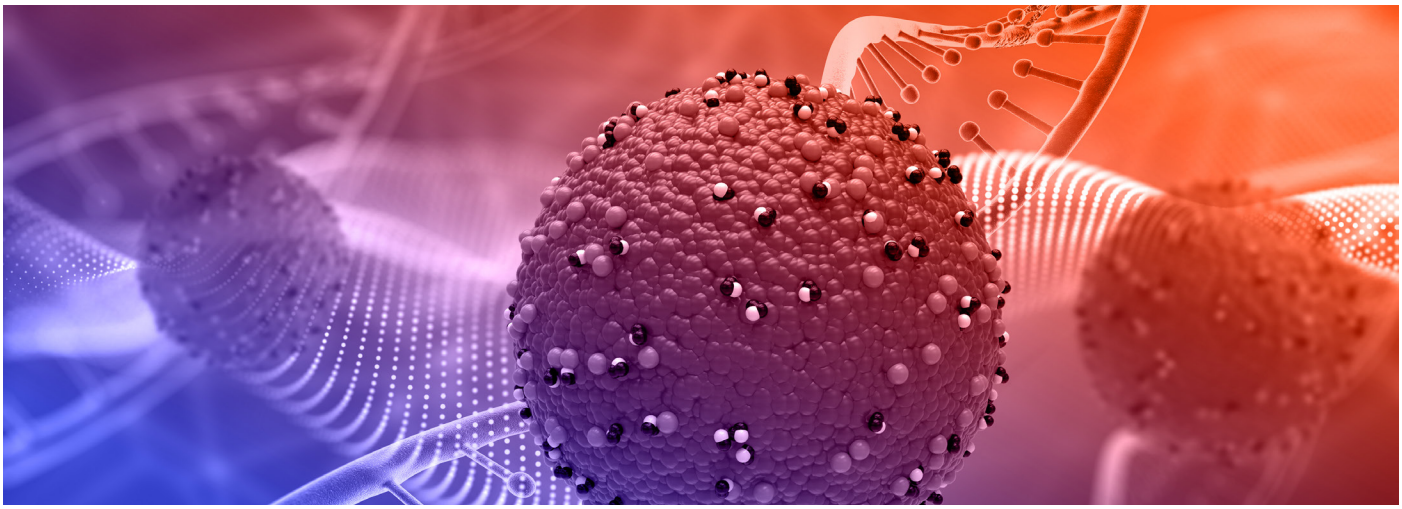
He is a biophysicist with a PhD from UC Berkeley under Jennifer Doudna, supports ARPA-H in designing transformative, equitable health innovation programs. Formerly an André Hoffmann Fellow, he advances global gene therapy and biotechnology impact.

Scientists are exploring the emerging frontier of retrotransposons, naturally occurring "copy-and-paste" elements that researchers are re-engineering to insert much larger pieces of DNA than current tools allow. This could make it possible to replace entire genes or restore missing genetic information in ways previously thought impossible. We will also explore how artificial intelligence is accelerating progress—designing experiments, predicting safety outcomes, and improving delivery systems. Speaking of delivery, one of the greatest challenges in gene therapy is getting therapies to the right cells. Cutting-edge approaches such as non-viral delivery systems, lipid nanoparticles, and organ-targeted carriers are enabling safer, more precise treatments than traditional viral methods.

Finally, we will look at how these advances are moving gene therapy into more common diseases, from heart disease and high cholesterol to neurodegenerative conditions. Together, these innovations demonstrate that gene therapy is no longer just about rare disorders—it is evolving into a powerful set of tools that may soon transform how we approach me medicine as a whole.

WEBINAR 5

HOPE FOR RARE DISEASES: SPOTLIGHT ON CASE STUDIES" (PROF. LUIS ALMEIDA)



Gene Therapy brought the most extraordinary successes of the last years, with an increasing number of gene therapy products on the European and USA markets. Gene therapy is a therapeutic technique that uses genetic material to treat or prevent diseases. It involves a new class of medicines that work by inserting recombinant genetic material into the organism.

Viral and non-viral vectors can be used to deliver this genetic material. Viral vectors use the machinery of viruses to enter cells, are more efficient and have a longer expression, but have size limitations for incorporating genetic material, carry a higher risk of triggering an immune response in the body, and are more difficult to produce in large quantities. Non-viral vectors use physical and chemical methods that involve encapsulating or binding therapeutic genetic material to synthetic particles or delivering it directly through physical methods. The main advantages are lower toxicity, lower production costs, and easier scalability.

However, they are less efficient at delivering therapeutic material and do not have a long-lasting effect on the body. This therapeutic material can be delivered directly by injection into the patient's target organisms (in vivo), or it can be delivered to cells outside the body, which are then expanded and injected into the body (ex vivo).

He is an Associate Professor at the University of Coimbra, leads the GeneT–Gene Therapy Center of Excellence. With over 40 projects, his research advances gene therapy for rare brain diseases like Machado-Joseph.

With advances in science, it is now possible to use viral vectors to produce animal models of diseases, such as neurodegenerative diseases. This makes it possible to mimic a human disease in an animal model, such as mice, increasing knowledge about a particular disease without putting humans at risk.

Gene therapies entered the pharmaceutical market in 2012, and since then more and more drugs have been developed in this area, saving millions of lives, sometimes with a simple injection. Even some of the most common vaccines for Covid-19 use this gene therapy technology.

With all this success and the great potential of these therapies, a center of excellence in gene therapy (GeneT) is being created in Portugal, with partnerships with academia, biotechnology companies, and hospitals. This center aims to establish a Gene Therapy research & innovation hub, advancing gene therapy research and development excellence, creating a bridge between the laboratories to the market and a bridge from the bench to the bedside.

WEBINAR 6

ETHICS, ACCESS & EQUITY: THE BIGGER CONVERSATION BY DR KARINE DUBE

Ethics and Regulation Are Distinct but Complementary

Regulations set minimum legal standards, while ethics asks what should be done to ensure respect, fairness, and accountability, especially in diverse global contexts such as Uganda.

Ethics Shapes Innovation Responsibly

Applying an ethical lens early in cell and gene therapy development ensures that scientific advances are grounded in social responsibility, community values, and local realities.

Improving Preclinical Predictability

Better modeling, transparency, and data sharing in animal studies can strengthen translational reliability and reduce unnecessary risks when moving toward human trials.

Translational Research Requires Ethical Foresight

Moving from lab to clinic raises complex questions about informed consent, equity, and long-term follow-up. Embedding ethics throughout this process promotes trust and sustainability.

Risk–Benefit Balance Must Reflect Local Contexts

Assessing potential risks and benefits is not only a scientific exercise: it requires understanding community perspectives and healthcare systems.

Ethical Research Is Contextual and Inclusive

In resource-limited settings, ethical research depends on meaningful informed consent, fair participant selection, appropriate benefit-sharing, and strong local partnerships.

She is an Associate Professor at UCSD's School of Medicine, specializing in infectious diseases, ethics, and HIV-related socio-behavioral research. She has over 20 years' experience integrating biomedical research, ethics, and patient engagement across Sub-Saharan Africa.

Addressing Therapeutic Misconception

Clear communication about the distinction between research and treatment helps participants make informed decisions and supports genuine partnership in research.

Equity and Global Access are Central Ethical Imperatives

Justice, equity, diversity, inclusion, and accessibility go beyond slogans: they demand fair access to emerging therapies, investment in local capacity, and shared global responsibility.

Community Engagement Builds Trust and Relevance

Sustained, two-way engagement with communities ensures that research is culturally grounded, ethically responsive, and more likely to yield equitable outcomes.

Preparing Participants Ethically

Supporting participants through education, counseling, and long-term follow-up is essential to uphold dignity, autonomy, and trust in cell and gene therapy research.

Global Collaboration Can Model Ethical Leadership

Initiatives like the Global Gene Therapy Initiative (GGTI) show how international partnerships can advance scientific innovation while promoting African scientific leadership and ethical integrity.

WEBINAR 7

IN THEIR OWN WORDS: TWO AFRICANS CURED OF SICKLE CELL BY GENE THERAPY. BY ALLAN BYAMUKAMA AND JIMI OLEGHERE

1. Burden of Sickle Cell Disease (SCD)
The patients highlighted the profound physical, emotional, and logistical challenges of living with SCD:

- **Mental and Emotional Toll:** Both experienced significant psychological strains, including feelings of hopelessness and depression (Jimmy), and constant "fear of the unknown" regarding the next crisis (Alan).

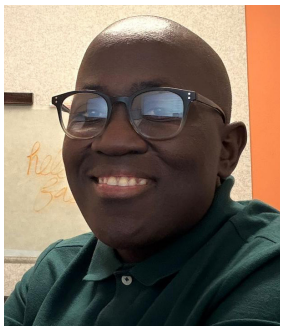
- **Severe Complications:** They endured life-threatening complications, such as acute chest syndrome, pulmonary embolisms, and vascular necrosis (requiring Alan to have a total hip replacement).

- **Healthcare Strain:** Alan reported being hospitalized an alarming 48 times in the year prior to his therapy, illustrating a severely diminished quality of life.

2. Gene Therapy Treatment and Outcome
Both patients successfully underwent gene therapy, describing the process and its life-changing results:

- **Therapy Type and Status:** Jimmy, 5 years post-treatment, received CRISPR-based gene therapy and has a "functional cure". This therapy works by increasing the expression of fetal haemoglobin (HbF). Alan is 4 months post-therapy and is also doing well.

- **Rigorous Process:** The most difficult parts were the intensive procedures, including:
- **Stem Cell Collection:** Multiple 8-hour sessions required for stem cell harvest.
- **Chemotherapy:** The chemotherapy conditioning caused severe side effects, notably debilitating mouth sores.
- **Result Verification:** Alan verified the therapy's success through normalized blood work, with his haemoglobin rising from a baseline of 8 or 9 to 13. Crucially, he has had zero sickle cell crises since the treatment.



ALLAN BYAMUKAMA

JIMI OLAGHERE

- **Psychological Adjustment:** Both emphasized that recovery requires a psychological adjustment, describing the feeling of having to be "reborn all over again" to build a normal life after living decades with chronic illness.

3. Logistics, Cost, and Future Access
Discussions on the practicalities of the cure revealed significant barriers to global access:

- **Cost:** The current cost of the gene therapy is approximately $2.1 million.

- **Access Limitations:** The therapy is currently accessible primarily in the US, UK, and Europe.

- **Hope for Africa:** There is optimism for future accessibility in Africa through innovations like in vivo (in-body) therapies and localized manufacturing to reduce costs and logistical hurdles.

- **Long-Term Monitoring:** Patients are enrolled in long-term follow-up studies (up to 15 years) to monitor potential delayed side effects, including the risk of secondary cancers and infertility.

THANK YOU!

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