The History of CRISPR-Cas9

1. CRISPR-Cas9 originated in ancient bacteria.
2. In 1987, Japanese scientists noticed a strange group of nucleotides in segments of bacterial DNA.
3. About ten years later, researchers at a Danisco yogurt factory noticed bacteria that had these nucleotides lived longer than those that did not.
4. Several years later Dr. Francisco Mojica, a biostatistician, discovered that the DNA pieces belonged to viruses.
5. Dr. Jennifer Doudna and Dr. Emmanuelle Charpentier, from University of California Berkley, engineered it to edit the human genome.

Applications in Cancer

The Goal of treatment
A key objective in the war against cancer is enabling the human body to defend itself without using powerful drugs or invasive procedures. CRISPR-Cas9 provides a way to better equip the body for this fight using the patient’s own immune cells, specifically T cells, to attack malignant tumors. Currently, there are two major players in this type of CRISPR-Cas9: Dr. Carl June and Dr. Michael Sadelain. June is a professor of pathology and laboratory medicine and the director of translational research and in the University of Pennsylvania’s Abramson Cancer Center and Perelman School of Medicine. Additionally, Sadelain is the director of the Center for Cell Engineering at the Memorial Sloan Kettering Cancer Center.

All cancerous cells, regardless of type, have in common unique proteins on their surface, known as antigens, which characterize them as foreign and malignant. When T cells recognize these proteins, they mobilize for attack against the cancer cells. However, the cancerous cells can detect and deactivate T cells permanently because of an antigen specific to immune cells, thus inhibiting attacks by those cells.

Dr. June
• Plans to use CRISPR-Cas9 to edit three T cell proteins.
• The first edit will enable the T cell to produce a protein that allows them to better recognize cancer cells.
• The second suppression expression of a protein that would interfere with the previous edit.
• The third will remove the antigen on the T cell’s surface that would otherwise allow the cancer to identify and incapacitate it.

Dr. Sadelain
• Plans to use CRISPR-Cas9 to insert one sequence of DNA that will serve multiple purposes.
• Advancing toward clinical trials for cancer treatment.
• Targeting melanoma (skin cancer), myeloma (cancer of the bone marrow), and sarcoma (cancer of the connective tissue).
• The edit will make the T cell produce a chimeric antigen receptor (CAR) on its surface.
• CAR will improve the T cell’s ability to identify precancerous cells.
• It will shield the T cell from being detected by cancerous cells and extend the life of the T cell.

Preclinical and Clinical Trials
• The engineered portion which is responsible for the majority of CRISPR-Cas9 functionality.
• It is composed of six regions with distinctly different functions.
• Together they work in concert to locate and cleave a targeted strand of DNA.

In the past fifteen years, CRISPR-Cas9 funding dramatically increased and, consequently, many new applications emerged.

Success Rate and Simplest Utilization
CRISPR-Cas9 is the most successful tool used in clinical trials for cancer treatment. It is composed of six regions with distinctly different functions. Together, they work in concert to locate and cleave a targeted strand of DNA. It is composed of six regions with distinctly different functions. Together, they work in concert to locate and cleave a targeted strand of DNA.

Cancer
• The three common treatments are chemotherapy, radiation therapy, and they come with a variety of side effects.
• 20% of people with health insurance cannot afford the treatment necessary to save their lives.
• Average cost for an additional year of life for localized and metastatic cancer is $483,142 and $1,190,332 respectively.

Sustainability
• June and Sadelain are using CRISPR-Cas9 to edit T cells so they can effectively target cancer cells.
• This technique will lower the cost of treatment for patients and manufacturers and save millions of lives.

In the past fifteen years, CRISPR-Cas9 funding dramatically increased and, consequently, many new applications emerged.

Success Rate and Simplest Utilization
CRISPR-Cas9 is the most successful tool used in clinical trials for cancer treatment. It is composed of six regions with distinctly different functions. Together, they work in concert to locate and cleave a targeted strand of DNA. It is composed of six regions with distinctly different functions. Together, they work in concert to locate and cleave a targeted strand of DNA.

Cancer
• The three common treatments are chemotherapy, radiation therapy, and they come with a variety of side effects.
• 20% of people with health insurance cannot afford the treatment necessary to save their lives.
• Average cost for an additional year of life for localized and metastatic cancer is $483,142 and $1,190,332 respectively.

Sustainability
• June and Sadelain are using CRISPR-Cas9 to edit T cells so they can effectively target cancer cells.
• This technique will lower the cost of treatment for patients and manufacturers and save millions of lives.

Zika, Dengue, and Lyme Disease
• Zika often results in children being born with an underdeveloped head and brain. The estimated cost of lifetime care for these children is $1 million to $10 million.
• Dengue is responsible for over 1200 child deaths yearly.
• Researchers at the University of Massachusetts used CRISPR-Cas9 to identify proteins Zika and Dengue need to survive, and now a vaccine can be developed.

Old Gene Editing Techniques
• Transcription activator-like effector nucleases (TALEN) for human use cost $5,000.
• Zinc Finger Nuclease (ZFN) for human use begin at $1,125 and can be as expensive as $5,000.

The price of enough CRISPR-Cas9 to edit the genome of mice, where Lyme disease originated, and halt its transmission.

Both breakthroughs are going the increase the affordability of treatment and/or exhibit life-saving potential.

The price of enough CRISPR-Cas9 to edit the genome of an entire organism is only $500 on average.

CRISPR-Cas9 also boasts the highest success rate and simplest utilization.

Vaccination
• Vaccination against Zika, Dengue, and Lyme Disease currently affects 40% of Nantucket residents. Total treatment costs about $1 billion annually. Post treatment Zika and Dengue need to survive, and now a vaccine can be developed.

A team at the University of Massachusetts Medical School, lead by Dr. Abraham Brass, used CRISPR-Cas9 to identify the proteins that Zika and Dengue need to replicate while in the host. Because of this discovery, an affordable vaccine for these two prolific viruses can be developed.

Dr. Esvelt plans to focus on using CRISPR-Cas9 to edit the genome of mice, where Lyme disease originated, and halt its transmission.

Both breakthroughs are going the increase the affordability of treatment and/or exhibit life-saving potential.

The price of enough CRISPR-Cas9 to edit the genome of an entire organism is only $500 on average.

CRISPR-Cas9 also boasts the highest success rate and simplest utilization.

The price of enough CRISPR-Cas9 to edit the genome of mice, where Lyme disease originated, and halt its transmission.

Both breakthroughs are going the increase the affordability of treatment and/or exhibit life-saving potential.