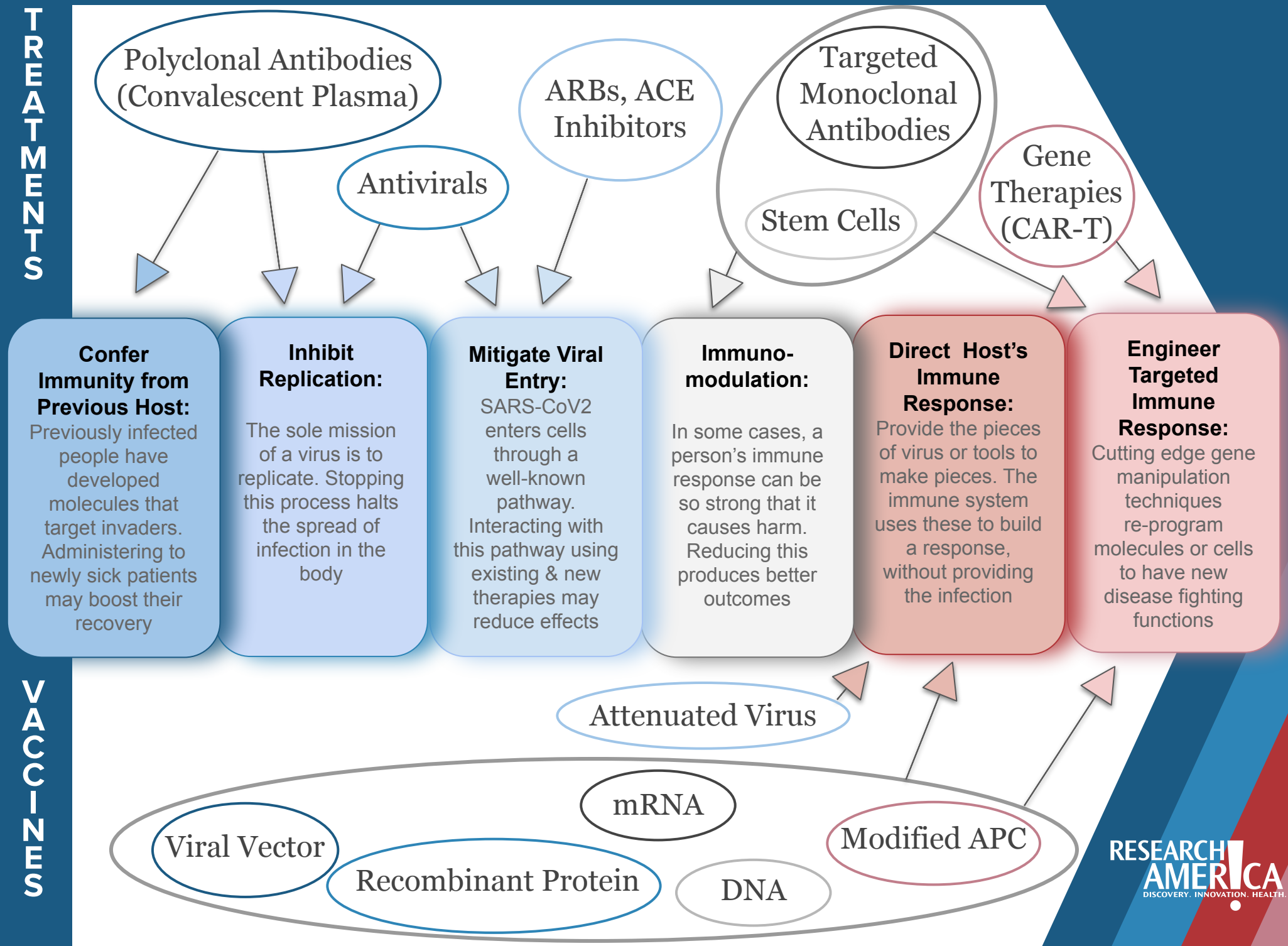
COVID-19 R&D, By The Science: *What is the Objective?*



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COVID-19 R&D, By The Science: *Treatments*

Polyclonal Antibodies

Recovered patients have antibodies in their blood that recognize SARS-CoV2 and signal the immune system to attack it. Injecting these antibodies into sick patients may boost their immune system to better fight the virus.

Targeted Monoclonal Antibodies

Lab-engineered, humanized molecules that directly target SARS-CoV2 proteins (mainly the spike protein) and can initiate an immune response cascade when injected into a patient.

Antivirals

Molecular compounds designed to stop the function of proteins and enzymes necessary for the virus to replicate. The virus cannot spread when it cannot make more copies. These drugs can be intravenous or oral.

Stem Cells

Cells that have been carefully re-programmed to behave in a specific way. They can be directed to stop the immune system from overreacting, or to focus on other targets.They can be administered to patients via injection.

ARBs, ACE Inhibitors

Angiotensin receptor blockers and angiotensin converting enzyme inhibitors, respectively. These oral drugs are widely prescribed to alleviate hypertension, but also affect SARS-CoV2's mechanism of cell entry via the ACE2 receptor. Manipulating this signaling pathway, known as the Renin Angiotensin Aldosterone System (RAAS) may help alleviate acute effects of COVID-19

Gene Therapies

Engineered DNA can be delivered to immune cells, which read the DNA and modify themselves to be able to now recognize and attack SARS-CoV2. These cells are drawn from the patient, engineered, and then transfused back to the patient with new disease fighting properties.

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COVID-19 R&D, By The Science: *Vaccines*

Viral Vector

Viruses are better at infecting cells than many available technologies. An efficient way to deliver information to cells is by hijacking a harmless virus, putting specific pieces of SARS-CoV2 into it, and letting it infect cells as it normally would, providing pieces to the immune system that generate a response.

mRNA

Segments of RNA that code for a piece of SARS-CoV2. They can be engineered or extracted. After injection, the patient uses its own cells to create the viral pieces that the mRNA provide a template for. Then, the patient generates a targeted immune response against those self-manufactured pieces.

Recombinant Protein

Composed of specific elements of SARS-CoV2 that have been engineered in a lab. These antigens can be injected into a patient without the pieces that cause coronavirus disease (COVID-19), stimulating an immune response that builds immunity without infection.

DNA

Also segments that code for a piece of the virus, but made of DNA rather than mRNA. The aim is the same: provide the patient with instructions to make a viral piece, then let their immune system initiate a targeted response against it. DNA alternatives differ slightly in delivery method and scalability when compared to mRNA.

Attenuated Virus

A truncated form of the virus, with reduced infection-causing abilities, is injected into a patient to stimulate an immune response that generates future protection but does not produce robust symptoms. A traditional approach for vaccine development.

Modified APC

Uses similar technology to gene therapies. Engineered DNA tells an antigen presenting cell (APC) how to make pieces that recognize SARS-CoV2. From there, the APC stimulates an immune response that recruits cells to eliminate virus.

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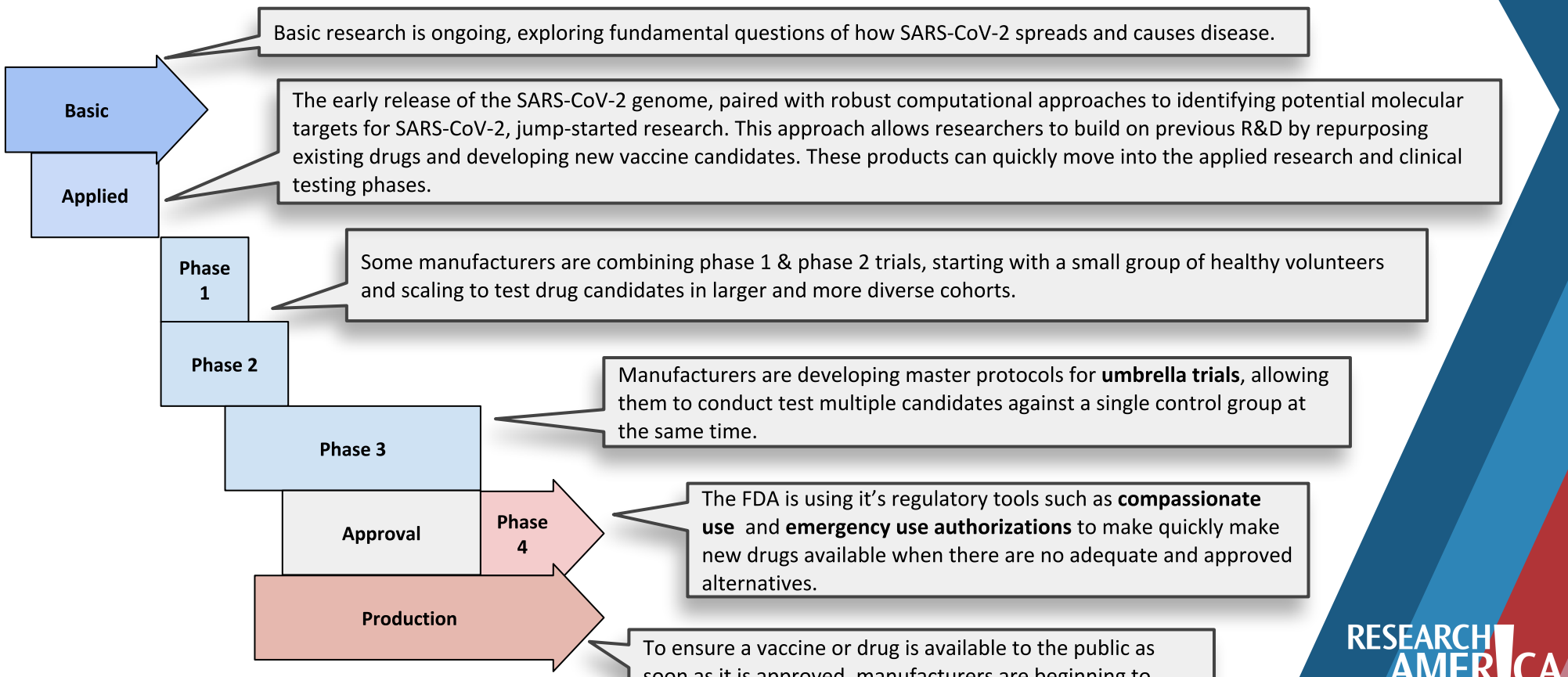
COVID-19 R&D, By The Science: *What is the Process?*

Typically, the **R&D process** is linear, with the most promising candidates progressing through each stage.

Basic Research:	Applied Research:	Clinical Trials:			Approval:	Phase 4:	
To understand scientific phenomena, without an immediate commercial target.	To solve a problem by developing new, or repurposing earlier, candidate drugs or vaccines	Determine whether the new candidate is safe and effective.			To determine whether the benefits of the drug outweigh the risks.	Ongoing monitoring	**Production:** Manufacturing & distribution
		Phase 1: Tests whether the drug is safe	Phase 2: Tests whether the drug is effective	Phase 3: Tests safety & efficacy in a large & diverse group			

Now, in the race to safely develop treatments and a vaccine for **SARS-CoV-2**, research institutions, federal agencies, and private companies are working collaboratively to share data and finding innovative ways to compress the R&D timeframe.



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