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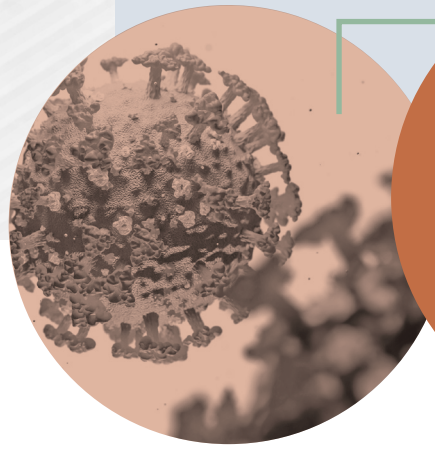
Vaccine Development for Infectious Disease

Increased globalization facilitates rapid dispersal of infectious diseases. In less than six months, SARS-CoV-2 spread across the world.[1]

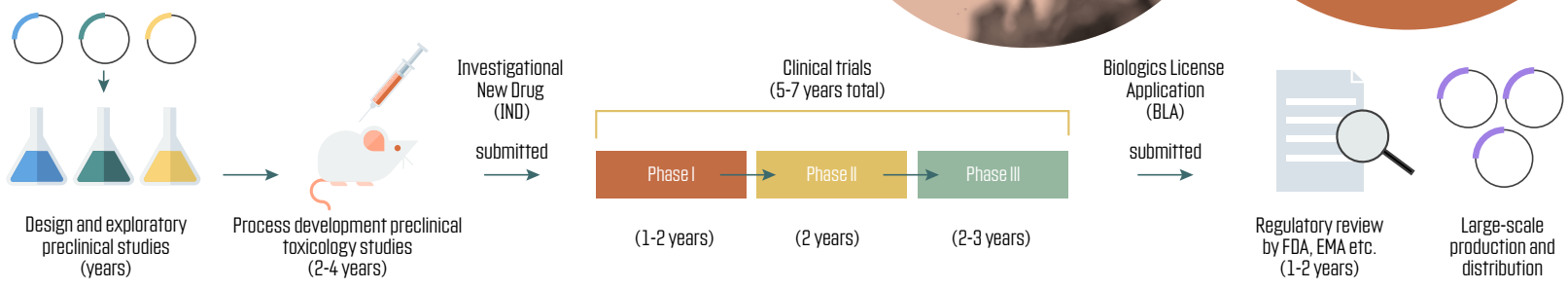
Vaccines are humanity's best defense against pathogens, but traditional vaccine development takes 10 – 15 years.[2] Each emerging infectious disease presents a unique challenge due to distinct epidemiology and mechanisms of transmission. Vaccine development for infectious diseases requires shorter production times and flexibility to account for evolving knowledge about emerging disease pathogenesis.[3]

The 2014 **Ebola** virus epidemic changed the paradigm of vaccine production.[3] The World Health Organization urged acceleration of the vaccine development pipeline. Today, non-replicating adenovirus vaccines (Ad26 and chAd3) and live-attenuated measles-based or vesicular stomatitis virus-based vaccines (MVA or VSV) are available for Ebola.[1]



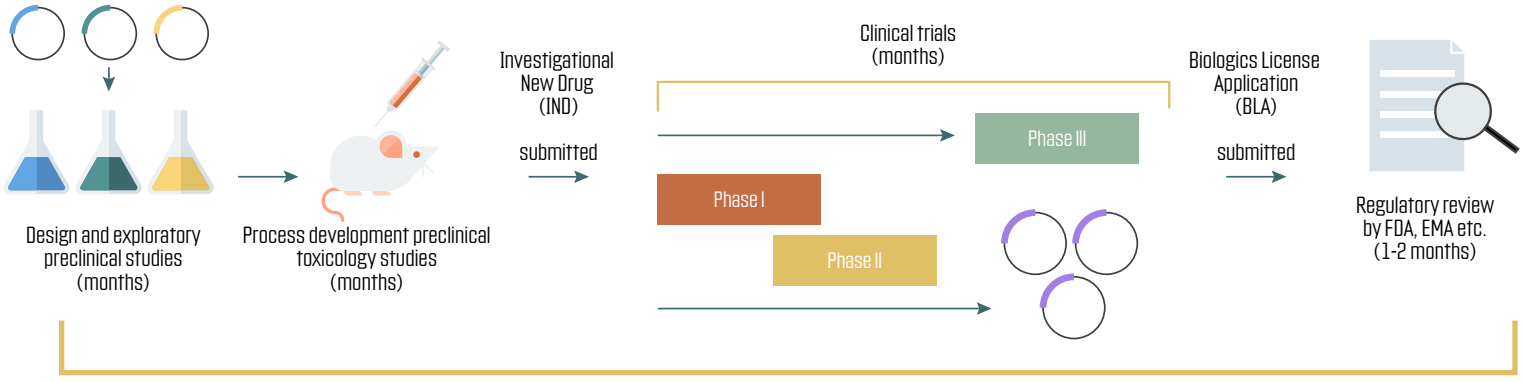
The emergence of **SARS-CoV-2** in 2019 led to a monumental acceleration of the vaccine development pipeline. In less than 300 days, scientists began vaccine efficacy trials. SARS-CoV-2 spurred the development and approval of the first mRNA-based vaccine. Similar to vaccines for other infectious diseases, non-replicating adenovirus-based vaccines have also been approved.[1]

Traditional Vaccine Development



15 years or longer

Infectious Disease Vaccine Development

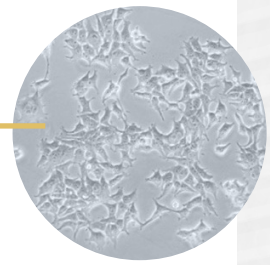


10 months to 1.5 years total

Computational modeling helps scientists pick the optimal virus region to target and design a vaccine strategy. Scientists use the genetic sequence and other known information about pathogens to predict antigen processing and immune response.[4]

Cell lines are critical to vaccine development. Scientists often use Vero cell lines or historical mammalian cell lines, such as HEK-293 and PER.C6, to grow and test viral vectors for vaccines. Historical mammalian cell lines are also used as a closer approximation of human physiology.[5,6]

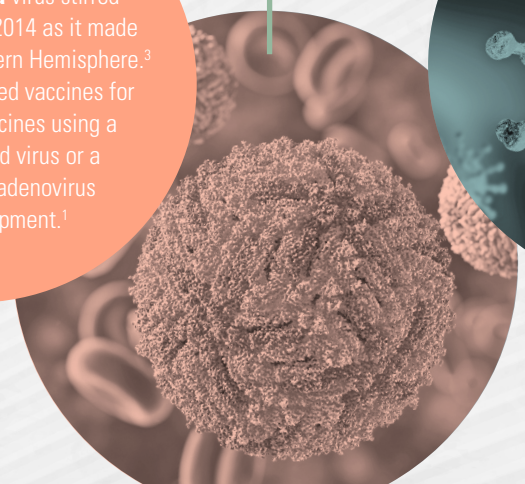
Bioreactors provide a controlled environment to conveniently scale up cell growth. Using bioreactors, scientists maximize vaccineproduction to meet the demand needed to inoculate large populations.[6]

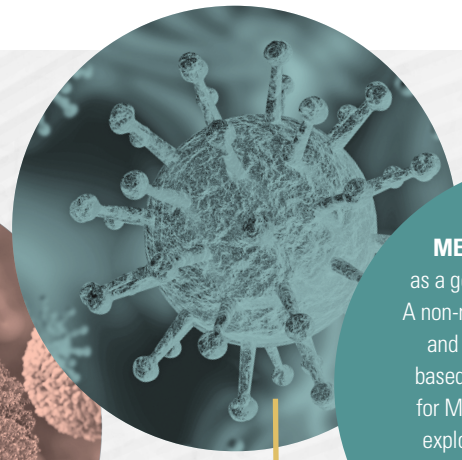


Emerging infectious diseases require accelerated vaccine production timelines.[3]

- Overlapping clinical phases
- Production prior to large-scale safety and immunogenicity assays
- Rolling FDA/EMA review

Although not a new pathogen, the **Zika** virus stirred a lot of attention in 2014 as it made its way into the Western Hemisphere.[3] There are no approved vaccines for the Zika virus. Vaccines using a whole inactivated virus or a non-replicating adenovirus are in development.[1]





MERS-CoV emerged in 2012 as a genetically novel coronavirus.[3] A non-replicating adenovirus vaccine and a live-attenuated measles-based vaccine are in development for MERS-CoV. Scientists are also exploring experimental vaccines that use a molecular clamp protein to maintain protein shape and prevent infection.[1]

References

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