

Breakthroughs that change patients' lives

BioNTech-Pfizer COVID-19 Vaccine Program


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BIONTECH **Pfizer** WORLDWIDE RESEARCH, DEVELOPMENT AND MEDICAL
Vaccine Research & Development

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BioNTech

- A pioneer in the mRNA therapeutics* field, follows a highly-innovative approach, and owns the most diversified mRNA technology portfolio in the industry.
- Highly potent lipid nanoparticle (LNP) mRNA vaccine platforms capable of eliciting neutralizing antibody and T cell responses at low doses.
- Operates 3 GMP, certified manufacturing facilities in Germany occupying in total more than 50,000 sq. ft. of laboratory and GMP manufacturing space.
- BioNTech & Pfizer have a seasonal influenza vaccine development collaboration using the mRNA platforms



Breakthroughs that change patients' lives * More than 100 peer-reviewed publications including 5 mRNA publications in the Journals Nature and Science in the last 4 years

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BioNTech & Pfizer Approach

BNT162 vaccine program - based on mRNA platform


- Four vaccine candidates, each representing different mRNA formats and target antigens.
 - two of the four vaccine candidates include a nucleoside modified mRNA (modRNA),
 - one includes an unmodified mRNA (uRNA),
 - the fourth vaccine candidate includes a self-amplifying mRNA (saRNA).
- Each mRNA is combined with a lipid nanoparticle (LNP) formulation.
- The full length spike sequence is included in two of the vaccine candidates, and the smaller optimized spike receptor binding domain (RBD) sequenc is included in the other two candidates.
- The RBD-based candidates contain the piece of the spike that is thought to be most important for eliciting antibodies that can inactivate the virus

<https://www.biontech.com/news-center/2020/02/22/2020-02-22-biontech-and-pfizer-announce-regulatory-approval-from-german-authority-to-advance-their-collaborative-development-of-covid-19-vaccine-candidates.html>

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BNT162 RNA platforms


Uridine mRNA (uRNA)¹



Rationale

- Prime / boost
- Strong adjuvant effect
- Active at low doses
- Strong antibody response
- CD8 T-Cells > CD4 T-Cells


Nucleoside-modified mRNA (modRNA)²



Rationale

- Prime / boost
- Moderate adjuvant effect
- Very strong antibody response
- CD4 T-Cells > CD8 T-Cells

Self-amplifying mRNA (saRNA)³



Rationale

- Prime (1x injection)
- Long-term activity
- Very strong antibody response
- Very strong T-Cell response (CD8 and CD4)
- Potent immune protection at low doses (approx. 60x lower dosages required to induce immunity vs. uRNA observed in preclinical models)

¹ Kreiler et al., Nature 2015; Kranz, Diken et al., Nature, 2016; Sahin et al., Nature 2017; Reinhard et al., Science 2020
² Parodi et al., Nature, 2017; Parodi et al., Mol Ther 2019; ³ Vogel et al., Mol Ther 2016; Mayo et al., Mol Ther 2019

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Phase 1/2, randomized, placebo-controlled, observer-blind, dose-finding, and vaccine candidate-selection study in healthy adults

- US phase 1/2 study start - May 4, 2020
- Informed by German phase 1/2 study – Started April 23, 2020
- Evaluates the safety, tolerability, immunogenicity, and potential efficacy of COVID-19 vaccine candidates
- Multiple hypotheses tested
 - Four RNA vaccine candidates
 - Three dose levels
 - Three age groups: 18-55 years old; 65-85 years old; 18-85 years old
 - Two alternative two dose schedules and a one dose schedule
- Three stages
 - Stage 1: Identify preferred vaccine candidate(s), dose level(s), number of doses, and schedule of administration (with the first 15 participants at each dose level of each vaccine candidate comprising a sentinel cohort)
 - Stage 2: An expanded-cohort stage
 - Stage 3: A final candidate/dose/schedule large-scale stage
- Estimated enrollment – 7,600 subjects

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Scaling for Success – Adding Pfizer Manufacturing Capacity to Existing Capacity of BioNTech and its EU Affiliates

mRNA is a new mechanism for vaccine creation that requires rapid development and scale-up of novel manufacturing technologies. We have the potential to supply millions of vaccine doses by the end of 2020, and then rapidly scale up to capacity to produce hundreds of millions in 2021. Pfizer has manufacturing and distribution sites across the U.S. Initially for the COVID-19 vaccine program, we are leveraging three of them:



ST. LOUIS, MO Critical Raw Material Manufacturing
KALAMAZOO, MI Formulations & Fill
ANDOVER, MA Drug Substance Manufacturing

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