Here’s the latest on COVID-19 vaccines

**These are the COVID-19 vaccine prospects that have made it to phase three trials and beyond.**

11 MINUTE READ

BY AMY MCKEEVER

PUBLISHED NOVEMBER 20, 2020

More than 150 coronavirus vaccines are in development across the world—and hopes are high to bring one to market in record time to ease the global crisis. Several efforts are underway to help make that possible, including the U.S. government’s [Operation Warp Speed](https://www.hhs.gov/about/news/2020/06/16/fact-sheet-explaining-operation-warp-speed.html) initiative, which has pledged $10 billion and aims to develop and deliver 300 million doses of a safe, effective coronavirus vaccine by January 2021. The World Health Organization is also coordinating global efforts to develop a vaccine, with an eye toward [delivering two billion doses](https://www.who.int/news-room/detail/26-06-2020-act-accelerator-update) by the end of 2021.

It can typically take [10 to 15 years](https://www.weforum.org/agenda/2020/06/vaccine-development-barriers-coronavirus/) to bring a vaccine to market; the fastest-ever—the vaccine for mumps—[required four years](https://www.nationalgeographic.com/science/2020/04/why-coronavirus-vaccine-could-take-way-longer-than-a-year/) in the 1960s. Vaccines go through [a three-stage clinical trial process](https://www.cdc.gov/vaccines/basics/test-approve.html) before they are sent to regulatory agencies for approval—which can be a lengthy process itself.

Even after a vaccine is approved, it faces potential roadblocks when it comes to scaling up production and distribution, which also includes [deciding which populations should get it first](https://hub.jhu.edu/2020/07/01/covid-vaccine-ethics-faden/)—and at what cost. Many vaccines also stay in what’s called phase four, a perpetual stage of regular study. ([Here's how we'll know when a COVID-19 vaccine is ready](https://www.nationalgeographic.com/science/2020/06/how-we-will-know-when-coronavirus-vaccine-is-ready-cvd/).)

Given the urgent need, some vaccine developers are compressing the clinical process for SARS-CoV-2 by running trial phases simultaneously. Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, [has stated](https://www.cnn.com/2020/09/01/health/coronavirus-vaccine-trials-early-fauci/index.html) that independent Data and Safety Monitoring Boards can end trials early if their interim results are overwhelmingly positive or negative. Meanwhile, the Trump Administration [pressured](https://www.cnbc.com/2020/10/07/trump-says-no-presidents-ever-pushed-the-fda-like-him-vaccine-coming-very-shortly.html) the U.S. Food and Drug Administration to quickly approve a vaccine by Election Day, which some observers worried [was politically motivated](https://www.statnews.com/pharmalot/2020/08/31/most-americans-believe-the-covid-19-vaccine-approval-process-is-driven-by-politics-not-science/). By mid-October, several states—including California, New York, and West Virginia—[announced](https://www.politico.com/news/2020/10/20/states-covid-vaccine-safety-reviews-430428) plans to independently review the data for any vaccine the FDA approves. On November 7, the presidential election [was called for](https://www.nationalgeographic.com/history/2020/11/election-is-over-see-photos-america-divided-reaction/) Democratic challenger Joe Biden.

While the FDA has agreed to expedite the approval process, on October 6 the independent federal agency [released](https://apnews.com/article/virus-outbreak-archive-efdb363953cc5e2d64028b60baabdc90) more stringent safety standards that had been initially opposed by the White House. In a meeting on October 23, the primary advisory panel for the FDA approval process [appeared hesitant](https://www.statnews.com/2020/10/23/fda-shows-signs-of-cold-feet-over-emergency-authorization-of-covid-19-vaccines/) to issue an emergency use authorization—which allows the use of an unapproved medical product in a life-threatening situation—to any vaccine candidate. Members said doing so could interfere with ongoing trials; participants may drop out of the trials to ensure they receive the actual vaccine rather than the placebo, which would muddy the data and make it close to impossible to prove the efficacy of a vaccine. CDC director [Robert Redfield](https://www.washingtonpost.com/health/cdc-director-says-coronavirus-vaccines-wont-be-widely-available-till-the-middle-of-next-year/2020/09/16/209fecf6-f827-11ea-be57-d00bb9bc632d_story.html), vaccine developers, and the FDA have also said it’s unlikely a vaccine will be widely available until the middle of 2021.

The COVID-19 candidates, like all vaccines, essentially aim to instruct the immune system to mount a defense, which is sometimes [stronger than what would be provided through natural infection](https://www.chop.edu/centers-programs/vaccine-education-center/vaccine-safety/immune-system-and-health) and [comes](https://www.who.int/vaccine_safety/initiative/tools/vaccinfosheets/en/) with [fewer health consequences](https://www.cdc.gov/vaccinesafety/ensuringsafety/history/index.html).

To do so, some vaccines use the whole coronavirus, but in a killed or weakened state. Others use only part of the virus—whether a protein or a fragment. Some transfer the coronavirus proteins into a different virus that is unlikely to cause disease or even incapable of it. Finally, some vaccines under development rely on deploying pieces of the coronavirus’s genetic material, so our cells can temporarily make the coronavirus proteins needed to stimulate our immune systems. ([Find out more about vaccines and how they work](https://www.nationalgeographic.com/science/health-and-human-body/human-body/searching-for-coronavirus-vaccine-how-would-it-work/).)

Though it’s too soon to say which candidates will ultimately be successful, here’s a look at the prospects that have reached phase three and beyond—including a quick primer on how they work and where they stand.

[Pfizer](https://www.pfizer.com/science/coronavirus/vaccine), One of the world’s largest pharmaceutical companies, based in New York, in collaboration with German biotech company BioNTech, is producing vaccine BNT162b2. This vaccine candidate relies on injecting snippets of a virus’s genetic material, in this case messenger RNA (mRNA), into human cells. It spurs the production of viral proteins that mimic the coronavirus, training the immune system to recognize its presence. Any successful vaccine based on this technology would be the first mRNA vaccine approved for human use. This vaccine requires two doses taken 21 days apart. On November 20, Pfizer and BioNTech [said](https://www.pfizer.com/news/press-release/press-release-detail/pfizer-and-biontech-submit-emergency-use-authorization) they were filing for emergency authorization from the FDA just two days after [announcing](https://www.pfizer.com/news/press-release/press-release-detail/pfizer-and-biontech-conclude-phase-3-study-covid-19-vaccine) the conclusion of their phase three trials. The companies stated that they’ve met their primary goals: The analysis found the candidate to be 95 percent effective in preventing mild and serious cases of COVID-19—and 94 percent effective in adults over 65 years old—with no serious safety concerns. The announcement updates figures from an interim analysis released a little more than a week ago, wherein the companies reported 90 percent efficacy. As yet, they have provided no underlying data to back the claim, and it’s still unclear if the vaccine produces a durable immune response. The companies also haven’t explained if the vaccine works by reducing disease symptoms or blocking the virus entirely. Pfizer [has also launched](https://pfe-pfizercom-d8-prod.s3.amazonaws.com/2020-11/US_State_Pilot_Program_Nov162020L.pdf?ozcFYSz1AHRBD4FaujjsvwulBZIgfKMd) a vaccine delivery pilot program with four U.S. states—Rhode Island, Texas, New Mexico, and Tennessee—to prepare for deployment of the vaccine.

In July, the companies [launched a trial that combines phase two and three by enrolling a diverse population in areas with significant SARS-CoV-2 transmission.](https://www.pfizer.com/news/press-release/press-release-detail/pfizer-and-biontech-choose-lead-mrna-vaccine-candidate-0) It has [expanded the trial](https://www.pfizer.com/news/press-release/press-release-detail/pfizer-and-biontech-propose-expansion-pivotal-covid-19)to include 44,000 people across multiple countries. Preliminary results of phase one/two data showed the vaccine produces antibodies and T-cell responses specific to the SARS-CoV-2 protein.

Pfizer expects to be able to produce up to 50 million vaccine doses in 2020 and 1.3 billion doses by the end of 2021. It [has signed](https://www.nytimes.com/2020/07/22/us/politics/pfizer-coronavirus-vaccine.html) a nearly $2 billion contract with the U.S. government to provide 100 million doses for free, though the New York Times [reports](https://www.nytimes.com/2020/11/18/health/pfizer-covid-vaccine.html?action=click&module=Spotlight&pgtype=Homepage) that only half its supply will go to the U.S. this year. Questions have also been raised over the vaccine’s storage, which requires ultra-cold freezers set at minus 70 degrees Celsius (minus 94 degrees Fahrenheit).

Query1: When will vaccine be available?

Query2: Who is producing vaccines?

Query3: How long would a vaccine typically take to bring a vaccine to market?

Query4: Which states plans to independently review the data for any vaccine the FDA approves?

Query5: who is director of the National Institute of Allergy and Infectious Diseases?

Query6: which company [has signed](https://www.nytimes.com/2020/07/22/us/politics/pfizer-coronavirus-vaccine.html) a nearly $2 billion contract with the U.S. government to provide 100 million doses for free?

Query7: what primary goal Pfizer has met?

Query8: How does BNT162b2 work?

Query9: what is BNT162b2?

Query10: what is the attitude of CDC director [Robert Redfield](https://www.washingtonpost.com/health/cdc-director-says-coronavirus-vaccines-wont-be-widely-available-till-the-middle-of-next-year/2020/09/16/209fecf6-f827-11ea-be57-d00bb9bc632d_story.html) about developing vaccine?

LSTM code run1

FINAL DTATA SHAPES X (1521, 1047) y (1521, 48)

Model: "sequential\_11"

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Layer (type) Output Shape Param #

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embedding\_10 (Embedding) (None, 1047, 256) 268032

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spatial\_dropout1d\_10 (Spatia (None, 1047, 256) 0

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lstm\_10 (LSTM) (None, 256) 525312

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dense\_19 (Dense) (None, 256) 65792

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dropout\_10 (Dropout) (None, 256) 0

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dense\_20 (Dense) (None, 48) 12336

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Total params: 871,472

Trainable params: 871,472

Non-trainable params: 0

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Train on 1521 samples

Epoch 1/15

1521/1521 [==============================] - 682s 449ms/sample - loss: 4.0400 - acc: 0.0421

Epoch 2/15

1521/1521 [==============================] - 679s 447ms/sample - loss: 3.9904 - acc: 0.0454

Epoch 3/15

1521/1521 [==============================] - 683s 449ms/sample - loss: 3.9834 - acc: 0.0375

Epoch 4/15

1521/1521 [==============================] - 684s 450ms/sample - loss: 3.9858 - acc: 0.0526

Epoch 5/15

1521/1521 [==============================] - 684s 450ms/sample - loss: 3.9765 - acc: 0.0447

Epoch 6/15

1521/1521 [==============================] - 692s 455ms/sample - loss: 3.9758 - acc: 0.0440

Epoch 7/15

1521/1521 [==============================] - 697s 458ms/sample - loss: 3.9698 - acc: 0.0388

Epoch 8/15

1521/1521 [==============================] - 699s 460ms/sample - loss: 3.9790 - acc: 0.0467

Epoch 9/15

1521/1521 [==============================] - 704s 463ms/sample - loss: 3.9693 - acc: 0.0434

Epoch 10/15

1521/1521 [==============================] - 692s 455ms/sample - loss: 3.9673 - acc: 0.0381

Epoch 11/15

1521/1521 [==============================] - 697s 458ms/sample - loss: 3.9616 - acc: 0.0394

Epoch 12/15

1521/1521 [==============================] - 685s 451ms/sample - loss: 3.9623 - acc: 0.0329

Epoch 13/15

1521/1521 [==============================] - 699s 460ms/sample - loss: 3.9494 - acc: 0.0460

Epoch 14/15

1521/1521 [==============================] - 767s 504ms/sample - loss: 3.9302 - acc: 0.0434

Epoch 15/15

1521/1521 [==============================] - 762s 501ms/sample - loss: 3.9146 - acc: 0.0447

1521/1521 [==============================] - 342s 225ms/sample - loss: 3.8631 - acc: 0.0592

Accuracy: 5.92 , % Loss: 386.31 %

FINAL DTATA SHAPES X (1521, 1047) y (1521, 48)

Here's the latest on Covid-19 vaccines:

Query: When will vaccine available?

HIT COUNTS: Counter({22: 2})

22 : CDC director Robert Redfield, vaccine developers, and the FDA have also said itâ€™s unlikely a vaccine will be widely available until the middle of 2021.

Query: Who is producing vaccine?

HIT COUNTS: Counter({30: 2})

30 : Pfizer, One of the worldâ€™s largest pharmaceutical companies, based in New York, in collaboration with German biotech company BioNTech, is producing vaccine BNT162b2.

Query: How long does it take to bring a vaccine to market?

HIT COUNTS: Counter({9: 6, 6: 2, 7: 1, 8: 1, 11: 1, 13: 1, 16: 1, 21: 1, 22: 1})

9 : It can typically take 10 to 15 years to bring a vaccine to market; the fastest-everâ€”the vaccine for mumpsâ€”required four years in the 1960s.

6 : More than 150 coronavirus vaccines are in development across the worldâ€”and hopes are high to bring one to market in record time to ease the global crisis.

7 : Several efforts are underway to help make that possible, including the U.S. governmentâ€™s Operation Warp Speed initiative, which has pledged $10 billion and aims to develop and deliver 300 million doses of a safe, effective coronavirus vaccine by January 2021.

Query: Which states plan to independently review the data for any vaccine?

HIT COUNTS: Counter({17: 7, 21: 1, 33: 1})

17 : By mid-October, several statesâ€”including California, New York, and West Virginiaâ€”announced plans to independently review the data for any vaccine the FDA approves.

21 : Members said doing so could interfere with ongoing trials; participants may drop out of the trials to ensure they receive the actual vaccine rather than the placebo, which would muddy the data and make it close to impossible to prove the efficacy of a vaccine.

33 : Any successful vaccine based on this technology would be the first mRNA vaccine approved for human use.

Query: who is director of the National Institute of Allergy and Infectious Diseases?

HIT COUNTS: Counter({15: 13})

15 : Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, has stated that independent Data and Safety Monitoring Boards can end trials early if their interim results are overwhelmingly positive or negative.

Query: Which company has signed a nearly 2 billion contract with the U.S. government?

HIT COUNTS: Counter({46: 12})

46 : It has signed a nearly $2 billion contract with the U.S. government to provide 100 million doses for free, though the New York Times reports that only half its supply will go to the U.S. this year.

Query: What primary goal Pfizer has met?

HIT COUNTS: Counter({36: 2})

36 : The companies stated that theyâ€™ve met their primary goals:

Query: How effective is BNT162b2?

HIT COUNTS: Counter({37: 1, 30: 1})

37 : The analysis found the candidate to be 95 percent effective in preventing mild and serious cases of COVID-19â€”and 94 percent effective in adults over 65 years oldâ€”with no serious safety concerns.

30 : Pfizer, One of the worldâ€™s largest pharmaceutical companies, based in New York, in collaboration with German biotech company BioNTech, is producing vaccine BNT162b2.

Query: What is BNT162b2?

HIT COUNTS: Counter({30: 1})

30 : Pfizer, One of the worldâ€™s largest pharmaceutical companies, based in New York, in collaboration with German biotech company BioNTech, is producing vaccine BNT162b2.

Query: What is CDC director Robert Redfield's attitude about developing vaccine?

HIT COUNTS: Counter({22: 6, 8: 1})

22 : CDC director Robert Redfield, vaccine developers, and the FDA have also said itâ€™s unlikely a vaccine will be widely available until the middle of 2021.

8 : The World Health Organization is also coordinating global efforts to develop a vaccine, with an eye toward delivering two billion doses by the end of 2021.

Here's the latest on Covid-19 vaccines:

Query: When will vaccine available?

HIT COUNTS: Counter({20: 6})

20 : In a meeting on October 23, the primary advisory panel for the FDA approval process appeared hesitant to issue an emergency use authorizationâ€”which allows the use of an unapproved medical product in a life-threatening situationâ€”to any vaccine candidate.

Query: Who is producing vaccine?

HIT COUNTS: Counter({20: 6})

20 : In a meeting on October 23, the primary advisory panel for the FDA approval process appeared hesitant to issue an emergency use authorizationâ€”which allows the use of an unapproved medical product in a life-threatening situationâ€”to any vaccine candidate.

Query: How long does it take to bring a vaccine to market?

HIT COUNTS: Counter({20: 14})

20 : In a meeting on October 23, the primary advisory panel for the FDA approval process appeared hesitant to issue an emergency use authorizationâ€”which allows the use of an unapproved medical product in a life-threatening situationâ€”to any vaccine candidate.

Query: Which states plan to independently review the data for any vaccine?

HIT COUNTS: Counter({20: 14})

20 : In a meeting on October 23, the primary advisory panel for the FDA approval process appeared hesitant to issue an emergency use authorizationâ€”which allows the use of an unapproved medical product in a life-threatening situationâ€”to any vaccine candidate.

Query: who is director of the National Institute of Allergy and Infectious Diseases?

HIT COUNTS: Counter({20: 20})

20 : In a meeting on October 23, the primary advisory panel for the FDA approval process appeared hesitant to issue an emergency use authorizationâ€”which allows the use of an unapproved medical product in a life-threatening situationâ€”to any vaccine candidate.

Query: Which company has signed a nearly 2 billion contract with the U.S. government?

HIT COUNTS: Counter({20: 22})

20 : In a meeting on October 23, the primary advisory panel for the FDA approval process appeared hesitant to issue an emergency use authorizationâ€”which allows the use of an unapproved medical product in a life-threatening situationâ€”to any vaccine candidate.

Query: What primary goal Pfizer has met?

HIT COUNTS: Counter({20: 8})

20 : In a meeting on October 23, the primary advisory panel for the FDA approval process appeared hesitant to issue an emergency use authorizationâ€”which allows the use of an unapproved medical product in a life-threatening situationâ€”to any vaccine candidate.

Query: How effective is BNT162b2?

HIT COUNTS: Counter({20: 6})

20 : In a meeting on October 23, the primary advisory panel for the FDA approval process appeared hesitant to issue an emergency use authorizationâ€”which allows the use of an unapproved medical product in a life-threatening situationâ€”to any vaccine candidate.

Query: What is BNT162b2?

HIT COUNTS: Counter({20: 5})

20 : In a meeting on October 23, the primary advisory panel for the FDA approval process appeared hesitant to issue an emergency use authorizationâ€”which allows the use of an unapproved medical product in a life-threatening situationâ€”to any vaccine candidate.

Query: What is CDC director Robert Redfield's attitude about developing vaccine?

HIT COUNTS: Counter({20: 20})

20 : In a meeting on October 23, the primary advisory panel for the FDA approval process appeared hesitant to issue an emergency use authorizationâ€”which allows the use of an unapproved medical product in a life-threatening situationâ€”to any vaccine candidate.

LSTM (second run)

FINAL DTATA SHAPES X (1521, 1047) y (1521, 48)

Model: "sequential\_1"

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Layer (type) Output Shape Param #

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embedding\_1 (Embedding) (None, 1047, 256) 268032

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spatial\_dropout1d\_1 (Spatial (None, 1047, 256) 0

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lstm\_2 (LSTM) (None, 1047, 256) 525312

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lstm\_3 (LSTM) (None, 256) 525312

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dense (Dense) (None, 256) 65792

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dropout (Dropout) (None, 256) 0

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dense\_1 (Dense) (None, 48) 12336

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Total params: 1,396,784

Trainable params: 1,396,784

Non-trainable params: 0

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WARNING:tensorflow:From C:\Users\13465\anaconda3\envs\tensorflow2\lib\site-packages\tensorflow\_core\python\ops\math\_grad.py:1424: where (from tensorflow.python.ops.array\_ops) is deprecated and will be removed in a future version.

Instructions for updating:

Use tf.where in 2.0, which has the same broadcast rule as np.where

Train on 1521 samples

Epoch 1/8

1521/1521 [==============================] - 1448s 952ms/sample - loss: 4.6961 - acc: 0.0322

Epoch 2/8

1521/1521 [==============================] - 1733s 1s/sample - loss: 3.9767 - acc: 0.0487

Epoch 3/8

1521/1521 [==============================] - 2281s 1s/sample - loss: nan - acc: 0.0053

Epoch 4/8

1521/1521 [==============================] - 2282s 2s/sample - loss: nan - acc: 0.0053

Epoch 5/8

1521/1521 [==============================] - 1974s 1s/sample - loss: nan - acc: 0.0053

Epoch 6/8

1521/1521 [==============================] - 2246s 1s/sample - loss: nan - acc: 0.0053

Epoch 7/8

1521/1521 [==============================] - 2371s 2s/sample - loss: nan - acc: 0.0053

Epoch 8/8

1521/1521 [==============================] - 2289s 2s/sample - loss: nan - acc: 0.0053

1521/1521 [==============================] - 7359s 5s/sample - loss: nan - acc: 0.0053

Accuracy: 0.53 , % Loss: nan %

FINAL DTATA SHAPES X (1521, 1047) y (1521, 48)

WARNING:tensorflow:From C:\Users\13465\anaconda3\envs\tensorflow2\lib\site-packages\tensorflow\_core\python\ops\init\_ops.py:97: calling GlorotUniform.\_\_init\_\_ (from tensorflow.python.ops.init\_ops) with dtype is deprecated and will be removed in a future version.

Instructions for updating:

Call initializer instance with the dtype argument instead of passing it to the constructor

WARNING:tensorflow:From C:\Users\13465\anaconda3\envs\tensorflow2\lib\site-packages\tensorflow\_core\python\ops\init\_ops.py:97: calling Orthogonal.\_\_init\_\_ (from tensorflow.python.ops.init\_ops) with dtype is deprecated and will be removed in a future version.

Instructions for updating:

Call initializer instance with the dtype argument instead of passing it to the constructor

WARNING:tensorflow:From C:\Users\13465\anaconda3\envs\tensorflow2\lib\site-packages\tensorflow\_core\python\ops\init\_ops.py:97: calling Zeros.\_\_init\_\_ (from tensorflow.python.ops.init\_ops) with dtype is deprecated and will be removed in a future version.

Instructions for updating:

Call initializer instance with the dtype argument instead of passing it to the constructor

Here's the latest on Covid-19 vaccines:

Query: When will vaccine available?

HIT COUNTS: Counter({22: 2})

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HIT COUNTS: Counter({30: 2})

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Query: How long does it take to bring a vaccine to market?

HIT COUNTS: Counter({9: 6, 6: 2, 7: 1, 8: 1, 11: 1, 13: 1, 16: 1, 21: 1, 22: 1})

9 : It can typically take 10 to 15 years to bring a vaccine to market; the fastest-everâ€”the vaccine for mumpsâ€”required four years in the 1960s.

6 : More than 150 coronavirus vaccines are in development across the worldâ€”and hopes are high to bring one to market in record time to ease the global crisis.

7 : Several efforts are underway to help make that possible, including the U.S. governmentâ€™s Operation Warp Speed initiative, which has pledged $10 billion and aims to develop and deliver 300 million doses of a safe, effective coronavirus vaccine by January 2021.

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HIT COUNTS: Counter({17: 7, 21: 1, 33: 1})

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HIT COUNTS: Counter({46: 12})

46 : It has signed a nearly $2 billion contract with the U.S. government to provide 100 million doses for free, though the New York Times reports that only half its supply will go to the U.S. this year.

Query: What primary goal Pfizer has met?

HIT COUNTS: Counter({36: 2})

36 : The companies stated that theyâ€™ve met their primary goals:

Query: How effective is BNT162b2?

HIT COUNTS: Counter({37: 1, 30: 1})

37 : The analysis found the candidate to be 95 percent effective in preventing mild and serious cases of COVID-19â€”and 94 percent effective in adults over 65 years oldâ€”with no serious safety concerns.

30 : Pfizer, One of the worldâ€™s largest pharmaceutical companies, based in New York, in collaboration with German biotech company BioNTech, is producing vaccine BNT162b2.

Query: What is BNT162b2?

HIT COUNTS: Counter({30: 1})

30 : Pfizer, One of the worldâ€™s largest pharmaceutical companies, based in New York, in collaboration with German biotech company BioNTech, is producing vaccine BNT162b2.

Query: What is CDC director Robert Redfield's attitude about developing vaccine?

HIT COUNTS: Counter({22: 6, 8: 1})

22 : CDC director Robert Redfield, vaccine developers, and the FDA have also said itâ€™s unlikely a vaccine will be widely available until the middle of 2021.

8 : The World Health Organization is also coordinating global efforts to develop a vaccine, with an eye toward delivering two billion doses by the end of 2021.

Here's the latest on Covid-19 vaccines:

Query: When will vaccine available?

Dr.Tarau’s code:

FINAL DTATA SHAPES X (1525, 1051) y (1525, 49)

Model: "sequential\_7"

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Layer (type) Output Shape Param #

=================================================================

dense\_14 (Dense) (None, 128) 134656

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dense\_15 (Dense) (None, 49) 6321

=================================================================

Total params: 140,977

Trainable params: 140,977

Non-trainable params: 0

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Train on 1525 samples

Epoch 1/100

1525/1525 [==============================] - 0s 164us/sample - loss: 4.0860 - acc: 0.0859

Epoch 2/100

1525/1525 [==============================] - 0s 99us/sample - loss: 3.8816 - acc: 0.1574

Epoch 3/100

1525/1525 [==============================] - 0s 99us/sample - loss: 3.5403 - acc: 0.1659

Epoch 4/100

1525/1525 [==============================] - 0s 98us/sample - loss: 2.7378 - acc: 0.6518

Epoch 5/100

1525/1525 [==============================] - 0s 100us/sample - loss: 1.6289 - acc: 0.8761

Epoch 6/100

1525/1525 [==============================] - 0s 98us/sample - loss: 0.9806 - acc: 0.9134

Epoch 7/100

1525/1525 [==============================] - 0s 100us/sample - loss: 0.6695 - acc: 0.9285

Epoch 8/100

1525/1525 [==============================] - 0s 97us/sample - loss: 0.5037 - acc: 0.9423

Epoch 9/100

1525/1525 [==============================] - 0s 99us/sample - loss: 0.4048 - acc: 0.9469

Epoch 10/100

1525/1525 [==============================] - 0s 99us/sample - loss: 0.3394 - acc: 0.9541

Epoch 11/100

1525/1525 [==============================] - 0s 98us/sample - loss: 0.2947 - acc: 0.9620

Epoch 12/100

1525/1525 [==============================] - 0s 98us/sample - loss: 0.2623 - acc: 0.9652

Epoch 13/100

1525/1525 [==============================] - 0s 99us/sample - loss: 0.2382 - acc: 0.9652

Epoch 14/100

1525/1525 [==============================] - 0s 104us/sample - loss: 0.2189 - acc: 0.9685

Epoch 15/100

1525/1525 [==============================] - 0s 102us/sample - loss: 0.2033 - acc: 0.9652

Epoch 16/100

1525/1525 [==============================] - 0s 101us/sample - loss: 0.1907 - acc: 0.9698

Epoch 17/100

1525/1525 [==============================] - 0s 105us/sample - loss: 0.1811 - acc: 0.9692

Epoch 18/100

1525/1525 [==============================] - 0s 107us/sample - loss: 0.1726 - acc: 0.9744

Epoch 19/100

1525/1525 [==============================] - 0s 109us/sample - loss: 0.1651 - acc: 0.9718

Epoch 20/100

1525/1525 [==============================] - 0s 115us/sample - loss: 0.1587 - acc: 0.9764

Epoch 21/100

1525/1525 [==============================] - 0s 104us/sample - loss: 0.1531 - acc: 0.9731

Epoch 22/100

1525/1525 [==============================] - 0s 103us/sample - loss: 0.1472 - acc: 0.9731

Epoch 23/100

1525/1525 [==============================] - 0s 107us/sample - loss: 0.1436 - acc: 0.9751s - loss: 0.1470 - acc: 0.974

Epoch 24/100

1525/1525 [==============================] - 0s 111us/sample - loss: 0.1403 - acc: 0.9757

Epoch 25/100

1525/1525 [==============================] - 0s 109us/sample - loss: 0.1369 - acc: 0.9738

Epoch 26/100

1525/1525 [==============================] - 0s 117us/sample - loss: 0.1336 - acc: 0.9777

Epoch 27/100

1525/1525 [==============================] - 0s 116us/sample - loss: 0.1324 - acc: 0.9744

Epoch 28/100

1525/1525 [==============================] - 0s 98us/sample - loss: 0.1311 - acc: 0.9784

Epoch 29/100

1525/1525 [==============================] - 0s 97us/sample - loss: 0.1279 - acc: 0.9718

Epoch 30/100

1525/1525 [==============================] - 0s 97us/sample - loss: 0.1256 - acc: 0.9751

Epoch 31/100

1525/1525 [==============================] - 0s 107us/sample - loss: 0.1249 - acc: 0.9757

Epoch 32/100

1525/1525 [==============================] - 0s 98us/sample - loss: 0.1239 - acc: 0.9770

Epoch 33/100

1525/1525 [==============================] - 0s 98us/sample - loss: 0.1223 - acc: 0.9705

Epoch 34/100

1525/1525 [==============================] - 0s 98us/sample - loss: 0.1234 - acc: 0.9770

Epoch 35/100

1525/1525 [==============================] - 0s 126us/sample - loss: 0.1202 - acc: 0.9738

Epoch 36/100

1525/1525 [==============================] - 0s 108us/sample - loss: 0.1189 - acc: 0.9764

Epoch 37/100

1525/1525 [==============================] - 0s 100us/sample - loss: 0.1182 - acc: 0.9757

Epoch 38/100

1525/1525 [==============================] - 0s 118us/sample - loss: 0.1180 - acc: 0.9744

Epoch 39/100

1525/1525 [==============================] - 0s 111us/sample - loss: 0.1169 - acc: 0.9744

Epoch 40/100

1525/1525 [==============================] - 0s 106us/sample - loss: 0.1153 - acc: 0.9777

Epoch 41/100

1525/1525 [==============================] - 0s 102us/sample - loss: 0.1153 - acc: 0.9770

Epoch 42/100

1525/1525 [==============================] - 0s 106us/sample - loss: 0.1147 - acc: 0.9751

Epoch 43/100

1525/1525 [==============================] - 0s 91us/sample - loss: 0.1142 - acc: 0.9751

Epoch 44/100

1525/1525 [==============================] - 0s 94us/sample - loss: 0.1135 - acc: 0.9777

Epoch 45/100

1525/1525 [==============================] - 0s 109us/sample - loss: 0.1119 - acc: 0.9764

Epoch 46/100

1525/1525 [==============================] - 0s 106us/sample - loss: 0.1130 - acc: 0.9751

Epoch 47/100

1525/1525 [==============================] - 0s 107us/sample - loss: 0.1131 - acc: 0.9764

Epoch 48/100

1525/1525 [==============================] - 0s 105us/sample - loss: 0.1115 - acc: 0.9757

Epoch 49/100

1525/1525 [==============================] - 0s 101us/sample - loss: 0.1118 - acc: 0.9751

Epoch 50/100

1525/1525 [==============================] - 0s 100us/sample - loss: 0.1103 - acc: 0.9764

Epoch 51/100

1525/1525 [==============================] - 0s 100us/sample - loss: 0.1106 - acc: 0.9784

Epoch 52/100

1525/1525 [==============================] - 0s 101us/sample - loss: 0.1102 - acc: 0.9757

Epoch 53/100

1525/1525 [==============================] - 0s 101us/sample - loss: 0.1117 - acc: 0.9751

Epoch 54/100

1525/1525 [==============================] - 0s 100us/sample - loss: 0.1103 - acc: 0.9770

Epoch 55/100

1525/1525 [==============================] - 0s 99us/sample - loss: 0.1088 - acc: 0.9757

Epoch 56/100

1525/1525 [==============================] - 0s 106us/sample - loss: 0.1094 - acc: 0.9777

Epoch 57/100

1525/1525 [==============================] - 0s 101us/sample - loss: 0.1094 - acc: 0.9725

Epoch 58/100

1525/1525 [==============================] - 0s 103us/sample - loss: 0.1084 - acc: 0.9803s - loss: 0.1197 - acc: 0.97

Epoch 59/100

1525/1525 [==============================] - 0s 99us/sample - loss: 0.1090 - acc: 0.9751

Epoch 60/100

1525/1525 [==============================] - 0s 141us/sample - loss: 0.1092 - acc: 0.9764

Epoch 61/100

1525/1525 [==============================] - 0s 124us/sample - loss: 0.1091 - acc: 0.9790

Epoch 62/100

1525/1525 [==============================] - 0s 92us/sample - loss: 0.1102 - acc: 0.9757

Epoch 63/100

1525/1525 [==============================] - 0s 95us/sample - loss: 0.1137 - acc: 0.9757

Epoch 64/100

1525/1525 [==============================] - 0s 92us/sample - loss: 0.1114 - acc: 0.9784

Epoch 65/100

1525/1525 [==============================] - 0s 97us/sample - loss: 0.1087 - acc: 0.9751

Epoch 66/100

1525/1525 [==============================] - 0s 98us/sample - loss: 0.1068 - acc: 0.9770

Epoch 67/100

1525/1525 [==============================] - 0s 96us/sample - loss: 0.1061 - acc: 0.9777

Epoch 68/100

1525/1525 [==============================] - 0s 97us/sample - loss: 0.1055 - acc: 0.9757

Epoch 69/100

1525/1525 [==============================] - 0s 115us/sample - loss: 0.1061 - acc: 0.9770

Epoch 70/100

1525/1525 [==============================] - 0s 132us/sample - loss: 0.1059 - acc: 0.9777

Epoch 71/100

1525/1525 [==============================] - 0s 116us/sample - loss: 0.1062 - acc: 0.9744

Epoch 72/100

1525/1525 [==============================] - 0s 105us/sample - loss: 0.1067 - acc: 0.9751

Epoch 73/100

1525/1525 [==============================] - 0s 95us/sample - loss: 0.1064 - acc: 0.9744

Epoch 74/100

1525/1525 [==============================] - 0s 91us/sample - loss: 0.1055 - acc: 0.9777

Epoch 75/100

1525/1525 [==============================] - 0s 95us/sample - loss: 0.1064 - acc: 0.9731

Epoch 76/100

1525/1525 [==============================] - 0s 91us/sample - loss: 0.1058 - acc: 0.9784

Epoch 77/100

1525/1525 [==============================] - 0s 90us/sample - loss: 0.1053 - acc: 0.9725

Epoch 78/100

1525/1525 [==============================] - 0s 94us/sample - loss: 0.1050 - acc: 0.9790

Epoch 79/100

1525/1525 [==============================] - 0s 93us/sample - loss: 0.1063 - acc: 0.9777

Epoch 80/100

1525/1525 [==============================] - 0s 127us/sample - loss: 0.1046 - acc: 0.9757

Epoch 81/100

1525/1525 [==============================] - 0s 108us/sample - loss: 0.1053 - acc: 0.9764

Epoch 82/100

1525/1525 [==============================] - 0s 90us/sample - loss: 0.1049 - acc: 0.9738

Epoch 83/100

1525/1525 [==============================] - 0s 92us/sample - loss: 0.1063 - acc: 0.9757

Epoch 84/100

1525/1525 [==============================] - 0s 92us/sample - loss: 0.1067 - acc: 0.9770

Epoch 85/100

1525/1525 [==============================] - 0s 90us/sample - loss: 0.1064 - acc: 0.9784

Epoch 86/100

1525/1525 [==============================] - 0s 90us/sample - loss: 0.1051 - acc: 0.9777

Epoch 87/100

1525/1525 [==============================] - 0s 91us/sample - loss: 0.1049 - acc: 0.9751

Epoch 88/100

1525/1525 [==============================] - 0s 90us/sample - loss: 0.1042 - acc: 0.9803

Epoch 89/100

1525/1525 [==============================] - 0s 91us/sample - loss: 0.1032 - acc: 0.9718

Epoch 90/100

1525/1525 [==============================] - 0s 94us/sample - loss: 0.1038 - acc: 0.9777

Epoch 91/100

1525/1525 [==============================] - 0s 90us/sample - loss: 0.1038 - acc: 0.9764

Epoch 92/100

1525/1525 [==============================] - ETA: 0s - loss: 0.0998 - acc: 0.9780 - 0s 91us/sample - loss: 0.1030 - acc: 0.9764

Epoch 93/100

1525/1525 [==============================] - 0s 114us/sample - loss: 0.1038 - acc: 0.9777

Epoch 94/100

1525/1525 [==============================] - 0s 124us/sample - loss: 0.1032 - acc: 0.9757

Epoch 95/100

1525/1525 [==============================] - 0s 89us/sample - loss: 0.1037 - acc: 0.9751

Epoch 96/100

1525/1525 [==============================] - 0s 91us/sample - loss: 0.1039 - acc: 0.9816

Epoch 97/100

1525/1525 [==============================] - 0s 92us/sample - loss: 0.1036 - acc: 0.9698

Epoch 98/100

1525/1525 [==============================] - 0s 92us/sample - loss: 0.1035 - acc: 0.9790

Epoch 99/100

1525/1525 [==============================] - 0s 89us/sample - loss: 0.1030 - acc: 0.9770

Epoch 100/100

1525/1525 [==============================] - 0s 97us/sample - loss: 0.1039 - acc: 0.9797

1525/1525 [==============================] - 0s 79us/sample - loss: 0.1029 - acc: 0.9744

Accuracy: 97.44 , % Loss: 10.29 %

there are 1629 words here

FINAL DTATA SHAPES X (1525, 1051) y (1525, 49)

Here's the latest on Covid-19 vaccines:

Query: When will vaccine available?

HIT COUNTS: Counter({20: 2})

20 : CDC director Robert Redfield, vaccine developers, and the FDA have also said itâ€™s unlikely a vaccine will be widely available until the middle of 2021.

Query: Who is producing vaccine?

HIT COUNTS: Counter()

Query: How long does it take to bring a vaccine to market?

HIT COUNTS: Counter({7: 6, 4: 2, 5: 1, 6: 1, 9: 1, 11: 1, 14: 1, 19: 1, 20: 1})

7 : It can typically take 10 to 15 years to bring a vaccine to market; the fastest-everâ€”the vaccine for mumpsâ€”required four years in the 1960s.

4 : More than 150 coronavirus vaccines are in development across the worldâ€”and hopes are high to bring one to market in record time to ease the global crisis.

5 : Several efforts are underway to help make that possible, including the U.S. governmentâ€™s Operation Warp Speed initiative, which has pledged $10 billion and aims to develop and deliver 300 million doses of a safe, effective coronavirus vaccine by January 2021.

Query: Which states plan to independently review the data for any vaccine the FDA approves?

HIT COUNTS: Counter({15: 10, 19: 1, 34: 1, 17: 1, 20: 1, 36: 1})

15 : By mid-October, several statesâ€”including California, New York, and West Virginiaâ€”announced plans to independently review the data for any vaccine the FDA approves.

19 : Members said doing so could interfere with ongoing trials; participants may drop out of the trials to ensure they receive the actual vaccine rather than the placebo, which would muddy the data and make it close to impossible to prove the efficacy of a vaccine.

34 : Any successful vaccine based on this technology would be the first mRNA vaccine approved for human use.

Query: who is director of the National Institute of Allergy and Infectious Diseases?

HIT COUNTS: Counter({13: 13})

13 : Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, has stated that independent Data and Safety Monitoring Boards can end trials early if their interim results are overwhelmingly positive or negative.

Query: Which company has signed a nearly 2 billion contract with the U.S. government to provide 100 million doses for free?

HIT COUNTS: Counter({47: 21, 5: 1, 46: 1})

47 : It has signed a nearly $2 billion contract with the U.S. government to provide 100 million doses for free, though the New York Times reports that only half its supply will go to the U.S. this year.

5 : Several efforts are underway to help make that possible, including the U.S. governmentâ€™s Operation Warp Speed initiative, which has pledged $10 billion and aims to develop and deliver 300 million doses of a safe, effective coronavirus vaccine by January 2021.

46 : Pfizer expects to be able to produce up to 50 million vaccine doses in 2020 and 1.3 billion doses by the end of 2021.

Query: What primary goal Pfizer has met?

HIT COUNTS: Counter({37: 2})

37 : The companies stated that theyâ€™ve met their primary goals:

Query: What is the status of BNT162b2?

HIT COUNTS: Counter({29: 1})

29 : Pfizer

Name: BNT162b2

Query: What is BNT162b2?

HIT COUNTS: Counter({29: 1})

29 : Pfizer

Name: BNT162b2

Query: What is CDC director Robert Redfield's attitude about developing vaccine?

HIT COUNTS: Counter({20: 6, 6: 1})

20 : CDC director Robert Redfield, vaccine developers, and the FDA have also said itâ€™s unlikely a vaccine will be widely available until the middle of 2021.

6 : The World Health Organization is also coordinating global efforts to develop a vaccine, with an eye toward delivering two billion doses by the end of 2021.

Here's the latest on Covid-19 vaccines:

Query: When will vaccine available?

HIT COUNTS: Counter({20: 5, 19: 1})

20 : CDC director Robert Redfield, vaccine developers, and the FDA have also said itâ€™s unlikely a vaccine will be widely available until the middle of 2021.

19 : Members said doing so could interfere with ongoing trials; participants may drop out of the trials to ensure they receive the actual vaccine rather than the placebo, which would muddy the data and make it close to impossible to prove the efficacy of a vaccine.

Query: Who is producing vaccine?

HIT COUNTS: Counter({46: 3, 45: 1, 40: 1, 19: 1})

46 : Pfizer expects to be able to produce up to 50 million vaccine doses in 2020 and 1.3 billion doses by the end of 2021.

45 : Preliminary results of phase one/two data showed the vaccine produces antibodies and T-cell responses specific to the SARS-CoV-2 protein.

40 : As yet, they have provided no underlying data to back the claim, and itâ€™s still unclear if the vaccine produces a durable immune response.

Query: How long does it take to bring a vaccine to market?

HIT COUNTS: Counter({7: 8, 4: 3, 28: 1, 5: 1, 19: 1})

7 : It can typically take 10 to 15 years to bring a vaccine to market; the fastest-everâ€”the vaccine for mumpsâ€”required four years in the 1960s.

4 : More than 150 coronavirus vaccines are in development across the worldâ€”and hopes are high to bring one to market in record time to ease the global crisis.

28 : Though itâ€™s too soon to say which candidates will ultimately be successful, hereâ€™s a look at the prospects that have reached phase three and beyondâ€”including a quick primer on how they work and where they stand.

Query: Which states plan to independently review the data for any vaccine the FDA approves?

HIT COUNTS: Counter({15: 10, 19: 3, 23: 1, 0: 1, 34: 1, 36: 1})

15 : By mid-October, several statesâ€”including California, New York, and West Virginiaâ€”announced plans to independently review the data for any vaccine the FDA approves.

19 : Members said doing so could interfere with ongoing trials; participants may drop out of the trials to ensure they receive the actual vaccine rather than the placebo, which would muddy the data and make it close to impossible to prove the efficacy of a vaccine.

23 : To do so, some vaccines use the whole coronavirus, but in a killed or weakened state.

Query: who is director of the National Institute of Allergy and Infectious Diseases?

HIT COUNTS: Counter({13: 15, 30: 3, 20: 2})

13 : Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, has stated that independent Data and Safety Monitoring Boards can end trials early if their interim results are overwhelmingly positive or negative.

30 : Who:

20 : CDC director Robert Redfield, vaccine developers, and the FDA have also said itâ€™s unlikely a vaccine will be widely available until the middle of 2021.

Query: Which company has signed a nearly 2 billion contract with the U.S. government to provide 100 million doses for free?

HIT COUNTS: Counter({47: 29, 31: 2, 28: 1, 46: 1})

47 : It has signed a nearly $2 billion contract with the U.S. government to provide 100 million doses for free, though the New York Times reports that only half its supply will go to the U.S. this year.

31 : One of the worldâ€™s largest pharmaceutical companies, based in New York, in collaboration with German biotech company BioNTech.

28 : Though itâ€™s too soon to say which candidates will ultimately be successful, hereâ€™s a look at the prospects that have reached phase three and beyondâ€”including a quick primer on how they work and where they stand.

Query: What primary goal Pfizer has met?

HIT COUNTS: Counter({37: 7, 0: 1})

37 : The companies stated that theyâ€™ve met their primary goals:

0 : Hereâ€™s the latest on COVID-19 vaccines

Query: What is the status of BNT162b2?

HIT COUNTS: Counter({36: 5, 32: 3, 29: 1})

36 : Status: On November 20, Pfizer and BioNTech said they were filing for emergency authorization from the FDA just two days after announcing the conclusion of their phase three trials.

32 : What: This vaccine candidate relies on injecting snippets of a virusâ€™s genetic material, in this case messenger RNA (mRNA), into human cells.

29 : Pfizer

Name: BNT162b2

Query: What is BNT162b2?

HIT COUNTS: Counter({32: 4, 29: 1})

32 : What: This vaccine candidate relies on injecting snippets of a virusâ€™s genetic material, in this case messenger RNA (mRNA), into human cells.

29 : Pfizer

Name: BNT162b2

Query: What is CDC director Robert Redfield's attitude about developing vaccine?

HIT COUNTS: Counter({20: 12, 32: 4, 6: 2, 27: 1, 19: 1})

20 : CDC director Robert Redfield, vaccine developers, and the FDA have also said itâ€™s unlikely a vaccine will be widely available until the middle of 2021.

32 : What: This vaccine candidate relies on injecting snippets of a virusâ€™s genetic material, in this case messenger RNA (mRNA), into human cells.

6 : The World Health Organization is also coordinating global efforts to develop a vaccine, with an eye toward delivering two billion doses by the end of 2021.