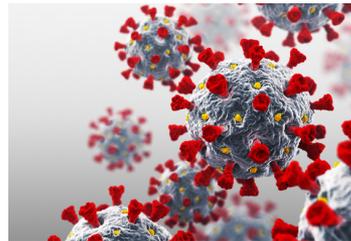


Covid-19 “Vital Signs”

Issue # 270

January 26, 2021



Highlights – Vaccine & Herd Immunity Model

- **For discussion purposes, we will presume that 70% immunity will be required for herd immunity and that 30% natural immunity will be reached by that time.** Then, we can illustrate the model's sensitivity to these levels.
- **Vaccinating all interested persons in the US:**
 - **With only the Pfizer/BioNTech and Moderna vaccines, it may not be possible to achieve 70% population immunity from vaccinations alone;**
 - **With the addition of the JNJ vaccine, 70% population immunity from the vaccinations could occur by late-August ;**
 - If the AstraZeneca vaccine shows promising results and gains emergency use authorization in the next several weeks, 70% of population immunity from vaccinations could occur by the end of June.
- **Reaching herd immunity:**
 - By increasing the pace of vaccinations as President Biden has now signaled, herd immunity still may not be reached until November if we only have the Pfizer/BioNTech and Moderna vaccines (it would be December without the improved pace of vaccinations);
 - **Adding the JNJ vaccine makes a significant difference: herd immunity could be reached by mid-July;**
 - **Adding both the JNJ and AstraZeneca vaccines by March 1 accelerates the timetable for herd immunity to mid-June.**
- **The sensitivity of required immunity level needed for herd immunity:**
 - **At 60% instead of 70% immunity needed for herd immunity, the timetable for reaching herd immunity (with the faster vaccine pace and addition of the JNJ vaccine) moves up from mid-June to late July;**
 - **At 80% instead of 70%, the timetable pushes back to early-August.**
- **The sensitivity of the herd immunity determination to the level of natural immunity:**
 - **At 35% natural immunity instead of 30%, herd immunity may be reached one-to-two weeks earlier;**
 - **At 25% natural immunity, the timetable could be pushed back several weeks.**
- **The US continues to show improvement across most of the Covid-19 vital signs we track:**
 - Another 1.1 million doses of vaccine were administered yesterday; the average for the past four days is 1.3 million doses;
 - **New cases and estimated true infections continue on downward trajectories. It appears that infections have been declining throughout January;**
 - Test volume is dropped in the past week; however, **the test-positive rate continues to improve;**
 - **Covid-19 hospitalizations have declined for most of the past three weeks; yesterday's census was 17% lower than its peak about three weeks ago;**
 - **Deaths reported with the coronavirus are slightly lower over the past week than for preceding weeks.**

Vaccination Rollout

The rollout to-date has come under widespread criticism. Our aim here is to look forward – when can we expect to reach target vaccination levels in the US

- The Biden Administration has set an expectation of “100 million doses in the first 100 days” of the new administration
- We find this goal to be remarkably underwhelming and problematic:
 - Despite heavy criticism of the rollout under the Trump Administration, this pace is no better than what has already been achieved
 - It does not account for the addition of one or possibly two additional vaccines (JNJ and AstraZeneca)
 - It further does not provide for any impact from improved organization, the natural learning curve seen with any process of this complexity or, from invoking the Defense Production Act
 - It fails to address the widespread gap between supply and demand for vaccines, or growing concerns about inequities in who is prioritized for vaccination
 - At this rate, falling infection rates may diminish interest in vaccinations long before enough people are vaccinated.

Note: Late yesterday, President Biden signaled that his Administration is now targeting 150 million doses in the first 100 days

Vaccine Rollout Model

This model enables us to test the effect of various vaccine scenarios on the ability to meet targeted vaccination levels

Assumptions used:

- 2-week lag: vaccination to immunity
- 3-week lag: first to second dose
- 0.5M doses per day of each vaccine, except AstraZeneca, 1M doses per day (once available)
- Sufficient people will seek vaccination, including both doses as appropriate

Scenarios Tested:

1. Current Pace (approved and under contract)
 - Pfizer: 2 tranches of 100M doses
 - Moderna: 2 tranches of 100M doses
 - Both: 60% efficacy, dose 1; 95% dose 2
2. Increase pace of vaccinations by 20% (consistent with Biden's revised target)
3. Add JNJ, starting on 3/1:
 - 100 M single doses under contract
 - 70% efficacy (estimate, unknown at this time)
4. Add AstraZeneca, starting on 3/1
 - 300 M doses under contract
 - 50% efficacy, dose 1; 70% efficacy, dose 2 (estimate, unknown at this time)

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Vaccine Rollout Model – Scenario Results

This model enables us to test the effect of various vaccines scenarios on the ability to meet targeted vaccination levels



Scenario 1 (current pace) - US never achieves 70% of population immune via vaccination; 137 million doses by 4/30



Scenario 2 (20% faster pace) – US never achieves 70% of population immune via vaccination; 165 million doses by 4/30



Scenario 3 (20% faster pace & adding JNJ) – 70% immune by 8/30; 200 million doses by 4/30



Scenario 4 (20% faster pace & adding JNJ and AstraZeneca) – 70% immune by 6/30; 310 million doses by 4/30



These results are provided for illustration purposes only and are intended to suggest the directional impact of various assumptions and scenarios. There is no assurance that the results illustrated will be achieved.

Herd Immunity Model

Herd immunity also may be achieved in part by natural immunity – that is, via an infection. This model is designed to test scenarios of achieving herd immunity from a combination of vaccination and natural immunity

Additional Assumptions:

- Sustained immunity from both vaccines and natural immunity
- Previously-infected persons will receive vaccines at same rate as uninfected persons
- Vaccines and natural immunity protect against new variants
- Current infection prevalence is ~25% (based on Gu's mean estimate for January 10, as of January 24) and should increase from this date forward
- Immunity established 14 days post-infection

Scenarios Evaluated:

- The four vaccine scenarios from previous pages
- Level of immunity required for herd immunity:
 - 60%
 - 70%
 - 80%
- Level of natural immunity reached:
 - 25%
 - 30%
 - 25%

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Herd Immunity Model – Scenario Results

The timing of achieving herd immunity is highly dependent on the underlying assumptions, the vaccines deployed and the levels of natural immunity and required immunity. Scenario 3 is highlighted as a reasonable possibility.

1. Current Pace, Pfizer & Moderna

Immunity Required for Herd Immunity

		60%	70%	80%
Natural Immunity	25%	x	x	x
	30%	Oct 3	Dec 17	x
	35%	Aug 17	Oct 3	Dec 8

2. 20% Improvement

Immunity Required for Herd Immunity

		60%	70%	80%
Natural Immunity	25%	Nov 15?	x	x
	30%	Sep 6	Nov 6	x
	35%	Jun 19	Sep 6	Oct 31

3. 20% Imp. + JNJ

Immunity Required for Herd Immunity

		60%	70%	80%
Natural Immunity	25%	Jul 21	Aug 9	Aug 24
	30%	Jun 27	Jul 18	Aug 3
	35%	Jun 5	Jun 27	Jul 14

4. Add Both Vaccines & 20% Imp.

Immunity Required for Herd Immunity

		60%	70%	80%
Natural Immunity	25%	Jun 6	June 13	Jun 19
	30%	May 17	Jun 14	Jun 11
	35%	May 4	May 13	Jun 2

Herd Immunity Model – Overall Thoughts

With the President's accelerated vaccination target and the anticipated approval of the JNJ vaccine, herd immunity may be achieved in July. Getting the AstraZeneca vaccine or improving the overall organization and pace could bring it sooner

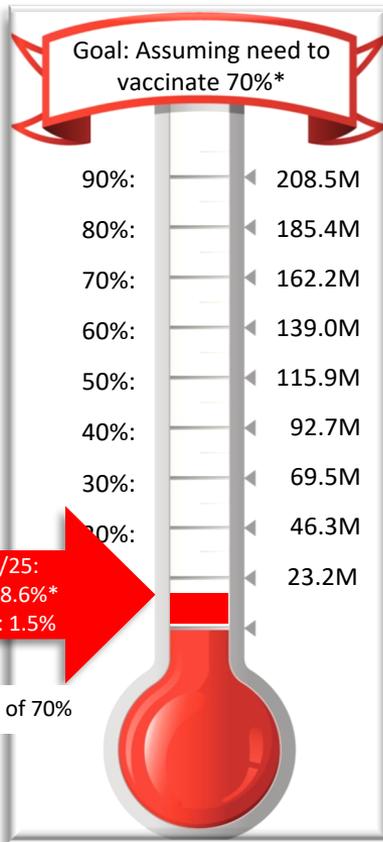
- Herd immunity is highly sensitive to estimates of both the immunity level required and the natural immunity level reached via infections – modifying either assumption can shift the herd immunity date by 1-2 weeks
- President Biden's new target of 150 million doses in his first 100 days appears to accelerate herd immunity by about a month
- The JNJ vaccine, however, is crucial to achieving targeted vaccination levels and accelerates herd immunity by about two months
- With the improved pace of vaccinations and anticipated JNJ vaccine, herd immunity could occur in July
- Adding the AstraZeneca vaccine – assuming strong efficacy – could accelerate reaching herd immunity to early- to mid-June
- By spring, unless a new variant(s) causes infections to surge again, several modelers (Gu, IHME, the ensemble forecast) suggest the US will be seeing relatively few new infections. There is a risk that low infection rates may prematurely discourage people from seeking vaccination

These results are provided for illustration purposes only and are intended to suggest the directional impact of various assumptions and scenarios.
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Vaccine Tracking

As of yesterday, about 23.5 million doses were reportedly administered. There were 1.1 million doses administered yesterday and an average of 1.3 million daily over the past four days. At least 3.3 million people have received two doses



Vaccination: Phase 1a Progress

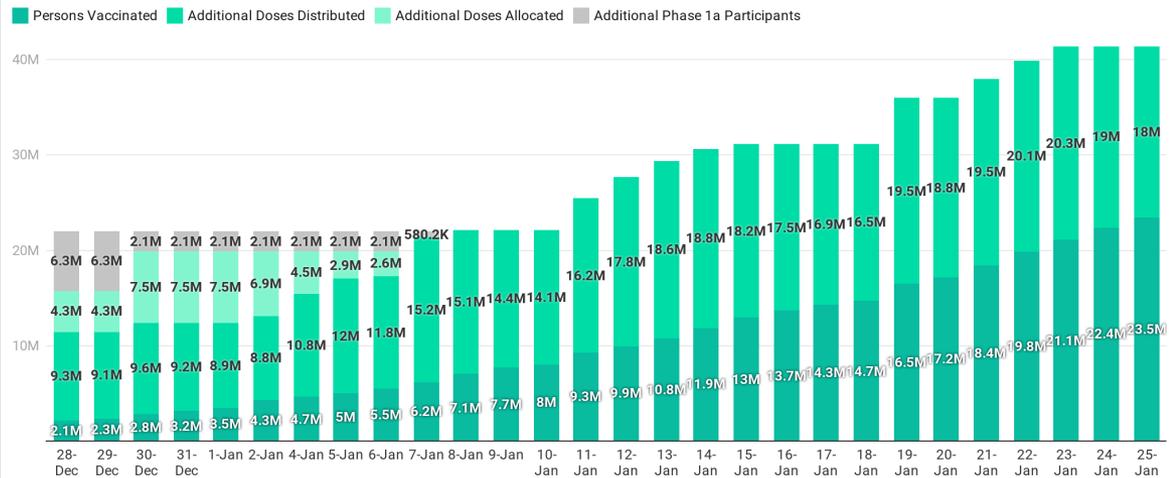


Chart: Health Industry Advisor LLC - Source: CDC, Bloomberg - Created with Datawrapper

From the CDC vaccine webpage: "Healthcare providers report doses to state, territorial, and local public health agencies up to 72 hours after administration. There may be additional reporting lag for data to be transmitted from the state, territorial, or local public health agency to CDC."

Vaccine data from: [Centers for Disease Control and Prevention](#) and [Bloomberg Vaccine Tracker](#)

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Testing Results - US

The 7-day average test volume has receded recently. Nonetheless, the test-positive rate for the day and the past week showed solid improvement

Tests / Million / Day (US)

As of January 25

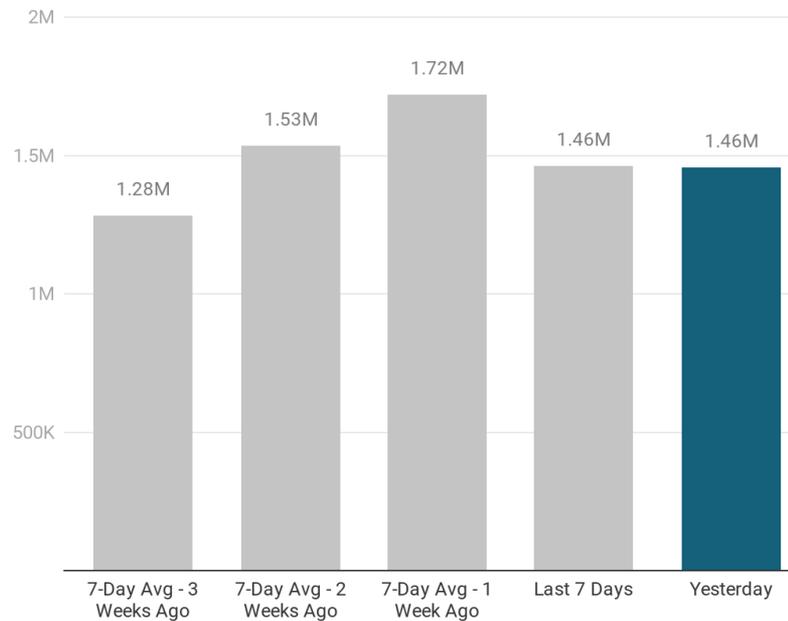


Chart: Health Industry Advisor LLC • Source: The Atlantic • Created with Datawrapper

Test-Positivity Rate

As of January 25

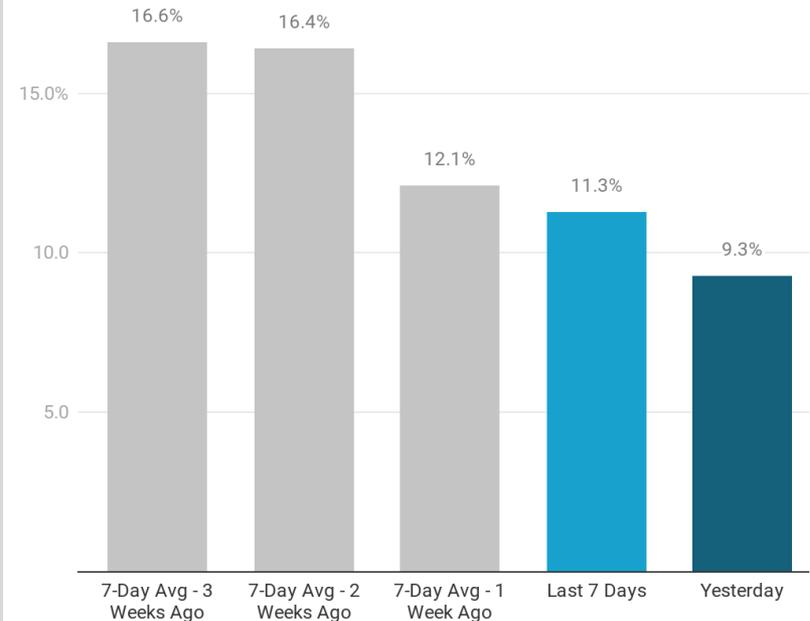


Chart: Health Industry Advisor LLC • Source: The Atlantic • Created with Datawrapper

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Two Models of Estimated Daily Infections

Models from both Youyang Gu and the Yale School of Public Health suggest that new infections may have peaked, following nearly three-month surge. Gu estimates these peaked on December 24; Yale on December 31. By comparison, the 7-day new case rate peaked on January 4-11

- Two models:
- Youyang Gu: <https://covid19-projections.com>
- Yale School of Public Health: <https://covidestim.org>
- Gu model lags by two weeks

Estimated Daily Infections v. Detected Cases

Gu & Yale School of Public Health Models

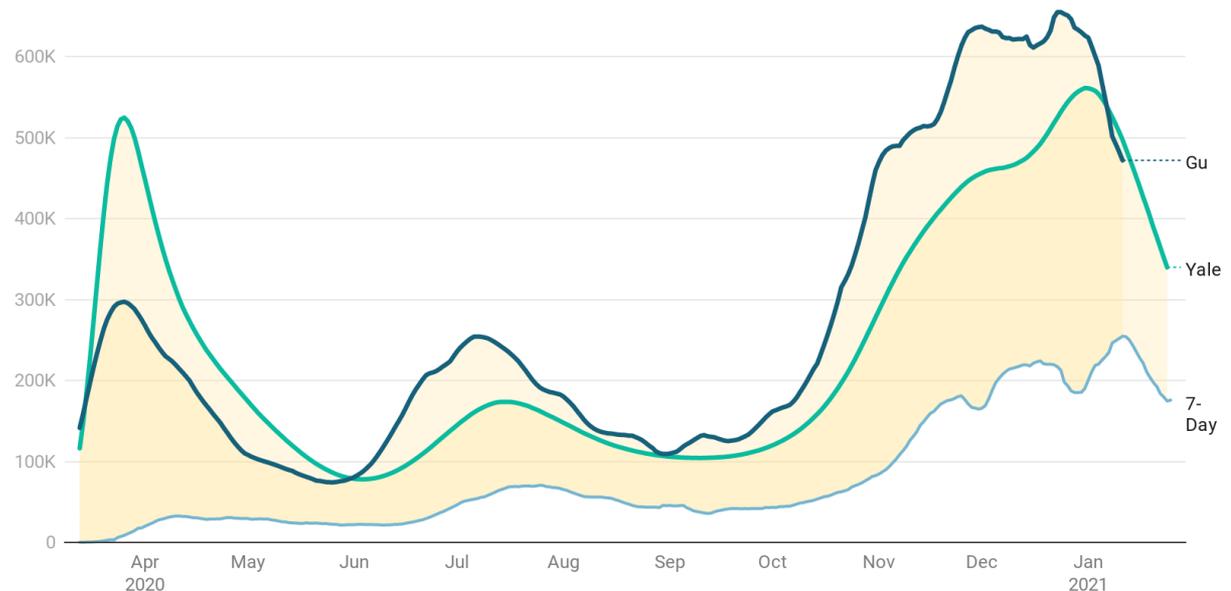


Chart: Health Industry Advisor LLC • Source: Youyang Gu, Yale School of Public Health • Created with Datawrapper

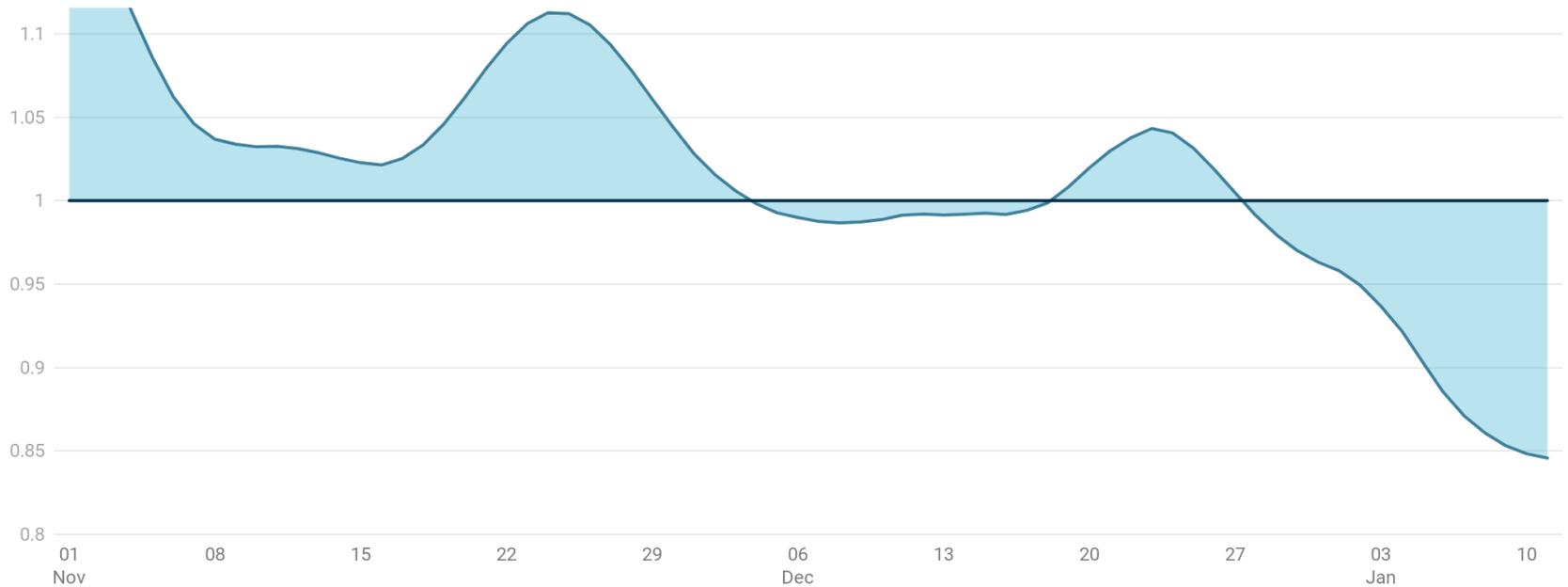
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Reproduction Rate (R_t) – Gu* Model

Gu's estimate of R_t continues to decline and has been below 1.0 for fifteen successive days. The most-recent estimate is lower than it has been since May 2. Notably, the recent peaks occurred two days before Thanksgiving and Christmas

Reproduction Rate (R_t) - US

Youyang Gu Estimate, November 1, 2020 - January 11, 2021

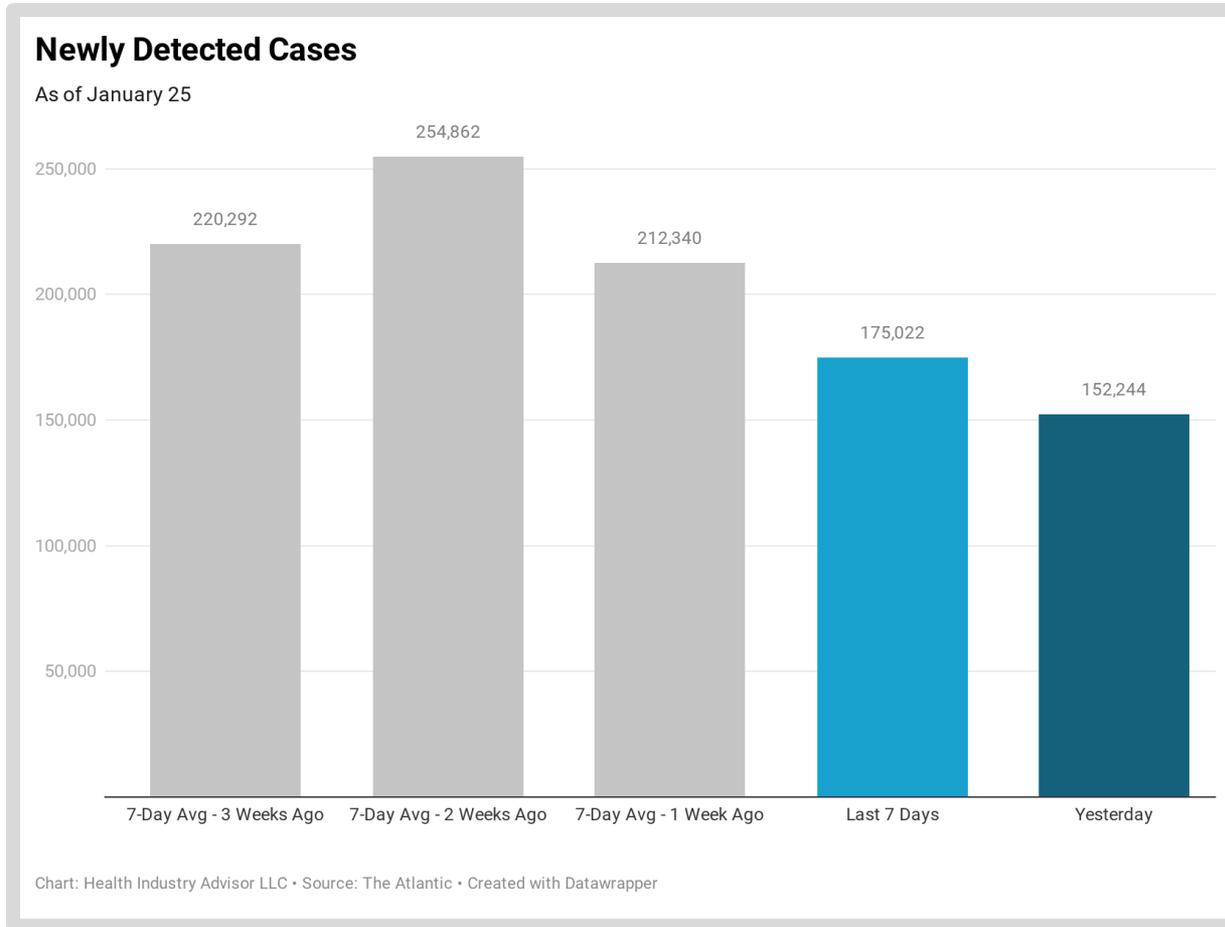


R_t is an estimate of how many additional people a single person will infect

Chart: Health Industry Advisor LLC • Source: Youyang Gu • Created with Datawrapper

Newly Detected Cases Per Day

Reported new cases in the US yesterday were low, typical for a Monday. Still, new cases for the past week dropped significantly from comparable periods from the prior three weeks – even the periods that included Christmas and New Year’s Eve.



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Covid-19 Hospitalizations

Hospitalizations have declined seventeen of the past nineteen days, dropping more than 17%% in that time. Yesterday's Covid-19 census lower than the same day-of-week each of the prior four weeks

Hospitalized Covid-19 Patients

Compared to Same Day, Prior Weeks, As of January 25

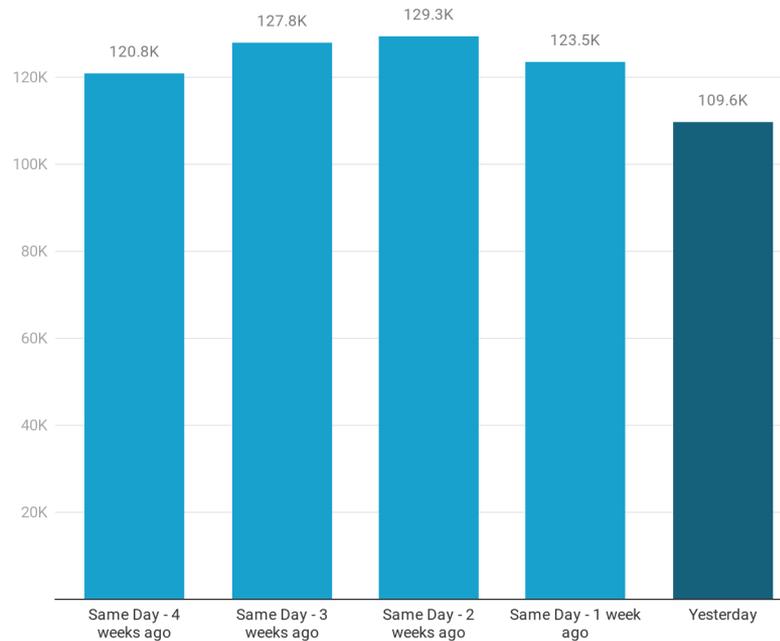


Chart: Health Industry Advisor LLC • Source: The Atlantic • Created with Datawrapper

% in ICU - Hospitalized Covid-19 Patients

Compared to Same Day, Prior Weeks, As of January 25

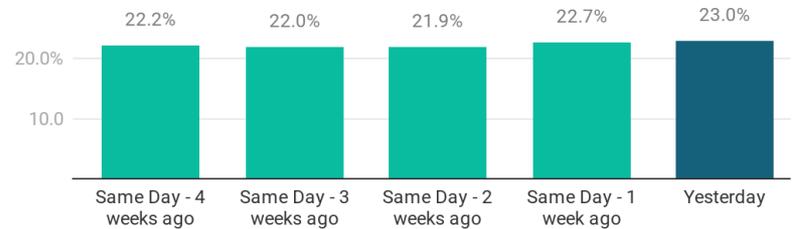
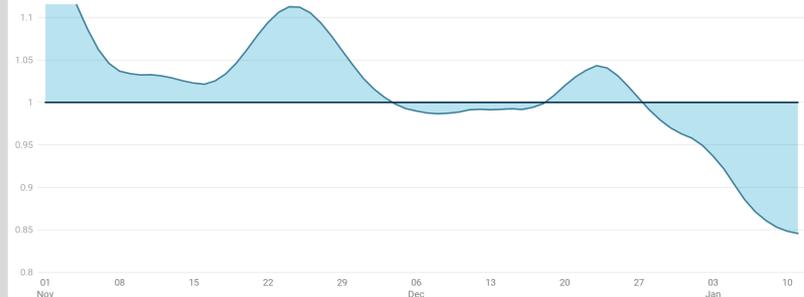


Chart: Health Industry Advisor LLC • Source: The Atlantic • Created with Datawrapper

Reproduction Rate (Rt) - US

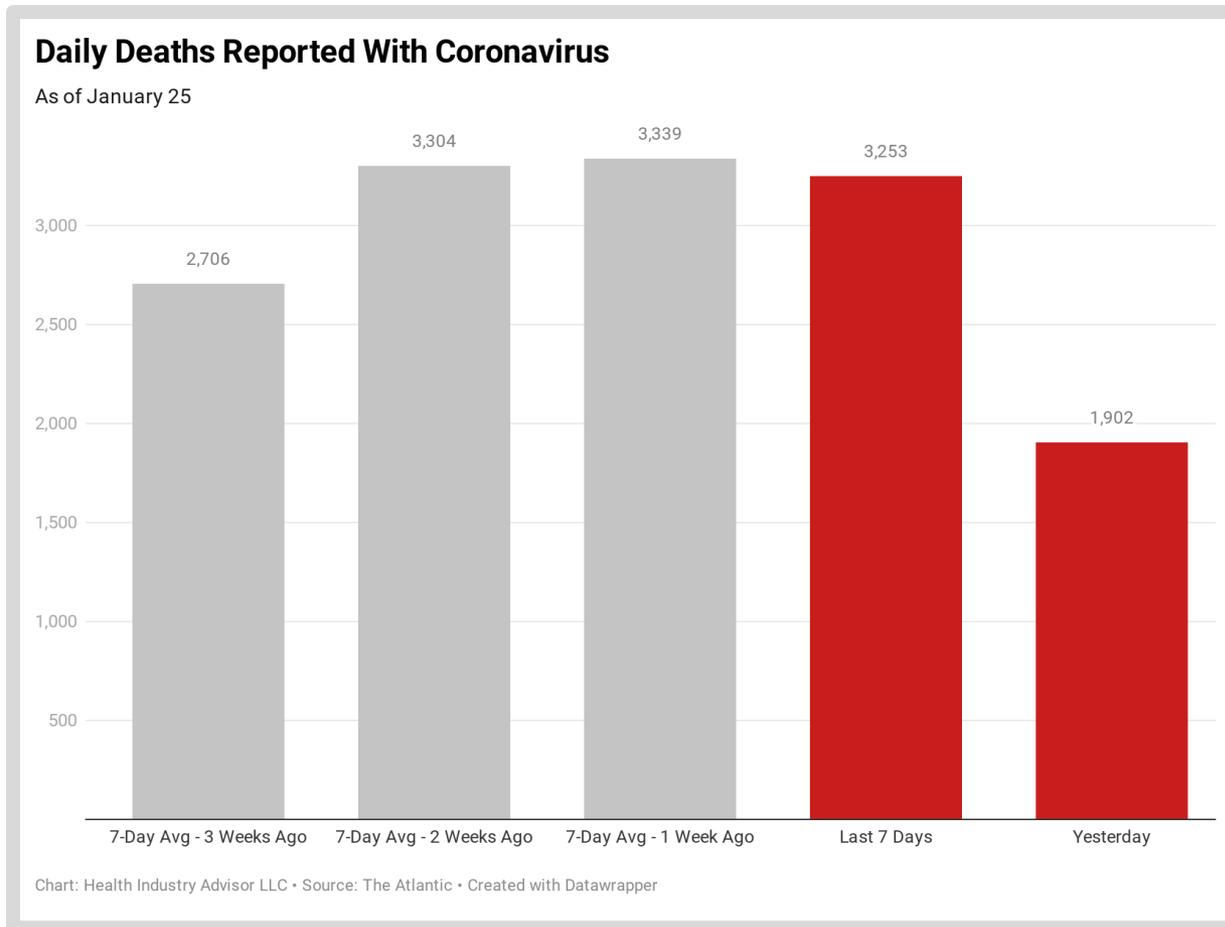
Youyang Gu Estimate, November 1, 2020 - January 11, 2021



Rt is an estimate of how many additional people a single person will infect
Chart: Health Industry Advisor LLC • Source: Youyang Gu • Created with Datawrapper

Deaths Reported With Coronavirus

Typically for a Monday, there were fewer deaths reported with coronavirus than on recent days. The 7-day average death rate was slightly lower than each of the prior two comparable 7-day periods



Sources

The following data sources are accessed on a daily or weekly basis

- The Atlantic’s Covid Tracking Project: <https://covidtracking.com>
- Worldometers.info: <https://www.worldometers.info/coronavirus/>
- Centers for Disease Control and Prevention, National, Regional, and State Level Outpatient Illness and Viral Surveillance <https://gis.cdc.gov/grasp/fluview/fluportaldashboard.html>
- Centers for Disease Control and Prevention, COVID-19 Laboratory-Confirmed Hospitalizations https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html
- Centers for Disease Control and Prevention, COVID Data Tracker <https://www.cdc.gov/covid-data-tracker/index.html#mobility>
- Centers for Disease Control and Prevention, Vaccines, <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/index.html>
- Institute for Health Metrics and Evaluation, COVID-19 estimate downloads <http://www.healthdata.org/covid/data-downloads>
- New York Times, Covid-19 data <https://github.com/nytimes/covid-19-data>
- COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University <https://github.com/CSSEGISandData/COVID-19>
- COVID-19 Projections Using Machine Learning, <https://covid19-projections.com>
- Covid-19 Forecast Hub, <https://viz.covid19forecasthub.org>
- Oliver Wyman Pandemic Navigator, <https://pandemicnavigator.oliverwyman.com/forecast?mode=country®ion=United%20States&panel=mortality>
- [Rt.live](https://rt.live)
- Yale School of Public Health & Harvard TH Chan School of Public Health, <https://covidestim.org>
- Bloomberg Vaccine Trackers, <https://www.bloomberg.com/graphics/covid-vaccine-tracker-global-distribution/?sref=Z0b6TmHW>