CDC COVID-19 Vaccine Effectiveness Studies

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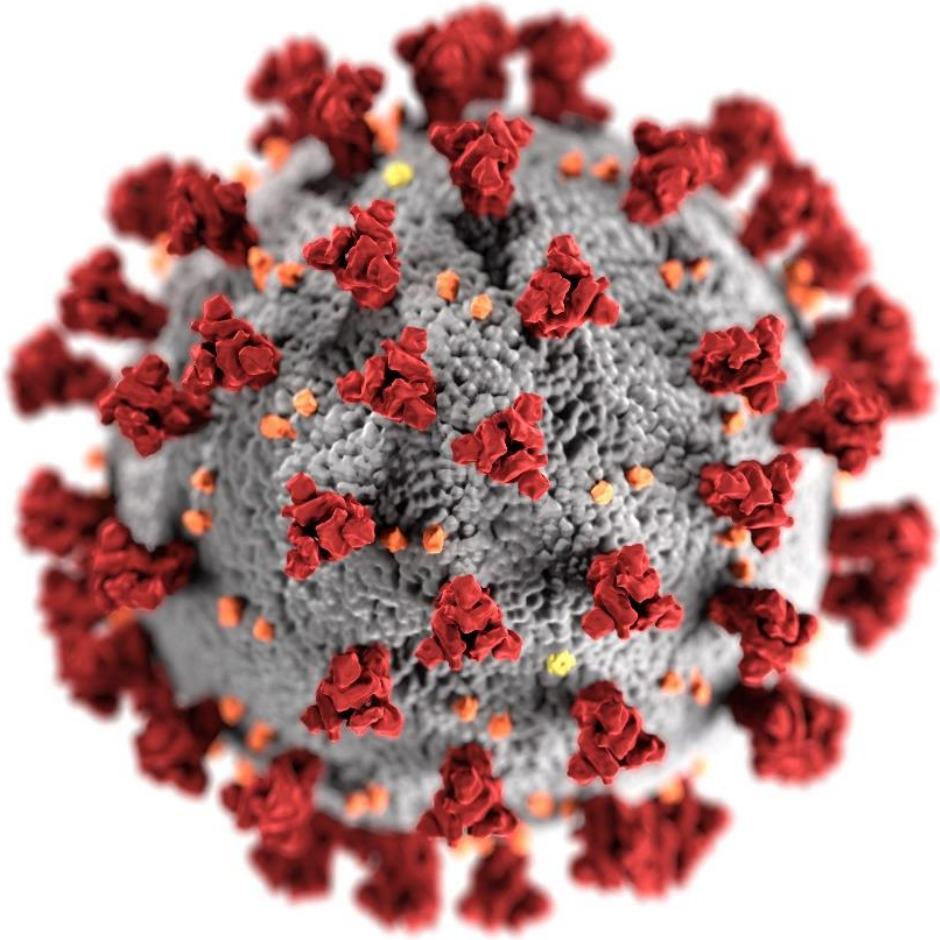
COVID-19 Response

May 12, 2021



cdc.gov/coronavirus

Need for post-authorization vaccine effectiveness (VE) estimates

- Real-world effectiveness may differ from efficacy under trial conditions due to implementation differences in:
  - Adherence to cold chain requirements
  - Broader population eligible to receive the vaccine
  - For 2-dose regimens, timing and coverage of second dose

- Build on evidence from clinical trials, specifically for:
  - Groups experiencing disproportionate impact of COVID-19
  - Severe disease
  - SARS-CoV-2 infection and transmission
  - Duration of protection

CDC COVID-19 VE policy priorities: results of internal and external input

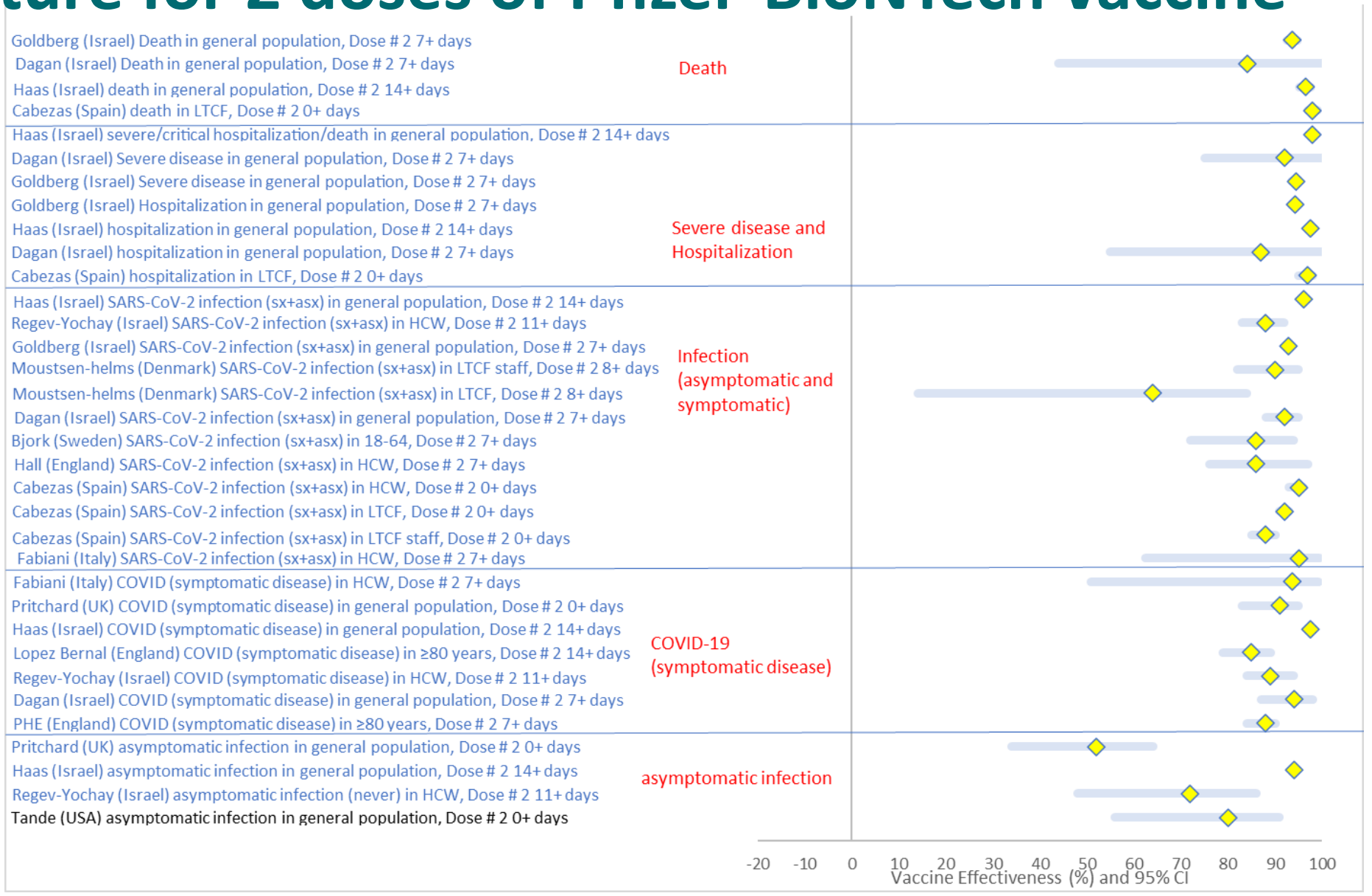
Timeline after introduction	Priority
Immediate	• Does vaccine protect against symptomatic disease as expected?
Subsequent	• VE against key outcomes ▪ Severe disease ▪ Non-severe disease ▪ Infection and transmission • VE in groups experiencing disproportionate impact of COVID-19 ▪ Adults aged ≥65 years, including those in long-term care facilities (LTCFs) ▪ People with key underlying conditions (e.g., immunocompromising conditions, obesity, diabetes) ▪ Racial and ethnic minority groups experiencing disproportionate impact • VE for regimen-related questions for 2 dose products ▪ Single-dose and prolonged intervals; mixed-dose schedules (>1 product) • Viral evolution: Do genome changes impact VE?
Later stage	• Duration of protection • Comparison of VE across products

COVID-19 mRNA vaccine effectiveness literature globally

COVID-19 mRNA VE literature caveats

- The literature is rapidly evolving and growing exponentially.
- Wide variety of methods, populations, definitions are used.
- Most literature is currently in pre-print form, with few peer-reviewed publications.
- Quality varies widely.
- Meta-analyses and formal comparisons are not appropriate at this time due to these caveats.

VE literature for 2 doses of Pfizer-BioNTech vaccine



Purple font=in context of P1
Black font=in context of non VOCs
Blue font=in context of B.1.1.7

Figure courtesy of Dr. Minal Patel, World Health Organization, Individual studies results only, VOC=variant of concern

VE literature for 2 doses of mRNA vaccine

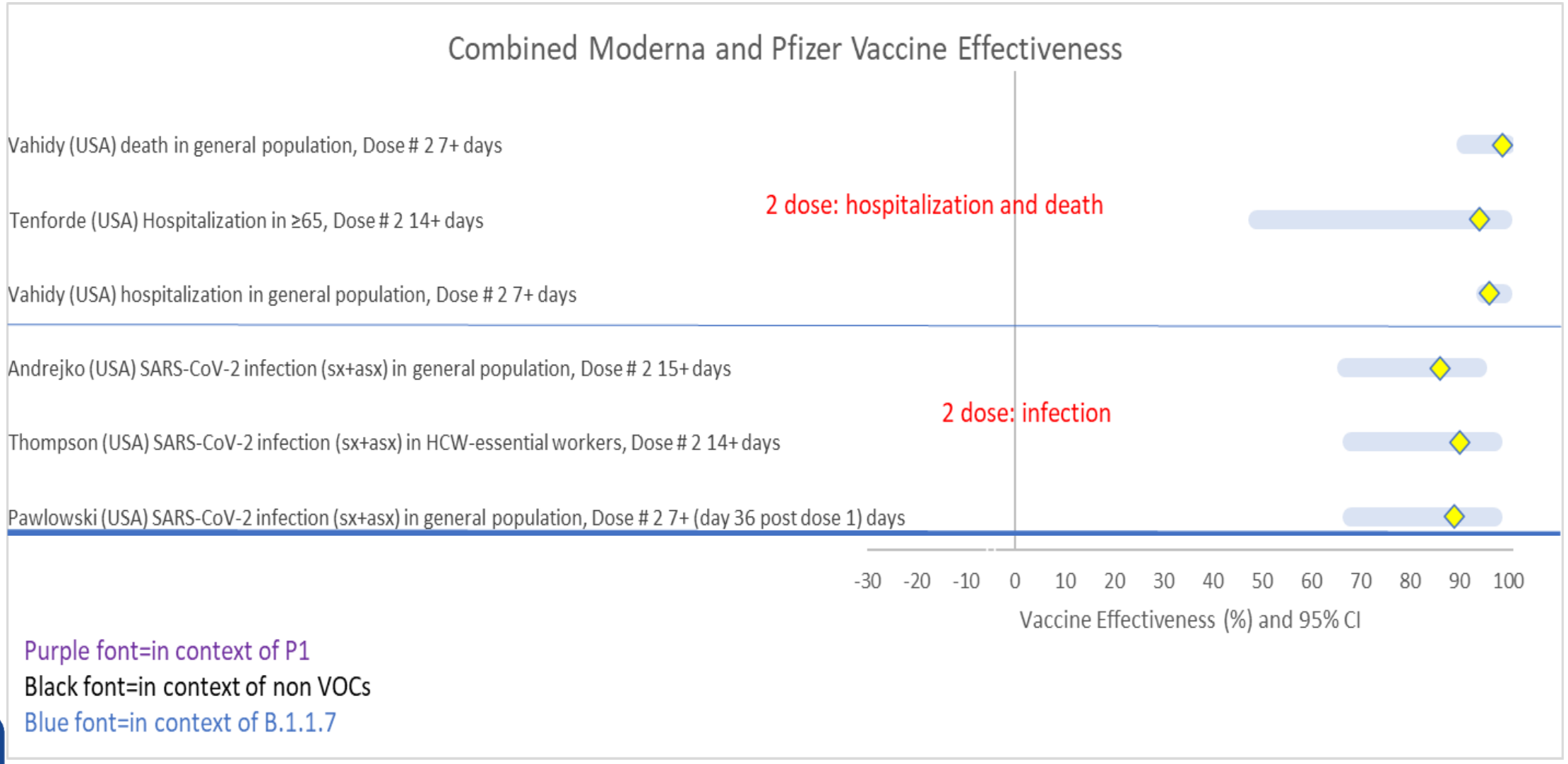


Figure courtesy of Dr. Minal Patel, World Health Organization, Individual studies results only, VOC=variant of concern

CDC vaccine effectiveness studies: Published literature

Morbidity and Mortality Weekly Report (*MMWR*)

CDC

Effectiveness of the Pfizer-BioNTech COVID-19 Vaccine Among Residents of Two Skilled Nursing Facilities Experiencing COVID-19 Outbreaks — Connecticut, December 2020–February 2021

Weekly / March 19, 2021 / 70(11);396–401

On March 15, 2021, this report was posted online as an MMWR *Early Release.*

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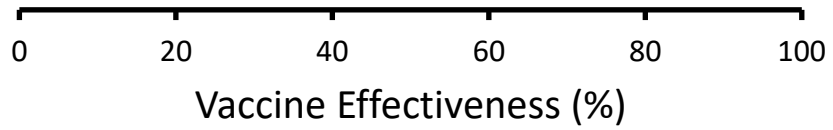
https://www.cdc.gov/mmwr/volumes/70/wr/mm7011e3.htm?s_cid=mm7011e3_w

VE against infection among residents of 2 skilled nursing facilities

COVID-19 immunization status with Pfizer-BioNTech vaccine	Vaccine effectiveness against infection % (95% confidence interval [CI])
Partially immunized: ≥14 days after first dose through dose 2 + 7 days	63 (33–79)
Partially immunized with exclusion of prior SARS-CoV-2 infection	60 (30–77)
Partially immunized: ≥14 days after first dose through dose 2 + 0 days	66 (29–83)
Partially immunized: ≥14 days after first dose through dose 2 + 14 days	60 (33–77)



https://www.cdc.gov/mmwr/volumes/70/wr/mm7011e3.htm?s_cid=mm7011e3_w

Morbidity and Mortality Weekly Report (*MMWR*)

CDC

Interim Estimates of Vaccine Effectiveness of BNT162b2 and mRNA-1273 COVID-19 Vaccines in Preventing SARS-CoV-2 Infection Among Health Care Personnel, First Responders, and Other Essential and Frontline Workers — Eight U.S. Locations, December 2020–March 2021

Weekly / April 2, 2021 / 70(13);495–500

On March 29, 2021, this report was posted online as an MMWR *Early Release.*

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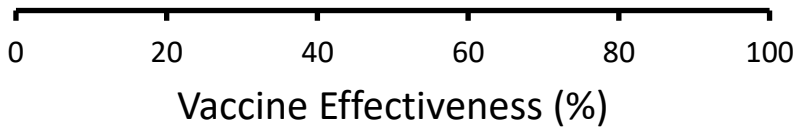
https://www.cdc.gov/mmwr/volumes/70/wr/mm7013e3.htm?s_cid=mm7013e3_w

Interim VE against infection

COVID-19 immunization status with mRNA vaccines	Adjusted vaccine effectiveness against infection*,† % (95% confidence interval [CI])
Partially immunized (≥14 days after dose 1 through receipt of dose 2)	80 (59–90)
Fully immunized (≥14 days after dose 2)	90 (68–97)



* Vaccine effectiveness was estimated using a Cox proportional hazards model accounting for time-varying immunization status.
† Hazard ratio is adjusted for study site

https://www.cdc.gov/mmwr/volumes/70/wr/mm7013e3.htm?s_cid=mm7013e3_w

Morbidity and Mortality Weekly Report (*MMWR*)

CDC

Effectiveness of Pfizer-BioNTech and Moderna Vaccines Against COVID-19 Among Hospitalized Adults Aged ≥65 Years — United States, January–March 2021

Early Release / April 28, 2021 / 70

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https://www.cdc.gov/mmwr/volumes/70/wr/mm7018e1.htm?s_cid=mm7018e1_w

Interim VE against hospitalization among adults aged ≥65 years

COVID-19 immunization status with mRNA vaccines	Adjusted vaccine effectiveness against hospitalization % (95% confidence interval [CI])
Full vaccination	94 (44–99)
Partial or full vaccination	71 (44–85)
Partial vaccination	64 (28–82)

https://www.cdc.gov/mmwr/volumes/70/wr/mm7018e1.htm?s_cid=mm7018e1_w

Morbidity and Mortality Weekly Report (*MMWR*)

CDC

COVID-19 Outbreak Associated with a SARS-CoV-2 R.1 Lineage Variant in a Skilled Nursing Facility After Vaccination Program — Kentucky, March 2021

Weekly / April 30, 2021 / 70(17);639-643

On April 21, 2021, this report was posted online as an MMWR *Early Release.*

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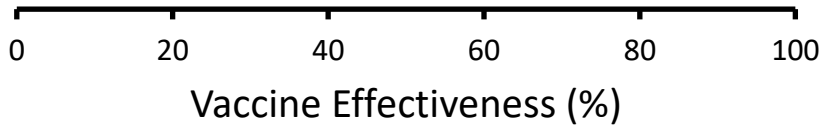
View suggested citation

https://www.cdc.gov/mmwr/volumes/70/wr/mm7017e2.htm?s_cid=mm7017e2_w

VE against symptomatic disease in a Kentucky skilled nursing facility with a SARS-CoV-2 R.1 lineage variant outbreak

COVID-19 immunization status with Pfizer-BioNTech vaccine	Adjusted vaccine effectiveness against symptomatic disease % (95% confidence interval [CI])
Residents who were fully immunized (≥14 days after dose 2)	87 (66–95)
Healthcare personnel who were fully immunized (≥14 days after dose 2)	87 (46–97)



https://www.cdc.gov/mmwr/volumes/70/wr/mm7017e2.htm?s_cid=mm7017e2_w

Additional ongoing CDC VE assessments

Current VE assessments

VE priority	Prospective data collection	Electronic health record (EHR) and claims analyses (coordination across US gov)
Immediate priority		
Does vaccine work as expected to prevent symptomatic disease?	Test-negative design case-control among healthcare personnel	
Subsequent priorities		
Older adults, including residents of long-term care facilities (LTCFs)	Case-control among adults ≥65 years (COVID-NET linked to CMS); National Healthcare Safety Network (NHSN)	CMS cohort (FDA, CMS) EHR data sets (CDC, VA, FDA)
Infection and transmission	Prospective longitudinal cohorts, including among healthcare personnel and frontline workers; case-ascertained household cohorts for transmission	
Severe disease/hospitalization	Test-negative design (for adults and children); conventional case-control using hospitalized controls; screening method	EHR data sets (CDC, VA, FDA); retrospective cohort or test-negative design
Non-severe disease	Test-negative design among outpatients	Potentially using EHR data sets
Those with key underlying conditions (e.g., immunocompromised)	Captured in above studies	CMS (FDA, CMS); EHR data sets (CDC, VA, FDA)
Racial and ethnic groups disproportionately affected by COVID-19	Captured in above studies; test-negative design in American Indian and Alaska Native populations	CMS (FDA, CMS); EHR data sets (CDC, VA, FDA); exploring IHS EHR (IHS)
Vaccine impact	Ecologic analyses of disease incidence/seroprevalence and vaccination coverage; comparisons of expected vaccine impact from models with observed impact	

Current VE assessments including children

VE priority	Prospective data collection	Electronic health record (EHR) and claims analyses (coordination across US gov)
Immediate priority		
Does vaccine work as expected to prevent symptomatic disease?	Test-negative design case-control among healthcare personnel	
Subsequent priorities		
Older adults, including residents of long-term care facilities (LTCFs)	Case-control among adults ≥65 years (COVID-NET linked to CMS); National Healthcare Safety Network (NHSN)	CMS cohort (FDA, CMS) EHR data sets (CDC, VA, FDA)
Infection and transmission	Prospective longitudinal cohorts, including among healthcare personnel and frontline workers; case-ascertained household cohorts for transmission	
Severe disease/hospitalization	**Test-negative design (for adults and children);** conventional case-control using hospitalized controls; **screening method**	**EHR data sets** (CDC, VA, FDA); retrospective cohort or test-negative design
Non-severe disease	**Test-negative design among outpatients**	Potentially using EHR data sets
Those with key underlying conditions (e.g., immunocompromised)	Captured in above studies	CMS (FDA, CMS); EHR data sets (CDC, VA, FDA)
Racial and ethnic groups disproportionately affected by COVID-19	Captured in above studies; **test-negative design in American Indian and Alaska Native populations**	CMS (FDA, CMS); EHR data sets (CDC, VA, FDA); exploring IHS EHR (IHS)
Vaccine impact	Ecologic analyses of disease incidence/seroprevalence and vaccination coverage; comparisons of expected vaccine impact from models with observed impact	

OVERCOMING2: VE against COVID-19 or Multisystem Inflammatory Syndrome in Children (MIS-C) among hospitalized children <19 years

- Based on an intensive care unit (ICU) network assessing influenza VE against critical illness in pediatric patients (aged <19 years)
- During 2020: Overcoming enrolled all MIS-C patients and ICU patients with COVID-19 at ~57 US pediatric hospitals
- Primary objectives:
    - VE against any hospitalized COVID-19 and MIS-C
        - Two control groups (test-negative acute respiratory illness and non-acute respiratory illness hospitalizations)
    - VE by subgroup: variant, vaccine type, age, race/ethnicity, sex, time since vaccination, partial vaccination

Do viral genome changes impact VE?

- Selected prospective platforms will collect specimens from cases, where possible, for whole genome sequencing.
  - Will not be performed in real time
  - May not be powered for variant-specific VE assessments
- Vaccine evaluation unit is assessing vaccine breakthrough cases with hospitalization or death.
  - A collaboration with the Emerging Infections Program comparing the frequency of variants among vaccinated and unvaccinated persons may shed light.
- Work is part of broader CDC efforts to monitor the impact of SARS-CoV-2 variants.

Current VE assessments including genomic characterization

VE priority	Prospective data collection	Electronic health record (EHR) and claims analyses (coordination across US gov)
Immediate priority		
Does vaccine work as expected to prevent symptomatic disease?	Test-negative design case-control among healthcare personnel	
Subsequent priorities		
Older adults, including residents of long-term care facilities (LTCFs)	Case-control among adults ≥65 years (COVID-NET linked to CMS); National Healthcare Safety Network (NHSN)	CMS cohort (FDA, CMS) EHR data sets (CDC, VA, FDA)
Infection and transmission	**Prospective longitudinal cohorts, including among healthcare personnel and frontline workers;** case-ascertained household cohorts for transmission	
Severe disease/hospitalization	**Test-negative design (for adults and children); conventional case-control using hospitalized controls**; screening method	EHR data sets (CDC, VA, FDA); retrospective cohort or test-negative design
Non-severe disease	Test-negative design among outpatients	Potentially using EHR data sets
Those with key underlying conditions (e.g., immunocompromised)	Captured in above studies	CMS (FDA, CMS); EHR data sets (CDC, VA, FDA)
Racial and ethnic groups disproportionately affected by COVID-19	Captured in above studies; **test-negative design in American Indian and Alaska Native populations**	CMS (FDA, CMS); EHR data sets (CDC, VA, FDA); exploring IHS EHR (IHS)
Vaccine impact	Ecologic analyses of disease incidence/seroprevalence and vaccination coverage; comparisons of expected vaccine impact from models with observed impact	

Duration of protection from COVID-19 vaccines

- An important VE priority is to understand the duration of protection provided by COVID-19 vaccines.
  - This will inform the question about the need for a booster.
  - It is important to take into account changes in the circulating variants over time.

Current VE assessments including duration of protection

VE priority	Prospective data collection	Electronic health record (EHR) and claims analyses (coordination across US gov)
Immediate priority		
Does vaccine work as expected to prevent symptomatic disease?	Test-negative design case-control among healthcare personnel	
Subsequent priorities		
Older adults, including residents of long-term care facilities (LTCFs)	**Case-control among adults ≥65 years (COVID-NET linked to CMS);** National Healthcare Safety Network (NHSN)	CMS cohort (FDA, CMS) **EHR data sets (CDC, VA, FDA)**
Infection and transmission	**Prospective longitudinal cohorts, including among healthcare personnel and frontline workers;** case-ascertained household cohorts for transmission	
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Non-severe disease	**Test-negative design among outpatients**	Potentially using EHR data sets
Those with key underlying conditions (e.g., immunocompromised)	Captured in above studies	CMS (FDA, CMS); EHR data sets (CDC, VA, FDA)
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Vaccine impact	Ecologic analyses of disease incidence/seroprevalence and vaccination coverage; comparisons of expected vaccine impact from models with observed impact	

CDC VE assessments in outbreak settings

- Residents of long-term care facilities
- Incarcerated and detained persons and staff in corrections facilities

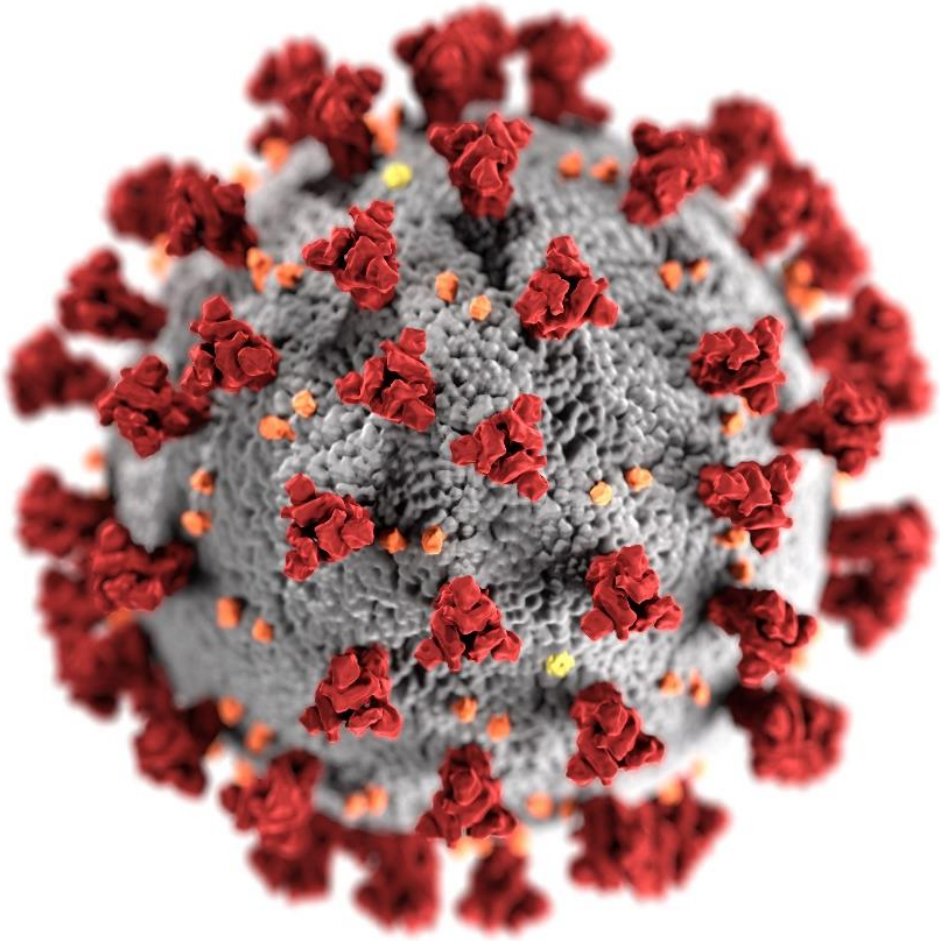
- Actively looking for COVID-19 outbreaks in congregate settings to assess:
  - Variant-specific VE
  - VE for Johnson & Johnson's Janssen vaccine
  - VE among adolescents and children once eligible for vaccine

Conclusion

- Initial COVID-19 VE estimates from recently published reports are demonstrating remarkably consistent results across studies with a variety of methods and populations.
- There is an urgent need for VE data to guide vaccine policy.
- A broad approach, including a diversity of projects, methods, bias control, populations, and sample sizes strengthens our understanding of the true real-world performance of these vaccines.

Ensuring COVID-19 Vaccines Work:
https://www.cdc.gov/coronavirus/2019-ncov/vaccines/effectiveness.html

COVID-19 Vaccine Effectiveness Research:
https://www.cdc.gov/vaccines/covid-19/effectiveness-research/protocols.html



For more information, contact CDC
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TTY: 1-888-232-6348 www.cdc.gov

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