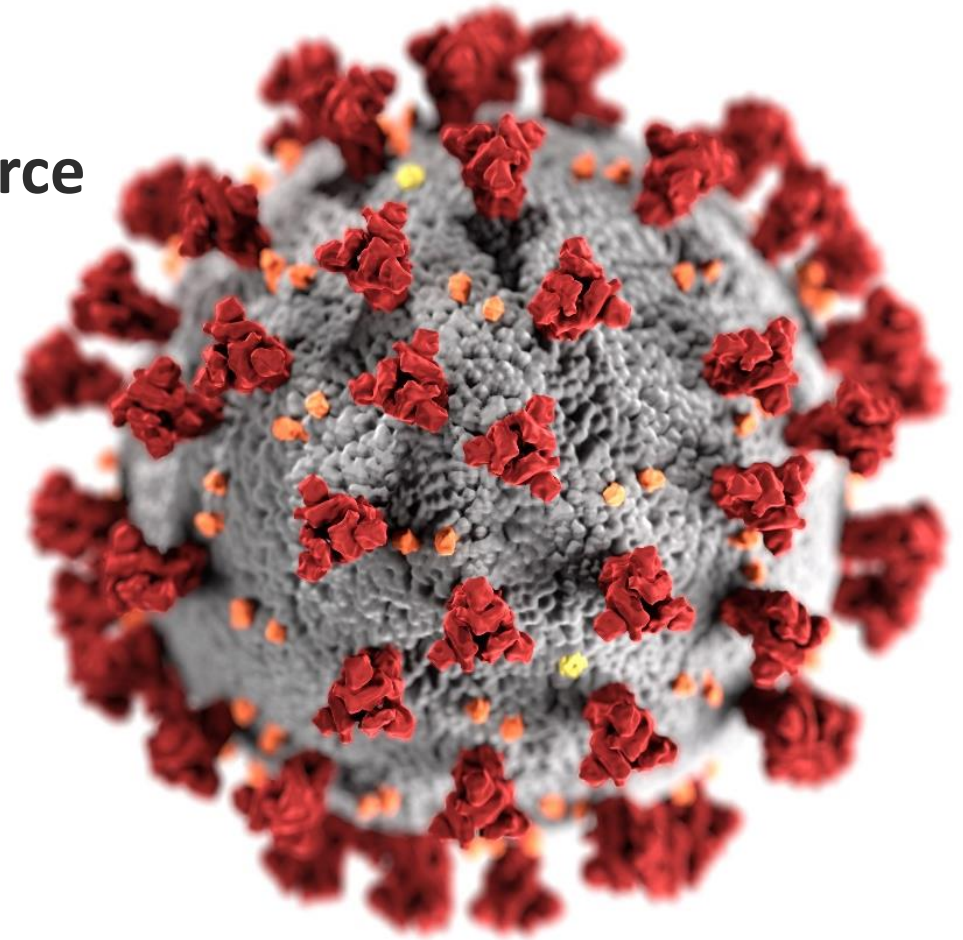


Modeling Strategies for the Initial Allocation of SARS-CoV-2 Vaccines

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Practices Meeting

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cdc.gov/coronavirus

Question

- What is the potential impact, in terms of preventing COVID-19 infections and deaths, of initially allocating vaccine to one of the following groups after vaccinating healthcare personnel in Phase 1A?
 - Adults aged 65+
 - Adults with high-risk medical conditions
 - Essential workers



Methods: Population



Population Stratification

- 5 Age Groups:
 - 0-4, 5-17, 18-49, 50-64, 65+ (~55 M nationally)
- Risk Status (within each adult age strata):
 - Low-risk
 - High-risk (having 1 or more select high-risk medical conditions)¹
 - COPD, heart disease, diabetes, kidney disease, or obesity
 - Prevalence of having 1+ condition estimated from BRFSS
 - ~40% of adults (100M nationally), increasing with age
 - Assume 3x higher risk of mortality upon infection relative to the low-risk group ²

¹ <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html>

² <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/evidence-table.html>

Population Stratification, continued

- Occupational Status
 - ~40% of adults aged 18-64 (80M nationally) classified as “essential workers”
 - Healthcare Personnel: 25% of essential workers (20M nationally)
 - Assume essential workers are only able to reduce their workplace contact rates 35% as much as other adults of the same age.
 - Varied from: 20% to 50% in sensitivity
- Baseline contact patterns:
 - Social contacts and mixing study, adjusted for the US (Prem 2017)
 - Stratified by age and setting (home, work, school, and other)

Methods: Vaccination



Vaccine Product Assumptions

- Full course: 2 doses given 28 days apart
- Vaccine Efficacy (VE)
 - Both doses: $VE = 70\%$
 - First dose: $VE = 17.5\%$ (1/4 of full protection)
 - Sensitivity analysis: reduced immunogenicity in adults aged 65+ (half of above)
 - $VE_{\text{age 65+}} = 8.75\%$ (first dose) and 35% (both doses)
- Protection from the first or second dose achieved 14 days following the vaccination

Vaccine: Completeness of Protection

- Every vaccinated person is partially protected
- Infection-Blocking
 - Protection against infection and onward transmission
 - If breakthrough infection, no attenuation of severity or transmission
- Disease-Blocking (Sensitivity Analysis)
 - No protection against infection or onward transmission
 - Reduced risk of severe disease if infected
- Assume no waning of immunity (naturally or vaccine-induced)

Vaccine Allocation Assumptions: Phase 1

Phase 1: Initial Vaccine Supply
200M Courses* Nationally



20M Courses

Phase 1A: Healthcare Personnel (HCP)



180M Courses

Phase 1B:
Adults Aged 65+
Adults with High-Risk Medical Condition
Essential Workers

* 1 course =
2 doses

Vaccine Allocation Assumptions: Phase 1B

**Phase 1B: Non-Healthcare Personnel Target
180M Courses* Nationally**



First 20M Courses

**Allocated exclusively to one of:
Adults Aged 65+
Adults with High-Risk Medical Condition
Essential Workers**



Wider Availability: 160M Courses

Remaining unvaccinated Phase 1B groups (see above)

* 1 course =
2 doses

Methods: Epidemic Dynamics



Epidemic Scenarios

- Percentage of the population infected 2 months prior to vaccine introduction= 15% (sensitivity analysis 5% & 20%)
- Future epidemic trajectories simulated using compartmental models with time-varying mitigation
- Outcomes (infections and deaths averted) compared 6 months following vaccine introduction

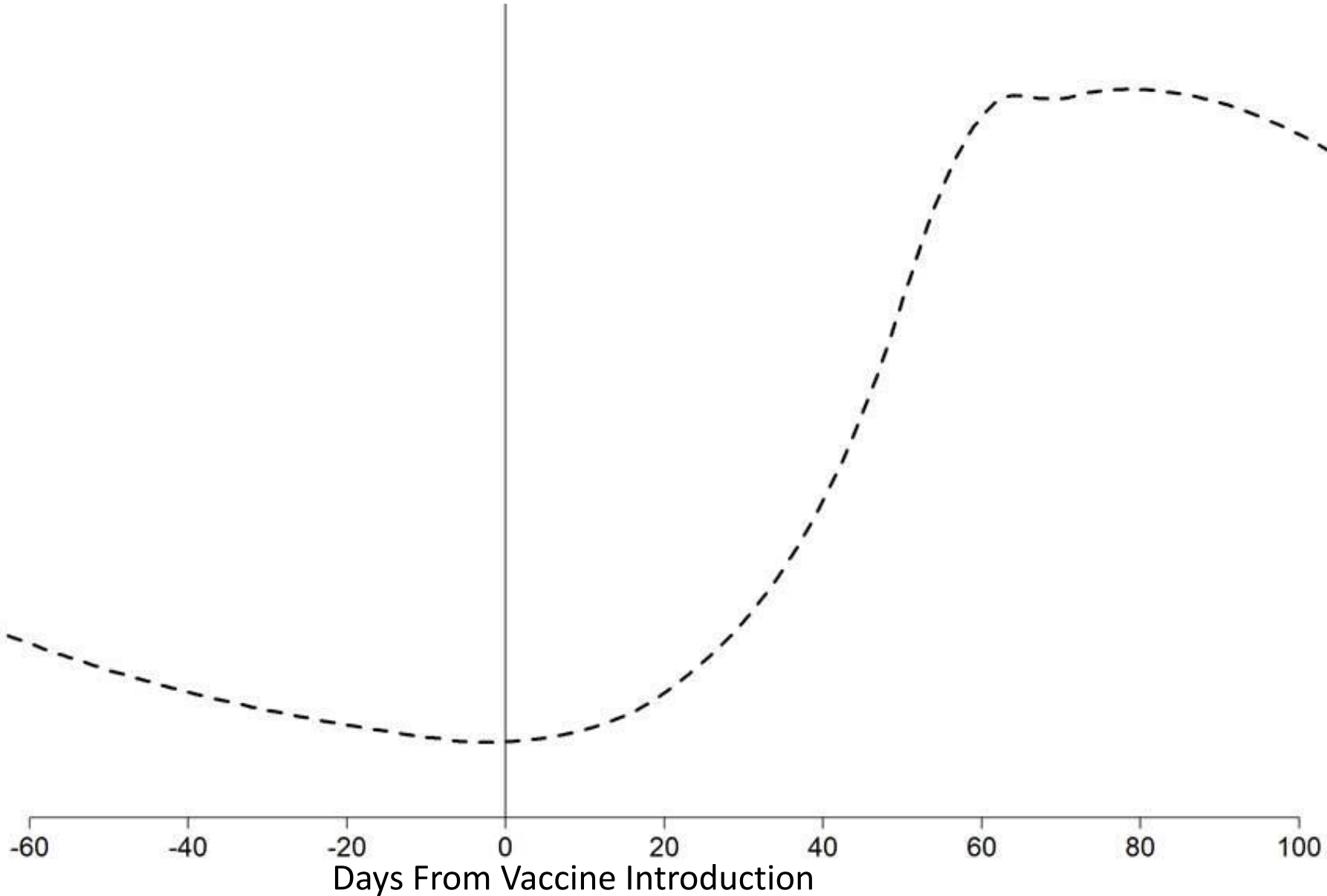


Administration Assumptions

- Assumed 100% of the individuals either vaccinated or not yet eligible for the second dose before moving to subsequent phases
- Vaccine administered regardless of infection history
- 10 million people can be vaccinated each week
 - Phase 1A and Phase 1B fully vaccinated in ~9 months
- Administration of second doses prioritized over first doses
- Timing of vaccine introduction (first administration) varied
 - Before rise in incidence
 - As incidence rises
 - As incidence falls

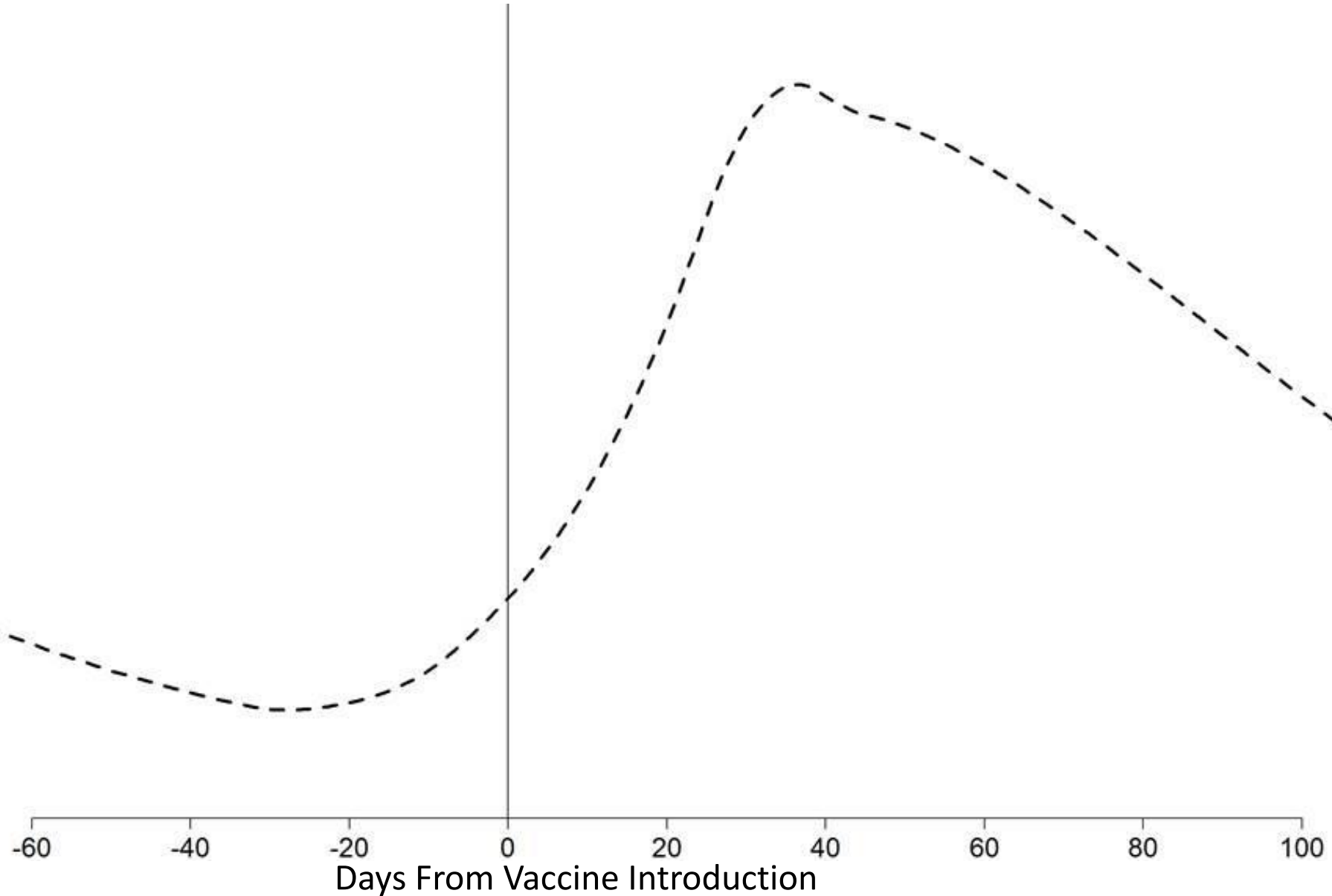
Vaccine Introduced Before Rise in Incidence

Incidence of SARS-CoV-2 Infections

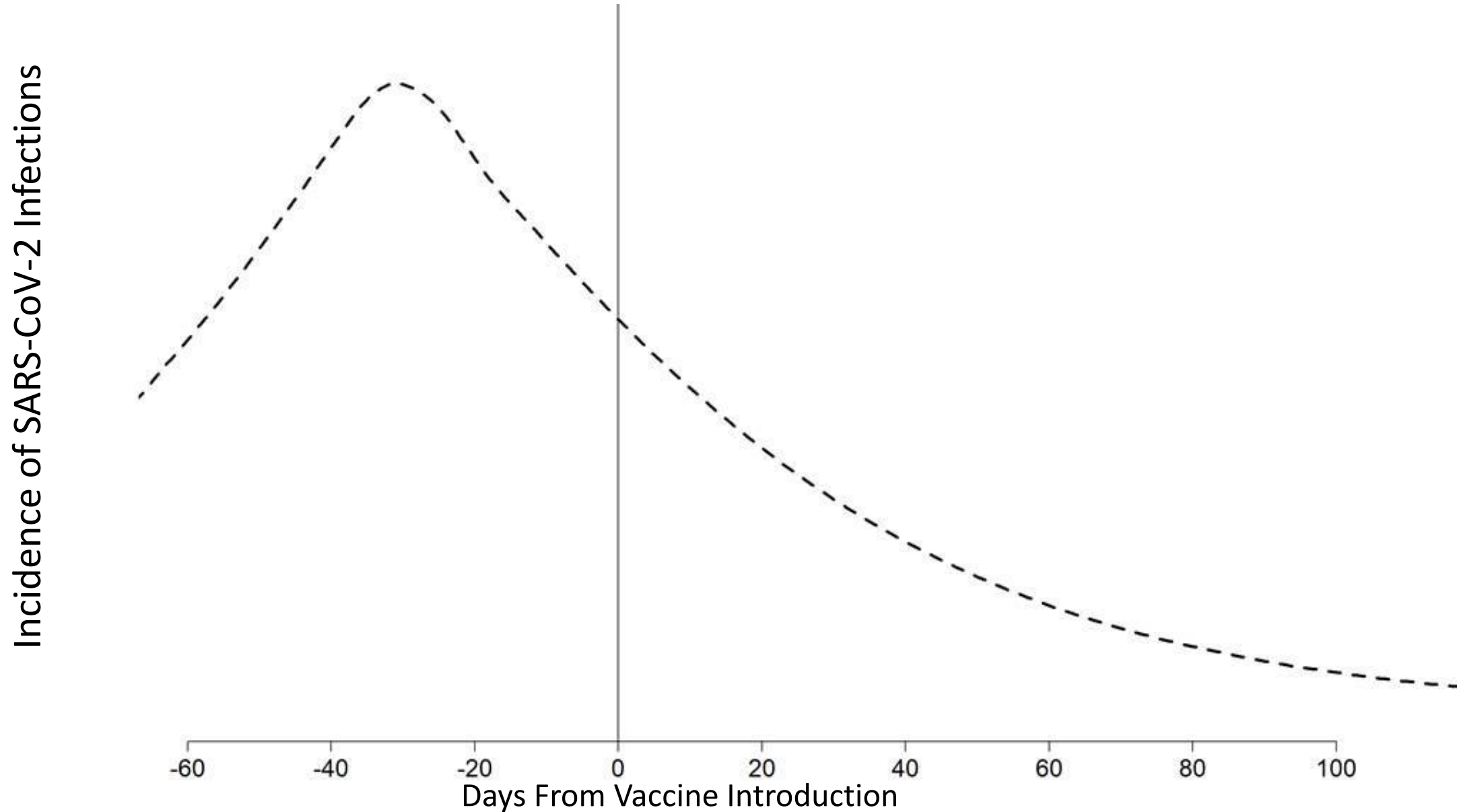


Vaccine Introduced as Incidence Rises

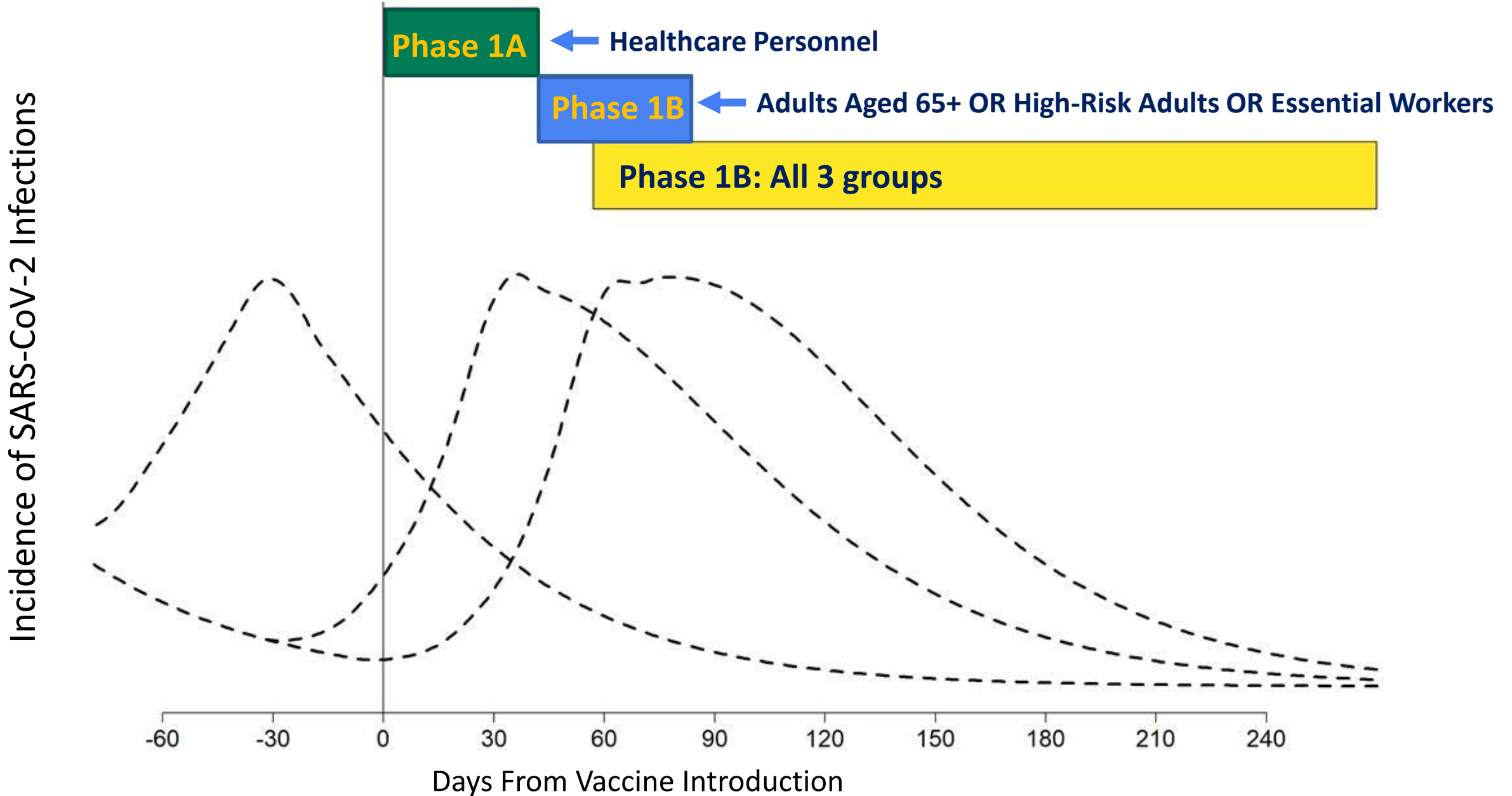
Incidence of SARS-CoV-2 Infections



Vaccine Introduced as Incidence Falls



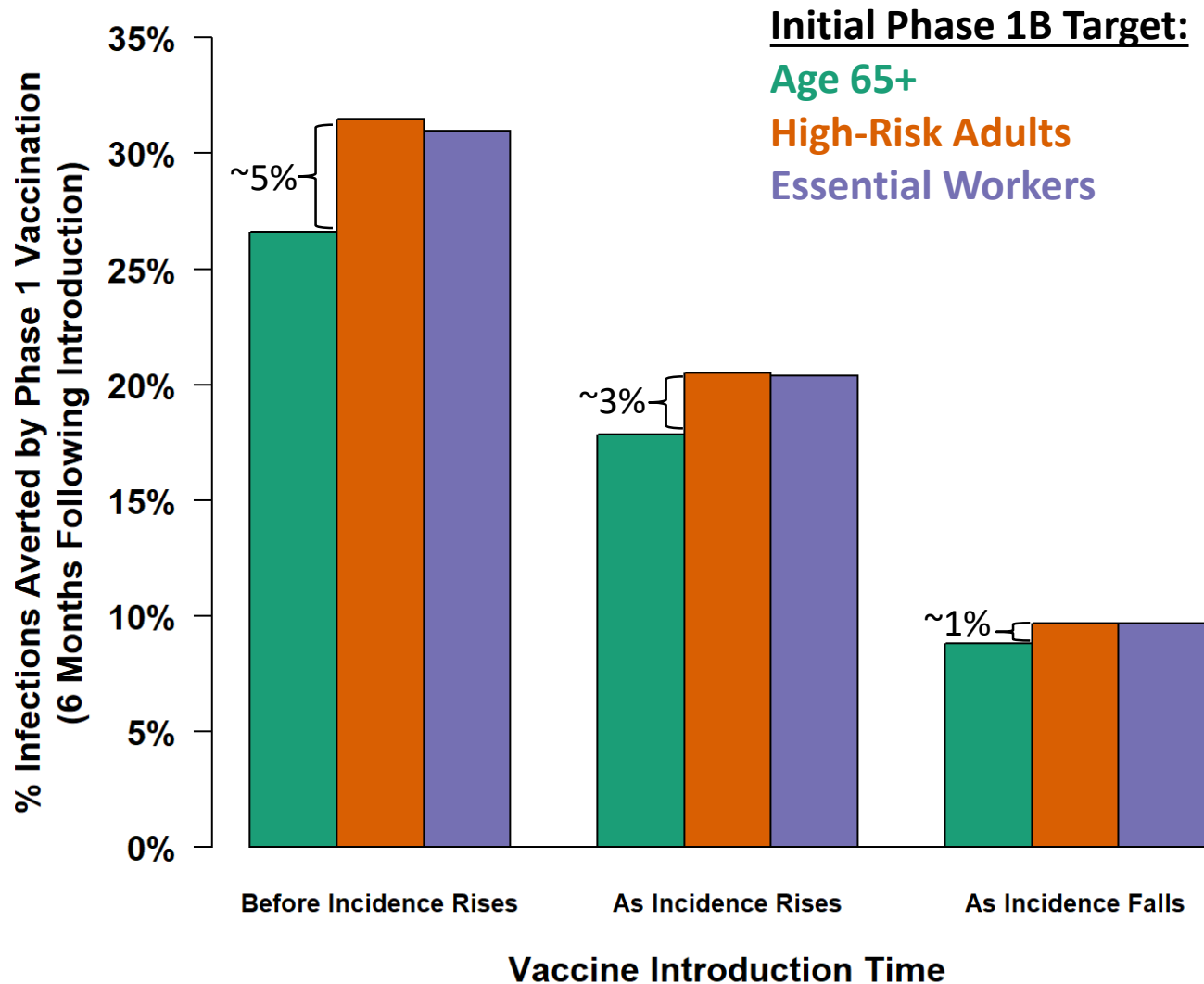
Approximate Timing of Vaccine Rollout in Context



Findings



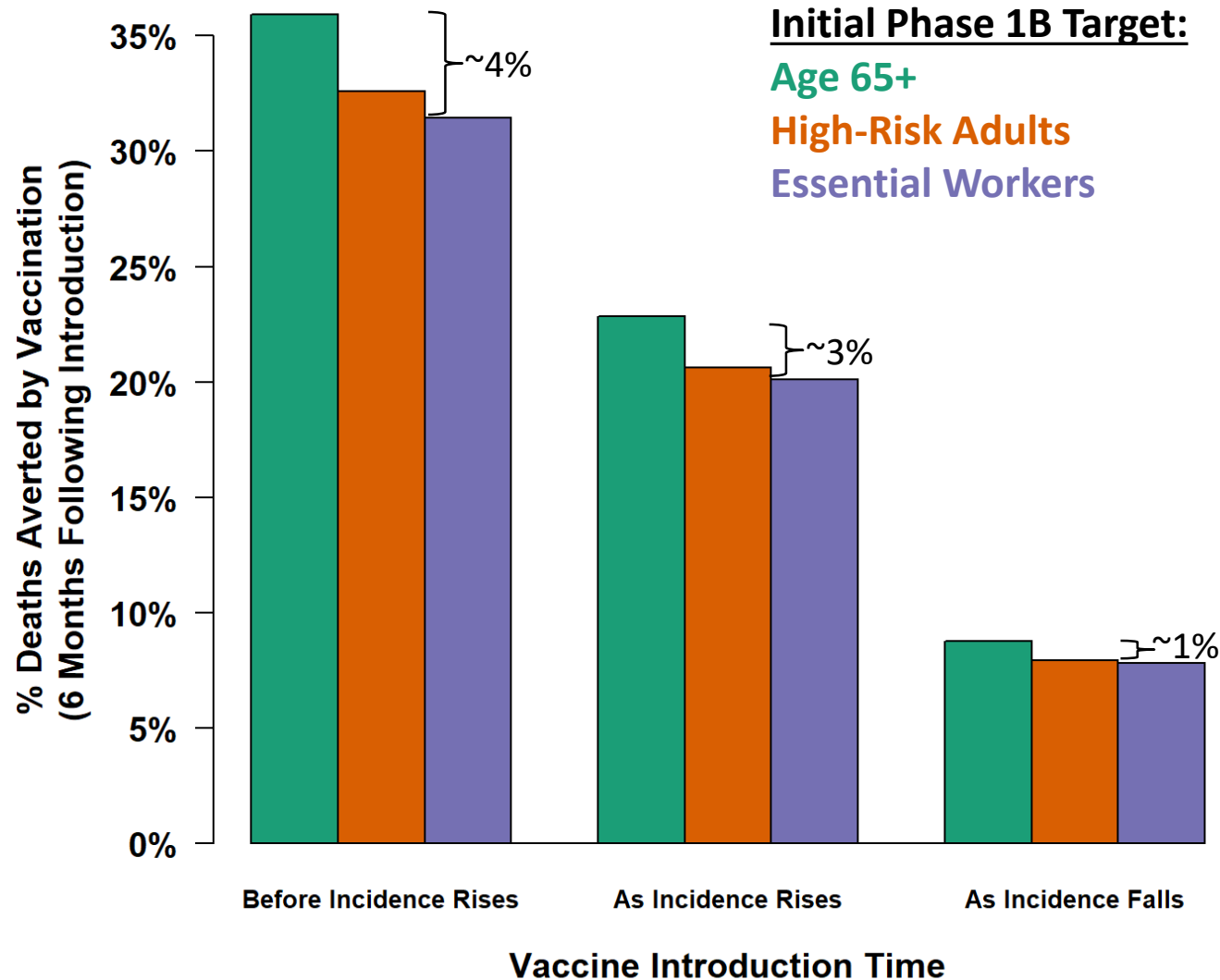
Population-Wide Averted Infections: Infection-Blocking Vaccine, Older Adults Receive Full Protection



- Initially vaccinating **high-risk adults** or **essential workers** in Phase 1B averts approximately 1–5% more infections, compared to targeting **age 65+**
 - This difference is greatest in the scenario where the vaccine is introduced before incidence rises
- Findings are robust to assumptions of reduced VE in older populations

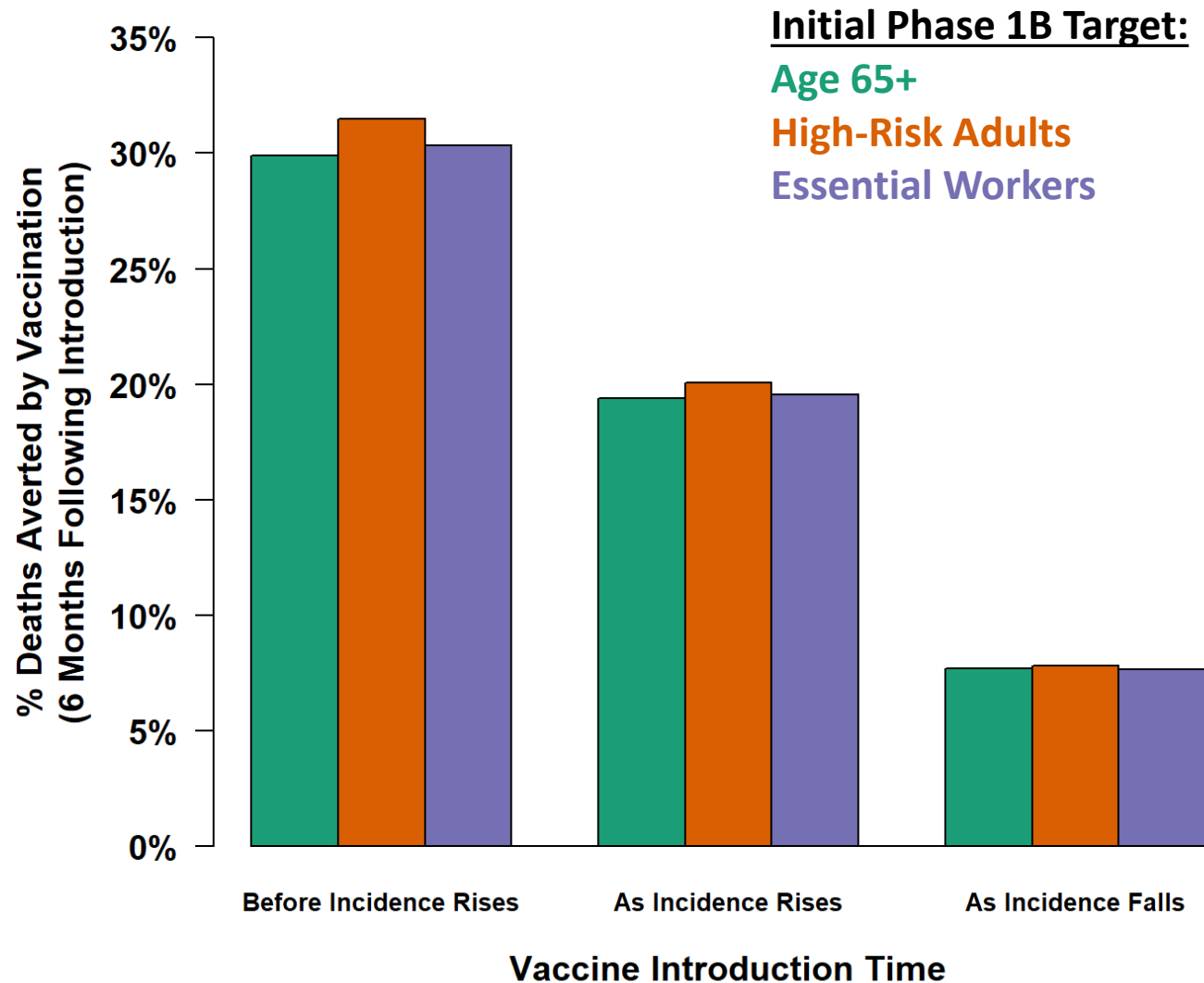
Population-Wide Averted Deaths:

Infection-Blocking Vaccine, Older Adults Receive Full Protection



- Initially vaccinating **age 65+** in Phase 1B averts approximately 1–4% more deaths, compared to targeting **high-risk adults** or **essential workers**
 - As before, this difference is greatest in the scenario where the vaccine is introduced before incidence rises

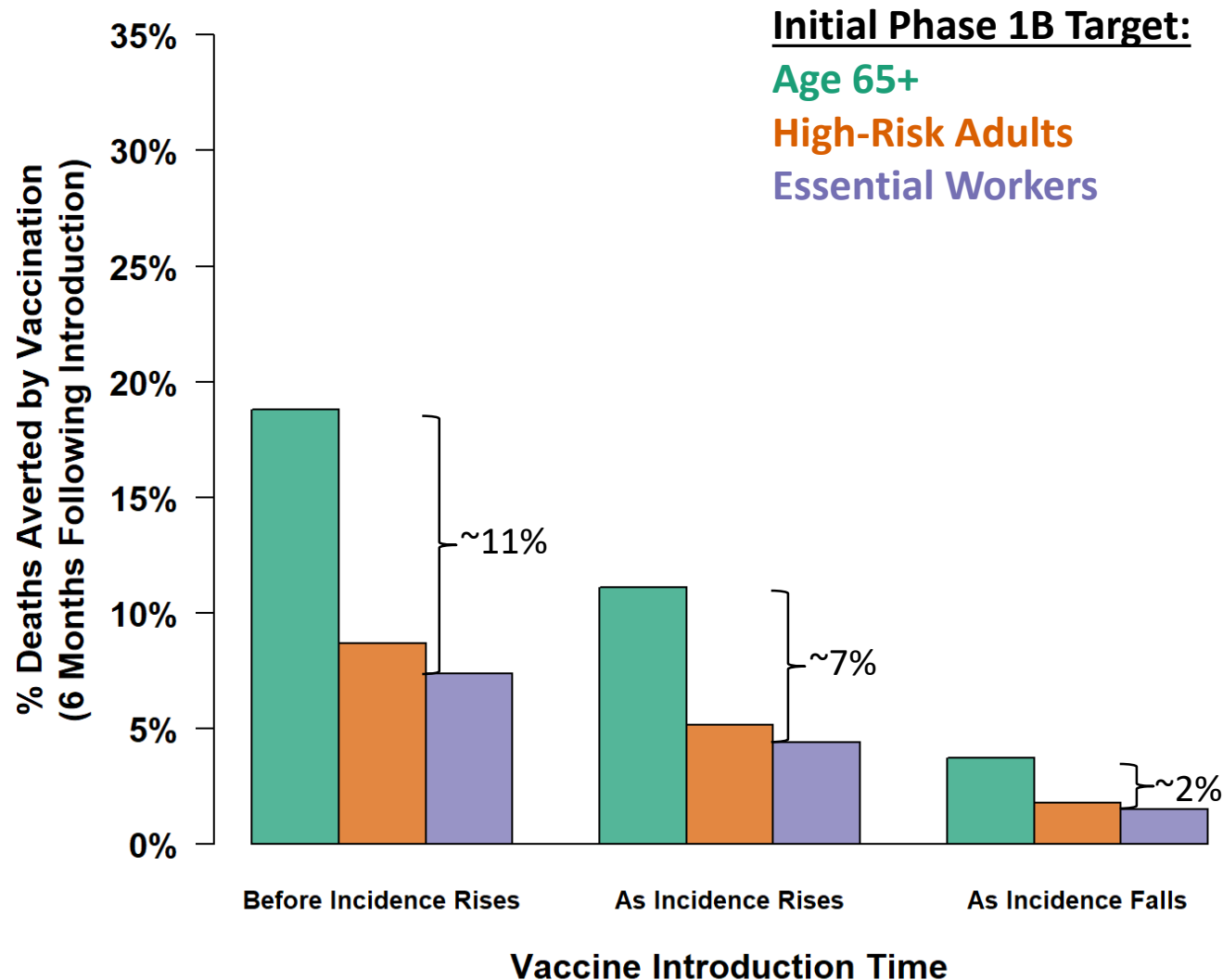
Population-Wide Averted Deaths: Infection-Blocking Vaccine, Older Adults Receive Half Protection



- The percentage of deaths averted changes if VE is reduced in older populations
- Initially vaccinating **high-risk adults**, **age 65+**, or **essential workers** in Phase 1B averts a similar percentage of deaths across the scenarios

Population-Wide Averted Deaths:

Disease-Blocking Vaccine, Older Adults Receive Full Protection



- Initially vaccinating **age 65+** in Phase 1B averts approximately 2–11% more deaths, compared to targeting **high-risk adults** or **essential workers**
 - As before, this difference is greatest in the scenario where the vaccine is introduced before incidence rises
- Findings robust to assumptions of reduced VE in older populations but percentage averted drops

Conclusions



Limitations

- The efficacy and ability of the vaccine candidates to prevent transmission, as well as the time vaccine may become available, is currently unknown
- Modeled epidemic trajectories are only for illustration and are not forecasts
- Overall averted burden should be interpreted cautiously:
 - Sensitive to the future trajectory of the epidemic
 - Findings reflect an idealized rollout, with minimal delays and 100% uptake
 - The aim of this study was to demonstrate the relative impact of different initial vaccine allocation strategies

Limitations

- The following inputs were assumed and will require reassessment as more information becomes available
 - All infections confer protective immunity
 - Immunity (either naturally- or vaccine-acquired) doesn't wane significantly within a year of infection/immunization
 - Given exposure, younger age groups are just as likely to become infected as older age groups (susceptibility independent of age)
 - Individuals with comorbidities are just as likely as their peers to practice social distancing and other protective behaviors
 - No reduction in VE among those with high-risk medical conditions

Discussion

- Initially vaccinating adults 65+ in Phase 1B generally averts greatest % of **deaths**
 - Approximately 1 to 11% increase in averted deaths across the scenarios
- Initially vaccinating essential workers or high-risk adults in Phase 1B generally averts greatest % of **infections**
 - Approximately 1 to 5% increase in averted infections across the scenarios
- Earlier vaccine roll-out relative to increasing transmission, the greater the averted percentage and differences between the strategies
 - Differences not substantial in some scenarios
 - Emphasizes need to continue efforts to slow the spread
- Findings are consistent in sensitivity analyses where the % of the population infected prior to vaccine introduction was varied

Consistency with External Literature

- Reviewed peer-reviewed and pre-publication studies that model the impact of vaccination under different initial allocation strategies
- General agreement across the study results with results presented here

Questions

