Ministry of Health
Estimation of Vaccine Effectiveness: Methodology

Division of Epidemiology

Public Health Services

Methods

- Person-time incidence of important outcomes in vaccinated and unvaccinated
- Adjustment for age-group, sex, and week
- De-identified linking of surveillance data on infection, clinical severity and vaccination status

Steps

- Denominator
  - Census population (Central Bureau of Statistics – CBS)
  - Stratified into 8 age groups and sex:
    - 16-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84, 85+
  - For each of 16 age-gender strata, exposure groups calculated on a daily basis
    - Vaccinated 2+7: Persons who received 2 doses of vaccine at least 7 days prior
      - For month analyses – only persons who received the second dose during the calendar month
    - {Persons who received 1 dose through 6 days after the second dose – not analyzed}
    - Unvaccinated: Census population minus persons who received at least 1 dose of vaccine prior.
  - Persons with prior SARS-CoV-2 PCR positive removed from all strata

Steps

- Numerator
  - All SARS-CoV-2 infections diagnosed by PCR
  - Stratified into 8 age groups and sex:
    - 16-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84, 85+
  - For each of 16 age-gender strata, exposure groups calculated on a daily basis
    - Vaccinated 2+7: Persons who received 2 doses of vaccine at least 7 days prior
      - For month analyses – only persons who received the second dose during the calendar month of interest
    - {Persons who received 1 dose through 6 days after the second dose – not analyzed}
    - Unvaccinated: All SARS-CoV-2 infections minus persons who received at least 1 dose of vaccine prior.
  - Persons with prior SARS-CoV-2 PCR positive removed from all strata

Steps

- Additional outcomes
  - On daily basis, SARS-CoV-2 infections that were:
    - Symptomatic (fever and/or respiratory symptoms at epi investigation or hospitalized)
    - Hospitalized
    - Severe disease
    - {Critical and death will be analyzed if sample size sufficient}
  - Severe outcomes for the last 1-2 weeks of follow up may not include sufficient time to develop outcome

Calculation

- For each outcome (infection, symptomatic disease, hospitalization, severe COVID)

$$Incidence\ rate\ ratio\ (IRR) = \frac{Incidence\ rate\ _{vaccinated}}{Incidence\ rate\ _{unvaccinated}}$$

where incidence rate = number of events/person-time

$$Vaccine\ effectiveness(VE) = 1 - \mathrm{IRR}$$

Statistical model

- Negative binomial regression
  - For each outcome – SARS-CoV-2 infection, symptomatic COVID-19, COVID-19 hospitalization, severe COVID-19
  - Offset – natural logarithm of person-time
  - Main effect – vaccine status
  - Confounders – age (8 groups), sex, epi-week
  - Confidence intervals around IRR converted to confidence intervals around VE
    - Lower VE CI: 1-Upper IRR CI
    - Upper VE CI: 1-Lower IRR CI