Vaccine efficacy, effectiveness, impact
Proposed definitions

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What vaccine effect do we measure?

- **Rationale**
  - Efficacy, effectiveness, impact studies definitions / interpretations vary a lot in the literature
  - Need for an understanding on the meaning for the purpose of this meeting

- **Presentation**
  - Efficacy, effectiveness and impact studies imply a comparison
  - Various types of vaccine effect (Halloran’s diagramme)
  - What effect applies to efficacy, effectiveness, impact?
  - Related study designs
Direct effect

Elizabeth Halloran diagramme on vaccine effects

Vaccination programme
Population: 1

Vaccinated
$R_{1v}$

Unvaccinated
$R_{1u}$

Direct effect

- Efficacy
  - pre-marketing studies
    - RCT

- Effectiveness
  - observational post-marketing studies
    - Cohort, case control,
    - Screening, Broome, etc.

Direct effect

$1 - \frac{R_{1v}}{R_{1u}}$
**Indirect effect**

Elizabeth Halloran diagramme on vaccine effects

**Vaccination programme**
Population: 1

- Vaccinated: $R_{1v}$
- Unvaccinated: $R_{1u}$

**No vaccination programme**
Population: 2

- Unvaccinated: $R_{2u}$

**Indirect effect**

\[ 1 - \frac{R_{1u}}{R_{2u}} \]

- We frequently use only one population & we compare rates before and since introduction of a vaccination programme
- **Herd immunity**
- Only cohort studies
- Age group specific indirect effect (e.g. PCV)
Types of effect

Elizabeth Halloran diagramme on vaccine effects

Vaccination programme
Population: 1

Overall effect
\[ 1 - \frac{R_{1\text{overall}}}{R_{2u}} \]

No vaccination Programme
Population: 2

Unvaccinated
\[ R_{1u} \]

Vaccinated
\[ R_{1v} \]

Unvaccinated
\[ R_{2u} \]

Total effect
\[ 1 - \frac{R_{1v}}{R_{2u}} \]
Types of effect

Elizabeth Halloran diagramme on vaccine effects

Vaccination programme
Population: 1

Overall effect
\[ 1 - \frac{R_{1\text{overall}}}{R_{2u}} \]

No vaccination Programme
Population: 2

Vaccinated

\( R_{1v} \)

Unvaccinated

\( R_{1u} \)

Direct effect
\[ 1 - \frac{R_{1v}}{R_{1u}} \]

Indirect effect
\[ 1 - \frac{R_{1u}}{R_{2u}} \]

Total effect
\[ 1 - \frac{R_{1v}}{R_{2u}} \]
Suggested classification

- **Vaccine efficacy**
  = direct effect measured in clinical trials

- **Vaccine effectiveness**
  = direct effect
  measured in post marketing observational studies in one population with a vaccination programme

- **Impact**
  = indirect, total, overall effects
  two populations or a before / after study
Effect measured depends upon

✓ Populations that we compare
  o Direct effect requires one population (including vaccinated and unvaccinated)
  o Impact (indirect, total, overall effects) requires two populations (with and without a vaccination programme)
    • 2 populations at the same time (unlikely)
    • 1 population before and after vaccine introduction

Effect does not depend upon
the chosen outcome (clinical or laboratory confirmed)

PCV vaccines
Direct, indirect, total, overall effect on:
  ▪ Pneumonia all causes
  ▪ AOM
  ▪ Pn. Meningitis
  ▪ IPD
    ✓ Specific serotypes
  ▪ Death all or specific
  ▪ Carriage
  ▪ Etc.
# Effects and study designs

## Observational

<table>
<thead>
<tr>
<th>Effect</th>
<th>Direct</th>
<th>Indirect</th>
<th>Total</th>
<th>Overall</th>
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<tbody>
<tr>
<td>Cohort studies</td>
<td>YES</td>
<td>YES</td>
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<tr>
<td>✓ Risk (%)</td>
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<tr>
<td>✓ Rate (person time)</td>
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<tr>
<td>Case control studies</td>
<td>YES</td>
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<tr>
<td>✓ Traditional (Odds Ratio)</td>
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<tr>
<td>✓ Density (Rate Ratio)</td>
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<tr>
<td>✓ Case cohorts (Risk Ratio)</td>
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<tr>
<td>Screening / Broome</td>
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## Experimental

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<tbody>
<tr>
<td>Randomised Control Trials</td>
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<td>Group Randomised Trials</td>
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Available studies
Measures of effect
AMN, 21/10/2009
Merci