Three-sources capture-recapture analysis to evaluate the comprehensiveness of reporting invasive meningococcal infections in France, 2005

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The log-linear model selected included the positive dependences found between MN and NRC and between NRC and Epibac network by the Wittes method (table 1).

<table>
<thead>
<tr>
<th>Sources</th>
<th>N obs</th>
<th>N est</th>
<th>completeness</th>
<th>lower 95% CI</th>
<th>upper 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>MN</td>
<td>588</td>
<td>650</td>
<td>90.5</td>
<td>88.2</td>
<td>92.6</td>
</tr>
<tr>
<td>NRC</td>
<td>481</td>
<td>650</td>
<td>74.0</td>
<td>72.2</td>
<td>75.7</td>
</tr>
<tr>
<td>Epibac *</td>
<td>429</td>
<td>650</td>
<td>66.0</td>
<td>64.4</td>
<td>67.6</td>
</tr>
<tr>
<td>Epibac **</td>
<td>429</td>
<td>531</td>
<td>80.8</td>
<td>79.0</td>
<td>82.5</td>
</tr>
</tbody>
</table>

**Overall comprehensiveness  **"Internal" comprehensiveness restricted to Epibac area coverage

Comprehensiveness of reported IMD cases
Considering the gold model in table 1, the estimated total number of laboratory culture confirmed IMD in 2005 in France is estimated at 650 [95% CI: 635-666]. MN comprehensiveness reached 90.5% (table 2).

Because Epibac has an incomplete geographical coverage, an analysis restricted to cases hospitalized in hospitals participating to Epibac network was also performed, providing an "internal" comprehensiveness estimate for Epibac of 81%; estimates obtained for MN and NRC comprehensiveness were similar than in the first global analysis.

Material and Methods

IMD case definition
The analysis was restricted to laboratory culture confirmed IMD cases (isolation of Neisseria meningitidis strains from blood and/or CSF).

Data sources
Mandatory notification (MN), National Reference Centre for the Meningococci (NRC) and Epibac network were the three studied sources. Unlike the two other sources, Epibac is a sentinel hospital laboratory network and does not cover all French hospitals.

Surveillance network

Capture-recapture analysis
The capture-recapture method consists of matching cases from two or more sources in order to estimate the number of cases not registered in any of the sources and therefore, the total number of cases.

Dependence between paired sources were studied using a written method (sources are considered independent when the probability of notification in one case does not depend on its probability of notification in the other source).

Log-linear models allowed estimation taking into account dependances and unequal catchability (equal catchability meaning that the probability of notification of one case in each source is not influenced by its characteristics).

Criteria used for model selection were model fit (using deviance), the Akaike’s Information Criterion (AIC) and the Bayesian Information Criterion (BIC). Analysis were performed using Stata™ and Excel™.

Duplicates and matching analysis
Date of birth, sex, date of hospitalization, zip code of hospital and serogroup were patient criteria used to identify duplicates within each source and to match cases between sources.

Results

In 2005, 631 cases were identified at least by one of the three sources: 83% of cases were identified at least by 2 sources (figure 1). Using the study results, IMD incidence is estimated at 1.3/100,000.

Capture-recapture method represents an attractive and reproducible approach to assess the completeness of surveillance sources and to estimate more reliable incidence rates. However it relies on good quality data on each case in each source.

MN comprehensiveness increased from 73% in 2000 to 90.5% in 2005 suggesting that media coverage of sporadic cases, specific interventions (e.g. vaccination campaigns) and specific guidelines on IMD prevention disseminated to physicians, biologists and public health professionals contributed to improve mandatory notification.

Completeness of NRC is stable (74% in 2000 and 2005) and needs to be improved. Results of variable catchability analysis suggested that sources comprehensiveness decreased with age (figure 2) in particular for MN source and that capture probability varied with serogroup (figure 3).

Discussion and conclusion
The surveillance network

In France invasive meningococcal disease (IMD) surveillance is based on mandatory notification (MN) and microbiological characterization of invasive strains at the National Reference Centre for the Meningococci (NRC). Between 1985 and 2004, the observed incidence varied between 0.5 and 1.3 cases per 100,000 inhabitants.

To monitor trends in incidence, comprehensiveness of IMD notification is regularly evaluated by the two or three sources capture-recapture method and observed incidence is corrected for under-reporting.

Two capture-recapture studies using three data sources were performed in 1996 and 2000 and the comprehensiveness of MN was estimated at 67% and 73% respectively.

The objectives of this study were to:
- estimate the comprehensiveness of 3 IMD surveillance sources in 2005;
- identify the main factors influencing IMD reporting;
- estimate the overall incidence of IMD in 2005.

Background

Material and Methods

IMD case definition

Data sources

Surveillance network

Capture-recapture analysis

Duplicates and matching analysis

Results

Discussion and conclusion

The IMD case definition

The material and methods describe the study design, data sources, surveillance network, and analysis methods used to assess the comprehensiveness of reporting IMD cases in France.

Comprehensiveness of reported IMD cases

The comprehensiveness of the three sources was assessed using a capture-recapture analysis. The table shows the estimated completeness for each source, with confidence intervals.

Variable catchability

Figure 2 illustrates the completeness of each source by age group. Figure 3 shows the completeness by serogroup.

Discussion and conclusion

The discussion concludes with the implications of the findings, including the importance of improving MN and NRC comprehensiveness, the need for better capture of meningococcal cases, and the potential benefits of using serogroup-specific guidelines for meningococcal vaccination programs.

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