Estimation of the Number of the Cases of Meningococcal Disease in Barcelona by Means of Capture-Recapture Methodology

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Abstract. This study is aimed at estimating the number of cases of meningococcal disease that appeared in Barcelona between the years 1993 and 1994. We develop log-linear models for capture-recapture methods when there are more than two incomplete lists. The capture-recapture model that we used allows for the sources being not independent and for heterogeneity in the probability of being in a source.

Keywords. Capture-recapture, log-linear model, meningococcal disease.

1 Introduction

This study is aimed at estimating the number of cases of meningococcal disease that appeared in Barcelona between the years 1993 and 1994 by means of capture-recapture methodology. Capture-recapture methodology in epidemiology tries to estimate the population size using information from matching incomplete lists of cases from distinct sources. The assumptions required by the classical methodology are (Hook & Regal, 1995):

1. Each case has been diagnosed accurately and the matching of cases that appear in different sources has been done correctly.
2. Homogeneity: For any single source, each case in the population has the same probability of being included in the list, although two sources may have a different probability.
3. Independence: The sources are independent
4. The population under study is "closed", i.e. there are no entries or losses during the study period.

In epidemiology, assumptions 2 and 3 are generally not true (International Working Group for Disease Monitoring and Forecasting, 1995)

Log-linear models are developed for capture-recapture methods when there are more than two incomplete lists (Cormack, 1989), since each individual may or may not be in the list. Assuming that there are four sources, let $r_{1234}$ represent the number of individuals in the first, third and fourth list but not in the second. The
observations \( r_{ijkl} \) could be represented as a 2\(^4\) contingency table with one unobservable category – a structural zero in one cell. This cell represents the individuals not “caught” by any list, i.e. the number of cases that we want to estimate by means of a log-linear model. This procedure has the following advantages:

1. Only the assumptions 1: accuracy of the declarations, and 4: closed population, are required.
2. The log-linear model permits the estimation of the individuals which are not identified by any of the registers when there is heterogeneity of capture probability and/or dependence of the sources.

2 Material and methods

We work with the following surveillance systems: the morbidity register, the register of discharges from Barcelona’s hospitals, the hospital’s Microbiology laboratory register and the Majadahonda register.

We construct a specific piece of software for the matching of four registers. The problem of dependency has been solved by adjusting a log-linear model with interactions, using the statistical package GLIM4. A GLIM macro proposed by Agresti (1994) allows us to estimate the population size with heterogeneity “catch” probability. To select a unique model, we consider the deviance, the residuals and the Bayesian Information Criterion, BIC. To minimise capture heterogeneity, we stratified by age, by region of residence and by declaration year, constructing a model for each.

3 Results

The capture-recapture model that we used allowed us to make estimates of the total number of cases due to meningococcal disease in Barcelona, which would have not been possible without this methodology.

Significant differences were only found for age in the morbidity register. This means that the system is more sensible for children than for adults.

The most profitable source to capture cases has been the discharge from hospital register.

References


