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Estimation of sojourn time and sensitivity in cancer screening: a systematic review

A.M.W.M. Aarts[1], S.M.E. Geurts[1], A.L.M. Verbeek[1], M.J.M. Broeders[1], S.W. Duffy[2]
[1] Radboud Institute for Health Sciences, Department for Health Evidence, Radboud University Medical Center, Nijmegen, The Netherlands
[2] Wolfson Institute of Preventive Medicine, Barts and The London School of Medicine and Dentistry, Queen Mary University of London, London, UK

Background: Sojourn time (i.e. the duration of the preclinical detectable phase) and test sensitivity play an important role in the design and assessment of cancer screening programmes. As a result, many mathematical models have been developed to estimate these key parameters using data from screening studies. In this systematic review, we will present an overview of these methods with the aim to provide researchers guidance to select the most appropriate method matching their own study data.

Methods: We systematically searched PubMed and Embase for original studies of new mathematical models that estimated sojourn time using individual patient data from screening studies. Direct observation of sojourn time (e.g. growth rates, survival benefits) or microsimulation estimates were excluded. From the selected studies we categorized method and study design and extracted the required data, assumptions and outputs. Furthermore, as an example, sojourn time estimates of colorectal cancer were collected to investigate the impact of the used method on this estimate.

Results: Thirty–two papers met the inclusion criteria. We grouped the studies into five methodological categories: prevalence-incidence ratio (n=5); interval incidence rates (parametric) (n=18); interval incidence rates (non-parametric) (n=3); Markov Chain Monte Carlo estimation (n=4) and other (n=3). Twelve of these methods were applied to RCTs, seventeen to observational studies and three to case-control studies. Ten publications were found estimating the overall mean sojourn time of colorectal cancer based on eight studies, including two RCTs. The mean sojourn time estimates varied between 2.1 and 4.9 years. The sojourn time estimates of breast cancer will be presented at the ICSN meeting.

Conclusions: Five major methodological categories were identified as models to estimate population sojourn time. Methods based on the prevalence-incidence ratio and using RCTs based on interval incidence resulted in lower sojourn time estimates than the other methodological categories.

Keywords: systematic review; sojourn time; parameter estimation; interval incidence rates; Markov Chain Monte Carlo; cancer screening; prevalence-incidence ratio