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Capture-mark-recapture as a tool for estimating the number of articles available for systematic reviews in critical care medicine ☆

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Abstract

Introduction: Systematic reviews are an important knowledge synthesis tool for critical care medicine clinicians and researchers. With new literature available each day, reviewers must balance identifying all relevant literature against timely synthesis. We therefore sought to apply capture-mark-recapture, a novel methodology, to estimate the population of articles available for a systematic review of effective patient rounding practices in critical care medicine.

Methods: Capture-mark-recapture was applied retrospectively to estimate the population of articles available for a systematic review of 4 bibliographic databases. All research studies (no methodology restrictions) of patient rounding practices in critical care medicine were included. Estimates of article population size were calculated for search of the bibliographic databases, selection of articles for full-text review, and selection of articles for inclusion in the systematic review.

Results: Capture-mark-recapture estimated a population of 28 839 articles (95% confidence interval [CI], 12 393-70 990) for search of the bibliographic databases, 169 articles (95% CI, 152-202) for full-text review, and 48 articles (95% CI, 39-131) for inclusion in the systematic review. These estimates suggest that our search identified 15% (4462/28 839) of the population of potentially available articles for the search of the bibliographic databases, 79% (133/169) of articles for full-text review, and 79% (38/48) of articles for inclusion in the systematic review.

Abbreviations: CMR, capture-mark-recapture; ICU, intensive care unit; CI, 95% confidence intervals.

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Conclusions: The capture-mark-recapture technique can be applied to systematic reviews in critical care medicine with heterogeneous study methodologies to estimate the population of articles available. Capture-mark-recapture may help clinicians who use systematic reviews to estimate search completeness and researchers who perform systematic reviews to develop more efficient literature search strategies.

1. Introduction

Systematic reviews are an important tool for synthesizing evidence to inform clinical practice and policy in critical care medicine [1-3]. However, with the increasing number of published research studies, the process of completing a systematic review has become more labor intensive and inefficient as most articles identified from multiple databases searches are discarded [4]. A methodology for determining when a sufficient number of articles have been selected might reduce workload, improve efficiency, and facilitate timely publication of systematic reviews.

Capture-mark-recapture (CMR) is an ecologic technique designed to estimate population size (also called *horizon estimation*) that may allow clinicians and researchers to evaluate the completeness of a literature search. The technique involves sampling items from a population (eg, catching fish in a lake), tagging the items (eg, applying a dorsal fin tag), releasing the items (eg, releasing tagged fish back into the lake), and then resampling the items (eg, catching more fish from the same lake) at a later time. The number of items with tags captured during resamplings (eg, tagged fish) can then be used to estimate the population (eg, total number of fish in a lake) [5,6].

Capture-mark-recapture has been applied to estimate population sizes in health care. For example, in epidemiology, it has been used to estimate the number of patients with chronic medical conditions [7-9]. In health services research, it has received limited evaluation as a tool for guiding systematic searches of the literature [10-12]. These evaluations have concluded that CMR may be an effective tool to estimate the population of articles available for a given topic and therefore guide the development of efficient search strategies. However, current evaluations have been limited to systematic reviews of randomized controlled trials in rheumatology, gastroenterology, surgery, and hematology [10-12]. We therefore sought to apply CMR to estimate the population of articles available for a systematic review of effective patient rounding practices in critical care medicine that included a heterogeneous mixture of research methodologies (ie, no methodology restrictions, review included qualitative and quantitative studies).

2. Materials and methods

2.1. Methods of systematic review

Studies were identified by searching 4 bibliographic databases: Medline/Ovid (1950 forward), Embase (1980 forward), CINAHL (1982 forward), and the Cochrane Library on June 5, 2011. Retrieved articles were screened, and reference lists of appropriate articles were searched. A hand search of relevant journals in critical care medicine (*American Journal of Respiratory and Critical Care Medicine*, *Critical Care Medicine*, *Journal of Critical Care*, *Intensive Care Medicine*, and *Critical Care forum*) was completed for the past 5 years (June 2006–June 2011), and experts in the field were contacted to determine if they were aware of any missed studies. Searches were completed using a combination of the following terms: critical care/intensive care and rounds, with appropriate wildcards and variations in spelling. Two reviewers (D.L. and M.F.) independently reviewed the retrieved titles and abstracts, followed by full texts if appropriate. Articles were selected for inclusion in the systematic review if they were original research articles (no methodology restrictions) that examined practice patterns or interventions targeting intensive care unit patient rounds. Agreement between reviewers was good for full-text review (estimated $\kappa = 0.5$) and very good for final inclusion (estimated $\kappa = 1.0$) [13]. Disagreements were resolved through discussion and a third reviewer if necessary (H.T.S.).

2.2. Methods of horizon estimation

Estimates of article population size were calculated for search of the bibliographic databases, selection of articles for full-text review, and selection of articles for inclusion in the systematic review. After the search of each bibliographic database, articles were marked as being retrieved from that search (eg, Medline was arbitrarily selected to be the first database searched) and compared with articles retrieved

Table 1 How to apply CMR as a stopping rule for systematic reviews in critical care

Step 1	Define a priori estimate of completeness for literature search or criteria for search-stopping rule (eg, % articles and saturation).
Step 2	Perform search in the predicted most productive databases and screen to final inclusion.
Step 3	Calculate the horizon estimate.
Step 4	Compare retrieval with the horizon estimate to determine if a priori estimate of completeness is satisfied.
Step 5	Continue with searching additional sources until a priori estimate of completeness is satisfied

Modified from Kastner et al [10].