Accounting for reporting fatigue is required to accurately estimate incidence in voluntary reporting health schemes

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Abstract

Objective: Accurate estimation of the true incidence of ill-health is a goal of many surveillance systems. In surveillance schemes including zero reporting to remove ambiguity with nonresponse, reporter fatigue might increase the likelihood of a false zero case report in turn underestimating the true incidence rate and creating a biased downward trend over time.

Study Design and Setting: Multilevel zero-inflated negative binomial models were fitted to incidence case reports of three surveillance schemes running between 1996 and 2012 in the United Kingdom. Estimates of the true annual incidence rates were produced by weighting the reported number of cases by the predicted excess zero rate in addition to the within-scheme standard adjustment for response rate and the participation rate.

Results: Time since joining the scheme was associated with the odds of excess zero case reports for most schemes, resulting in weaker calendar trends. Estimated incidence rates (95% confidence interval) per 100,000 person years, were approximately doubled to 30 (21−39), 137 (116−157), 33 (27−39), when excess zero-rate adjustment was applied.

Conclusion: If we accept that excess zeros are in reality nonresponse by busy reporters, then usual estimates of incidence are likely to be significantly underestimated and previously thought strong downward trends overestimated.   © 2016 Elsevier Inc. All rights reserved.

Keywords: Surveillance; Excess zeros; Zero-inflated negative binomial; Work-related ill-health; Voluntary reporting; Incidence estimation; Trends; Reporter fatigue

1. Introduction

In 2006, the World Health Organization (WHO) produced a set of recommendations regarding standards in surveillance of disease and health conditions [1]. This included the presence of zero reporting within the scheme to remove any ambiguity between a zero occurrence report and a nonresponse. One prominent surveillance scheme currently operating within Great Britain, The Health and Occupational Reporting network (THOR) [2], requests a report of new cases regardless of whether any new cases occurred.

THOR is a national occupational health reporting scheme consisting of specially trained occupational health physicians, hospital consultants, or general practitioners (GPs) with some occupational health training who voluntarily report new cases of work-related ill-health (WRIH) on a monthly basis [2]. The case-reporting methodology has been explained in more detail elsewhere [2−6]. However, briefly, a monthly count of new WRIH cases is reported by physicians designated to be either a "core" or "sample" reporter; where "core" reporters are asked to report every month of the year and "sample" reporters on one randomly chosen month per year. "Sample" reports are then multiplied by 12 and added to the "core" reports to estimate the total yearly number of cases reported by all participating reporters. The THOR network in various forms has been active since 1989 with a number of reporters being members for many years. Although it is accepted that there may be

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What is new?

Key findings
- The odds of a reporter responding with a false zero increase as membership time of the scheme increases. Reporters with responses that are designed to be intermittent, for example, one per year are more likely to respond with a false zero than a reporter responding continuously throughout the year.

What this adds to what was known?
- Accurately estimating the true incidence of ill-health is the goal of many surveillance schemes. Requesting zero reporting helps to remove ambiguity with nonresponse but health surveillance schemes that request zero case reports are vulnerable to the inclusion of false zero report, that is, a zero case report even if cases have occurred.

What is the implication and what should change now?
- Failure to adequately account for excess zeros at the design or modeling stage in any current or future surveillance scheme can result in underestimation of the true incidence rate and overestimation of any trends in incidence over time.

underestimation of the true incidence, these data have been used to estimate the true trends in new cases of WRIH.

Participation in the scheme for extended time periods may cause reporting fatigue especially if an automated or efficient time management system has not been implemented by the reporter. This reporting fatigue may manifest in a nonresponse or an increase in zero case reports as reporters are asked to submit a response even if zero cases have occurred.

In a study investigating time trends in the incidence of work-related mental ill-health and musculoskeletal disorder, Carder et al. (2012) noted over time an increase in both nonresponse and the return of zero case reports in the THOR scheme Surveillance of Occupational Stress and Mental Illness which might be attributable to reporter fatigue [7]. McNamee et al. (2008) also noted in three THOR schemes, a link between reporter membership time and both nonresponse and zero case reports [8]. To account for increasing fatigue, McNamee estimated calendar time trends from Poisson models adjusted firstly by membership time as a covariate, and secondly by only including reports from within 5 years of first reporting month. Neither method was considered adequate as including two highly correlated time variables resulted in very wide confidence intervals (CIs), and restricting the data to within 5 years dramatically reduced the sample size.

Equally, incidence rates may have been overestimated. "Sample" reporters may feel the need to justify their inclusion by possibly harvesting cases occurring in the month or months before the designated reporting month. McNamee et al. (2010) attempted to investigate the accuracy of estimating the incidence using a randomized crossover trial of continuous sampling ("core") vs. time-sampled ("sample") reporting. Results indicated that over reporting present in the "sample" group may increase the total estimate by 26%, and that rates declined gradually in the "core" group over time [9]. McNamee commented that the 26% increase may equally have been due to under reporting in the "core" reporters due to fatigue and excess zeros.

The aim of the work presented here is to look for evidence of excess zero case reports. A zero-inflated regression model explicitly models the probability of a "false" or "excess" zero under the influence of membership time increases, as would be expected if reporter fatigue is present. Estimates of true calendar time trends are generated after accounting for the presence of excess zeros within the data. Finally, model predictions of an excess zero are used to estimate the true WRIH incidence rates corrected for the presence of excess zero case reports along with estimates of the true change over time.

2. Methods

Monthly reports of new cases of WRIH are collected in three THOR schemes under a multilevel structure comprised of the repeated monthly counts (level 1) of newly observed cases per reporter (level 2 clusters), with 12 per year for each "core" and one per year for each "sample" reporter. THOR originally focused on occupational lung disease but has since expanded into specialists reporting networks for specific causes of WRIH such as skin and respiratory problems. A full description of the three schemes and the methodology behind them can be found elsewhere [2−6], but in brief, EPIDERM (Occupational Skin Surveillance) employs consultant dermatologists to report the incidence of occupational skin disease, for example, contact dermatitis. Cases of occupational respiratory disease such as occupational asthma are submitted to Surveillance of Work-Related and Occupational Respiratory Disease (SWORD) by specialist chest physicians. As of 1996, some 800 occupational physicians report a range of work-related disease to the Occupational Physicians Reporting Activity (OPRA) scheme. OPRA may include both skin and respiratory cases but also, for example, musculoskeletal, mental ill-health, or infectious diseases. Each scheme also recorded the year and month of report along with first month as a reporter, time as a member of scheme, season, peak holiday season, and bank holiday months.

The schemes then calculate the incidence of WRIH by dividing the total number of new cases occurring by the