Assessment of vaccine coverage following the introduction of a publicly funded pneumococcal vaccine program for the elderly in Victoria, Australia

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Abstract

In 1998, a publicly funded pneumococcal vaccine program was introduced for persons aged ≥ 65 years in Victoria, Australia. In 2000, vaccine coverage over the previous 5 years was assessed through a telephone survey of 385 randomly selected subjects aged ≥ 65 years. Self-reported pneumococcal vaccine coverage within the previous 5 years was 46.0% (95% CI 40.5–51.6). Self-report was validated against the medical records of the nominated provider for 278 (72%) subjects. Among this subgroup, self-reported coverage was 51.1% but was 57.9% according to medical records (positive predictive value 91.5%, negative predictive value 77.2%, sensitivity 80.7%, specificity 89.7%). After accounting for response bias among those subjects for whom self-report was not validated, the revised estimate of pneumococcal vaccine coverage within the previous 5 years was 50.5% (95% CI 44.8–56.1). Comparison of vaccine coverage over time suggests the introduction of the publicly funded program in Victoria has dramatically increased coverage among the elderly.

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1. Background

Persons aged ≥ 65 years in Victoria, Australia, have been offered the 23-valent pneumococcal polysaccharide vaccine (23vPPV) through a publicly funded program since 1998 [1]. Although recommended for the prevention of invasive pneumococcal disease among Australians aged ≥ 65 years (and for others in certain high risk groups) [2], Victoria was the only jurisdiction that had a publicly funded 23vPPV program for this age group [3].

Telephone surveys relying on self-report of pneumococcal vaccination status are a commonly utilised method for determining vaccination coverage in the elderly [4–7]. However, the validity of self-reported pneumococcal vaccination has only been tested in three studies, all conducted in the USA [8–10].

The aim of this study was to assess the impact of the publicly funded program on vaccine coverage among the elderly by validating self-reported coverage against medical records, estimating cumulative 23vPPV coverage overtime and comparing these results to data on available vaccine distribution.

2. Methods

Subjects who had participated in a previous survey, the 1999 Victorian Population Health Survey (VPHS), were used as the sampling frame. The 1999 VPHS was a general health survey that selected households using random digit dialing
Fig. 1. Selection of subjects from the 1999 VPHS for validation of self-reported pneumococcal vaccination status.

1,466 subjects aged ≥ 65 years in 1999
27.3% (405/1466) vaccinated
1,493 (79%) consented to further contact
28.4% (424/1466) vaccinated
400 selected for validation survey

Sensitivity, specificity, positive and negative predictive values of self-reported vaccination status were compared against the medical record. The kappa coefficient was used to assess reliability of self-report when compared to medical record in the same manner as Mac Donald et al. [8].

The proportion of subjects who had received 23vPPV within the previous 5 years was determined for both the validated group (based on medical records) and for the unvalidated group (based on self-report alone). The two groups were combined to estimate overall 23vPPV coverage on the assumption that self-reported vaccination status among the unvalidated group was accurate. A revised estimate of overall coverage was calculated excluding vaccinated subjects where the date of vaccination was unknown (i.e. based on self-report or an incomplete date provided by the nominated provider).

Analyses were conducted using Epi Info version 6.04d, including exact 95% confidence intervals [12]. For comparison of proportions, uncorrected $p$-values and Fisher’s exact tests were reported where appropriate. The study was approved by the Victorian Government Department of Human Services Ethics Committee (reference number 17/00).

Cumulative 23vPPV coverage from the validation survey was compared to vaccine distribution data obtained for:

- a) Prescriptions issued by medical practitioners in Victoria from 1992 to 2001 [13] and
- b) Doses distributed under Victoria’s publicly funded program (i.e. no prescription required) from 1998 to 2001 (personal communication, Ted Jamieson, Department of Human Services, Victoria, March 2003).

### 3. Results

Fifteen subjects were excluded because they had moved or the telephone was disconnected (11), had died (1) or were aged <65 years when the 1999 VPHS was conducted (3). Of the remaining 385 eligible subjects, 326 (85%) completed the telephone survey. Self-reported coverage among the respondents in this first stage was 46.0% (95% CI 40.5–51.6) for receipt of pneumococcal vaccination within the previous 5 years.

Self-report was subsequently validated against a medical record for 278 subjects (72% of eligible subjects) with the remaining 48 subjects considered “unvalidated” (Fig. 2). Self-reported vaccination status was known for the unvalidated group but could not be validated against a medical record because they had either: (a) not consented to their nominated provider being contacted (32); or (b) had consented but the nominated provider could not be found (2); refused or did not respond to follow-up (11), or did not know the subject (3).

The median age of the 278 respondents with a validated vaccination status was 73 years (range 66–93 years), 59% were female. The age and gender distribution of respondents was similar at each stage of the validation study (data not shown).
As a marker of response bias, data on self-reported influenza or pneumococcal vaccination was used from the 1999 VPHS. There was no evidence of response bias for participation in the first stage of the validation survey \((p = 0.4)\), however, there was a clear difference between respondents and non-respondents at each of the subsequent stages (Fig. 3). Those who consented to their provider being contacted were more likely to have reported receiving either vaccine when asked in the 1999 VPHS \((p = 0.004)\) and, although unaware of the subject’s response, providers were also more likely to respond if the subject believed they had been vaccinated \((p = 0.004)\).

3.1. Validity of self-report

Self-report of pneumococcal vaccination within the previous year overestimated vaccination coverage when compared to medical records (Table 1). In the 1999 VPHS, 77 respondents (27.7%) reported receiving pneumococcal vaccination that year but, when these responses were subsequently validated against a medical record, only 33 had been vaccinated in 1999 (positive predictive value 42.9%). The same number, 33 (42.9%), had actually been vaccinated prior to 1999.

Similarly, when asked as part of the validation survey in 2000, 50 respondents (18.0%) reported receiving a pneumococcal vaccination in that year but only 20 (40.0%) had been vaccinated in 2000 according to their nominated provider (Table 1). A further 23 (46.0%) who reported receiving the vaccine in that year (2000) had been vaccinated prior to that time.

Self-report of pneumococcal vaccination within the previous 5 years was much more reliable but underestimated true coverage when compared to medical records, 51.1% versus 57.9% (Table 1). Almost one in 5 persons who had been confirmed as vaccinated from medical records (31/161) would have been considered unvaccinated based on self-report. For influenza vaccination, the sensitivity of self-report was near universal. The kappa coefficients also indicated self-reported
pneumococcal vaccination for either time frame was less reliable than self-reported influenza vaccination (Table 1).

### 3.2. Revised estimates of pneumococcal vaccine coverage

Pneumococcal vaccination coverage within the previous 5 years was substantially higher among the validated group, 57.9% (95% CI 52.0–63.6), than the unvalidated group, 16.7% (95% CI 7.5–30.2). When coverage was adjusted to account for response bias, the revised estimate of 23vPPV coverage within the previous 5 years was 50.5% (95% CI 44.8–56.1) (Table 2). Assessment of the revised estimate by year of vaccination showed the greatest increase occurred in 1998, coinciding with the commencement of the publicly funded program (Fig. 4).

As shown in Fig. 4, prescriptions for 23vPPV in Victoria were rising in the years leading up to the introduction of the public program (from 1143 in 1992 to 66,322 in 1997) but then declined six fold to 10,944 in 2001.

### Table 2

<table>
<thead>
<tr>
<th>Vaccination status</th>
<th>n</th>
<th>% (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Validated group (n=278)</td>
<td>161</td>
<td>57.9% (52.0–63.6)</td>
</tr>
<tr>
<td>Unvalidated group (n=48)</td>
<td>8</td>
<td>16.7% (7.5–30.2)</td>
</tr>
<tr>
<td>Total (n=326)</td>
<td>169</td>
<td>51.4% (46.4–57.2)</td>
</tr>
</tbody>
</table>

Note: Vaccination status was based on medical records for validated subjects but on self-report for unvalidated subjects. "Revised total" excludes vaccinated subjects where the vaccination date was unknown (i.e. all those in the unvalidated group plus one from the validated group).
4. Discussion

Achieving adequate vaccination coverage is one of the fundamental indicators of success in any population based vaccination program and can be critical to decisions regarding the program’s future. However, reliance on self-report for assessment of pneumococcal vaccination is problematic. Like Mac Donald et al. [8] self-report was more reliable for influenza vaccination than for pneumococcal vaccination. This is not surprising since the influenza vaccine is given annually as opposed to the pneumococcal vaccine which may have been given anytime in the previous 5 years. Ironically, recall of pneumococcal vaccination within the previous year was much less reliable than recall of pneumococcal vaccination within the previous 5 years. The error was not that subjects had not been vaccinated but rather that the subject’s recall of the timing of vaccination was wrong—it was more than a year ago.

Whereas, self-report of pneumococcal vaccination within the previous year had overestimated coverage, problems with recall over a longer time period (5 years) meant that self-report underestimated coverage when compared to medical record. This was true even among subjects who were more likely to believe they had been vaccinated—in the validated group self-reported coverage was 51.1% but coverage based on medical records was 57.9%. Self-report also underestimated pneumococcal vaccination in the studies by Mac Donald et al. (74% versus 79%) and Long et al. (58% versus 48%) but overestimated coverage in the study by Zimmerman et al. (71% versus 52%) [8–10].

Confirming that a subject was not vaccinated was also problematic. In an attempt to improve the specificity of self-reported pneumococcal vaccination, subjects were contacted again if they believed they had been vaccinated but their nominated provider had no record of the vaccination. In each case, the subject was advised and details were requested of alternative providers. Some subjects were adamant that their nominated provider had given the vaccine, raising the possibility that incomplete medical records may have resulted in some vaccinated subjects being misclassified as unvaccinated.

Misclassification of some subjects as unvaccinated may have also occurred among those who had reported that they had not been vaccinated. These subjects were considered “unvaccinated” if their nominated provider had no record of the vaccination but it is possible that some of these subjects may have been vaccinated through an unidentified provider.

It is possible that some subjects may have been incorrectly classified as vaccinated due to an error in reporting from the vaccine provider. However, this seems unlikely with provision of a vaccination date generally accepted as confirmation of vaccination. Much more likely is that complete ascertainment of vaccination status would have only identified more vaccinated subjects because those that had already been identified as vaccinated would remain vaccinated. Therefore, the differential between self-reported pneumococcal coverage and coverage based on medical record may have been even greater.

Three other studies have endeavoured to evaluate the validity of self-reported pneumococcal vaccination status in varying settings [8–10]. These studies considered the implications of unreliable self-reporting in terms of inappropriate revaccination but not from a vaccination program perspective. In contrast to the other studies, the study population in Victoria were subjects who had participated in a computer-assisted telephone interview (CATI) twelve months earlier [11]. The VPHS was originally intended to be the basis of coverage assessment in Victoria with the CATI approach being one of the most common methods for assessment of vaccination coverage among the elderly [4–7]. In addition to the study population, another major strength of the Victorian validation study was the capacity to measure response bias. This was unique among the validation studies and provided the Victorian study with the capacity to determine an adjusted coverage estimate that not only directly measured the accuracy of population based surveys (CATIs) as a means of assessing pneumococcal vaccination coverage in the elderly but also improved the generalisability of the results.

The adjusted coverage estimate in this study, 50.5% (95% CI 44.8–56.1%), accounted for response bias that was identified between the initial self-report and the subsequent steps leading to validation of self-report. There was no evidence of response bias in any of the earlier steps, i.e. from the 1860 elderly subjects who participated in the original CATI (the 1999 VPHS) through to the 326 subjects who participated in the first stage of the validation survey. Under these circumstances, it seems reasonable to assume the adjusted estimate is generalisable to that proportion of the elderly population in Victoria who participate in CATIs. While it could be argued that persons who participate in such surveys may be more likely to be vaccinated, being able to generalise the results of a validation survey to this level has not been demonstrated previously for pneumococcal vaccination of the elderly.

The publicly funded 23vPPV program in Victoria appears to have dramatically increased vaccination coverage among the elderly, particularly in 1998—the year that the program commenced. An earlier study of a non-random sample of hospitalised patients also found an increase in 23vPPV coverage, from 4% in 1997 to 41% in 1998 [14]. The data on available vaccine adds further supportive evidence. There were only two sources of vaccine (via prescription or through the publicly funded program). The amount of vaccine available through the public program was limited by the available budget each year [1], and yet coverage increased in line with the availability of free vaccine whilst the alternative source (prescriptions) was declining. In other Australian States and Territories that did not have a public program, the number of prescriptions issued for 23vPPV actually increased over the same period [13].

A national immunisation survey conducted in 2000 found self-reported pneumococcal vaccination coverage was higher in Victoria than in any other Australian jurisdiction. How-
ever, at 34.5% (95% CI 31.7–37.4), coverage was substan-
tially lower than the estimates from the validation study [15].
Self-report has underestimated coverage in other populations
with moderate to high 23vPPV coverage [8,9]. Another fac-
tor which may have contributed to the discrepancy was that
respondents in the national survey were first asked “can you
tell me what a pneumococcal injection is for” before going
on to ask if the subject had received the vaccine [15]. The vast
majority of Victorian subjects in the national survey (83%) said
they had either not heard of the vaccine or were unsure
of the purpose of the vaccine [15]. Having already indicated
an ignorance of the purpose of the vaccine, those who had
been vaccinated may have been even less likely to say they
were vaccinated than they may otherwise have been.

The 23vPPV is recommended for prevention of invasive
pneumococcal disease among all persons aged ≥ 65 years in
Australia [2]. Pneumococcal vaccination of the elderly has
been shown to be a cost-effective option in the USA and
Europe [16–18], and is likely to be as cost-effective as the
existing influenza vaccine program for the elderly in Aus-
tralia [19]. The experience in Victoria suggests the provision
of free 23vPPV through a nationally funded program will
dramatically increase coverage for all elderly Australians.

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