Method for Ascertaining Denominators for Evaluation of Population Coverage with Pneumococcal Vaccine

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ABSTRACT

Background: Immunization programs may collect numerator data for the estimation of pneumococcal vaccine coverage, but program evaluators do not have appropriate denominator data for estimation of pneumococcal vaccine coverage, particularly among those eligible for vaccine on the grounds of having chronic health conditions.

Methods: We partitioned the Alberta population into 6 mutually exclusive groups, all but one of which met Canadian recommendations for pneumococcal vaccination. Age-sex specific prevalence rates for each group were estimated using data on chronic health conditions from the Alberta over-sample of the 1996 Household component of the National Population Health Survey, from Alberta Health and Wellness rosters of nursing home residents, and from the Alberta Health Care Insurance Plan Stakeholder Registry. We applied these to Alberta Population Projections to estimate the numbers of persons who should be vaccinated.

Results: The proportion of persons recommended for vaccination on the grounds of chronic health condition ranged from 1.5% among those aged less than 12 years to 36% among persons aged 80 years or older. The total number of persons recommended for vaccination at mid-year 2000 is estimated to be 638,561 (21.5% of the Alberta population).

Interpretation: This methodology provides denominators for the estimation of pneumococcal vaccine coverage and permits monitoring of local and regional progress towards national goals.

The sixth edition of the Canadian Immunization Guide¹ recommends that conjugate pneumococcal vaccine be routinely administered to all children ages less than 24 months. It is further recommended that pneumococcal vaccines (polysaccharide and/or conjugate) should be given to all persons aged 65 years or older, and to persons aged 24 months or older with asplenia, splenic dysfunction or sickle-cell disease, as well as those with chronic cardiorespiratory disease (except asthma), diabetes mellitus, and some other chronic health conditions. Routine administration of vaccine is not recommended for children aged 24-59 months who do not have one of these conditions, although the conjugate vaccine "should be considered".

In 1998, a Canadian Consensus Conference agreed that target coverage rates (based upon the then National Advisory Committee on Immunization (NACI) recommended target groups) for pneumococcal vaccine should be 95% coverage for residents of long-term care facilities, and 80% coverage for all other recommended target groups by the year 2003.²

The existence of these targets poses a challenge for persons who evaluate immunization programs, namely, how to evaluate progress towards the national goals. One option for such an evaluation is to do a population-based survey. The results of such a survey (commissioned by Health Canada's Division of Respiratory Diseases) among persons aged 18 years or older have recently been published.³ A major disadvantage of such a strategy for program evaluation is the necessity to have large samples with the attendant high costs, as well as the need to conduct such surveys on a regular basis in order to monitor trends in vaccination coverage rates. An alternate approach would be to capture numerator data for calculation of vaccine coverage from a population-based immunization information system, and to estimate denominators from some other information source. One way would be to apply population-based prevalence rates of indications for pneumococcal vaccination to the distributions of a particular population to obtain an estimation of the number of persons who should be vaccinated for each indication for vaccination. Even if the denominators so estimated are not exact matches for the numerators or the pro-

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gram criteria, comparisons of vaccine coverage estimated from year to year with these denominators would still provide useful information on trends in vaccine coverage. This would permit evaluators, especially evaluators of provincial or local immunization programs, to determine if progress is being made towards national goals, and potentially to better target their programs. Russell (1996) used this approach to estimate denominators for influenza vaccine coverage among medically high-risk persons under the age of 65.⁴ However, the indications for influenza vaccination include having asthma, in contrast to those for pneumococcal vaccine. A refinement and expansion of the methods used previously is therefore needed.

We estimate age-sex-specific prevalences of membership in population groups that would qualify individuals for pneumococcal vaccination and illustrate the application of these data to Alberta population data to provide denominators for the calculation of pneumococcal vaccination coverage for the province as a whole.

METHODS

We defined each member of the population as falling into one of six groups (Table I) where the members of all groups except for those in Group 4 are recommended for pneumococcal vaccination according to NACI recommendations.¹ We estimated the age-sex specific prevalences for Group 1 for Alberta as a whole from Household Sample of the 1996 National Population Health Survey (NPHS) which contained an additional large sample of Albertans. The sample consisted of household residents and excluded persons living on Indian Reserves, or on the Canadian Forces Bases.⁵

Persons were categorized in Group 1 if they, or a proxy responding on their behalf, answered affirmatively to one or more of the relevant questions (lasting or expected to last 6 or more months, currently problematic, diagnosed by a doctor) pertaining to chronic diseases relevant to indications for pneumococcal vaccination. These were chronic bronchitis or emphysema, diabetes, heart disease or cancer.

Age- and sex-specific prevalences for having one or more of the health conditions of interest were calculated from the 1996 NPHS data. These prevalences were

TABLE I

Groups into which the Population Can be Categorized

Group 1	Recommended for pneumococcal vaccination	People (regardless of age) with NACI-identified high-risk medical conditions and not in Group 3
Group 2	Recommended for pneumococcal vaccination	People aged 65 years or older and neither in Group 1 nor Group 3
Group 3	Assumption: all recommended for vaccination (older age and/or at least one eligible chronic health condition)	People living in nursing homes and long-term care facilities
Group 4	Not recommended for pneumococcal vaccination	People aged 5-64 years and neither in Group 1 nor Group 3
Group 5	Recommended for pneumococcal vaccination	People aged less than 2 years and neither in Group 1 nor Group 3
Group 6	To be considered for pneumococcal vaccination	People aged 2 to 4 years and neither in Group 1 nor Group 3

TABLE II

Percentage of Population in Group 1*

Age Group (years)	Males		Sex	
	%	Standard Error	%	Standard Error
0-1	Data not available		Data not available	
2-4	Data not available		Data not available	
5-11	Data not available, assume same as for 12-14 year olds		Data not available, assume same as for 12-14 year olds	
12-14	1.93	0.71	1.48	0.64
15-19	2.10	0.79	2.23	0.76
20-24	2.29	0.69	3.12	0.93
25-29	2.41	0.84	3.97	1.03
30-34	2.60	0.63	4.82	0.87
35-39	3.48	0.67	5.97	0.97
40-44	5.32	0.85	7.45	1.22
45-49	8.06	1.45	9.23	1.51
50-54	12.11	1.73	10.85	1.68
55-59	17.11	2.43	12.46	2.30
60-64	23.00	2.91	16.02	2.42
65-69	27.42	3.38	21.76	2.81
70-74	30.15	4.14	26.56	3.64
75-79	32.56	4.86	30.99	4.32
80+	35.44	5.49	36.95	4.29

* People with NACI-identified high-risk medical conditions and not in Group 3.

then smoothed across age within each sex separately using locally weighted regression methods.⁶ All analysis was conducted using SPSS 10.1 (2001).

We made the assumption that persons who live in nursing homes and long-term care facilities (Group 3) are predominantly elderly and have chronic health conditions such that all should be vaccinated against pneumococcal disease. This assumption is supported by health expectancies such as Health Adjusted Life Expectancies calculated on individuals in long-term care institutions.⁷ We determined the number and age-sex composition of individuals in these facilities using the Alberta Health and Wellness Long Term Care database and calculated prevalence rates using Alberta populations estimated by the Alberta Health Care Insurance Plan (AHCIP)

Stakeholder Registry as denominators. Comparisons with Canadian census figures for 1996 show that this source provides accurate population counts by geography. Because Alberta collects a health care insurance premium, accuracy of the registry is maintained during inter-censal periods.⁸

The number of persons in groups 1 and 3 were estimated by application of the age-sex specific prevalences to the age-sex distribution of the mid-year 2000 Alberta Population. The Alberta Population was estimated in age-sex specific categories and by individual Regional Health Authority from the AHCIP Stakeholder Registry. The number of persons in groups 2, 4, 5 and 6 were then estimated by subtraction. For estimates for future years, the same procedures could be applied to Alberta Population Projections.⁹

TABLE III
Percentage of Population in Group 3*

Age Group (years)	Males	Sex Females
50-54	0.07	0.08
55-59	0.12	0.13
60-64	0.30	0.25
65-69	0.55	0.61
70-74	1.22	1.40
75-79	2.79	3.23
80-84	5.11	8.03
85-89	11.27	16.33
90+	23.91	35.12

* People living in nursing homes and long-term care facilities

RESULTS

Table II displays the age-sex specific prevalences of having one or more of the chronic health conditions of interest for Group 1. For both males and females, the proportion exceeds 10% starting with the age group 50-54 years. These proportions then increase rapidly with each five-year age group to 35% for males aged 80 years or older, and 37% for females in the same age group. Table III displays the population-based prevalence of living in a nursing home (Group 3). For every age group from 10-74 years and older, a larger proportion of females than males lives in a nursing home. Among those aged 85-89 years, the proportion of males is about 11% compared to 16% for females, while for those aged 90 years or older the respective proportions are 24% and 35%. Table IV displays the total number of persons in each category for Alberta. Group 1 (people of any age with a NACI-identified high-risk medical condition) accounts for the largest number of persons recommended to be vaccinated (7.6% of the Alberta population). Group 2 (people aged 65 years or older who do not have a high-risk medical condition and who do not live in a nursing home or long-term care facility) has the second largest number of persons recommended to be vaccinated (6.9%). Overall, it is estimated that 648,561 persons are recommended for vaccination at mid-year 2000. This represents 21.5% of the Alberta population.

DISCUSSION

Our approach to denominator estimation has both strengths and limitations. One of the strengths is that it permits program

TABLE IV
Estimated N of Persons by Population Group for Alberta, 2001

Group	N of Persons	% of Alberta Population	Comment
1 = People (regardless of age) with NACI-identified high-risk medical conditions and not in Group 3	226,440	7.63	Recommended to be vaccinated
2 = People aged 65 years or older and neither in Group 1 nor Group 3	203,576	6.86	Recommended to be vaccinated
3 = People living in nursing homes and long-term care facilities	13,588	0.44	Recommended to be vaccinated
4 = People aged 5-64 years and neither in Group 1 nor Group 3	2,329,766	78.5	NOT recommended to be vaccinated
5 = People aged less than 2 years and neither in Group 1 nor Group 3	76,516	2.58	Recommended to be vaccinated
6 = People aged 2 to 4 years and neither in Group 1 nor Group 3	118,441	3.99	Consider for vaccination
Total	2,968,327 (includes 193 not allocated to a region)	100	

evaluators at the regional level to calculate denominators on an annual basis; this is important particularly for those who are providing services to populations that are experiencing rapid growth. Further, because the approach is based upon age- and sex-specific prevalences, it permits program evaluators to estimate coverage for specific population subgroups based upon age and health status.

It is recognized that these methods underestimate the denominators for coverage among persons with chronic health conditions as not all health conditions that are indications for vaccination were included in the NPHS data. However, this method permits year to year comparisons of coverage by program evaluators as relative changes are of importance in measuring progress towards goals and targets. It is also recognized that the use of self-reported health conditions might lead to misclassification of persons with and without the diseases of concern. However as many persons who are provided with pneumococcal vaccines are given it on the basis of self report of having one or more of the health conditions for which vaccination is indicated, this is not necessarily a disadvantage. The proportion of the population that is resident in nursing homes and long-term care facilities may change over time; and should

be assessed periodically; the necessary data are available from the provincial Ministries of Health.

CONCLUSION

The application of census data or of health insurance program registry data to the rates provided in this paper will provide program evaluators with denominators that can be used to monitor pneumococcal vaccination coverage rates over time and to assess progress towards national goals.

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RÉSUMÉ

Contexte : Les programmes d'immunisation permettent de recueillir les numérateurs nécessaires à l'estimation de la couverture du vaccin antipneumococcique, mais les évaluateurs de programmes n'ont pas les dénominateurs nécessaires à l'estimation de cette couverture, en l'occurrence, les personnes qui auraient droit au vaccin en raison de troubles médicaux chroniques.

Méthode : Nous avons divisé la population de l'Alberta en six groupes s'excluant mutuellement, dont cinq répondaient aux recommandations canadiennes en matière de vaccination antipneumococcique. Les taux de prévalence selon l'âge et le sexe pour chaque groupe ont été estimés à l'aide de données sur les troubles médicaux chroniques tirées du suréchantillonnage pour l'Alberta du volet des ménages de l'Enquête nationale sur la santé de la population (1996), des listes des pensionnaires de maisons de soins infirmiers du ministère albertain de la Santé et du Bien-être et du registre des prestataires du régime d'assurance-santé de l'Alberta. Nous avons appliqué ces taux aux prévisions démographiques de l'Alberta pour estimer le nombre de personnes qui devraient se faire vacciner.

Résultats : La proportion des personnes pour qui le vaccin serait recommandé en raison de troubles médicaux chroniques varie de 1,5 % chez les moins de 12 ans à 36 % chez les 80 ans et plus. Le nombre total de personnes pour qui le vaccin aurait été recommandé au milieu de l'année 2000 est estimé à 638 561 (21,5 % de la population albertaine).

Interprétation : Cette méthode fournit les dénominateurs nécessaires à l'estimation de la couverture vaccinale antipneumococcique et permet de suivre les progrès locaux et régionaux réalisés en vue d'atteindre les objectifs nationaux.