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Measles incidence estimations based on the notification by general practioners were suboptimal

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Abstract

Objective: The aim of this study was to determine the notification by general practitioners (GPs) to the Municipal Health Service (MHS) and the presentation of measles complaints by patients to the GP during a measles epidemic in a 78% vaccinated population.

Study Design and Setting: Measles cases in children under 13 years were identified via questionnaires, GPs' records, and MHS's records. Consultation rate, notification rate, and completeness of notification were determined. Determinants of consultation were identified by multivariable logistic regression analysis.

Results: Among 1654 responders, 164 measles cases were identified. Consultation rate: 30%; notification rate: 30% (range among GPs: 0–62%); completeness of notification: 9%. Determinants of GP consultation: perceived seriousness of illness (adjusted OR 45; 95% CI: 6–347), self-reported complications (adjusted OR 9; 95% CI: 1–70), and need to consult for respiratory tract infections (adjusted OR 8; 95% CI: 1–51).

Conclusion: Incidence estimations based on the notification by GPs to the MHS are suboptimal for measles in The Netherlands. Perceived seriousness of illness seemed to be the most important factor to consult. © 2004 Elsevier Inc. All rights reserved.

Keywords: Measles; Epidemic; General practitioner; Complications; Notification; The Netherlands

1. Introduction

Measles is an acute viral, highly contagious, respiratory infection. Measles-associated complications occur relatively often. Acute otitis media (AOM) (3–9%) and pneumonia (1–5%) are the most frequent, occurring most often in the very young [1,2]. In The Netherlands, the introduction of a measles vaccination in 1976 radically reduced the number of measles cases [3]. The national coverage in The Netherlands for the combined measles, mumps and rubella (MMR), vaccination is 96% (on January 1, 1999), but this rate has an unequal distribution throughout the country [4]. Therefore, measles epidemics still occur in regional asynchronously elapsing epidemic cycles, mainly in clustered communities that refrain from vaccination on religious grounds. Nevertheless, the herd immunity is sufficient to prevent persistence of the virus [5]. In other Western countries a similar pattern can be recognized, with flareups of measles in subgroups of poor socioeconomic circumstances or based on religious grounds or specific individual beliefs regarding health and illness [6–8].

Inadequate notification is an internationally recognized problem in many countries [9,10]. Since the introduction of MMR vaccination, measles is a notifiable disease. Dutch figures are based upon notification by practising physicians, mostly by general practitioners (GPs). It is acknowledged that this official registration is an underestimation of the incidence in the population. This might be due to two factors: selective consultation of patients with measles, and inadequate notification to the Municipal Health Service (MHS) by the GPs. Concerning the former, determinants of GP consultation for measles remain unknown.

From June 1999 to June 2000, the most recent measles epidemic occurred in The Netherlands [11,12]. We collected data on the epidemic in a municipality with a relatively low vaccine coverage (78% for MMR-1 and 76% for MMR-2, at the ages of 14 months and 9 years, respectively [on January 1, 1999]) [4]. Because measles infection in The Netherlands is mainly a childhood illness, children are the focus in this study. By combining data from a population survey, GPs'

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records, and MHS's records, this study aims to determine the presentation of cases to the GP and the notification of cases by the GPs to the MHS. Subsequently, we identified determinants of GP consultation in patients.

2. Methods

2.1. Study population

This study was carried out in the GP group practice Rhenen with eight GPs caring for about 13,500 people living in a semiurban area in the center of The Netherlands. Its population and vaccination status have been steady over the years. In Rhenen, the epidemic lasted from June to December 1999, according to the MHS's records. From the GPs' records, we selected all 2,326 children younger than 13 years at the start of the outbreak, living in 1,271 families.

2.2. Data collection

We used three information sources:

1. *Questionnaire.* In December 2000, the parents of each child younger than 13 years of age received a questionnaire, enquiring about the occurrence of a possible measles infection in 1999 or 2000. In case of a possibly positive diagnosis, detailed symptoms of measles virus infection were obtained and data about GP consultation. Vaccination status and self-reported complications were obtained, to identify determinants of GP consultation. Statements about perceived seriousness of this illness episode (11 items) and parents' views on respiratory tract infections (the need to consult a GP: three items; perceived self-limiting character: three items) were rated on a five-point scale (1: strongly disagree; 5: strongly agree) [13–16]. After 4 weeks a reminder was sent. A random sample ($n = 42$, 10%) of nonresponders were interviewed by telephone in a semistructured way, for motives of nonresponse.
2. *GPs' records.* The GPs in Rhenen have been participating in the University Network Utrecht, and have been trained extensively to electronically register disease uniformly according to the International Classification of Primary Care classification (ICPC) [17]. Patient information derived from the database for scientific research has been used according the approval of the medical ethical committee of the Utrecht University. For all children younger than 13 years, we performed an electronic search of the GPs' records for the ICPC-code A71 (measles) and for free-text "measles," in the period ranging from 2 months previous to the start of the national outbreak, to 2 months after the end of the national outbreak. The included patient files were checked (CvI) for dates of first contact and complications.
3. *MHS's records.* GPs notify cases by filling in a standard form, and sending it to the MHS. For all measles cases according to the GPs' records, the MHS's records were checked manually by gender, date of birth, and date of notification, to identify those cases that were notified by the GPs.

2.3. Outcome measures

Measles cases were identified via three sources, using the following case classifications:

1. *Questionnaire:* a generalized rash lasting ⩾3 days, and fever ⩾38.0ºC, and either cough, coryza, or conjunctivitis,
2. *GP records:* measles diagnosis and/or presence of measles-associated complications, with or without the ICPC-code A71, and
3. *MHS records:* cases notified by the GPs to the MHS [18].

The *consultation rate* is defined as the number of cases according to the GP's records divided by the number according to the questionnaire; the *notification rate* as the number of cases according to the MHS records divided by the number according to the GP's records; and the *completeness of notification* as the number of cases notified to the MHS divided by the number according to the questionnaire.

2.4. Data analyses

Data from the questionnaire were processed automatically using Teleform software and analyzed using SPSS 10.1 software.

The reliability of the statements about perceived seriousness of this illness episode and of parents' views on respiratory tract infections was assessed by calculating the intracorrelation coefficient (Cronbach's α) with the following results: perceived seriousness of this illness episode (11 items, $\alpha = 0.91$), need to consult a GP in case of respiratory tract infection (three items, $\alpha = 0.87$), and the perceived self-limiting character of respiratory tract symptoms (three items, $\alpha = 0.71$) [16]. Results were expressed as means.

The association between patients' characteristics (age, gender, complications), family characteristics (vaccination status, family size), perceived seriousness of this illness episode, and parents' views on respiratory tract symptoms on the one hand, and GP consultation on the other hand, was determined by means of a multivariable logistic regression analysis (method: enter). Age (categories 0 through 3 years (preschool age) and above 3 years), gender, and all factors with a P-value $<.20$ in the bivariate analysis were entered in the multivariate analysis model. The analyses were performed containing only one randomly selected child per family ($n = 81$ families).

3. Results

Data on 885 (70%) of 1,271 families could be analyzed in the study, with a total of 1,654 (71%) children younger

than 13 years of age. In the random sample of nonresponders interviewed by telephone, the most frequent motives for nonresponse mentioned were "forgot to reply" (24%) and "I lost questionnaire" (18%).

3.1. Outcomes

Among the 1,654 children of whom interview data were available, 164 (10%) cases of measles were identified. Of these, 50 patients consulted the GPs (consultation rate: 30%), of whom 15 were notified by the GPs to the MHS (notification rate: 30%, range among GPs: 0–62%). The completeness of notification was 9%. For June to December 1999, the numbers of consulting cases and those notified to the MHS are shown in the Table 1. At the start of the epidemic more cases were notified.

Case characteristics are shown in Table 2. Patients reported complications in 33 (21%) of 156 cases; 146 (89%) of 164 were MMR vaccination-negative. According to the GPs' records, 22 of 50 (44%) patients that consulted the GP, had one or more complications, which is twice as high as among all cases; 46 (92%) were not vaccinated.

3.2. Determinants of GP consultation and notification

Strong determinants of GP consultation for measles were the perceived seriousness of this illness episode (adjusted OR 45; 95% confidence interval [CI: 6, 347]), self-reported measles-associated complications (adjusted OR 9; 95% CI: 1, 70), and the need to consult a GP in case of respiratory tract infection (adjusted OR 8; 95% CI: 1, 51) (Table 3). Adjusted ORs for gender and vaccination status were 4 (95% CI: .7,25) and 0.9 (95% CI: .1, 6), respectively.

4. Discussion

This study focuses on a measles epidemic in a 78% vaccinated population. Both consultation and notification rates were 30%. Nine percent of the measles patients among children under 13 years of age were notified to the MHS (completeness of notification). Complications were reported in 21% of all cases, and in 44% of consulting cases. The most important determinant of GP consultation was the perceived seriousness of this illness episode (OR 45).

Inadequate notification is an international problem. The figure found in this study, 9%, is consistent with the literature [9,10]. In an Australian study, the completeness of notification for measles was 11%. In an Italian study of a paediatric sentinel surveillance system, the estimated incidence rate for measles was 3.9 times higher than that estimated by statutory reporting.

National registries are mainly based on notification by physicians. As shown in this study, incidence estimates based on this notification are suboptimal in case of measles in The Netherlands. In theory, capture–recapture analyses, in which at least three (independent) sources of cases are needed, can be applied to estimate the true incidence of a disease [9]. In this study, however, the cases notified to the MHS form a subgroup of the cases from the GPs' records, and therefore, a capture–recapture analysis was not feasible.

The level of notification for GPs as a group declines rapidly in the course of the epidemic, indicating elapse of time possibly being a factor contributing to notification. However, on the individual level, differences in notification among GPs are immense (0–62%). Two peaks in the numbers of notified cases are recognized, in June/July and October/December, corresponding to the course of the epidemic according to the national registry [19].

Our study was of a retrospective nature; thus, cases could not be confirmed serologically systematically. Because appropriate preconditions were present, this is unlikely to lead

Table 1
Cases notified to the MHS

Month	Number of consulting cases	Number of notified cases (%)
June[a]	10	9 (90)
July	16	2 (13)
August	0	0 (0)
September	1	0 (0)
October	7	2 (29)
November	9	2 (22)
December	7	0 (0)
Total	50	15 (30)

Number of consulting cases ($n = 50$), number of cases notified by the GPs to the MHS ($n = 15$), for June to December 1999.

[a] June 14th to 30th.

Table 2
Case characteristics

Item	n (%)[a]
Symptoms ($n = 164$)	
Coughing	144 (88)
Coryza	89 (54)
Conjunctivitis	131 (80)
Other	
Sore throat	109 (66)
Headache	71 (43)
Koplik's spots	58 (35)
Aching muscles/joints	56 (34)
Complications ($n = 156$)	
Total	33 (21)
AOM, or other ear complaints	23 (15)
Pneumonia, or other symptoms of a lower respiratory tract disorder	14 (9)
MMR vaccination status ($n = 164$)	
Negative	146 (89)
MMR-1	16 (10)
MMR-1 and MMR-2	2 (1)

Number of self-reported symptoms (%) among identified cases ($n = 164$), number of self-reported complications (%) among identified cases, that filled in at least one question about complications ($n = 156$), and number of MMR vaccinated cases (%) (self-report) among identified cases ($n = 164$).

Abbreviations: AOM, Acute Otitis Media; MMR, Measles, Mumps and Rubella.

[a] Sum of percentages may exceed 100%.

Table 3
Determinants of GP consultation

Determinant	Unadjusted OR (95%CI)		Adjusted OR (95%CI)[a]
Patient characteristics			
Age (0–3 years)	2 (0.7, 4)	$n = 81$	0.8 (0.2, 4)
Gender (female)	3 (0.9, 7)	$n = 80$	4 (0.7, 25)
Self-reported measles-associated complications (presence of)	6 (2, 22)*	$n = 77$	9 (1, 70)*
Family characteristics			
Vaccination status in the family (vaccinated)	3 (0.9, 7)	$n = 81$	0.9 (0.1, 6)
Number of children younger than 13 years of age (1 or 2)	0.9 (0.4, 2)[b]	$n = 81$	—
Reasons for consulting the GP's office			
Perceived seriousness of this illness episode (serious)	25 (5, 121)*	$n = 73$	45 (6,347)*
Parents' views on respiratory tract symptoms			
Need to consult a GP (strong)	2 (0.8, 6)	$n = 77$	8 (1,51)*
Perceived self-limiting character (strong)	0.4 (0.2, 1)	$n = 78$	0.6 (0.1, 3)

Determinants of GP consultation ($n = 81$ families). Reference category in parentheses.
[a] $n = 65$ due to missing data.
[b] Not included in the final model ($p > .20$).
* $p < .05$.

to any bias. In a separate study performed by the National Institute of Public Health and the Environment (RIVM, Rijksinstituut voor Volksgezondheid en Milieu), measles cases were confirmed serologically. By using the same case definition to diagnose measles, 34 of 41 (83%) of these cases were confirmed serologically. As both studies were performed in overlapping populations, the predictive value of measles cases in our study to be confirmed serologically would be in that order. As all cases were living in the same community, that study demonstrated them to be epidemiologically linked, as well as to be related to serologically confirmed cases [20].

The complication rate is somewhat higher than reported in the literature, in which acute otitis media is reported in 3–9% of cases, and pneumonia in 1–5% [1,2]. This difference can possibly be explained by self-report and by the less strict definition of complications used in this study (including other symptoms of ear and lower respiratory tract disorders). Twice as many patients that consulted the GP had one or more complications. This further illustrates that medical problems presented to physicians are more severe or bothersome compared to nonpresented problems [21].

We could not confirm that parents usually consult sooner for younger children [22]. Perhaps measles infection is such a serious disease that other factors like the presence of complications become more important. In a measles outbreak, the vaccination status in the family seems to play no role in contacting the GP's office. Apparently, it is known that vaccinated children also can be infected with the measles virus, without this being a reason for concern. The trend to contact earlier for girls could not be verified in literature [22]. No more complications had occurred among girls.

In The Netherlands, measles epidemics still occur in communities that refrain from vaccination, mainly on religious grounds. In other Western countries a similar pattern can be recognized, mainly due to poor socioeconomic circumstances or based on religious grounds or specific individual beliefs regarding health and illness [6–8]. To interrupt virus spread, it is essential to achieve and maintain a (worldwide) vaccination coverage sufficiently high to create herd immunity. This will be the key issue in disease control.

We conclude that incidence estimations based on the notification of GPs to the MHS are suboptimal in case of measles in The Netherlands. Although this study focuses on only one region, it indicates that the Dutch official registration is far from complete. Only one of three patients consults, of which only one of three is notified. The apparent influence of parents' views on respiratory tract symptoms on the actual consultation behavior was clearly demonstrated. Perceived seriousness of this illness episode seemed to be the most important factor to consult.

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