Reporting Efficiency during a Measles Outbreak in New York City, 1991

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ABSTRACT

Objectives. During an epidemic of measles among preschool children in New York City, an investigation was conducted in 12 city hospitals to estimate reporting efficiency of measles to the New York City Department of Health.

Methods. Measles cases were identified by review of hospital emergency room and infection control logs and health department surveillance records. The Chandra Sekar Deming method was used (1) to estimate the total number of measles cases in persons less than 19 years old who presented to the 12 hospitals from January through March 1991 and (2) to estimate reporting efficiency. Information on mechanisms for reporting measles cases was collected from hospital infection control coordinators.

Results. The Chandra Sekar Deming method estimated that 1487 persons with measles presented to the 12 hospitals during the study period. The overall reporting efficiency was 45% (range = 19% to 83%). All 12 hospitals had passive surveillance for measles; 2 also had an active component. These 2 hospitals had the first and third highest measles reporting efficiencies.

Conclusions. The reporting efficiency of measles cases by New York City hospitals to the health department was low, indicating that the magnitude of the outbreak was substantially greater than suggested by the number of reported cases. (*Am J Public Health.* 1993;83:1011–1015)

Introduction

Beginning in March 1990, New York City experienced a resurgence of measles.[1] For 1990, a total of 1108 confirmed measles cases[2] and 8 measles-associated deaths were reported to the New York City Department of Health (unpublished data). Measles transmission increased in 1991, with more than 4000 suspected measles cases and 13 measles-associated deaths reported (New York City Department of Health, unpublished data). In comparison, from 1981 through 1989, a median of 108 confirmed measles cases per year (range = 49 to 945) were reported. In 1986, a measles outbreak occurred with 945 cases. The 1990 through 1991 outbreak was the largest reported measles outbreak in New York City during the past decade[3]; however, the magnitude of the outbreak was difficult to measure because of suspected underreporting.

Measles is a reportable disease in all US jurisdictions.[4] However, the efficiency of measles reporting in the United States is not known. Successful reporting of a measles case depends on a chain of events that begins with the diagnosis of measles and ends with a report to the National Notifiable Disease Surveillance System, which is operated by the Centers for Disease Control in Atlanta, Ga. When a suspected case is detected by a health care provider, it should be reported to the local or state health department. Local or state health departments then investigate suspected cases of measles and report confirmed cases to the National Notifiable Disease Surveillance System.[5]

From 1981 through 1988, measles incidence in the United States was relatively stable, with approximately 3000 cases reported annually. Measles incidence increased dramatically in 1989 and 1990, however, with 18 193 and 27 786 cases reported, respectively.[2,6] During the mid-1980s, when measles incidence was low, most outbreaks were school based,[3] and reporting by school authorities or public health officials could be done easily by identifying potential measles patients from absentee records. In contrast, in community-based outbreaks involving predominantly children of preschool age, the most common type of outbreak that occurred from 1989 through 1991,[1,7–9] there is no defined population that can be easily accessed. In this situation, reporting is dependent more heavily on health care providers.

During the measles outbreak in New York City, we conducted a retrospective investigation of measles reporting from 12 city hospitals to the New York City Department of Health to estimate the magnitude of the outbreak, to assess the reporting efficiency of measles at the health care provider level, and to describe reporting practices in different hospitals.

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Methods

Sources of Data

Twelve of the 83 hospitals in New York City were selected for study. These 12 hospitals (5 public and 7 private) were located in areas of known high measles incidence (north Manhattan, the Bronx, and Brooklyn). Because it was not possible to study all hospitals, at least 1 large public hospital and at least 1 private hospital in each geographic area were selected for study. In each of the 12 hospitals, measles cases diagnosed in persons less than 19 years of age were ascertained through review of pediatric emergency room logs; computerized billing records for inpatients, outpatients, and emergency room patients; Health and Hospital Corporation billing records; and infection control records, where available. Data on suspected measles cases in persons less than 19 years old reported to the department of health from these 12 hospitals were obtained from the department of health surveillance records. To eliminate the effect of reporting delays, this analysis was limited to persons with measles with an onset of illness between January 1, 1991, and March 30, 1991, who were reported to the New York City Department of Health between January 1, 1991, and October 19, 1991.

Estimate of Number of Cases and Reporting Efficiency

Capture-recapture methods (described by Chandra Sekar and Deming[10]) were used to estimate the total number of persons with measles who presented to the 12 study hospitals and to calculate the efficiency of measles reporting during an outbreak. Adapted from capture, tagging, and recapture methods used to estimate the size of animal populations,[11] the Chandra Sekar Deming method compares two independent surveillance systems (in this case, the hospital record review system and the department of health system) that ascertain events (measles cases) from the same population. The method assumes that events have an equal chance of being recorded in either surveillance system and is dependent on the ability to accurately match cases between the two surveillance systems.[12]

In this investigation, hospital name, patient's name, and date of birth or age were used to match measles cases identified by review of hospital records to measles cases reported to the department of health. Duplicates were excluded by manually checking alphabetized lists of patient names for each hospital. Because the number of matched cases for a given hospital might be zero, the estimate of the total number of cases has a bias toward infinite.[13] To correct for this bias and to derive a more accurate estimate of the total number of cases, the modification proposed by Chapman was applied to the Chandra Sekar Deming methods.[14] Methods derived by Seber[15] were used to calculate 95% confidence intervals around the Chandra Sekar Deming estimate. The estimates of the total number of measles cases provided the basis for calculating the reporting efficiencies for each hospital and for all 12 hospitals combined. Reporting efficiency was calculated as the ratio of the number of measles cases reported to the department of health by the hospital(s) (numerator) to the number of measles cases estimated by the Chandra Sekar Deming method (denominator).

Definitions

A patient with a case of measles was defined as a person less than 19 years of age with a physician's clinical diagnosis of measles or possible measles with onset of illness between January 1 and March 30, 1991, who presented to 1 of the 12 study hospitals for diagnosis and care or who was reported to the department of health as a suspected measles case. No attempt was made to verify the physician's clinical diagnosis.

A passive surveillance system was defined as a system in which hospital-based health care providers were responsible for notifying either the hospital's infection control nurse or the department of health directly when they diagnosed a patient with a reportable disease.

A passive surveillance system with an active component was defined as a system that was primarily passive (as defined above) but also had an infection control nurse who reviewed emergency room logs on a regular basis to identify patients with reportable diseases.

Representativeness of Reported Measles Cases

To evaluate the representativeness of persons with measles reported to the department of health, age distribution was compared for the two surveillance systems. Race and ethnicity data were not available on a sufficient number of persons to allow meaningful comparison.

Mechanisms of Reporting

To collect information on mechanisms for reporting measles cases, a questionnaire was administered, at each hospital, to the person responsible for infection control activities (e.g., an infection control nurse, hospital epidemiologist, or physician).

Results

Estimates of Number of Cases and Reporting Efficiency

A total of 1160 persons with measles with onset of illness between January 1 and March 30, 1991, was identified from the 12 hospitals studied during the investigation. For the same hospitals and time period, 664 persons with measles were reported to the department of health. A total of 518 cases ascertained from hospital records matched cases reported to the department of health. Of these, 90% matched on date of birth or age and name, and 10% matched on name only because date of birth or age was not available.

The total number of persons with measles who were diagnosed at the 12 hospitals between January 1 and March 30, 1991, was estimated, through use of the Chandra Sekar Deming method, to be 1487 (95% CI = 1442, 1531). The overall reporting efficiency for the 12 hospitals was 45%, with a range from 19% to 83% (Table 1). Public and private hospitals had similar reporting efficiencies of 43% and 48%, respectively.

Representativeness of Cases

The age distribution of measles cases in persons less than 19 years of age ascertained by hospital review was similar to cases reported from the 12 study hospitals to the department of health, with the majority of persons less than 2 years old (Figure 1). Only 8% of all persons with measles reported from the 12 study hospitals to the department of health were greater than 19 years of age.

Mechanisms of Reporting

All 12 hospitals had passive surveillance for measles; 2 also had an active component in which an infection control nurse reviewed emergency room logs at least weekly (Table 1). Both were among the 3 hospitals with the highest reporting efficiencies. In most hospitals, an infection control nurse was responsible for communicable disease reporting to the department of health; however, in 3 hospitals, physicians alone reported.

Discussion

During the largest measles outbreak in New York City in the past decade, the

TABLE 1—Measles Reporting Practices in Selected New York City Hospitals: January 1 to March 30, 1991

Hospital	Location	Type	No. of Beds	Reporting Method[a]	Reporter(s) to Department of Health	No. of Cases Found by Review	No. of Cases Reported to Department of Health	Estimate of Total Cases[b]	Reporting Efficiency, %[c]
1	Manhattan	Private	1112	Passive/active	Infection control nurse	76	73	88	83
2	Brooklyn	Private	312	Passive	Infection control nurse	67	74	90	82
3	Manhattan	Private	780	Passive/active	Infection control nurse	37	30	43	70
4	Brooklyn	Public	1204	Passive	Physicians only	205	151	292	52
5	Manhattan	Public	569	Passive	Hospital epidemiologist	74	42	84	50
6	Brooklyn	Public	254	Passive	Physicians and infection control nurse	48	29	60	48
7	Bronx	Public	586	Passive	Physicians and infection control nurse	339	140	380	37
8	Manhattan	Private	190	Passive	Infection control nurse	6	2	6	33
9	Manhattan	Private	1291	Passive	Physicians only	121	58	188	31
10	Brooklyn	Private	783	Passive	Infection control nurse	59	17	59	29
11	Manhattan	Public	678	Passive	Physicians and infection control nurse	40	19	67	28
12	Bronx	Private	280	Passive	Not available	88	29	156	19
Total						1160	664	1487	45

[a]Passive = all passive surveillance; passive/active = passive surveillance with active component.
[b]Using Chandra Sekar Deming method[10] (see text for details).
[c]Reporting efficiency = number of measles cases reported to department of health divided by number of measles cases estimated by Chandra Sekar Deming method.

reporting efficiency of measles cases from the 12 study hospitals to the department of health was estimated to be only 45%. Since this outbreak was the subject of substantial publicity, the awareness of physicians and other medical personnel should have been high. There are few estimates[16,17] or studies[18–21] of reporting efficiency for measles in the United States or other countries. However, it is generally assumed that reporting efficiency is better in the postvaccine era than in the prevaccine era.[17,22] A 1980 survey of state health departments indicated that a majority (60%) believed that at least 80% of measles cases are reported.[17] Using methods different from those in our study, non–hospital-based studies in England, Wales, and Denmark have estimated reporting efficiencies for measles ranging from 40% to 60%.[18,19] Surveillance systems in the United States, which are relatively developed and sophisticated, may not be directly comparable to surveillance systems in other countries. However, estimates from other countries provide some comparison for the reporting efficiencies calculated for New York City hospitals during the 1991 measles epidemic.

It is likely that reporting efficiency has been higher than 45% in other outbreaks in the United States, such as those in schools or institutions. However, no assessment of reporting efficiency has been conducted in these settings.

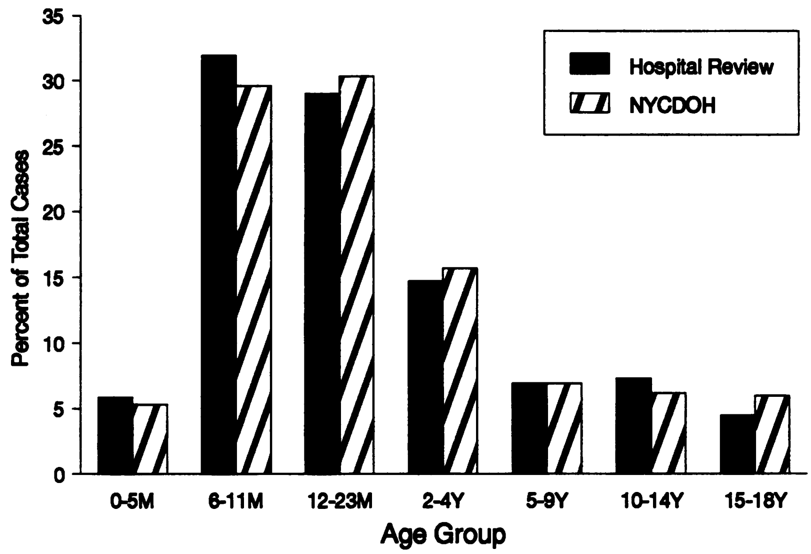

FIGURE 1—Age distribution of measles cases ascertained from hospital record review and of measles cases reported to New York City Department of Health (NYCDOH) from study hospitals, January through March 1991.

Our study was limited by three factors: (1) the unknown degree of independence between the two surveillance systems, (2) the lack of a community-based assessment of measles incidence, and (3) the lack of verification of the diagnosis of measles or possible measles. The Chandra Sekar Deming method used to estimate the total number of measles cases is valid only when true matches are identified between two surveillance systems and when the surveillance systems (the hospital record review system and the department of health system) are independent.[23] The probability of a case being omitted from one system should not be related to the chance of a case being omitted from the other system. In this study, only two hospitals had infection control nurses review emergency room logs. These nurses, in turn, reported cases found in emergency room logs to the department of health. Since our investigation involved reviewing the same emergency room logs reviewed by infection control nurses, the two surveillance systems were not completely independent for these two hospitals. When these two hospitals were excluded from the analysis, the estimate of overall reporting efficiency did not change substantially, decreasing from 45% to 41%.

Since a community-based assessment of measles cases was not conducted, it was not determined how representative persons with measles presenting to hospitals were of all measles cases in the community. Since many poor and racial/ethnic minority families use emergency rooms as their primary source of medical care,[24] and most of the study hospitals serve poor minority populations, it is reasonable to assume that the cases identified in this study were representative of persons with measles seeking health care from these communities.

Because we did not attempt to verify the diagnosis of measles or possible measles, it is not known how many cases would have met the Council of State and Territorial Epidemiologists standardized measles case definitions for public health surveillance.[25]

The age distribution of persons with measles ascertained by hospital review and cases reported to the New York City Department of Health was similar, suggesting that reported cases of measles were representative of all persons with measles presenting to hospitals. Whether the age distribution of all persons with measles in the community was similar to that identified by hospital record review is not known. If young children, who are more likely to experience more severe illness, are also more likely to present to hospitals, the age distribution of reported cases from hospitals would differ from all persons with measles in the community.[26] Furthermore, since persons with milder illness are less likely to present for medical care, the actual number of cases occurring in the communities surrounding the study hospitals may have been greater than the number identified in the hospital record review.

The reason why 146 cases found in the department of health records were not found in the hospital record review is unclear. It is possible that (1) our review process missed these cases; (2) these cases were not coded as measles or possible measles but were reported as measles based on other criteria, such as a rash illness; and/or (3) some of the 146 cases were reported with erroneous information and could not be matched.

Reporting practices in the study hospitals appeared to be similar, with the exception that the two hospitals with the first and third highest reporting efficiencies had periodic active review of emergency room logs. Active surveillance can be defined as the periodic solicitation of case reports from reporting sources, such as physicians.[27] Specific active surveillance techniques, such as routine telephone contact with providers, have been shown to improve reporting.[28,29] Within hospitals, infection control nurses have been shown to be the most important source of disease reports.[28] Based on these findings and the results of our investigation, hospital-based reporting efficiency could be improved by creating an emergency room log with discharge diagnoses and designating a person to review the log on a regular basis. Hospital-based surveillance with this active component could be a relatively easy method for ascertaining cases and defining disease trends during community-wide inner-city outbreaks.

Although our data cannot be extrapolated directly to all of New York City, they imply that the magnitude of the measles outbreak was substantially greater than suggested by the number of cases reported to the department of health. It is likely that measles reporting efficiency was not optimal during the 1989 through 1991 outbreaks in other large cities in the United States, such as Los Angeles[30] and Chicago,[31] and that the magnitude of these outbreaks was also underestimated.

While outbreak control should take precedence over counting cases during large outbreaks, accurate and timely assessment of the magnitude of the problem is crucial to determine the quantity and nature of the control measures. Based on the size of an epidemic, health officials would be guided to allocate more resources, including measles vaccine, for control strategies such as lowering vaccination age, vaccinating in emergency rooms, mounting education campaigns, and targeting high risk populations. Consequently, those responsible for reporting should immediately notify local or state health departments after identifying a suspected case of measles so that the true magnitude of the problem can be accurately assessed and timely control measures can be implemented. □

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Call for Abstracts for Epidemiology Late-Breaker Sessions

Oral Exchange Session

The Epidemiology Section will sponsor a late-breaker epidemiology oral exchange session on Wednesday, October 27, 1993, during the American Public Health Association's 1993 annual meeting October 24–28, 1993, in San Francisco. The exchange will provide a forum for the oral presentation of investigations or methods that have been conceived, conducted, and/or concluded so recently that members could not meet the deadline for abstract submission to other epidemiology sessions. Abstracts should report on work conducted during the last year.

Abstracts of fewer than 200 words (any format) and a stamped, self-addressed return envelope should be submitted to Polly A. Marchbanks, PhD, Chief, EIS Program, Epidemiology Program Office, Mailstop C08, Centers for Disease Control, Atlanta, GA 30333; tel (404) 639-3588.

Abstracts must be *received* by September 13, 1993. Decisions will be made by September 20, 1993.

Poster Session

The Epidemiology Section will again be sponsoring a late-breaker poster session at the APHA annual meeting in San Francisco. The session will take place on Wednesday, October 27 at noon. Work completed in 1992 is eligible for consideration. Submit an abstract of less than 200 words (any format) and a *return envelope* to Cathey Falvo, MD, MPH, Graduate School of Health Sciences, Munger Pavilion, New York Medical College, Valhalla, NY 10595; tel (914) 993-4250.

Abstracts must be *received* by September 13, 1993. Decisions will be mailed September 20. Students and recent graduates are particularly encouraged to submit abstracts.