Prevalence of measles susceptibility among health care workers in a UK hospital. Does the UK need to introduce a measles policy for its health care workers?

E. Ziegler¹, C. Roth² and T. Wreghitt³

Objectives	First, to determine the prevalence of measles non-immunity in a group of health care workers (HCW), and secondly, to investigate what pre-employment screening for measles is carried out by NHS occupational health departments.
Methods	Two hundred and eighteen HCWs with patient contact on the medical wards at Addenbrooke's hospital provided an oral fluid sample and answered a questionnaire. A postal survey of Association of National Health Occupational Physicians Society (ANHOPS) members was conducted to assess whether UK NHS Trusts identify measles non-immune individuals.
Results	Of the HCWs tested, 3.3% of were found to be non-immune to measles (both oral fluid and confirmatory serum sample were measles IgG negative). Less than one-third of a sample of 80 NHS occupational health departments enquired about measles immunity.
Conclusion	The prevalence of measles non-immune health care workers is low, but with a fall in uptake of MMR immunization and increased likelihood of measles outbreaks, it is important to identify these at-risk individuals. Serum testing is the most reliable method to use. Oral fluid testing and history of measles disease or vaccination are unreliable methods of identifying non-immune individuals. To achieve complete immunity, it is cost-effective to screen and then offer immunization. NHS trusts vary greatly in their measles policies for health care workers.
Key words	Health care worker; immunity; immunization; measles; occupational health.
Received	8 May 2002
Revised	3 December 2002
Accepted	7 April 2003

Introduction

This study determines the prevalence of measles susceptibility in a population of UK health care workers and examines NHS occupational health department policies on measles immunity for staff. It also determines the reliability of vaccination history or history of infection from subjects to identify susceptible individuals.

The incidence of measles has fallen in England and Wales since the introduction of the combined measles, mumps and rubella (MMR) vaccination in 1988 and the campaign to immunize all 5- to 16-year-olds against measles and rubella in November 1994 [1]. It is now a rare disease.

However, recent concerns about an unsubstantiated association between the MMR vaccine and autism [2], have led to a fall in immunization rates [3], so that by the age of 2, 88% have received one dose and by age 5, only

¹Communicable Disease Surveillance Centre, 61 Colindale Avenue, London NW9 5EQ, UK.²Cambridge Public Health Laboratory Service, Addenbrooke's Hospital, Hills Road, Cambridge CB2 2QW, UK.

³Occupational Health Department, Addenbrooke's Hospital, Hills Road, Cambridge CB2 2QQ, UK.

Correspondence to: Emma Ziegler, Communicable Disease Surveillance Centre, 61 Colindale Avenue, London NW9 5EQ, UK. e-mail: emma.ziegler@suht.swest.nhs.uk

77% of children have received two doses of MMR [4]. Outbreaks of measles have already been reported in groups with low immunization rates [5].

In countries close to achieving measles elimination, health care workers have been shown to be at greater risk of communicable diseases compared with the general population [6], with one study indicating an 18.6-fold risk [7]. Reports of hospital outbreaks of measles indicate that nosocomial spread to staff is more common for those with patient contact, but is not confined solely to this group [6].

Surveys outside the UK indicate that between 1.7 and 10.3% of health care workers are not immune to measles [8–11]. There are no comparable data available in the UK, although seroprevalence data from serum samples collected in 1991 estimated that \sim 5% of all adults aged 20–39 years were susceptible to measles [12].

With the predicted increase in measles infections resulting from falling MMR vaccination rates [4], it is important for all non-immune health care workers to be identified and offered immunization. There is a need to protect them, their non-immune patients and family members with whom they have contact. This would also prevent costly emergency infection control measures.

There are no guidelines for the immunization of health care workers in the UK. In the USA, the revised Advisory Committee on Immunization Practices (ACIP) guidelines [13] recommend active immunization of health care workers against hepatitis B, influenza, chickenpox, measles, mumps and rubella. For measles, documentation of immunity is required (defined as two doses of vaccine, laboratory evidence of measles infection or vaccine-induced immunity, or documentation of physician-diagnosed infection) for all persons born during or after 1957, not just new employees or those with direct patient contact. The World Health Organization (WHO) states that 'in some settings, medical personnel have been the source of measles spread. Policies requiring immunization or proof of immunization may need to be implemented' [14].

The Association of National Health Occupational Physicians Society (ANHOPS) and the Department of Health are developing guidelines for NHS health care workers.

This study was carried out following the case of a non-immune health care worker who contracted measles from an inpatient [15].

Methods

Oral fluid testing

Health care workers were screened for measles IgG by oral fluid (saliva) testing using antibody-capture radioimmunoassay [16]. Oral fluid testing was chosen because it is a non-invasive procedure and was expected to result in a high rate of compliance amongst study subjects. The sensitivity and specificity of the assay in comparison with serum IgG determined by enzyme-linked immunosorbent assay (ELISA) are 96.4 and 78.6% (Frerichs and Brown, unpublished observations). Negative oral fluid results were investigated by testing a serum sample by ELISA (Diamedix Measles IgG; Miami, FL). Stored serum samples from those with a positive measles IgG oral fluid result were tested for measles IgG to identify false-positive oral fluid results. Oral fluid testing was carried out at the Central Public Health Laboratory, Colindale, London and serum testing at Cambridge Public Health Laboratory.

Study population

All health care workers (n = 528) on 11 general medical wards at Addenbrooke's Hospital were invited to participate in the study, which was conducted between April and July 1998. A leaflet explaining the reason for testing measles immunity, a short questionnaire recording occupation, age and history of measles infection and immunization, together with an oral fluid sample kit (with instructions) were distributed to the wards. No reminder letters were sent.

All participants were informed of their results by letter. Those with a negative measles IgG saliva result were asked to provide a serum sample (or consent to the testing of a stored sample) to confirm non-immune status prior to being offered immunization. The sera (from stored specimens) from a random sample of those with a positive oral fluid result were analysed to identify false-positive results.

ANHOPS survey

A postal questionnaire was sent to ANHOPS members (n = 200) asking about screening of health care workers for measles immunity at pre-employment screening and action for those found to be non-immune. No reminder letters were sent.

Results

A total of 218 (41%) (age range 19–60 years) of the 528 staff who worked on the 11 wards answered the questionnaire and produced an oral fluid sample.

The breakdown of participants by age and occupation are shown in Tables 1 and 2.

Of the 218 staff, 176 (81%) had a positive measles IgG oral fluid result (Table 3). Of these, only 11 had stored serum samples, all of which indicated immunity for measles.

Forty-two individuals (19%) had a negative measles IgG oral fluid result, of which 5 (12%) were lost to

Table 1. Age breakdown of study population

Age breakdown of study group	Number (%)
<20	1 (0.5)
20-29	91 (42)
30–39	64 (29)
40-49	33 (15)
50-59	26 (12)
60-69	1 (0.5)
Unknown	2 (0.9)
Total	218 (100)

Table 2. Occupations of study group

Occupation	Number (%)	
Doctor	40 (18)	
Nurse	106 (49)	
Nurse assistant	24 (11)	
Ward clerk	9 (4)	
Occupational therapist	10 (5)	
Physiotherapist	7 (3)	
Ward assistant/domestic	20 (9)	
Phlebotomist	1 (0.5)	
Unknown	1 (0.5)	
Total	218 (100)	

Table 3. Oral fluid measles IgG results

	Total	Oral fluid measles IgG positive	Oral fluid measles IgG negative
Number of health care workers (%)	218 (100)	176 (81)	42 (19)

follow-up. Of the 37 who had confirmatory serum measles IgG analysis, only seven (17%) had a negative serum result and were classified as measles non-immune, giving a prevalence of 3.3% non-immune health care workers. Six out of the seven non-immune health care workers were aged between 20 and 39 years.

Questionnaire results shown in Table 4 indicate that a large proportion of health care workers do not know whether they have had measles (23%) or measles immunization (35%).

Stored serum was identified for 41 health care workers with positive oral fluid results. All confirmed measles immunity.

A total of 84 (42%) ANHOPS members replied from 80 NHS occupational health departments. Twenty-five (31%) occupational health departments inquired about measles immunity at the pre-employment stage and of these, 20 (80%) relied on history alone. Where there was no evidence of immunity, five (20%) offered immunization, four (16%) asked the general practitioner to immunize and for 16 (64%) there was no further action.

Table 4. History of vaccination and measles infection in 213 health care workers

History of measles	Immune health care worker (<i>n</i> = 206; oral fluid immune or oral fluid measles IgG negative but serum IgG positive)	Non-immune health care worker ($n = 7$; oral fluid and serum measles IgG negative)			
History of measles infection					
Yes	107 (52)	4 (57.1)			
No	50 (24)	3 (42.9)			
Don't know	48 (23)	0 (0)			
No answer	1 (0.5)	0 (0)			
Vaccination history					
Vaccinated	71 (34)	1 (14.3)			
Not vaccinated	58 (28)	2 (28.6)			
Don't know	70 (34)	4 (57.1)			
No answer	7 (4)	0 (0)			
Total	206 (100)	7 (100)			

Of the five NHS departments that did not rely on history, all checked serum measles antibodies. Only one NHS department checked measles antibodies in all staff with patient contact.

Discussion

A recent case of measles in a health care worker and the current falling uptake of MMR immunization in children, have led us to evaluate measles immunity in a group of UK hospital staff. Our figure of 7 out of 213 (3.3%) non-immune staff is similar to other work outside the UK [8–11]. Although the numbers were too small for statistical comparison, we found a tendency for nonimmune health care workers to be young, which may reflect the low uptake of vaccine amongst this group and low exposure to measles. This has been observed in other studies [11,17]. Seroprevalence data for this age group [12] and the current age distribution of confirmed cases of measles support these observations. Of the total 487 confirmed cases in England and Wales identified between 1995 and 1999, 119 were aged 20-34 years (Mary Ramsay, CDSC, personal communication). There were six clusters of cases in hospitals (including the Cambridge cluster), of which three had cases in health care workers (Mary Ramsay, CDSC, personal communication).

We used oral fluid testing as a convenient non-invasive method to determine non-immunity to measles. The sensitivity and specificity of oral fluid testing is lower than that for corresponding serum tests. We found 30 of 37 measles IgG oral fluid negative subjects to be measles IgG positive in serum. Although oral fluid testing has a lower sensitivity and specificity than serum tests, it has practical advantages compared with serum testing which make it a useful approach to population studies. Improvement of oral fluid testing for measles IgG is required, however, before it can be used to confirm immune status in individuals. Despite the convenience of oral fluid testing, our rate of compliance was low (41%). Those who already knew their immune status to be positive may not have participated, resulting in an over-estimate in the prevalence of measles non-immunity. The age and occupation of our participants was similar to that of the total staff population with patient contact.

There has been debate over the use of history of measles disease or vaccination to identify non-immune individuals. Ferson *et al.* [8] found a positive correlation when using history to identify immune individuals. However, we found 23 and 35% of individuals did not know whether they had either had measles or received immunization, respectively. If this history was used to identify non-immune health care workers, then five out of the seven (86%) non-immune individuals in this study would have been classified as immune, making this an unreliable method. This conclusion is supported by both Neumann *et al.* [18] and Stover *et al.* [10].

The cost of mass immunization (of those with no documentary evidence of measles immunity) versus screening and selective immunization depends on the prevalence of non-immunity, the cost of the screening test and the cost of the vaccine. With our low prevalence of non-immunity, approximate costs of $\pounds 4.30$ for serum testing, $\pounds 10$ for oral fluid testing and $\pounds 10.84$ for MMR vaccination, it is cheaper to screen sera followed by selective immunization.

Non-immune health care workers are best identified by laboratory methods. In this study, there was a large number of false negative oral fluid results, which is likely to reflect inadequate oral fluid samples and the lower sensitivity of this test. We were not able to identify the number of false-positive saliva results, but oral fluid assays are reported to be >90% specific and sensitive for the detection of measles IgM and are widely used to study notified cases [19].

Many health care workers provide serum for postvaccination and pre-employment hepatitis B antibody testing. Our recommendation is that it would be appropriate to check for measles (as well as rubella virus and varicella zoster virus) antibodies at the same time in those who cannot provide documentary evidence of immunity. For those health care workers who do not require hepatitis B immunization, immunity should be checked in staff with clinical contact when they first enter the health service.

ANHOPS members were chosen as a representative sample of trusts throughout the UK. This survey of NHS occupational health departments highlights the different approaches to the immunization of health care workers. Less than a third inquire about measles immunity and of these, 80% rely on history, which we have shown to be unreliable. Our response rate of 42% was low, but it may be that trusts with under-developed systems for identifying measles non-immune individuals will not have responded, leading to an even larger number who do not enquire about measles immunity. Guidelines are needed to ensure uniform standards throughout NHS Trusts and with evidence that only a small proportion of hospitals in the USA follow the ACIP guidelines [6,7,10], it is essential for there to be awareness of any UK guidelines.

Acknowledgements

We thank Rashpal Hunjan (CPHL) for analysing the oral fluid samples, Bernard Cohen (CPHL) and Joanne White (CDSC) for their comments, and ANHOPS for supporting the questionnaire and allowing the use of their mailing list.

References

- Gay N, Ramsay M, Cohen B, et al. The epidemiology of measles in England and Wales since the 1994 vaccination campaign. Commun Dis Rep CDR Rev 1997;7:17–21.
- Wakefield AJ, Murch SH, Anthony A, et al. Ileal– lymphoid nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children. Lancet 1998;351:1327–1328.
- Communicable Disease Surveillance Centre. MMR Vaccine coverage falls in the United Kingdom. Commun Dis Rep CDR Wkly 1999;9:37.
- Communicable Disease Surveillance Centre. Outbreaks of measles in communities with low vaccine coverage. *Commun Dis Rep CDR Wkly* 2000;10:29, 31, 32.
- Hanratty B, Holt T, Duffell E, et al. UK measles outbreak in non-immune anthroposophic communities: the implications for the elimination of measles form Europe. *Epidemiol Infect* 2000;125:377–383.
- Atkinson WL, Markowitz LE, Adams NC, Seastrom GR. Transmission of measles in medical settings—United States, 1985–1989. Am J Med 1991;91(Suppl. 3B): 320s–324s.
- Steingart KR, Thomas AR, Dykewicz CA, Redd SC. Transmission of measles virus in healthcare settings during a community outbreak. *Inf Control Hosp Epidemiology* 1999;2:115–119.
- Ferson MJ, Robertson PW, Whybin LR. Cost effectiveness of prevaccination screening of health care workers for immunity to measles, rubella and mumps. *Med J Aust* 1994;160:478–482.
- Schwarcz S, McCaw B, Fukushima P. Prevalence of measles susceptibility in hospital staff. Evidence to support the expanding recommendations of the Immunization Practices Advisory Committee. *Arch Intern Med* 1992;152:1481–1483.
- Stover BH, Adams G, Keubler CA, Cost KM, Rabalais GP. Measles-mumps-rubella immunization of susceptible hospital employees during a community outbreak: costeffectiveness and protective efficacy. *Inf Control Hosp Epid* 1994;15:18–21.

- 11. Wright LJ, Carlquist JF. Measles immunity in employees of a multihospital healthcare provider. *Inf Control Hosp Epid* 1994;**15**:8–11.
- Ramsay M, Gay N, Miller E, et al. The epidemiology of measles in England and Wales: rationale for the 1994 national vaccination campaign. *Commun Dis Rep CDR Rev* 1994;4:R141–146.
- Centres for Disease Control and Prevention. Immunization of health care workers: recommendations of the Advisory Committee on Immunization Practices (ACIP) and the Hospital Infection Control Practices Advisory Committee (HICPAC). *Mor Mortal Wkly Rep* 1997; 46:1–42.
- 14. www.who.int/vaccines/intermediate/measles.htm
- 15. Mendelson GM, Roth RE, Wreghitt TG, Brown NM, Ziegler ES, Lever AM. Nosocomial transmission of measles to health care workers. Time for a national

screening and immunization policy for NHS staff? J Hosp Inf 2000;44:153–154.

- Perry LR, Brown DW, Parry JV, Panday S, Pipkin C, Richards A. Detection of measles, mumps and rubella antibodies in saliva using antibody capture radioimmunoassay. *J Med Virol* 1993;40:235–240.
- Willy ME, Koziol DE, Fleisher T, et al. Measles immunity in a population of health care workers. *Inf Control Hosp Epid* 1994;15:12–21.
- Neumann PW, Weber JM, Jessamine AG, O'Shaughnessy MV. Comparison of measles anti-hemolysin test, enzyme linked immunosorbent assay, and haemagglutination test with neutralization test for determination of immune status. *J Clin Microbiol* 1985;22:296–298.
- Brown DJ, Ramsay ME, Richards AF, Miller E. Salivary diagnosis of measles: a study of notified cases in the United Kingdom 1991–3. Br Med J 1994;308:1015–1017.