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ORIGINAL ARTICLES AND REVIEWS

Lack of protection for measles among Italian nurses. A potential for hospital outbreak

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Abstract

Background and aims. Nurse's job involves staying close to the patient for an extended time period and a high risk of transmission for airborne pathogens, including measles. Previous studies found high rate of operators unprotected for measles. We evaluated the immunization status for measles in nurses of a large hospital in Rome.

Methods. We retrospectively evaluated the clinical records of nurses working in Tor Vergata hospital who underwent the occupational health screening program. Gender, age, work area and levels measles-specific IgG were evaluated.

Results. This study included 358 nurses. 77.7% (217) had a protective measles-specific IgG antibodies level. Protection rate was higher among workers aging 40 years (82.6% *vs* 68.7%; $p < 0.01$). The mean value of the anti-measles IgG was 217.2±91.1 AU/ml. Males showed higher values than females (253.3 *vs* 214.6; $p < 0.01$).

Conclusions. Our study revealed a non-protective anti measles IgG level in a high percentage of nurses, even among those working in high risk areas.

Key words

- occupational transmission of measles
- measles
- vaccination strategy

INTRODUCTION

Measles is a contagious and potentially dangerous acute viral disease. More than 2 million deaths occurred yearly before the increase in global measles vaccine coverage in the 1980s [1]. Nevertheless, it is still an important vaccine-preventable cause of morbidity and mortality, accounting for more than 100 000 deaths each year [1]. In the time period January 1-July 31 2019, 182 countries reported 364 808 new measles cases to the WHO [2]. Comparing the data referring to the same period of 2018, the African region recorded a 900% increase, the European region a 120% increase, the Eastern Mediterranean region a 50% increase, and the Western Pacific Region a 230% increase; by contrast, the Southeast Asia Region and the Americas Region each showed a 15% reduction in the reported cases [2].

In Italy, during the year 2019, 1627 measles cases (median age 30 years) were reported: eighty-six per cent were not vaccinated, and 31% experienced at least one complication. More than 60% of the cases occurred in people aging between 15 and 39 years, with the highest incidence observed in the 0-4 age group [3].

Since the virus persists viable in aerosol suspension for almost 1 hour [4], health care workers (HCWs) can be easily exposed when caring for measles infected patients. In fact, the risk of acquiring measles for HCWs is estimated to be 13 fold greater compared to the general population. Measles can spread from patients to unprotected HCWs: viral shedding is higher before the rush onset, when the disease is difficult to be recognized [4]. Not surprisingly, cases of measles contagion in the healthcare facilities have been widely reported in the literature during the last decade [5], and also in Italy during the 2018 epidemic, a large number of measles cases (115) involved HCWs [6]. Of note, in case of infection, HCWs may become a source of exposure for their patients, in fact transmission from affected operators to patients has been widely reported [7-8]. Hospitalized are more likely to be affected by chronic diseases or immunological deficit then general population, therefore measles transmitted by HCWs may often result in severe complications for them [1]. Baxi *et al.* reported one avoidable case of nosocomial transmission from one inpatient to an HCW, with subsequent transmission to another pediatric inpatient [9].

Nurse job involves a close contact with the patient for a protracted time for the duration of the work shift, including the performance of maneuvers at high risk of transmission for airborne pathogens, including measles. Thus, nurses have been often involved in the reported cases of occupational contagion [10].

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Vaccination remains the only effective measure to prevent the contagion, however, since the particular closeness that nurses have with patients, even if measles is mainly spread by the airborne route, the lack of strict adherence to alcohol-base hand rub before and after all patient contacts [11], and the delay of appropriate isolation measures may contribute to outbreaks in hospital settings [12, 13].

In Italy, during a large population outbreak in 2017, vaccination for measles, mumps, rubella and varicella (MMRV) became compulsory for children 0-2 years old, but it was barely recommended for HCWs, according to the national vaccine prevention plan approved by the Italian government in the same year. Unfortunately, in Italy a growing proportion of health professionals including nurses could be categorized as vaccine-hesitant; HCW's knowledge and attitudes about vaccination is a key determinant of their own vaccine acceptance [14, 15].

In this study we aimed to evaluate the immunological status for measles among nurses working in a university hospital in Rome one year after the enactment of the national vaccine prevention plan.

METHODS

This was a retrospective prevalence study which has been approved by the Independent Ethics Committee of the University Hospital Policlinico Tor Vergata (PTV), Rome, Italy. Exclusion criteria included diagnosis of diabetes, liver disease, renal insufficiency, thyroid disorders, heart failure, coagulopathy, history of any form of cancer, positive blood tests for HIV, hepatitis B, or hepatitis C.

We analyzed a group of nurses (n 358) who underwent periodic health surveillance screening in the Occupational Medicine service in the year 2018. Each participant performed a single annual health surveillance check throughout the study period. For each patient the following data were recorded: age, gender, job seniority working area and measles specific IgG antibodies title. According to the literature data, antibodies serum value higher than 16.5 AU/ml was considered protective [9]. A chemo luminescence immunoassay (the LIAISON® Measles IgG assay) was used to perform a semi-quantitative determination of specific IgG antibodies for measles in plasma.

Subjects with partial clinical and serological data, or positive measles-specific IgM antibodies were excluded from the study.

Nurses were divided into two subgroups according to their age: younger or equal to 40 years (≤40 y) and older (>40 y). We extracted information on job task, seniority (years) and working area from occupational records.

We studied the prevalence of serologically protected nurses and compared the mean values of IgG specific antibodies among different gender and the age group. Statistical analysis was performed by means of SPSS analytic software (release 25). Chi Squared test for dichotomous variables and t-test for continuous values were used to evaluate statistical significance. Logistic regression model was used to perform multivariate analysis. Only P values <0.001 were considered as significant in our study.

RESULTS

All the participants were eligible and therefore were included in the study. Main characteristics of study population are shown in *Table 1*. We evaluated 358 nurses (male n = 72, and female n = 286). The mean age of study population was 42.5 years (range = 28-58 years); 128 HCWs (male n = 36, and female n = 92) were younger or equal than 40 years old, whereas 230 (male = 36 and female = 194) were older than 40 years. Of note, 68.7% (95% CI = 63.7-73.2) had a work seniority of more than 15 years. As shown in *Table 1*, most of study participants worked in Surgery and Emergency areas. Among the 358 nurses, 268 (74.9%, 95% CI = 70.4-79.1) showed a protective measles IgG titre. *Table 2* shows the clinical and occupational characteristics of the study population (n = 358) in relation to their serological status. A higher, although not significant (p = 0.136), prevalence of serologically immune subjects was found in male gender (83.3%, 95% CI = -76.2-84.6) with respect to female nurses (78.4, 95% CI = 72.4-84.8). We observed a significantly higher percentage of nurses aged older than 40 years having a protective measles IgG level (82.6%, 95% CI = 77.8-87.2) in comparison to younger colleagues (68.7%, 95% CI = 64.1-72.3) (p <0.001). Moreover, a significant higher prevalence of immune subjects was detected in nurses having a work seniority longer than 15 years in comparison to the other nurses (82.9%, 95% CI = 77.7-85.3 *vs* 66.1%, 95% CI = 62.4-70.2 respectively; p <0.01).

Regarding working area, we found the higher rate

Table 1
Clinical and working characteristic of the study population

Variables	Study population (n = 358)	% (CI 95%)
Mean age (± SD), years	42.5 (6.4)	
Gender		
Male	72	20.1 (16.2-24.3)
Female	286	79.9 (75.7-83.8)
Age class		
≤40 years	128	35.8 (30.7-41.1)
>40 years	230	64.3 (58.9-69.3)
Working length		
≤15 years	112	31.3 (26.8-36.3)
>15 years	246	68.7 (63.7-73.2)
Working area		
Medicine	64	17.9 (14.0-22.1)
Infective	18	5.0 (2.8-7.3)
Surgery	130	36.3 (31.3-41.3)
Radiology	20	5..6 (3.4-7.8)
Emergency	86	24.0 (19.6-28.2)
Ambulatory	40	11.2 (7.8-14.5)
Measles serological immunity		
No	90	25.1 (20.9-29.6)
Yes	268	74.9 (70.4-79.1)

Table 2
Clinical and working characteristic of the study population (n = 358) divided upon protective serogical immunity for measles (positive for IgG >16.5 AU/ml)

Variables	Number of individuals immune for measles	% (95% CI) of individuals immune for measles	p
Gender			
Male (n = 72)	58	80.6 (84.6-76.2)	0.136
Female (n = 286)	210	78.4 (72.4-84.8)	
Age class			
≤40 years (n = 128)	88	68.7 (64.1-72.3)	<0.01
>40 years (n = 230)	190	82.6 (77.8-87.2)	
Working length			
≤15 years (n = 112)	74	66.1 (62.4-70.2)	<0.01
>15 years (n = 246)	204	82.9 (77.7-85.3)	
Working area			
Medicine (n = 64)	58	90.6 (85.2-96.0)	<0.01
Infective (n = 18)	11	61.1 (52.6-68.8)	
Surgery (n = 130)	94	72.3 (67.4-77.6)	
Radiology (n = 20)	20	100 (100.0-100.0)	
Emergency (n = 86)	66	76.7 (72.8-80-9)	
Ambulatory (n = 40)	30	75.0 (70.2-80.2)	

of protected subjects in radiology (20/20; 100%) and medicine (58/64 = 90.6%, CI 95% = 85.2-96.0) areas whereas infectious disease, surgery and ambulatory areas showed the lower percentage of serologically immune operators (11/18 = 61.1%, 95% CI = 52.6-68.8); 94/130 = 72.3%, CI 95% = 67.4-77.6; and 30/40 = 75%, CI 95% = 70.2-80.2, respectively). Surprisingly, in the emergency department, 20/86 nurses (23%) tested unprotected at serological screening.

To avoid any possible confounding factors, we built up a logistic regression analysis; we considered age, gender and seniority as independent variables. Moreover, since working area was significantly associated with protective antibody titres at univariate analysis, this variable was also included in the logistic regression model. Since infectious disease had the lower proportion of protected operators we kept it separated. We therefore regrouped the other working areas in two main categories according to care environment: 1) Emergency and Medicine Department *vs* 2) Surgical and Diagnostic Department (including radiology and ambulatory).

The regression model confirmed that protective antibodies levels for measles were significantly and independently associated with age (odds ratio = 1.045, 95% CI = 1.005-1.087, p = 0.027), even after adjustment for work seniority, gender and working areas *(Table 3)*.

The suboptimal protection in HCW category is also reflected in the number of nosocomial cases of measles. In 2017-2018 time period, the Service of Occupational Medicine of University Policlinic of Rome Tor Vergata reported 17 cases of nosocomial measles, seven out of which in nurses.

DISCUSSION

We found a high level of nurses serologically unprotected for measles, especially in workers aging equal or less than 40 years. In fact, among younger subjects who represent a large part of our sample due to the relatively low mean age of our hospital workforce, 31.3% resulted serologically non immunized.

Age showed a significant association with serological status, standing for a proportional relationship of protective antibodies titre with age. This finding is in keeping with previous reports [16]. Protective serology may be both the effect of immunization or natural infection among the individuals included in the study population.

Table 3
Logistic regression analysis for positive measels (IgG >16.5 AU/ml)

Variables	OR	95% CI for OR	p
Age (y)	1.021	1.001-1.092	0.047
Gender (male)	1.668	0.834-3.396	0.102
Working Length (>15 y)	1.042	0.443-2.496	0.956
Emergency Medicine Department	1.524	0.890-2.608	0.079

It should be taken into account that a large majority of our study population was born before 1985, a time at which the vaccination rate for MMR in Italy was lower than 5%, it is therefore plausible that natural immunization was the phenomenon underlying our data *(Figure 1)* [13-15].

Previous studies reported a paradoxical higher risk of infection among young adults due both to lower rate of natural immunization and inadequate MMR coverage [17-21]. According to the Italian infectious disease network [11], during the year 2018 the age group 15-39 reported the majority of cases of measles and 4.6% of cases involved HCWs. Median age of affected workers was 35 years and 47% of them reported at least one complication.

Our study showed a clear gender difference in serological status: male HCWs had both higher although non-significant rate of serum immunity and a significantly higher mean IgG level. Gender difference in immune status, in our opinion, can be explained by the paradoxical effect of higher vaccination rate among women due to MMR vaccinations programs for rubella prevention. After the administration of two doses of MMR vaccine, measles antibodies decline over years and are detectable in serum of vaccinated subjects for almost 15 years, while natural infection induces both higher and more persistent antibodies response.

Regarding employment area, we found a surprisingly high rate of unprotected nurses working in high-risk hospital setting such as infectious disease unit and emergency department: these subjects should be worried about their risk of measles infection since they faced the outbreak occurred in the previous year, when over 80 cases of measles were admitted in the facility [22]. Lack of awareness and vaccine hesitancy might have resulted in low vaccine acceptance among those operators [23].

According to the national guidelines, the administration of two does MMR is strongly recommended for HCWs having both no written documentation of vaccination and non-protective IgG titer. Based on the results of previous studies [24-37], workplace vaccination strategy should be offered since it showed to be highly cost-effective and to result in adequate level of protection among HCWs.

Based on the results of our study actual national policy regarding vaccine offer seems to miss the objective to reach adequate levels of protection among nurses working in high risk setting.

Our survey has some possible limitations: the number of male nurses included in the study is relatively low and so the lack of statistical significance in gender difference may be due to sample size. Moreover, we did not evaluate the records of the previous vaccination so a percentage subjects showing a non-protective titre could effectively be immune according to current recommendations. However, in Italy a national registry of vaccination is not present and a negligible part of study population had a written vaccine documentation.

CONCLUSIONS

Our study shows low rate of serological immunity among nurses working in a teaching hospital in Italy, even in exposure prone settings. Younger employees showed lower coverage rate and therefore a relatively high risk of contagion. Current government policy regarding the vaccine offer seems to be inadequate to reach acceptable level of immunity among HCWs. Since nosocomial transmission of measles represents a serious risk, occupational health service should increase prevention activities, including workplace vaccination of non-immune subjects.

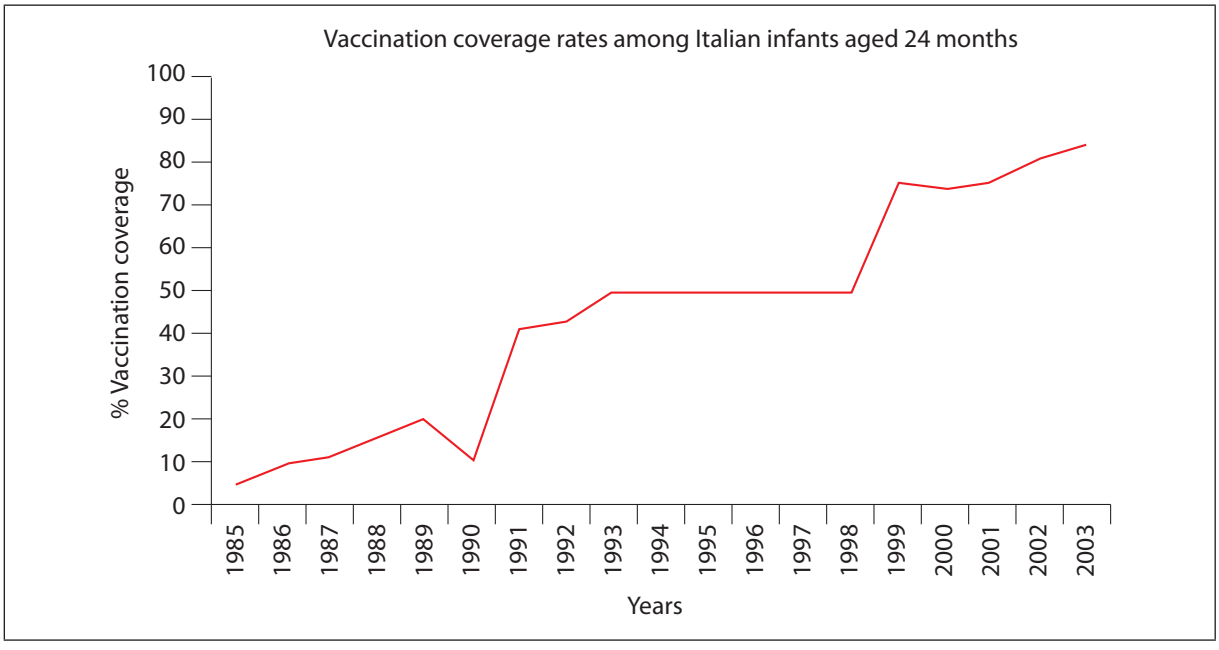

Figure 1
Historical coverage rate for measles, mumps and rubella (MMR) vaccination in Italy (period 1985-2003).

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Conflicts of interest statement

None declared.

Compliance with ethical standards

All procedures performed in studies were in accordance with the ethical standards of the Institutional Research Committee (approved with authorization number 170) and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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