

## Susceptibility to Measles, Rubella, Mumps, and Varicella-zoster Viruses among Healthcare Workers

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### Abstract

**Background:** It is important to identify and immunize susceptible healthcare workers to prevent and control hospital infections. Our aim was to evaluate the specific antibodies against the measles, mumps, and rubella viruses and the varicella zoster virus among healthcare workers in a tertiary-care hospital.

**Patients and Methods:** A total of 284 healthcare workers (89 men and 195 women; mean age, 33.5 ± 11 years), including 111 nurses, 87 physicians, 34 laboratory technicians, and 52 members of the housekeeping staff, of Van Training and Research Hospital were enrolled in this study. Antibodies were detected with an enzyme-linked immunosorbent assay.

**Results:** The numbers of workers with serological susceptibility to mumps, measles, rubella, or chicken pox were 26 (9.2%), 18 (6.3%), 7 (2.5%), and 5 (1.8%), respectively. Although the difference was not statistical significant, the rate of seroprevalence of antibodies was lowest for measles (90.8%;  $p > 0.05$ ). Susceptibility to measles, mumps, and rubella, and chicken pox was more prevalent among young healthcare workers ( $p < 0.001$ ). Not all healthcare workers born before 1957 were immune to these vaccine-preventable diseases.

**Conclusion:** These data confirm that screening and vaccination of susceptible healthcare workers is essential regardless of age.

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**Key words:** measles, mumps, rubella, varicella, healthcare worker

### Introduction

Measles, mumps, rubella, and chicken pox are vaccine-preventable infectious diseases to which healthcare workers are exposed more often than is

the general population<sup>1-4</sup>. These infections can be considered occupational hazards for healthcare workers and can result in serious illness and be spread to other susceptible persons<sup>3,6</sup>.

Immunity of healthcare workers against vaccine-preventable diseases is a special concern, because

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epidemics of measles and rubella continue to occur all around the world. For example, during a worldwide epidemic of measles from 1985 through 1991, approximately 60% of adults who contracted measles were healthcare workers<sup>35</sup>.

For these reasons in the present study we aimed to evaluate the immune status of healthcare workers against mumps, measles, rubella, and chicken pox in the largest hospital in Van, Turkey.

## Methods

### Setting and Subjects

Van Training and Research Hospital is a 400-bed, tertiary-care hospital with 550 employees. From September through October 2010, serologic testing for the measles, mumps, rubella viruses and the varicella zoster virus (VZV) was recommended to healthcare workers who had not have any documentation of vaccination, history of these diseases, or serologic evidence of immunity, regardless of age. The workers were divided into 4 job categories: physicians, nurses, laboratory technicians, and housekeeping staff. Blood samples were obtained for testing of antibody titers from 284 healthcare workers. Serum was separated from the blood and was kept refrigerated at 4°C until testing.

### Reagents and Antibody Assays

Immunoglobulin G (IgG) antibodies against the mumps, measles, and rubella viruses and VZV were detected with a qualitative enzyme-linked immunosorbent assay (Grifols Triturus, Grifols, S.A., Barcelona, Spain). The reagents used for the antibody assays were Enzygnost Anti-Measles Virus/IgG, Anti-Mumps Virus/IgG IgG, Anti-Rubella Virus/IgG IgG, and Anti-VZV Virus/IgG IgG (Vircell S.L., Santa Fé, Spain). IgG index values greater than 1.1 IU/mL were regarded as positive. All tests were performed and interpreted according to the manufacturers' instructions. All equivocal titers were retested. If the retesting result was equivocal again, it was considered nonreactive.

### Statistical Analysis

All statistical analyses were done with a software

Table 1 Characteristics of the healthcare workers tested

Characteristic	Number (%) of patients
Sex	
Men	89 (31.3)
Women	195 (68.7)
Age in years (mean ± SD)	33.5 ± 11
Age groups	
≤25	72 (25.4)
26-35	122 (42.9)
36-45	53 (18.7)
46-55	16 (5.6)
≥56	21 (7.4)
Job category	
Physicians	87 (30.6)
Nurses	111 (39.1)
Laboratory technicians	34 (12)
Housekeeping staff	52 (18.3)

package (SPSS for Windows, Version 18.0, SPSS Inc., Chicago, IL, USA). Categorical variables were compared by means of the chi-square test of independence or Fisher's exact test when conditions for a chi-square test were not met. A *P*-value less than 0.05 was considered to indicate statistical significance. All tests were two-sided.

## Results

This study included 284 healthcare workers in a tertiary hospital in Van, comprising 111 nursing staff, 87 physicians, 34 laboratory technicians and 52 housekeeping staff (**Table 1**). Their ages ranged from 18 to 65 years (mean ± standard deviation, 33.5 ± 11 years); the largest cohort of workers were aged 26 to 35 years, and 24 (8.5%) workers were born before 1957. Nurses (mean age, 28.5 ± 7.9 years) were younger than physicians (41.5 ± 12 years), laboratory technicians (33.8 ± 9.5 years), or housekeeping staff (30.8 ± 8 years). Eighty-nine subjects were men, and 195 were women.

The rates of serological immunity in the study population were 90.8% for measles, 93.7% for mumps, 97.5% for rubella, and 98.2% for chicken pox. The rate of immunity to measles was lower than that to mumps, rubella, or chicken pox but no significantly lower (*p*>0.05). Forty-three (15.1%) healthcare

## Healthcare Workers and Immunity

Table 2 Serologic results of healthcare workers subdivided according to sex, mean age, and job category

	Men n (%)	Women n (%)	Mean age (±SD*)	Physician n (%)	Nurse n (%)	Technician n (%)	Housekeeper n (%)
<b>Measles</b>							
Immune	83 (98)	175 (89.7)	33.9 (10.9)	84 (96.6)	99 (89.2)	30 (88.2)	46 (88.5)
Susceptible	6 (2)	20 (10.3)	29.7 (11.4)	3 (3.4)	12 (10.8)	4 (11.8)	6 (11.5)
P value	.341		.000	.062	.438	.574	.593
<b>Mumps</b>							
Immune	85 (95.5)	180 (92.3)	34 (11)	85 (97.7)	101 (91)	32 (94.1)	47 (90.4)
Susceptible	4 (4.5)	15 (7.7)	27.2 (9.8)	2 (2.3)	10 (9)	2 (5.9)	5 (9.6)
P value	.317		.000	.069	.210	.841	.350
<b>Rubella</b>							
Immune	86 (96.6)	189 (96.9)	33.7 (11.1)	87 (100)	106 (95.5)	34 (100)	50 (96.2)
Susceptible	3 (3.4)	6 (3.1)	29.1 (5.4)	0	5 (4.5)	0	2 (3.8)
P value	.896		.000	.043	.076	.261	.758
<b>Chicken pox</b>							
Immune	89 (100)	190 (97.4)	33.6 (10.9)	87 (100)	106 (95.5)	34 (100)	52 (100)
Susceptible	0	5 (2.6)	26.4 (11.7)	0	5 (4.5)	0	0
P value	.127		.000	.134	.005	.405	.285

\* : Standard deviation

Table 3 Immunity against measles, mumps, rubella, and chicken pox by age group

Age (n)	Measles		Mumps		Rubella		Chicken pox	
	Immune n (%)	Susceptible n (%)	Immune n (%)	Susceptible n (%)	Immune n (%)	Susceptible n (%)	Immune n (%)	Susceptible n (%)
≤25 (72)	57 (79.2)	15 (20.8)	58 (80.6)	14 (19.4)	70 (97.2)	2 (2.8)	65	3
26–35 (122)	118 (96.7)	4 (3.3)	120 (98.4)	2 (1.6)	118 (96.7)	4 (3.3)	120	1
36–45 (53)	49 (92.5)	4 (7.5)	52 (98.1)	1 (1.9)	52 (98.1)	1 (1.9)	53	1
46–55 (16)	15 (93.8)	1 (6.2)	16 (100)	0	16 (100)	0	16	0
≥56 (21)	19 (90.5)	2 (9.5)	20 (95.2)	1 (4.8)	21 (100)	0	21	0
TOTAL	258 (90.8)	24 (9.2)	266 (93.7)	18 (6.3)	277 (97.5)	7 (2.5)	279 (98.2)	5 (1.8)

workers were nonimmune to at least 1 disease. Although it was for statistically significant only for mumps, the rate of seronegativity was lower in physicians than in other staff. All VZV-seronegative healthcare workers were nurses. Rates of seronegativity did not differ significantly between men and women. However, seronegativity was significantly associated with young age ( $p < 0.001$ , **Table 2**); 12.5% (3 of 24) of those born before 1957 were seronegative. One of these workers was susceptible to mumps, and 2 were susceptible to measles. The immune status of the study population according to age groups is shown in **Table 3**.

### Discussion

This study analyzed the immune status of

healthcare workers against vaccine-preventable diseases. Susceptibility among healthcare workers varies by different geographical area. For example, the rates of seropositivity for mumps, measles, and rubella viruses, and VZV were reported to be 98.2%, 85.9%, 97.6%, and 97.9%, respectively, in Italy<sup>6</sup> and 93% , 84%, 88%, and 97.2%, respectively, in Japan<sup>7</sup>, and seropositivity rates for measles, mumps, and rubella were reported to be 98.3%, 83.0%, and 96.6%, respectively, in Australia<sup>8</sup>. Few data are available on immunity of healthcare workers in Turkey. Celikbas et al.<sup>9</sup> have reported rates of seropositivity in a major hospital in Turkey for measles, mumps, rubella, and VZV to be 98.6%, 92.2%, 98.3%, and 98%, respectively. Hatipoglu et al.<sup>10</sup> found rates of immunity to be 97.5% for measles, 72.8% for mumps, 100% for rubella, and 96.3% for chicken pox.

Previous studies have revealed that Western European countries have higher rates of immunity than does the United States or Eastern countries, with rates of immunity to mumps being lower than those for measles, rubella, and chicken pox<sup>8,11-14</sup>. In addition, the prevalence of antibodies to rubella among healthcare workers is considerably lower in Japan than in other countries<sup>7</sup>. Immunization rates in our hospital were similar to those previously reported in other countries and were higher than 90% for all job categories.

Physicians had the lowest susceptibility rates among healthcare workers tested. This might be due to their age (the oldest group among the study population), but it should also be kept in mind that physicians are more frequently exposed to these infections because of their professional duties. Dinelli et al. have also shown that other members of the staff were less frequently immunized than were physicians<sup>15</sup>.

The measles susceptibility rate of 9.2% among our healthcare workers is slightly higher than the rates in previous reports<sup>6-14</sup>. Although the guidelines of the United States Centers for Disease Control and Prevention have considered birth before 1957 to be acceptable evidence of immunity to measles, rubella (except for women of child-bearing age), and mumps, the age for assumed immunity varies from country to country<sup>3,5</sup>. From 1985 through 1991, 27% of all measles cases among US healthcare workers occurred in people born before 1957<sup>3,5</sup>. We found a significant association between younger age and seronegativity. This finding was consistent with previous studies that have shown that younger age groups have lower levels of immunity<sup>16-21</sup>. The Turkish Ministry of Health changed the childhood vaccination program in 2006 so that 2 doses of the measles, mumps, and rubella vaccine (MMR vaccine) are given: the first at the age of 1 year, and the second at the age of 4 to 6 years. Thus, the healthcare workers of our hospital were not included in the childhood vaccination program. Failure to receive 2 doses of the MMR vaccine, in addition to the decreasing prevalence of measles in Turkey, may drive the high susceptibility rates seen among young healthcare workers. Our data have revealed

that not all workers born before 1957 are immune: 1 was susceptible to mumps, and 2 were susceptible to measles. Therefore, in Turkey, birth before 1957 should not be regarded as evidence of immunity to mumps or measles.

Varicella is an endemic disease in Turkey, and most individuals are immune by adolescence<sup>22</sup>. Our findings were in line with previous studies. The highest rate of seropositivity was found against VZV in our hospital. Immunity against chicken pox in healthcare workers was also high in other countries. It was found to be 94% in Israel<sup>23</sup>, 96% in Japan<sup>7</sup>, 1% to 5% in the United States<sup>24,25</sup>, and 1.5% in Belgium<sup>26</sup>. Hatipoglu et al.<sup>10</sup> have reported a seropositivity rate to VZV among healthcare workers of 96.3%, which was lower than in our hospital.

The widely accepted recommendations for serological testing were based on a susceptibility prevalence of 8.8%<sup>27</sup>. Although labor-intensive, seroprevalence surveys of vaccine-preventable diseases among healthcare workers are invaluable. Because age is not a reliable criterion to predict immune status, We recommend, as do other researchers, serological screening of healthcare workers, despite its cost, to detect susceptible staff and vaccinating them to protect the hospital staff and prevent disease transmission, limit outbreaks, and reduce the resulting costs incurred<sup>6,9,28</sup>. Studies comparing the costs of dealing with an outbreak and the costs of an active screening and vaccination program for healthcare workers has shown the latter approach can save money and prevent morbidity<sup>29,30</sup>. It has been stated that all healthcare workers new to a healthcare facility should be screened for immunity to vaccine-preventable diseases within 10 working days after starting their job<sup>9</sup>. A rate of immunity greater than 94% is necessary to prevent the transmission of viruses<sup>31</sup>.

Our study was limited by the fact that it did not have serological data for all employed healthcare workers. The study relied on staff voluntarily presenting for screening; therefore, it was not a random sample of staff. Those screened may have had a greater commitment to ensuring their immunity to infectious diseases. Rates of nonimmunity among those not screened could

potentially be greater than in our screened subset.

### Conclusions

The immunity rates in the present study were high, but a significant proportion of employees are not immune to measles. To prevent infection in susceptible employees and to reduce the likelihood of nosocomial transmission to patients, nonimmune healthcare workers should be vaccinated against measles, mumps, rubella, and chicken pox.

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