

Serostatus of Measles, Mumps, Rubella and Varicella in Healthcare Workers in Oman

Nawal Al-Kindi¹, Zaina Al-Maskari, Hanan Al-Kindi and Amina Al-Jardani

Microbiology Department, The Royal Hospital, Muscat, Oman

Abstract: Seroprevalence studies of Measles, Mumps, Rubella and Varicella (MMRV) in Oman have not been previously reported in health care workers. These vaccine preventable diseases could be introduced into the healthcare setting by healthcare workers (HCW) who may serve as a reservoir for ongoing disease transmission. We conducted seropositivity analyses of IgG antibodies to MMRV in healthcare workers in the Royal Hospital in Muscat, Oman over a 4year period, 2010-2013.

A total of 1914 HCW were included, seropositivity in the study cohort was 88% for Measles; 74% for Mumps; 90% for Rubella; and 89% for Varicella. The highest rate of equivocal results at 7% and seronegativity at 19% was observed for mumps. The mean age of the HCW cohort was 36.72±9.09 years and was comprised of primarily females (83%).

Participants born in Oman made up 36% of the cohort, 38.5% were Indian and 17% were born in the Philippines. Analysis of healthcare occupation revealed that the majority were nurses (69%) and 17% were doctors. There was no difference in seroprevalence associated with gender or occupation ($p > 0.05$). However, younger HCW (<34 years) and HCW born outside Oman had higher rates of seronegativity ($p < 0.001$).

Immunity to measles, rubella and varicella is high in HCW in Oman whereas immunity to mumps remains low. The high seronegativity rates observed in non-Omani HCW raises serious concerns such as the importance of determination of immune status of healthcare workers and the need to prevent transmission of vaccine preventable diseases in the

healthcare setting.

may help to prevent outbreaks of vaccine preventable infectious diseases in the hospital setting.

Keywords: Seroprevalence, MMRV, HCW, Oman.

1. INTRODUCTION

The Sultanate of Oman introduced a national Expanded Program on Immunization (EPI) in 1981 which included a single dose of measles vaccine for all children aged 9 months [1]. A measles-rubella vaccine was introduced in 1994 after Oman experienced a large rubella outbreak with 257 reported rubella cases and 34 infants with congenital rubella syndrome (CRS). MMRV vaccination was introduced in 1997 and currently children in Oman receive 2 doses of vaccine at 12 and 18 months of age.

MMRV are vaccine preventable infectious diseases which HCW are exposed to more often than the general population. Due to their occupation, HCW are at major risk of infectious diseases and are also a potential source of vaccine preventable infectious diseases. An important method of protection from workrelated infection risk is vaccination that protects the individual HCW from communicable disease for which vaccines are available. Equally important is vaccination of HCW which can prevent transmission of communicable disease to patients who have compromised immune systems. Therefore, identification of immunity in HCW

Recent reports of seroprevalence of MMRV in different cohorts in various countries such as Saudi Arabia, Jordan, United Arab Emirates, India and Turkey have shown MMRV seroprevalence rates to be between 47-96% [2-6]. There is a dearth of such studies from Oman however a recent report on rubella and congenital rubella syndrome [1] found that Oman has interrupted endemic rubella virus transmission for a period greater than or equal to 12 months with no cases of CRS associated with endemic transmission [7].

MMRV infections are notifiable diseases and seroprevalence studies can be used to complement disease surveillance and provide information on a population's antibody level, identify the cohorts at risk and determine the level of vaccine coverage. To support the goals of the World Health Organization for control and elimination of MMRV, we performed a cross sectional seroprevalence study among HCW in the largest tertiary hospital in Muscat, Oman. The Royal hospital also serves as a reference hospital for the whole of Oman. Currently, there are no known documented seroprevalence studies in HCW in Oman.

¹ Address correspondence to this author at the Microbiology Department, The Royal Hospital, Muscat, Oman; Tel: 00 968 99010590; E-mail: Nawalakindi@gmail.com

2. MATERIALS AND METHODS

2.1. Study Population

This study was performed on a cohort of 1914 healthcare workers. Immunization records maintained in a centralised database at Royal Hospital in Muscat were examined over a 4 year period from 2010 to 2013. The immune status of four vaccine preventable diseases, measles, mumps, rubella and varicella from a total of 1914 healthcare workers was collated by the IT department including demographic data such as age, sex and country of origin. Ethical approval for this cross sectional retrospective record review was obtained from the Research Committee in the Royal Hospital.

2.2. Serological Determination of MMRV IgG

Blood samples were centrifuged to separate the serum prior to routine testing. Samples were analysed in the Microbiology Department, The Royal Hospital, in Muscat. Commercially available indirect enzyme linked immunosorbent IgG assays were used for the detection of IgG antibodies to measles (Euroimmun, Hamburg, Germany), mumps (Euroimmun, Hamburg, Germany) and varicella (NovaTec Immundiagnostica GmbH, Dietzenbach, Germany) in serum samples. Assays were performed in accordance with the manufacturer's instructions. Positive, equivocal and negative status of sera was determined using cut-offs specified by the manufacturer and is based on the index sample ratio values (ISR) which was calculated for each specimen by

dividing the optical density value of the specimen by the cut-off value proposed by the manufacturer. For the Measles and mumps IgG assays, the results were interpreted as follows: Ratio <0.8: negative, Ratio 0.8 to <1.1: borderline and Ratio > 1.1: positive. For the Varicella-Zoster IgG assay, seronegativity was defined as a serum ISR value of <0.90, sera with ISR values of >0.9 and <1.09 were considered equivocal and sera with ISR values ≥ 1.10 were defined as seropositive. Rubella IgG was detected using an automated analyser (Architect, Abbott Laboratories, Illinois, USA). Results were interpreted as follows: Negative: 0.0 to 4.9 IU/mL, Equivocal: 5.0 to 9.9 IU/mL and Positive: ≥ 10.0 IU/mL.

2.3. Statistical Analysis

Descriptive statistical analysis for MMRV seroprevalence was performed. Statistical tests used included Mann-Whitney U tests and Chi-square tests. All statistical tests were performed with SPSS 22 at significance value of 5%.

3. RESULTS

Serological screening for IgG to measles, mumps, rubella and varicella were performed in 1914 healthcare workers. The mean age of the HCW cohort was 36.72 ± 9.09 years and 83% of the subjects were female. There was no difference between the mean ages of the male and female groups (males: 38.42 ± 9.91 years, females 36.39 ± 8.88 years). Table 1

Table 1: Demographic Characteristics of Healthcare Workers, n=1914

Variable	Number of participants (%)		P value
Sex			>0.05
Female	1597	(83%)	
Male	317	(17%)	
Age in years (mean \pm SD)	36.72 \pm 9.09		
Age cohorts			<0.001
< 34 Years	842	(44%)	
34-44 years	708	(37%)	
>44 years	364	(19%)	
Country of birth			<0.001
Oman	689	(36%)	

India	737	(38.5%)	
Philippines	325	(17%)	
Others	163	(8.5%)	
Occupation			>0.05
Doctors	325	(17%)	
Nurses	1320	(69%)	
Others*	269	(14%)	

*Includes laboratory personal, housekeeping staff and administrative team.

Seroprevalence of MMRV in HCW in Oman

shows the demographic characteristics of the study cohort. In all age groups, more women participated in the study. Seropositivity in the study cohort for measles was 88% (95% CI 87.6-90.4), for mumps was 74% (95% CI 71.9-76.1), for rubella was 90% (95% CI 88.691.4) and for varicella was 89% (95% CI 87.6-90.4). The percentage of sera which tested seropositive, equivocal and seronegative is shown in Figure 1. From 2010 to 2013, the annual seropositivity of measles ranged from 74% in 2010 to 92% in 2011 to 90% in 2012 and 85% in 2013. Mumps seropositivity remained the lowest over the study period from 70-78%. The highest rate of equivocal results at 7% (95% CI 5.8-8.2) and seronegative, at 19% (95% CI 17.1-20.9) was observed for mumps immunity. Seropositivity to rubella was high at 91% from 2010 to 2012 but dropped to 85% in 2013. The annual seropositivity for varicella from 2010-2013 ranged from 78% in 2010 to 86% in 2011 to 92% in 2012 and 87% in 2013. Immunity to MMRV did not reveal any

Global Journal of Immunology and Allergic Diseases, 2017, Vol. 5

significant differences according to gender (Figure 2). Serological analyses of age cohorts showed that younger HCW (<34 years) consistently showed a higher rate of seronegativity for all 4 vaccine preventable diseases tested in this study ($p < 0.001$). As shown in Figure 3, seronegativity for the younger age cohort ranged from 7% to 22%.

Participants born in Oman made up 36% of the cohort, 38.5% were Indian and 17% were born in the Philippines. The remaining 8.5% of participants were made up of HCW from twenty other countries. HCW born outside Oman had significantly higher rates of seronegativity for mumps, rubella and varicella ($p < 0.001$) (Figure 4). Analysis of healthcare occupation revealed that the majority were nurses (69%) and 17% were doctors. There was no difference in seroprevalence associated with occupation.

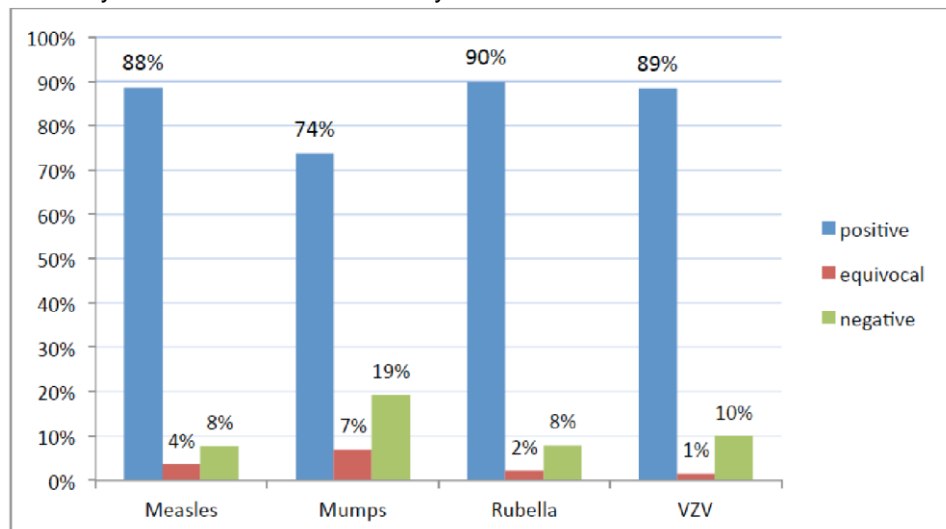


Figure 1:

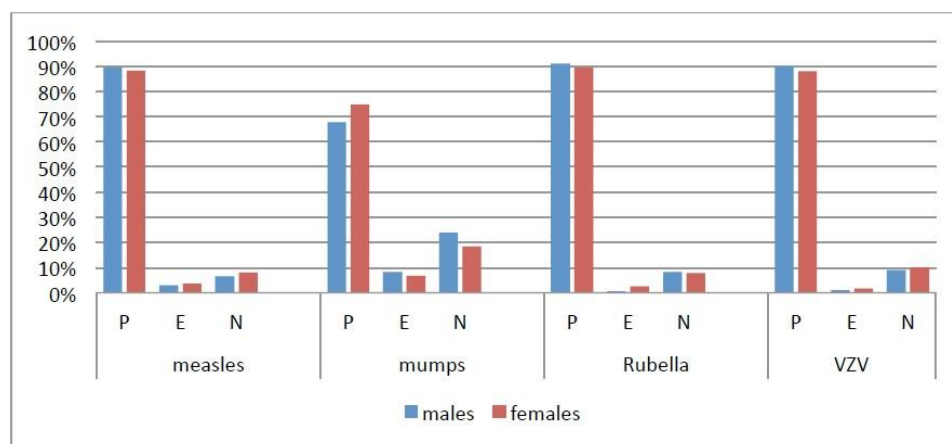


Figure 2:

4 Global Journal of Immunology and Allergic Diseases, 2017, Vol. 5

Nawal et al.

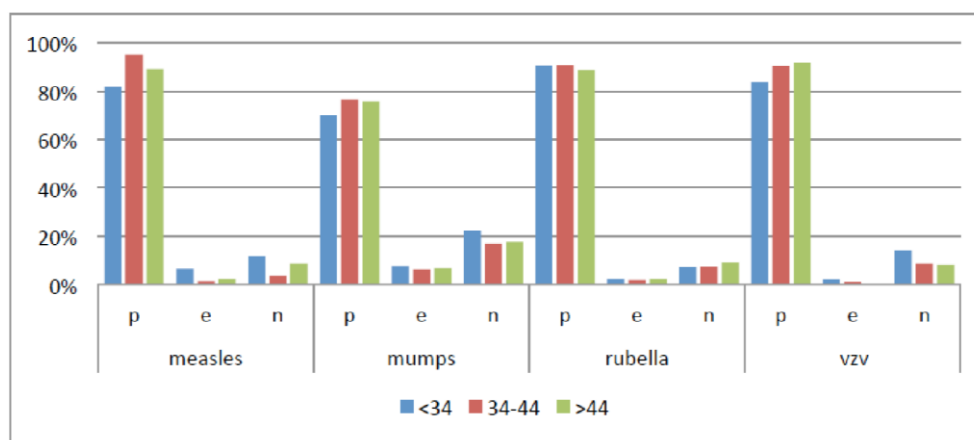


Figure 3:

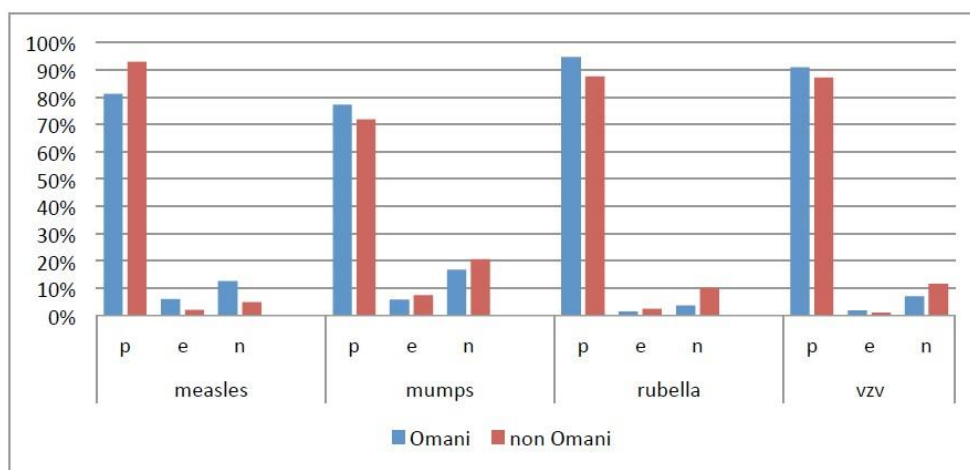


Figure 4:

4. DISCUSSION

To our knowledge, this is the first comprehensive study to evaluate seroprevalence to measles, mumps, rubella and varicella in a large cohort of healthcare

workers in a hospital in Oman. Our findings show that although seroprevalence rates were high for measles, rubella and varicella, seropositivity levels for mumps is alarming low at 70%-78% over the 4 year study period, 2010-2013. In agreement with several other previously reported studies, this finding confirms the low efficacy of the mumps component of the trivalent measles, mumps and rubella vaccine [8, 9]. Furthermore, mumps outbreaks continue to occur worldwide.

Immunity to measles and rubella in this cohort of HCW of 88% and 90% is high, although it is well below the threshold of 95% necessary to meet the WHO goal of measles elimination. In 1997, the Eastern Mediterranean Region (EMR) in the World Health Organization (WHO) which includes Oman adopted a goal of measles elimination by 2010 [10]. Although significant progress was made toward measles elimination in the EMR during 1997–2007, the measles elimination goal was not reached by the target date of 2010, and the date was revised to 2015. A report published in 2014 summarizing the progress made toward measles elimination in EMR during 2008-2012, found that large outbreaks occurred in countries with a high incidence of measles, and that annual measles cases in EMR increased from 12,186 to 36,456 [11]. In this report however, Oman was found to be a country with low incidence of measles. In a recent report [13], countries close to measles elimination: (incidence < 5 cases/1,000,000 with a nationwide measles casebased surveillance, high measles coverage for both doses of vaccine included Egypt, Iran, Oman and Tunisia. Unlike Oman, several countries of the EMR have experienced political conflict, floods, and financial constraints which constitute major challenges facing measles elimination [13]. As a result, countries of the EMR are at different

Seroprevalence of MMRV in HCW in Oman

stages of measles endemicity and have variable capacity of measles elimination [11]. For example, medical students in the United Arab Emirates were found to have a very low measles seropositivity rate of 54% [3] and staff in a hospital in Saudi Arabia had rubella seropositivity rates of 47.9% [1].

Although, seroprevalence was not associated with gender or occupation, a finding of concern in this study was that younger healthcare workers and non-Omani individuals had significantly higher seronegative rates compared to older cohorts and individuals born in Oman. Since the majority of HCW are non-Omani (64%), a

cohort born primarily in India and Philippines, these findings raises questions of whether to immediately vaccinate non-Omani HCW or to first conduct serological testing and specifically vaccinate only individuals with insufficient immunity. Nevertheless, these findings raise serious concerns about the need to determine the immune status of healthcare workers with a view to offering vaccinations to prevent transmission of vaccine preventable diseases in the healthcare setting. A recent study in 2016, on serology guided vaccination against measles in asylum seekers in Germany during an outbreak was recently reported to be twice as expensive as mass vaccination without prior serological testing [13]. In fact, German national guidelines recommend that serology should not be used to guide individual vaccination decision, and that asylum seekers should not be serologically tested prior to vaccination [14]. In conclusion immunity to measles, rubella and varicella is high in HCW in Oman whereas immunity to mumps remains low. The high seronegativity rates observed in non-Omani HCW raises serious concerns such as the importance of determination of immune status of healthcare workers with a view to offering vaccinations and the need to prevent transmission of vaccine preventable diseases in the healthcare setting.

ACKNOWLEDGMENT

The authors would like to thank Mr Padma Mohan, and Mr Abdul Hakeem Al-Rawahi for their contribution to data analysis.

REFERENCES

- [1] Expanded programme on immunization (EPI). Measles elimination in Oman. *Wkly Epidemiol Rec* 1999; 74: 429-34.
- [2] Abbas M, Atwa M and Emara A. Seroprevalence of measles, mumps, rubella and varicella among staff of a hospital in Riyadh, Saudi Arabia. *J Egypt Public Health Assoc* 2007; 82(3-4): 283-97.
- [3] Sheek-Hussein M, Hashmey R, Alsuwaidi AR, Al Maskari F, Amin L and Souid AK. Seroprevalence of measles, mumps, rubella, varicella and hepatitis A-C in Emirati medical students. *BMC Public Health* 2012; 12: 1047-52. <https://doi.org/10.1186/1471-2458-12-1047>
- [4] Bakri FG, Abdelrahmim ZM, Alkalbani AS, *et al.* Seroprevalence of measles, mumps, rubella and varicella among physicians and nurses in Jordan. *Turk J Med Sci* 2016; 46: 614-9. <https://doi.org/10.3906/sag-1502-115>
- [5] Gohil DJ, Kotharu ST, Chaudhari AB, *et al.* Seroprevalence of measles, mumps and rubella antibodies in college students in

- Mumbai, India. *Viral Immunol* 2016; 29: 159-63. <https://doi.org/10.1089/vim.2015.0070>
- [6] Celikbas A, Ergonul O, Aksaray S, *et al.* Measles, rubella, mumps, and varicella seroprevalence among health care workers in Turkey: Is prevaccination screening costeffective? *Am J Infect Control* 2006; 34: 583-7. <https://doi.org/10.1016/j.ajic.2006.04.213>
- [7] Al Awaidy ST, Al Mahrouqi S, Al Den HMN, *et al.* Rubella and Congenital Rubella Syndrome Elimination, the Oman Experience. *JJ Vaccine Vaccination* 2015; 1(2): 009.
- [8] Savage E, Ramsay M, White J, *et al.* Mumps outbreaks across England and Wales in 2004: observational study. *BMJ* 2005; 330(7500): 1119-1120. <https://doi.org/10.1136/bmj.330.7500.1119>
- [9] Peltola H, Kulkarni PS, Kapre SV, Paunio M, Jadhav SS and Dhare RM. Mumps outbreaks in Canada and the United States: time for new thinking on mumps vaccines. *Clin Infect Dis* 2007; 45(4): 459-466. <https://doi.org/10.1086/520028>
- [10] World Health Organization. Measles: regional strategy for measles elimination. Geneva, Switzerland: World Health Organization 1999.
- [11] Teleb N, Lebo E, Ahmed H, *et al.* Progress Toward Measles Elimination — Eastern Mediterranean Region, Morbidity and Mortality Weekly Report 2008-2012. 2014; 63(23): 511-515.
- [12] Status Report on Progress Towards Measles and Rubella Elimination SAGE Working Group on Measles and Rubella 2013.
- [13] Jablonka A, Happel C, Grote U, *et al.* Measles, mumps, rubella and varicella seroprevalence in refugees in Germany in 2015. *Infection* July 2016; 1-7. <https://doi.org/10.1007/s15010-016-0926-7>
- [14] Robert Koch-Institut. Konzept zur Umsetzung frühzeitiger Impfungen bei Asylsuchenden nach Ankunft in Deutschland 2015. *Epidemiol Bull RKI* 2016; 41: 439-44.

Received on 20-11-2017

Accepted on 20-12-2017

Published on 31-12-2017

DOI: <http://dx.doi.org/10.20941/2310-6980.2017.05.1>

© 2017 Nawal, *et al.*; Licensee Synchro Publisher.

This is an open access article licensed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>), which permits unrestricted, non-commercial use, distribution and reproduction in any medium, provided the work is properly cited.