



# Varicella zoster virus infection among healthcare workers in Taiwan: seroprevalence and predictive value of history of varicella infection

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## SUMMARY

**Background:** Varicella zoster infection can be spread by infected healthcare workers (HCWs) to coworkers and patients. A self-reported history of chickenpox infection is sometimes taken as proof of immunity.

**Aim:** To establish the relationship between positive recall history and serological immunity against varicella zoster virus (VZV) amongst healthcare workers in a tertiary hospital in Taiwan.

**Methods:** Between May 2008 and April 2009, all HCWs in a Taiwanese tertiary care hospital were tested for VZV immunoglobulin G (IgG), and completed a self-administered questionnaire to determine their history of varicella infection or vaccination. Those who were seronegative were vaccinated.

**Findings:** All HCWs ( $N = 3733$ ) at the hospital participated in this study. Their mean age was 34.6 years, and the seroprevalence of VZV was 91.1%. Sensitivity, specificity, and positive and negative predictive values of a self-reported history of varicella infection were 82.3%, 48.6%, 96.3% and 14.4%, respectively. Corresponding figures for a history of varicella vaccination were 23.4%, 69.4%, 90.9% and 6.5%, respectively. The recall history of younger HCWs and medical professionals (doctors, nurses and paramedical staff) to varicella had higher sensitivity. However, only the recall history of medical professionals had a significantly higher positive predictive value.

**Conclusion:** A positive recall history of varicella infection and vaccination did not ensure the presence of protective VZV IgG, and a negative history was not predictive of a lack of immunity. For effective prevention of nosocomial infection, VZV IgG status should be documented for all HCWs, and susceptible HCWs should be vaccinated.

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## Introduction

Varicella (chickenpox), caused by varicella zoster virus (VZV), is a highly contagious disease that is spread by contact with respiratory droplets and/or vesicle fluid.<sup>1</sup> It is usually self-limited, but may cause severe complications such as lower

respiratory tract infection, skin and soft tissue infection, or even death.<sup>1</sup> In Taiwan, there are approximately 11,000 cases of varicella per year,<sup>2</sup> and the estimated varicella-related hospitalization rate is 60 per 1000 patients. The hospitalization rate is highest in patients aged 19–38 years or >75 years.<sup>3</sup>

Varicella is a recognized nosocomial infection among healthcare workers (HCWs), who, once infected, may transmit infection to susceptible coworkers and patients under their care.<sup>4</sup> The cost of controlling varicella in the hospital setting can be substantial because identification of cases, time off work, and serological testing of susceptible HCWs are often indicated after each episode of in-hospital exposure to varicella.<sup>5,6</sup> Therefore, VZV vaccination has been recommended by the US Centers for Disease Control and Prevention (CDC) for HCWs who are susceptible to varicella.<sup>7,8</sup> In Taiwan, national recommendations regarding varicella vaccination for susceptible HCWs have not been issued to date. The policy for free VZV vaccination for children >1 year of age has been in place since 2004, but there is no such policy for HCWs. To the authors' knowledge, few hospitals in Taiwan follow the CDC guidelines because of the costs of laboratory testing and vaccination of staff. However, several episodes of nosocomial outbreaks of varicella have occurred in hospitals in recent years.

To expedite the control of varicella in the hospital setting, some investigators have accepted a past history of varicella infection, self-reported by a HCW, as proof of immunity, and only used serology in cases of unclear or negative past history.<sup>1,6,9</sup> Nevertheless, it remains debatable whether selected individuals should be screened serologically, based on a negative VZV history, instead of screening all HCWs,<sup>10,11</sup> as the effectiveness of a selective screening programme may depend on the prevalence of the disease in the population examined, and the reliability of recall history of varicella infection.

To date, the seroprevalence and reliability of self-reported history of varicella among HCWs in Taiwan has not been evaluated. As such, this study evaluated the seroprevalence and reliability of self-reported history of varicella among HCWs in Taiwan to help guide the development of a local screening programme.

## Methods

### Hospital setting

This study was undertaken at Changhua Christian Hospital (CCH), a 1775-bed tertiary care hospital providing primary and tertiary care in central Taiwan (estimated population 4.48 million).

### Study population

All 3733 HCWs in the hospital participated in this varicella control programme. HCWs were classified as doctors ( $N = 537$ ), nurses ( $N = 1580$ ), paramedical staff (e.g. dietician, pharmacist, rehabilitation staff, laboratory personnel or diagnostic imaging staff) ( $N = 698$ ) or administrative staff (including maintenance, technical, catering staff etc.) ( $N = 918$ ). HCWs working in the paediatrics, emergency medicine, dermatology and infectious diseases departments were regarded as being at higher risk of exposure to varicella, in accordance with the study definitions of the Center for Infection Control at this hospital.

### Laboratory investigations and questionnaire

Blood tests for VZV antibodies were performed as part of each employee's annual occupational medical examination from May 2008 to April 2009. Annual medical examinations are mandatory for all employees in the hospital. VZV antibody was checked using a commercial enzyme-linked fluorescent immunoassay (ELFA) kit (VIDAS, bioMérieux, Marcy l'Etoile, France). ELFA is specific for the detection of immunoglobulin G (IgG) antibodies to VZV, with declared sensitivity and specificity of 99.7% and 97.6%, respectively. Each HCW's immune serum ratio value was classified as positive ( $\geq 0.9$ ), negative ( $< 0.60$ ) or equivocal ( $\geq 0.6$  and  $< 0.90$ ). HCWs with negative or equivocal serum responses were regarded as seronegative, and were offered VZV vaccination (Varilrix, GlaxoSmithKline, Rixensart, Belgium or Varivax Refrigerated, CSL-MSD, West Point, PA, USA).

A self-administered questionnaire was completed during the medical examination to obtain information regarding history of varicella infection or vaccination against varicella. Possible answers were 'yes', 'no' or 'unknown'. Data were collected retrospectively using a standardized case record form, and the results of this varicella control programme were analysed. The study was approved by the Institutional Review Board of CCH.

### Statistical analysis

Statistical analysis was performed using Statistical Package for the Social Sciences Version 17.0 (SPSS Inc., Chicago, IL, USA). The prevalence rates of VZV antibody and the history of varicella infection or vaccination were calculated for various groups (gender, age, type of occupation, exposure risk). Differences in proportions were assessed using Chi-squared test, with a  $P$ -value  $< 0.05$  considered to be statistically significant. Sensitivity, specificity, and positive (PPV) and negative predictive values (NPV) of recall history for the presence of VZV IgG were determined. Relative risk (RR) was calculated using a logistic regression model. Gender, age, type of occupation and exposure risk were included in the multi-variate analysis.

## Results

The demographic characteristics of all 3733 HCWs are shown in Table I. The participants were predominantly female (79.2%), and the age range was 18–68 years (mean 34.6 years). Overall, 75.2% of the participants were aged  $< 40$  years, 42.3% were nursing staff, and 11.2% were categorized as being at higher risk of exposure to varicella infection.

The prevalence of VZV seropositivity was 91.1%. The seronegative group included 200 HCWs (5.4%) whose serum samples were reported as seronegative and 133 (3.6%) whose samples were reported as sero-equivocal. No significant differences in characteristics were observed between HCWs who were VZV seronegative and those who were sero-equivocal, other than HCWs who were VZV seronegative were younger than those who were sero-equivocal (Table II). The prevalence of seropositivity was significantly higher in older HCWs compared with younger HCWs (Table II and Figure 1).

A history of varicella infection was reported by 1465 HCWs (39.2%), 354 (9.5%) reported no such history, and 1914 (51.3%) were unaware of their status. Younger HCWs (aged  $< 50$  years), female HCWs, medical professionals (doctors, nurses and

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