Short Communication

Prevalence and Characteristics of Pediatric Healthcare Workers without Immunity to Varicella zoster Virus

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SUMMARY: This study aimed to determine the proportion of varicella non-immune pediatric healthcare workers (HCWs) of the Pediatrics Department of King Chulalongkorn Memorial Hospital and to determine cost-effective strategies for identifying non-immune personnel. A cross-sectional study using a self-administered questionnaire to determine HCWs' histories of chickenpox or 2-dose varicella vaccination was conducted. From a total of 699 HCWs, 653 HCWs (93%), including 145 physicians (22%), 297 nurses (46%), and 211 administrative staff (32%), responded to questionnaires. There were 475 HCWs (73%) who had a history of chickenpox, 58 (9%) who had completed the 2-dose varicella vaccine schedule, and 120 (18%) whose varicella-zoster virus (VZV) immunity status was uncertain. In total, 107 HCWs (89%) were tested for VZV IgG, 90 of whom had immunity, and 17 were determined to be non-immune. After combining history and VZV IgG test results, the prevalence of non-immune HCWs was 2.6% (95%CI 1.4–3.8), with those ≤40 years of age at higher risk of non-immunity. Implementing a strategy that involves testing of only those with an unknown VZV status and vaccination for only those determined to be non-immune costs 1,801 United States dollar (USD), less than the total cost (4,601 USD) for vaccinating all HCWs with uncertain status.

Varicella-zoster virus (VZV) is highly contagious and can be transmitted as an airborne nosocomial infection (1). Healthcare workers (HCWs) are at higher risk of exposure to varicella due to their occupational contact with cases. VZV infection of HCWs can lead to nosocomial spread and can cause severe disease among immunocompromised patients (2). Recommendations regarding varicella vaccination of HCWs vary from country to country (3). In Thailand, varicella vaccination is recommended; however, there are no specific regulations or hospital policies. The annual number of varicella infections in Thailand is about 126 per 100,000 people per year (4). To improve hospital infection control, knowledge of HCWs' immunity status against this vaccine-preventable disease is needed.

A cross-sectional study was conducted to determine HCWs' immunity to varicella at the Pediatrics Department of King Chulalongkorn Memorial Hospital, a tertiary-care hospital with 1,479 beds (388 beds in the Pediatrics Department) in Bangkok, Thailand. A structured, self-administered questionnaire was administered to HCWs. This survey was part of the hospital's occupational health policy and was implemented to assess the status and risk of vaccine-preventable disease in HCWs. The questions included data on age, sex, profession, history of VZV infection and varicella vaccination status. History of VZV infection was defined as the diagnosis or verification of a history of varicella or herpes zoster disease. Based on published data, there is a good correlation between self-reported varicella history and seropositivity in HCWs, ranging from 96.3–100% (5,6). HCWs who had a history of VZV infection or who had completed 2 doses of the varicella vaccine were defined as immune (7). Those who reported an uncertain history of VZV infection or vaccination were tested for VZV IgG. Serological screening for VZV was performed using an enzyme-linked immunosorbent assay (Euroimmun, anti-VZV ELISA IgG, Luebeck, Germany). The cutoff IgG level set for the ELISA test was 110 IU/L. HCWs with VZV IgG level ≤110 IU/L were defined as non-immune to VZV and received 2 doses of the varicella vaccination. Varicella vaccination was administered using Varicella GCC (Green Cross Corp., Seoul, Korea).

Data were analyzed using Stata version 13.1 (Stata Corp., College Station, TX, USA). Categorical variables were compared using the Chi-square test. Continuous variables were compared using the Wilcoxon rank-sum test. A p-value less than 0.05 was considered statistically significant. We compared the cost for one-step vaccination for all HCWs with uncertain VZV immunity status versus the 2-step method with a blood test for varicella IgG among HCWs with an uncertain history of VZV exposure. The costs of VZV IgG antibody testing and the 2 doses of the VZV vaccine were 10 and 43 United States dollar (USD), respectively.

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Prevalence of HCWs with Non Immunity to Varicella

Table 1. Characteristics of healthcare workers

| Characteristic                        | History of chicken pox | Completion of 2-dose varicella vaccination | Uncertain status | Total |
|---------------------------------------|------------------------|------------------------------------------|------------------|-------|
| Median age (y) (IQR)                  | 35.1 (28.5–48.1)       | 29.8 (27.4–36.8)                        | 39.4 (31.1–49.1) | 35.8 (28.5–47.2) |
| Gender: female                        | 436 (91.8)             | 54 (93.1)                               | 111 (92.5)       | 601   |
| Occupational role                     |                        |                                          |                  |       |
| Physician                             | 123 (84.8)             | 20 (13.8)                               | 2 (1.4)          | 145   |
| Nurse                                 | 211 (71)               | 30 (10.1)                               | 56 (18.9)        | 297   |
| Administrative staff                  | 141 (66.8)             | 8 (3.81)                                | 62 (29.4)        | 211   |

| Characteristic                        | Immune (%) (N = 90) | Non immune (%) (N = 17) | Total (N = 107) | P-value |
|---------------------------------------|---------------------|-------------------------|-----------------|---------|
| Median age (y) (IQR)                  | 42.7 (36–51.4)      | 25.3 (24.3–35.2)        | 39.9 (31.2–50.4)| <0.001  |
| Gender: female                        | 84 (93.3)           | 16 (94.1)               | 100 (93.5)      | 0.91    |
| Occupational role                     |                     |                         |                 |         |
| Physician                             | 90 (84)             |                         |                 |         |
| Nurse                                 | 1 (100)             | 0 (0)                   | 1               | 0.01    |
| Administrative staff                  | 36 (72)             | 14 (28)                 | 50              |         |

Comparison of the 2 strategies, the expense of the blood tests in the 107 HCWs was 1,070 USD, combined with cost of 2-dose varicella vaccination in 17 non-immune HCWs, which was 731 USD; the total cost of this strategy was approximately 1,801 USD, which was less than the total cost of universal vaccination of all HCWs with uncertain VZV immune status, which was 4,601 USD (cost difference: 2,800 USD).

Previous studies in other countries report the seroprevalence of varicella to be between 50–98% depending on the institution, age, and national vaccination program (8–10). The prevalence of immunity to VZV among HCWs also differs by geographical area. Seroprevalence studies from tropical countries in Asia are consistent with the older age of acquisition of VZV infection compared to that observed in Europe and North America (11). The factors associated with susceptibility to VZV were age and profession (12). This correlated with published studies indicating that age was associated with serological susceptibility to VZV. From our studies, we determined that the proportion of immunity to VZV in HCWs who were born before 1974 was high (99.2%). In a previous study in Korea, seroprevalence was high (95%) among HCWs born in Korea before 1988 (9). The proportion of HCWs with
an uncertain history mainly consisted of administrative staff. Therefore, hospital policies should target this group to ensure that everyone is aware of their immune status.

As for the strategy of immunization in HCWs with a negative or unknown history of VZV exposure, serologic testing before immunization was more cost-effective; this result is comparable to those of most previous studies (9,13,14). A study by Alp et al. demonstrated that in the cases of uncertain VZV immune status, vaccination to all without serologic testing was more costly than serologic confirmation before vaccination, resulting in a 4-fold increase in the total cost (13). In another study, vaccinating all HCWs without serologic testing raised the costs markedly, with almost identical effectiveness (14).

The limitations of this study are that our estimates of cost did not include indirect costs, such as personnel and administrative expenses. As our assessment was a 2-step process of screening for uncertain immune status, followed by a call-back for serological testing, failure of HCWs to return for further testing would lead to a missed opportunity for vaccination. Moreover, there was a lack of data on varicella immunity in other departments for comparison with the data for the pediatric department.

Our data and previously published data support the design and implementation of a proper occupational health policy in the Asia-Pacific region wherein VZV serologic screening is followed by immunization of at-risk HCWs (6). In resource-limited tropical settings, hospital policies may be directed towards HCWs <40 years of age, and pre-vaccination screening by history and serological testing, which is more economical, may be employed.

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Conflict of interest None to declare.

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