

## Original Article



# Non-Mandatory Influenza Vaccination Rates among Healthcare Workers during the 2017–2018 Influenza Season: a Multicenter Study in Korea

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## OPEN ACCESS

**Received:** Jul 22, 2019

**Revised:** Oct 8, 2019

**Accepted:** Oct 9, 2019

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## ABSTRACT

**Purpose:** Annual influenza vaccination is the best strategy to prevent healthcare-associated influenza transmission. Influenza vaccination rates among healthcare workers (HCWs) vary by country, region, and year. We investigated the influenza vaccination rates for HCWs during the 2017–2018 influenza season in South Korea, where a non-mandatory vaccination campaign was conducted.

**Methods:** We retrospectively investigated factors affecting the influenza vaccination rate among HCWs during the 2017–2018 influenza season in three tertiary hospitals in Goyang City, where the non-mandatory influenza vaccination program is conducted.

**Results:** Consequently, 6,994 of 7,180 HCWs (97%) were included, and the overall vaccination rate was 85%. Nurses had the highest rate with 92%, followed by health technicians (88%), physicians (84%), and non-medical HCWs (79%,  $P<0.001$ ). Vaccination rates differed, depending on the frequency of contact with patients in the non-medical HCWs (frequent contact vs. less-frequent contact; 90% vs. 73%,  $P<0.001$ ).

**Conclusions:** The influenza vaccination rate among HCWs during the 2017–2018 influenza season in Korea was 85%, which is among the highest rates compared with previously reported non-mandatory vaccination rates in other countries. The vaccination rate may vary depending on the HCW's occupational characteristics, including the extent of contact with the patient. Therefore, a multifaceted strategy is needed to increase the vaccination rate of HCWs.

**Keywords:** Healthcare workers; Influenza vaccine; Mass vaccination; Korea; Healthcare worker-patient transmission

### Funding

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2019032869).

### Conflict of Interest

No potential conflict of interest relevant to this article was reported.

### Author Contributions

Conceptualization: Kang JM, Choi YJ; Data curation: Kang JM, Lee J, Park YS, Park Y, Kwak YG, Song JE; Formal analysis: Kang JM, Song JE, Choi YJ; Funding acquisition: Kang JM; Investigation: Kang JM, Park YS, Park Y, Song JE, Choi YJ; Methodology: Kang JM, Lee J, Park YS, Park Y, Kwak YG, Song JE; Project administration: Kang JM; Resources: Kang JM, Kwak YG; Supervision: Kang JM, Lee J, Park YS, Park Y, Kwak YG, Song JE, Choi YJ; Validation: Choi YJ; Visualization: Kang JM; Writing - original draft: Kang JM; Writing - review & editing: Kang JM, Choi YJ.

## INTRODUCTION

Healthcare-associated influenza transmission, particularly via healthcare workers (HCWs), is an important issue in healthcare-associated infection control. Annual influenza vaccination for HCWs has been proposed to be the most effective method to prevent nosocomial transmission.<sup>1,2)</sup> The Advisory Committee on Immunization Practices and many healthcare authorities recommend that all HCWs receive annual influenza vaccination to reduce influenza-related mortality and morbidity. However, many obstacles to the achievement of high vaccination rates, including lack of availability, vaccine avoidance, disbelief of vaccine efficacy, and lack of concern for influenza illness exist.<sup>3)</sup> Based on this background, several healthcare institutions and authorities recommend mandatory influenza vaccination for HCWs; however, some controversies on the exercise being 'mandatory' still exist.<sup>4,5)</sup> Therefore, in order to improve voluntary vaccination rate from the viewpoint of autonomy, it is important to identify the characteristics and associating factors of influenza vaccination among HCWs.

This study was planned to investigate influenza vaccination rates for HCWs during the 2017–2018 influenza season in South Korea, where a non-mandatory vaccination exercise was conducted. We also explored the factors affecting influenza vaccination rates, including demographic and occupational characteristics.

## MATERIALS AND METHODS

### 1. Study population and design

Three tertiary-care hospitals, National Health Insurance Service Ilsan Hospital (817 beds), Ilsan Paik Hospital (800 beds), and National Cancer Center (605 beds), in Gyeonggi Province, which has a population of 1,005,102 persons, participated in the study. All HCWs who worked in those hospitals were eligible for the study. The vaccination records on 2017–2018 influenza vaccine, age, sex, and occupational characteristics of HCWs during the vaccination campaign in each hospital, were collected retrospectively. HCWs who were 65 years or older were excluded from the study because they were also eligible for the national immunization program of seasonal influenza vaccination. Volunteers were excluded from the study because of lack of personal-identifiable data and service-related information. The study was approved by the Institutional Review Boards of the National Cancer Center (IRB No. NCC-2018-0119) and of the other participating hospitals. Requirements for informed consent were waived. All participant-identifiable data were deleted or modified prior to data analysis.

### 2. Categorization according to occupational characteristics

The occupational groups were divided into medical and non-medical groups. The medical group is defined as the occupational group that specializes in medical practice, and non-medical group is defined as the occupational group that conducts medical assistance or general service. The medical group was further divided into physicians, nurses, and health technicians. In the case of physicians, they were subdivided into medicine/pediatrics, surgery, intern doctor, and others subgroups. Others group included the specialist doctors of emergent department, radiology, pathology, laboratory medicine, dermatology and ophthalmology. Nurses were also subdivided into nurses working in in-patient wards, out-patient clinics, and other subgroups, depending on their workplace. Healthcare technicians

included emergency paramedical personnel, laboratory staffs, nursing assistants, pathology technicians, radiology technicians, and rehabilitation therapists. For non-medical groups, the HCWs were divided according to the degree of frequent contact with patients. Group A (frequent contact with patients) included security agents, patient transfer agents, janitors, and clinical trial-related researchers; whereas laboratory researchers, general office workers, medical records staffs, nutritionists, facility management staffs, and bioengineering staffs were included in group B (less-frequent contact with patients).

### 3. Influenza vaccination campaign for HCWs

Prior to the 2017–2018 influenza season, influenza vaccinations were provided to all HCWs at each hospital. To increase the accessibility of vaccination, all hospitals have provided free influenza vaccinations through in-service carts to hard-to-reach staff, and medical HCWs in 2 out of the 3 hospitals were allowed self-vaccination in general wards. Each hospital encouraged the seasonal influenza vaccination through a campaign, educated, and promoted the need for vaccination; each hospital headquarters received reports on the HCW vaccination rates. In the case of on-site vaccination or mobile cart services, vaccines were kept in a cold box/freezer set with a thermometer (2°C and 8°C) until vaccination to maintain a 'cold chain'. **Table 1** summarizes the details of the campaign program of each hospital.

### 4. Statistical analysis

Categorical variables were summarized with frequencies (percentages). To evaluate the association between categorical variables and vaccination rate,  $\chi^2$  test was used for univariate analysis. A difference of at least 5% among the groups was considered to be different, and estimates with smaller differences were considered similar.<sup>6)</sup> *P*-value <0.05 was considered as statistical significance. Statistical analysis was executed using SPSS version 19 (IBM Corp., New York, NY, USA) and GraphPad Prism version 7.03 (GraphPad Software, La Jolla, CA, USA).

**Table 1.** Encouraging methods and affecting factors for influenza vaccination for HCWs by hospitals

Policy	Hospital A	Hospital B	Hospital C
<b>Accessibility</b>			
Duration of vaccination campaign	5 days	2 days	5 days
No. of vaccination-clinic site during vaccination campaign	1	1	2
Mobile cart service for HCWs with inconvenient access	Yes	Yes	Yes
Possibility of self-vaccination in the department or ward	No	Yes	Yes
<b>Promotion for vaccination campaign</b>			
On-line notification about vaccination	No	Yes	Yes
Off-line notification using bulletin board	No	No	Yes
Off-line notification training or meeting time for HCWs	Yes	Yes	Yes
Notification via in-company e-mail	Yes	Yes	Yes
Individual notification via supervisor or infection control leader	No	Yes	Yes
<b>Education for influenza and influenza vaccination</b>			
Employee education for influenza and vaccination before the influenza season begins	No	No	Yes
Brochures about the dangers of influenza and the importance of vaccination	No	No	Yes
<b>Monitoring and feedback on HCWs' vaccination</b>			
Report of vaccination rate for HCWs to hospital headquarters	Yes	Yes	Yes
Feedback to HCWs who have not been vaccinated	No	Yes	No
Enable visual confirmation after vaccination (for example, sticker attachment)	No	No	No

Abbreviation: HCW, healthcare worker.

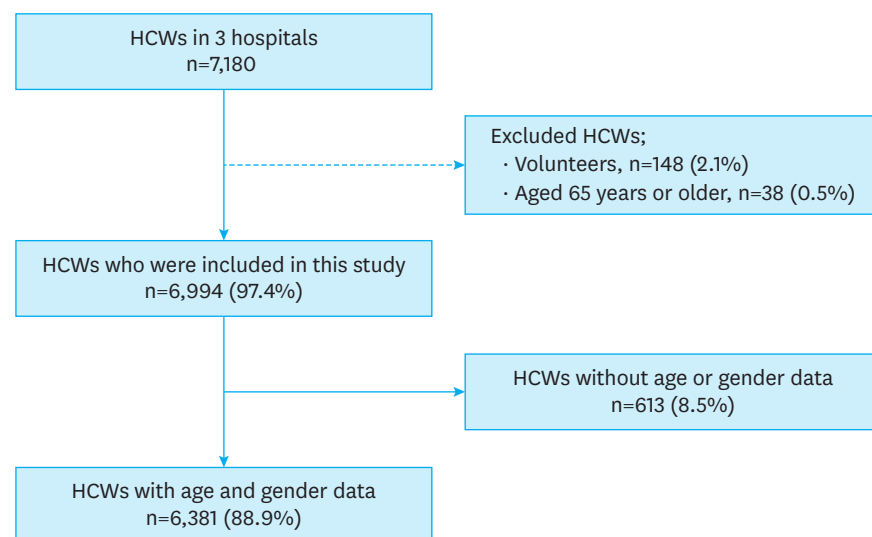
## RESULTS

A total of 7,180 HCWs were eligible for the influenza vaccination campaign during the 2017–2018 influenza season. Volunteers ( $n=148$ ) and HCWs whose ages were 65 years or older ( $n=38$ ) were excluded. As a result, only 6,994 HCWs (97%) were included in this study. Information on occupation was accessible for all eligible HCWs, but information on age and sex were available for only 89% of all eligible HCWs (**Fig. 1**).

Overall, influenza vaccination rate among HCWs was 85%. Differences in the influenza vaccination rates existed among the hospitals (A, 85%; B, 91%; and C, 80%,  $P<0.001$ ). Female HCWs were more likely to receive influenza vaccination than male HCWs (88% and 81%,  $P<0.001$ ). By age, the vaccination rate among HCWs between 30 and 39 years was the lowest with 83%; whereas the rate among HCWs between 60 and 64 years was the highest with 92% ( $P<0.001$ ). Even when looking at each hospital, it was observed that female HCWs had higher vaccination rates than male HCWs (A, 87% vs. 80%; B, 92% vs. 88%; and C, 86% vs. 73%,  $P<0.01$ ). However, in the case of age, the vaccination rate was lowest in the 30s in the A and B hospitals, while the lowest in the 40s in the C hospital (20s, 87%; 30s, 83%; 40s, 75%; and 50s, 79%;  $P<0.01$ , **Supplementary Tables 1 and 2**). Analysis of the vaccination rates according to occupational groups showed that nurses had the highest rate with 92%, followed by health technicians with 88%, physicians with 84%, and non-medical HCWs with 79% ( $P<0.001$ , **Table 2**).

### 1. Subgroup analysis according to detailed occupational groups

Among physicians, vaccination rate of the medicine/pediatrics subgroup was the highest with 88%, followed by others subgroup with 84%, surgery subgroup with 80%, and intern doctor subgroup with 77%. The vaccination rate of the medicine/pediatrics and others subgroups was 86%, which was significantly higher than that of the surgery and intern doctor subgroup (79%) ( $P=0.013$ , **Fig. 2A**). No difference in the vaccination rate among the age groups within the physician group was noted ( $P=0.94$ ). Female physicians seemed to have a higher influenza



**Fig. 1.** Selection of study population. Abbreviation: HCW, healthcare worker.

**Table 2.** Characteristics of study population

Characteristics	No. (%)	No. of vaccinations (%)	P-value
Total No. of HCWs	6,994 (100.0)	5,947 (85.0)	<0.001
Hospital A	1,772 (25.3)	1,502 (84.8)	
Hospital B	2,376 (34.0)	2,163 (91.0)	
Hospital C	2,846 (40.7)	2,282 (80.2)	
Sex			<0.001
Female	4,582 (65.5)	4,049 (88.4)	
Male	1,799 (25.7)	1,454 (80.8)	
Missing data	613 (8.8)	444 (72.4)	
Age (yr)			<0.001
20–29	2,333 (33.4)	2,071 (88.8)	
30–39	1,951 (27.9)	1,611 (82.6)	
40–49	1,226 (17.5)	1,039 (84.7)	
50–59	740 (10.6)	661 (89.3)	
60–64	131 (1.9)	121 (92.4)	
Missing data	613 (8.8)	444 (72.4)	
Occupational group			<0.001
Medical HCWs	4,098 (58.6)	3,654 (89.2)	
Physicians	914 (13.1)	765 (83.7)	
Nurses	2,297 (32.8)	2,110 (91.9)	
Health technicians	887 (12.7)	779 (87.8)	
Non-medical HCWs	2,896 (41.4)	2,293 (79.2)	
Group A (frequent contact with patients)	1,028 (14.7)	926 (90.1)	
Group B (less frequent contact with patients)	1,868 (26.7)	1,367 (73.2)	

Abbreviation: HCW, healthcare worker.

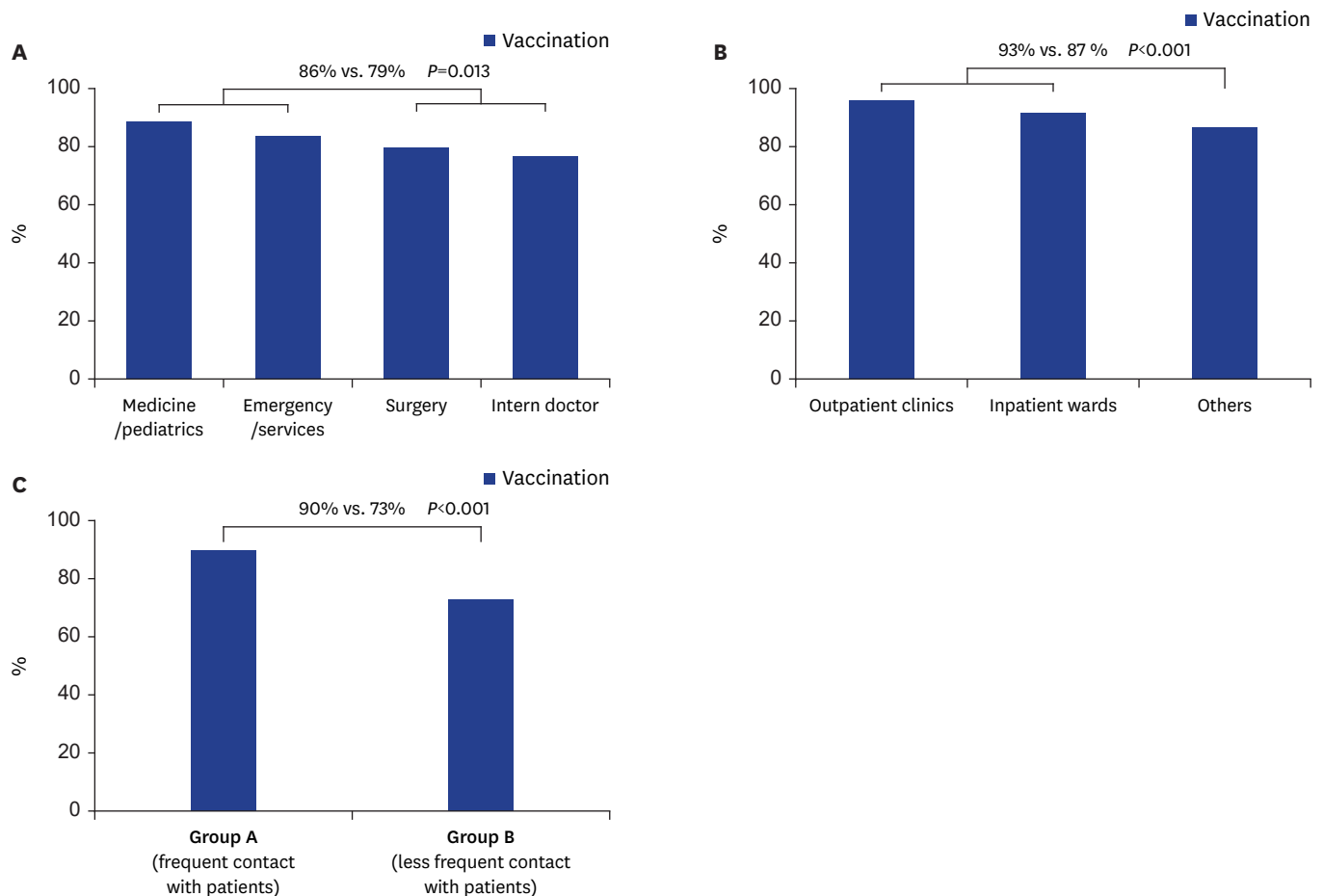
vaccination rate than male physicians, but there was no significant difference (87% and 82%,  $P=0.063$ ). Among nurses, the vaccination rate of the out-patient clinic and in-patient ward subgroups, who frequently contact and care for patients, was significantly higher than that of the other nurse subgroups (93% and 87%,  $P<0.001$ , **Fig. 2B**). In the subgroup analysis, the vaccination rate of in-patient ward subgroups was 92% and that of out-patient clinic subgroup was 96%, which was statistically significant ( $P=0.003$ ). Vaccination rate was highest in nurses who were at least 50 years (99%), followed by 40–49 years (94%), 20–29 years (93%), and 30–39 years (87%) ( $P<0.001$ ). Female nurses seemed to have a higher influenza vaccination rate than male nurses, but there was no significant difference (92% and 88%,  $P=0.288$ ). Among healthcare technicians, no difference in the vaccination rate according to age or sex was noted (data not shown).

For non-medical HCWs, influenza vaccination rates were different, depending on the frequency of contact with patients. In the case of group A non-medical HCWs, who had frequent contact with patients, the vaccination rate (90%) was significantly higher than that (73%) of group B non-medical HCWs, who had less frequent contact with patients ( $P<0.001$ , **Fig. 2C**).

## DISCUSSION

Compared with previous studies on mandatory influenza vaccination, non-mandatory influenza vaccination rate among Korean HCWs in this study is not as high as the mandatory vaccination. We observed that vaccination rates can differ according to HCWs' age, sex, and occupational characteristics.<sup>4,11)</sup>

Influenza vaccination rates among HCWs vary by country, region, and year. In general, vaccination rates in Europe are as low as less than 40% (range, 14–64%), but it is relatively



**Fig. 2.** Different influenza vaccination rate according to occupational subgroup. (A) Physicians, (B) Nurses, and (C) Non-medical HCWs. Abbreviation: HCW, healthcare worker.

high in North America (USA and Canada) with around 60–80% (range, 30–92%), with mandatory campaigns increasing the rate to 95–99%.<sup>4,5,7</sup> In addition, some studies reveal that the annual influenza vaccination rate among HCWs is gradually improving.<sup>1,6</sup> In South Korea, the vaccination rate among HCWs during the 2009–2010 season reported at 61% in a previous study conducted by Yoon et al.<sup>8</sup> the rate increased to 85% during the 2017–2018 season in our study. Although differences in demographics and regional distributions between the studies have to be taken into account, this trend may be due to an increased awareness against nosocomial influenza transmissions and/or arousal of personal protection for influenza vaccination.<sup>9</sup> To ensure that this trend is maintained, consecutive monitoring should be done for a longer period.

Different influenza vaccination rates according to specific occupational characteristics is one of the interesting findings in our study. Among physicians and nurses, the rate of vaccination was highest in medical doctors/pediatricians and out-patient/in-patient ward nurses, respectively. These medical HCWs are more likely to have contact with patients having the influenza illness than other medical HCWs. Therefore, they have a higher chance of infection and transfer of the influenza virus in the hospital. Moreover, among some non-medical HCWs, such as security agents and patient transfer agents in group A, their occupation exposes them to more contact with patients, since their range of work is broad

in the hospital. As a result, the extent of possible exposure in the hospital could be larger. Therefore, influenza vaccination in these groups needs to be emphasized.

Meanwhile, the vaccination rates differed from 80% to 91% by hospital. This can be caused by demographic and occupational distribution of HCWs, differences in vaccination campaigns, or differences in perceptions of vaccination. However, the sex ratios of the 3 hospitals in this study were 28:72, which was the same, and the age structure was similar. In addition, C hospital, which had the longest vaccination campaign period and had many intervention items, showed the lowest vaccination rate among the 3 hospitals. This suggests that there are other factors that affect vaccination rates, including factors such as disbelief or misbelief about vaccination.<sup>4,10)</sup> In order to clarify this hypothesis, it is necessary to conduct a questionnaire survey on HCWs to evaluate the extent of recognition, knowledge, and attitude to vaccination.

This study had limitations. This 1-year observation study did not monitor the vaccination rate for years. Therefore, it is difficult to directly compare changes in vaccination rates over a long period of time. In addition, we could not identify the difference in vaccination rate, according to the HCWs' awareness or attitude because the questionnaire used in the survey was not combined. Finally, in the subcategories of physicians, the others group includes a variety of specialty occupations, which may lead to different vaccination rates among them. However, there were limitations for subgroup analysis because there were many specialties in the physician's field and there were not enough number of specialists in each specialty. Therefore, we focused to identify the difference of vaccination rate between the medicine/pediatrics group and the surgeon group.

This study had several strengths. First, it gave the latest information about influenza vaccination rate among HCWs in Korea. Second, our data suggest that occupational characteristics may need to be considered when establishing an influenza vaccination strategy.<sup>3,10)</sup>

In conclusion, the influenza vaccination rate among HCWs for the 2017–2018 influenza season in Korea was 85%, which is higher than the previously reported non-mandatory vaccination rate in other countries. The vaccination rate may differ according to certain detailed characteristics. Therefore, a multifaceted approach is needed to increase the vaccination rate.

## SUPPLEMENTARY MATERIALS

### Supplementary Table 1

Demographic characteristics of each hospital

[Click here to view](#)

### Supplementary Table 2

Vaccination rate according to demographic characteristics of each hospital

[Click here to view](#)

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## 요약

**목적:** 인플루엔자 예방접종은 인플루엔자 감염을 예방하고 병원 내 전파를 차단할 수 있는 가장 효과적인 방법이다. 본 연구자들은 국내 병원내 직원들의 인플루엔자 예방 접종률의 현황 및 접종률과 연관된 인자들을 살펴보고자 하였다.

**방법:** 2017-2018 인플루엔자 시즌 전, 경기도 고양시 내 3개 종합 병원의 인플루엔자 예방접종 캠페인 대상인 병원 직원들이 연구에 포함되었다. 연구대상자의 인구학적인 특성 및 직업적 특성을 후향적으로 수집하였다.

**결과:** 총 7,180명의 병원내 직원 중 6,994명(97%)이 연구에 포함되었으며 전체 예방 접종률은 85%였다. 의료직종 중에서는 간호직군이 92%로 가장 높았고, 의료기술직군(88%), 의사직군(84%), 비의료직군(79%) 순이었다( $P < 0.001$ ). 비의료직군에서의 접종률은 환자와의 접촉 정도에 비해 서로 상이하였으며, 환자와 접촉이 빈번한 비의료직군의 접종률은 90%로 덜 빈번한 비의료직군의 73%보다 유의하게 높았다( $P < 0.001$ ).

**결론:** 2017-2018 인플루엔자 시즌 병원내 직원의 예방접종률은 85%이었다. 이는 기존의 병원내 직원 대상으로 자발적인 예방접종을 진행하는 여러 국가들의 보고들과 비교했을 때 높은 편에 속한다. 병원내 직원의 특성에 따라 예방 접종률은 서로 상이하며, 병원내 직원의 예방 접종률을 보다 높이기 위해서는 이러한 요인들을 포함한 다각적인 접근을 고려해야한다.