

Influenza and Pneumococcal Vaccine Coverage Rates among Patients Admitted to a Teaching Hospital in South Korea

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Background: Influenza and pneumococcal vaccinations can reduce morbidity and mortality especially in the elderly and patients with chronic medical disease. The purpose of this study was to estimate vaccination coverage of these populations in a hospital setting.

Materials and Methods: We conducted a cross-sectional, descriptive study involving adult patients admitted to a 1,000-bed teaching hospital on April 15, 2013. We ascertained the information on whether the patient had received influenza vaccination within a year prior to admission or pneumococcal vaccination by interviewing each patient.

Results: A total of 491 eligible patients aged ≥ 50 years or with chronic medical illnesses were analyzed. The overall vaccination rate for influenza was 57.2%, and that of pneumococcus was 17.6% among the vaccine-eligible subjects. Influenza/pneumococcal vaccination rates of patients by disease were 62.8%/17.2% for diabetes, 53.3%/15.6% for malignancy, 67.6%/23.5% for chronic pulmonary disease, 66.7%/15.3% for chronic cardiovascular disease, 68.7%/26.9% for chronic renal disease, and 51.2%/18.6% for chronic hepatic disease. Young adult patients with chronic medical conditions were consistently less likely to receive influenza and pneumococcal vaccines irrespective of the underlying disease.

Conclusion: The influenza and pneumococcal vaccine coverage rates among hospitalized patients were low in South Korea. This was especially the case for young adult patients with chronic medical illnesses.

Key Words: Influenza; *Streptococcus pneumoniae*; Vaccination; Hospitalization; Health survey

Introduction

The burden of influenza and pneumococcal diseases in South Korea is high despite remarkable advances in therapeutics and preventive measures [1, 2]. The most common serious

complication of influenza is pneumonia, and a quarter of community-acquired pneumonia cases are attributable to pneumococcus [3]. According to the National Health Insurance Statistical Yearbook 2012, pneumonia was the most common disease associated with hospitalization among sub-

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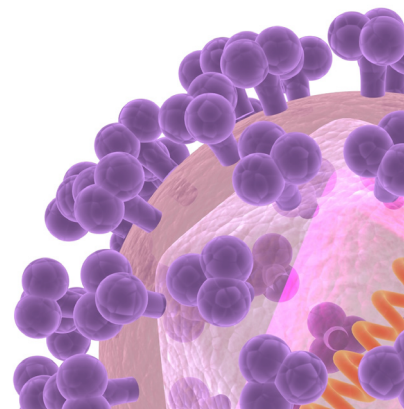
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jects aged ≥ 65 years in Korea, and it was the sixth leading cause of death in the elderly population [4, 5].

In addition to extreme ages, chronic medical diseases and immunocompromising conditions are considered important predisposing conditions for serious pneumococcal infection [6]. One US surveillance study demonstrated that the relative risk for invasive pneumococcal disease was 3–6-fold higher in diabetic patients or patients with chronic lung or heart diseases and 23–40-fold higher in patients with cancer, hematologic malignancy, or HIV/AIDS compared with healthy adults, and the risks increased with age [6]. Furthermore, the risk is dramatically increased in autologous (17.3 times) and allogeneic (51.3 times) hematopoietic stem cell transplant recipients compared with age-matched controls [7]. Vaccination of these comorbid adults has previously been demonstrated to be beneficial [6].

The importance of vaccination among the high-risk young adult population has been overlooked, and their vaccine coverage rates against pneumococcus and influenza are far lower than those of the elderly [8, 9]. In South Korea, overall influenza vaccine coverage rates are high, presumably because the national immunization program (NIP) against influenza provides free vaccinations to the elderly (aged ≥ 65 years) at nationwide public health centers. In contrast, the pneumococcal vaccine coverage rate is much lower compared with other countries though the vaccine has been licensed for clinical use for more than three decades [10–14]. A few Korean studies have reported on vaccine coverage rates of the elderly and of patients with chronic diseases at risk for influenza and pneumococcal infection [11, 15, 16]. Despite more opportunities to get vaccinated when visiting clinics for underlying medical conditions, vaccination rates for these populations have been suboptimal until recently [11, 15–17]. Vaccination against both influenza and pneumococcus can make a profound clinical impact on morbidity and mortality, especially in the elderly and in patients with chronic medical diseases.

The objective of this study was to estimate the influenza and pneumococcal vaccination rates among the elderly and patients with chronic medical diseases admitted to a teaching hospital, and to analyze the vaccine coverage rates by age group and underlying disease.

Materials and Methods

1. Study subjects

We performed a cross-sectional, descriptive study involving

patients who were admitted to Korea University Guro Hospital (KUGH) on 15 April 2013. KUGH serves an urban population, has 1,000 beds and had 43,227 discharges in 2012. Influenza and pneumococcal vaccination rates, demographic data, medical conditions, immunization status against influenza during the 2012–2013 influenza season and pneumococcus prior to admission was ascertained from short interviews with each patient by nurses of each ward. In this study, the types of vaccine were not identified.

We included all patients aged 19 years or older who were not admitted to intensive care units, the emergency department, or the psychiatric ward. The exclusion criteria were patients aged 19–49 years with any of the following conditions without chronic medical diseases: surgical conditions (elective and emergency surgery), surgical complications, trauma, delivery or acute medical diseases (e.g., acute viral hepatitis A, acute pyelonephritis). The chronic medical diseases referred to diabetes, malignancy, chronic cardiovascular diseases (except isolated hypertension), chronic pulmonary disease, chronic renal disease, chronic hepatic disease, organ/bone marrow transplantation, and HIV infection. Patients who had prolonged use of high-dose corticosteroids or immunosuppressive therapy due to autoimmune diseases such as systemic lupus erythematosus were also included.

Subjects eligible for each type of vaccine were defined by the current recommendation of the Korea Centers for Disease Control and Prevention (KCDC) and the Korea Society of Infectious Diseases [18, 19]. The priority groups recommended for influenza vaccination in Korea are 1) patients with chronic cardiovascular and pulmonary disease; 2) institutionalized persons; 3) patients with chronic hepatic, renal, neuromuscular or hemato-oncologic disease, patients with diabetes, immunosuppressed persons, children, and adolescents taking aspirin; 4) people aged ≥ 65 years; 5) healthcare personnel; 6) households of chronic medical disease patients, pregnant women or those aged ≥ 65 years; 7) caregivers of children aged < 6 months; 8) pregnant women; 9) adults aged 50–64 years; and 10) children age 6 through 59 months. Pneumococcal vaccine for adults is recommended for all adults 65 years of age or older or adults with certain medical conditions: chronic pulmonary disease, chronic cardiovascular disease, diabetes, chronic hepatic disease, chronic renal failure, nephrotic syndrome, functional or anatomic asplenia, immunocompromised patients (e.g., congenital immunodeficiency, HIV infection, leukemia, Hodgkin's disease, multiple myeloma, other malignancy, solid organ transplantation), prolonged use of high-dose corticosteroids or immunosuppressive therapy, or

cochlear implantation. Accordingly, for estimating influenza vaccine coverage rate, our study population included patients aged ≥ 50 years or those with chronic medical disease or immunocompromised conditions. For pneumococcal vaccination, we analyzed data from patients aged ≥ 65 years or those with predefined underlying chronic medical conditions.

2. Statistical analyses

The vaccine coverage rate was defined as the proportion of vaccinated subjects in relation to the eligible patients. The correlation between influenza and pneumococcal vaccination rates was analyzed using Pearson's Chi-square test. Data analyses were performed using SPSS version 20.0 (IBM Corporation, Armonk, NY, USA). All statistical tests were two-tailed, and *P*-values < 0.05 were considered statistically significant.

3. Ethics statement

This study was approved by the Institutional Review Board of KUGH (approval number: KUGH13265).

Results

A total of 595 patients ≥ 19 years of age were admitted to the general wards of KUGH on the study day (Fig. 1). Among them, 6 were excluded because they could not report their vaccination status due to poor physical conditions. Ninety-eight patients aged < 50 years without chronic medical dis-

ease who were admitted due to pre-defined conditions in exclusion criteria were excluded (Table 1). Among the 491 patients with underlying medical conditions or aged ≥ 50 years, 250 were male and 241 were female, and 69.5% (169/243) of patients aged ≥ 65 years had one or more underlying medical condition.

The overall influenza vaccine coverage rate in the study population was 57.2% (281/491) (Table 2). The vaccination rates of subjects aged ≥ 65 years and patients aged ≥ 19 years with chronic medical disease were 73.7% (179/243) and 56.9% (201/353), respectively. Three-quarters of patients aged ≥ 65 years with chronic medical diseases (75.2%, 124/165) received the influenza vaccine in the previous season, and their influenza vaccination rates were variable according to underlying diseases: diabetes (85.9%), chronic renal disease (85.3%), chronic hepatic disease (76.9%), chronic cardiovascular disease (75.0%), chronic pulmonary disease (72.7%), and malignancy (69.1%) (Fig. 2 and Supplementary Table 1). In comparison, younger patients aged 19–64 years showed lower rates of influenza vaccination: chronic pulmonary disease (58.3%); chronic renal disease (51.5%); chronic cardiovascular disease (50.0%); malignancy (40.4%); chronic hepatic disease (40.0%); diabetes (35.8%).

In our study population, 431 subjects were eligible for pneumococcal vaccination (Fig. 1). Among them, 78 patients aged ≥ 65 years did not have underlying medical disease, and 65 patients aged 19–49 years and 123 patients aged 50–64 years were included due to their underlying medical conditions

Table 1. Included number of people in each category

	19–49 years	50–64 years	≥ 65 years
Previously healthy	98 (A)	60 (B)	78 (C)
Patients with comorbidities	65 (D)	123 (E)	165 (F)

A: excluded.

C + D + E + F: eligible for analysis of pneumococcal vaccine.

B + C + D + E + F: eligible for analysis of influenza vaccine.

Table 2. Overall influenza and pneumococcal vaccine coverage rates in elderly subjects or in those with chronic medical disease hospitalized in a tertiary hospital

	Influenza vaccine		Pneumococcal vaccine	
	≥ 19 years	≥ 65 years	19–64 years	≥ 65 years
Vaccine coverage in study population ^a (regardless of comorbidities)	281/491 (57.2%)	179/243 (73.7%)	– ^b	53/243 (21.8%)
Vaccine coverage in patients with underlying comorbidities	201/353 (56.9%)	124/165 (75.2%)	23/188 (12.2%)	36/165 (21.8%)

^aSubjects aged ≥ 50 years or aged ≥ 19 years with underlying medical conditions (*e.g.*, diabetes, malignancy, chronic cardiovascular diseases [except isolated hypertension], chronic hepatic disease, chronic pulmonary disease, organ/bone marrow transplantation, human immunodeficiency virus infection, or prolonged use of high-dose corticosteroids or immunosuppressive therapy).

^bData is not applicable because the analysis of pneumococcal vaccine coverage rate among subjects aged 19–64 years includes only patients with comorbidities.

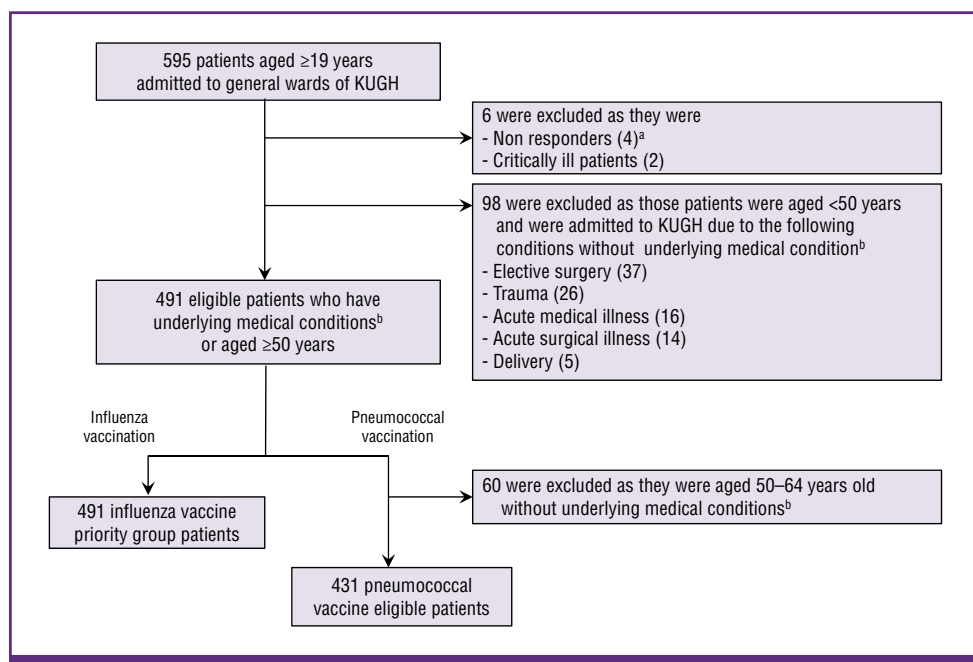


Figure 1. Screening, exclusion and assignment of the study population. KUGH, Korea University Guro Hospital. ^aNumbers in parentheses refer to the number of patients who meet the condition. ^bUnderlying medical condition denotes a chronic medical disease or immunocompromising conditions.

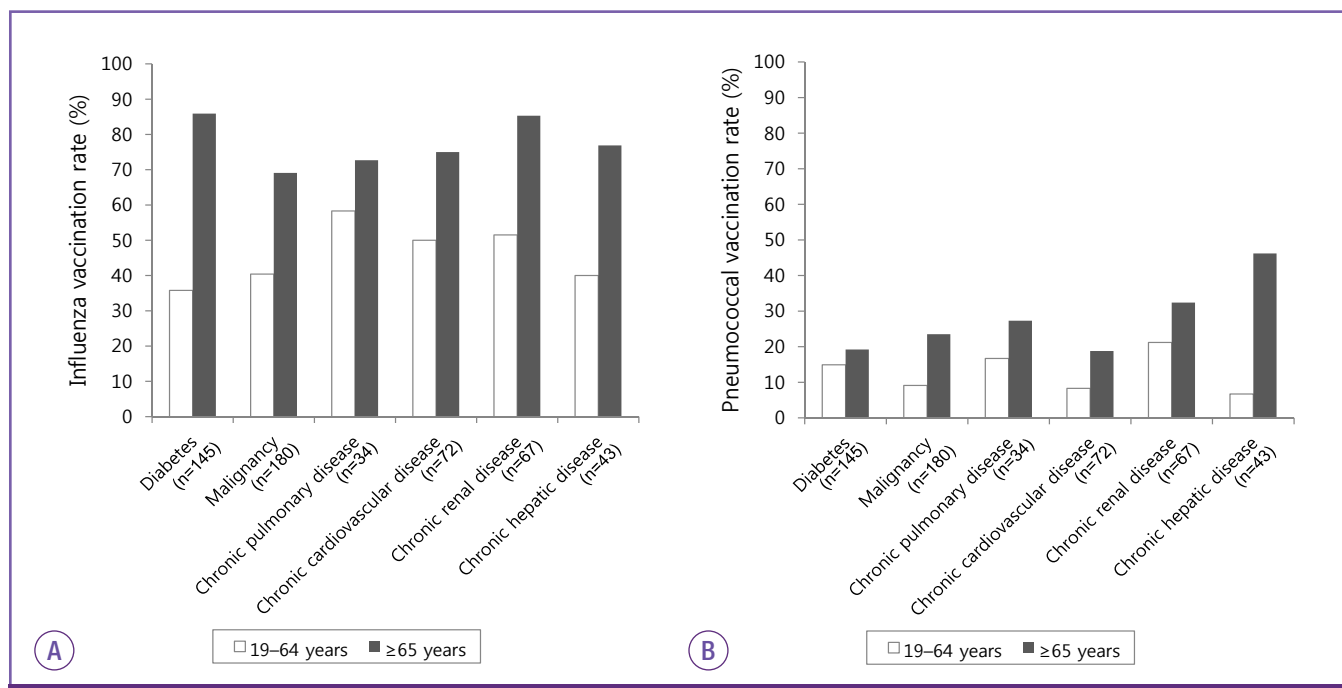


Figure 2. Influenza and pneumococcal vaccination rates by age group and chronic medical disease. (A) Influenza vaccine. (B) Pneumococcal vaccine.

(Table 1). The overall pneumococcal vaccine coverage rate among eligible hospitalized patients was 17.6% (76/431). Among hospitalized patients aged ≥65 years, 21.8% (53/243) stated they had received the pneumococcal vaccine, while 12.2% (23/188) of eligible patients aged 19–64 years stated being vaccinated (Table 2). Around 18–46% of patients aged ≥65 years were vaccinated against pneumococcus with underlying

diseases-related variation (Fig. 2 and Supplementary Table 1). In comparison, young patients aged 19–64 years who were eligible for the pneumococcal vaccine due to predefined risk factors showed a significantly lower rate of vaccination, with only around 6–21% being vaccinated. Patients with chronic renal disease showed a 1.5–3.0-fold higher pneumococcal vaccination rate compared with those who had other chronic

medical conditions: 21.2% (aged 19–64 years) and 32.4% (aged ≥ 65 years).

In patients aged ≥ 65 years, an underlying medical condition did not affect the rate of vaccination against influenza [75.2% (124/165) vs. 70.5% (55/78), $P = 0.441$] or pneumococcus [21.8% (36/165) vs. 21.8% (17/78), $P = 1.000$]. Among patients aged 50–65 years, the presence of underlying medical conditions did not affect influenza vaccine uptake [41.5% (51/123) vs. 41.7% (25/60), $P = 0.979$]. In contrast, patients aged ≥ 65 years who received influenza vaccine were more likely to be immunized against pneumococcus [26.8% vs. 7.8%, odds ratio: 4.324 (95% confidence interval: 1.637–11.416) ($P = 0.002$)]. No subjects received the pneumococcal vaccination during hospitalization according to the hospital administrative data. In-hospital influenza vaccination was not available at this study because the period was outside of influenza season.

Discussion

Among the patients who were admitted to a Korean teaching hospital on the study date, the influenza vaccination rate was 57.2% in patients with chronic medical disease or those aged ≥ 50 years, and the pneumococcal vaccination rate was 17.6% in those aged ≥ 65 years or with chronic medical diseases. Several Korean studies have shown an influenza vaccine coverage rate higher than those of other countries, but the pneumococcal vaccine coverage rate of Korea is lower than that of other countries (although it has increased over time) [10–14].

Patients with diabetes, malignancy, or chronic hepatic disease showed the lowest influenza vaccination rate, and patients with chronic hepatic disease, chronic cardiovascular disease, or malignancy showed the lowest pneumococcal vaccination rate, especially in young adults (Fig. 2, Supplementary Table 1). We also found that patients with chronic renal disease showed relatively higher influenza and pneumococcal vaccination rates regardless of age. The different vaccine coverage rates by disease imply that a targeted approach would be effective [20].

Individuals who suffer from chronic medical disease may have more opportunity to interact with healthcare personnel. However, our study suggests that the vaccine coverage rates for patients in the hospital are suboptimal. One Australian study showed that previous hospitalization was a risk factor for being unvaccinated [21]. Repeated hospitalization due to an acute medical condition may have delayed vaccination, though hospitalized patients are at-risk population for subse-

quent pneumococcal and influenza infection [22, 23]. In addition, one US case study demonstrated that 60% of pneumococcal bacteremia survivors and 70% of pneumococcal deaths had been hospitalized within the previous five years [22]. These data support the importance of active hospital-based vaccination.

In this study, the pneumococcal vaccine coverage rate in individuals aged 19–64 years in the high-risk population was 12.2%, while that in the elderly aged ≥ 65 years was 21.8%. In contrast, vaccination rates of the same age groups in the US were 20.0% and 59.9%, respectively, in 2012 [24]. Similar to our results, Nichol reported that both influenza and pneumococcal vaccination rates for high-risk persons aged 19–64 years lagged far behind those of the elderly [9].

In Korea, a phone survey of 1,000 random subjects aged ≥ 65 years who were stratified by age, gender and geographic region showed that the pneumococcal vaccination coverage was 15.4% in 2012 [25]. The coverage rate dramatically changed as the 23-valent pneumococcal polysaccharide vaccine (23vPPV) for all elderly Koreans aged ≥ 65 years was implemented by the NIP in May 2013 [26]. The program is served by 255 nationwide public health centers and is free of out-of-pocket cost for elderly people who reside in South Korea. According to the immunization registry, on 31 July, 2014, 46.7% of the patients aged ≥ 65 years received the 23vPPV during the 15 months of program operation, which is a dramatic increase considering that the previous coverage of the elderly population was estimated around 10% [11, 12, 26]. However, we must continue to monitor and exert efforts into promoting vaccination for younger adults with chronic medical diseases who are not included in the program.

Vaccination history should be reviewed upon admission to the hospital; physicians should assume an important role in increasing the vaccine coverage rate. Standard practice to review immunization histories and to provide vaccinations during hospitalization may be effective, and there have been several strategies and organizational changes to increase awareness among health professionals. For example, hospital-based vaccination strategies including standing order systems or nurse coordinator-based interventions have been considered as effective measures [27–29]. Physicians can use electronic medical records and immunization registries to generate patient reminders for recommended vaccinations. The KCDC runs a web-based national immunization registry system, thereby potentially covering all the people who live in South Korea. This system is linked to the national administrative data, which is based on universal identification number.

Currently, children aged 12 years or younger are managed with the system in order to identify unvaccinated children. If this system is expanded to adults, it could be utilized to alert physicians by automatic linkage with electronic medical records in hospitals. This may potentiate efforts to increase vaccine coverage rate among high-risk populations.

There are some limitations to this present study. Vaccine coverage rates were estimated for only one day and only among patients admitted in one hospital. Also, vaccination status was self-reported and not further validated by medical records or immunization registry, so it might be inaccurate as it relies on recall. In addition, pneumococcal vaccine indications other than chronic medical disease such as lifestyle choices (e.g., smoking, alcohol consumption), cochlear implantation, or splenectomy could not be identified; thus, it is possible that we underestimated the actual number of vaccine-eligible patients.

To the best of our knowledge, this is the first study to estimate vaccination rates of hospitalized patients in Korea. Furthermore, we were able to estimate the influenza and pneumococcal vaccine coverage rates in groups of people with different comorbidities, which was not available in former nationwide immunization surveys or in the national immunization registry. The coverage rate at the healthcare facility level could be a powerful motivator to healthcare personnel to improve performance [30]. Our study may assist the public health jurisdiction and physicians raising awareness of vaccine recommendations among high-risk populations and hospitalized patients.

In future studies, supplementary interviews of patients may help to ascertain risk factors and determining factors for vaccination levels in hospitalized patients and young adults with chronic medical diseases in order to develop better strategies to maximize coverage rates. Further, the impact of the pneumococcal vaccine campaign along with the introduction of underutilized vaccines to NIP among patients with chronic medical diseases could be assessed by surveying in the same setting.

In conclusion, the influenza and pneumococcal vaccine coverage rates among hospitalized patients with chronic diseases are low in South Korea. Increasing the vaccine coverage rates would reduce the occurrence of invasive pneumococcal disease and influenza infection and the risk of serious complications. Given the high burden of influenza and pneumococcal diseases in those targeted populations, hospital-based strategies to increase influenza and pneumococcal vaccine coverage rates are required.

Conflicts of Interest

No conflicts of interest.

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Supplementary material

Supplementary data including one tables can be found with this article online <http://www.icjournal.org/src/sm/ic-47-41-s001.pdf>.

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