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Evaluating the effectiveness of pneumococcal vaccines against hospitalization and intensive care unit admission in adults

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Abstract

Objective: To evaluate the efficacy of pneumococcal vaccines concerning hospital or intensive care unit (ICU) admissions due to pneumonia after vaccination.

Setting: Inpatient and ICUs at Hamad General Hospital.

Methods: The retrospective study included adults who were vaccinated between June 2012 and June 2013. Patient records were reviewed for hospital or ICU admissions due to pneumonia two years before and after vaccination.

Main outcomes measures: The primary outcome was to compare the rates of hospital and ICU admissions for pneumonia two years before and after vaccination.

The secondary outcome was to evaluate the efficacy of pneumococcal vaccines against different comorbidities.

Key findings: One hundred sixty-one patients were included with a dominant age group of 64–85 (52%) years old. Comorbidities reported were hypertension (HTN), diabetes mellitus (DM), chronic obstructive pulmonary disease (COPD) and asthma. The rate of hospital admission due to pneumonia was significantly reduced within two years after vaccination, 71% to 39% ($p < 0.001$). There was a trend toward reduced ICU admission (12.4% to 10.6), but the results did not achieve statistical significance ($p>0.72$).

In diabetic, hypertensive and COPD/Asthma patients, there was a statistically significant reduction in hospitalization. Although there was a reduction in ICU admission for both commodities the results did not achieve statistical significance

Conclusion: Adults who received pneumococcal vaccines experienced reduced rates of hospital versus ICU admissions due to pneumonia infection.

INTRODUCATION

Pneumococcal and influenza infection can cause significant morbidity and infection-related mortality. In 2006, pneumonia and influenza together were ranked as the eighth leading cause of death in the United States of America (USA) (1). In 2006, 55,477 people died of pneumonia in the USA (2). Throughout the last decade direct and indirect costs for pneumococcal and influenza infections have been estimated to be in millions (1). Pneumonia has become a worldwide concern due to its high prevalence and impact on health care systems. Yearly in USA, pneumonia infection accounts for 500,000 case of respiratory tract infection (RTI), 50,000 cases of bacteremia, and 3,000 cases of meningitis (2). There were no exact epidemiological studies for pneumonia in Qatar.

Pneumococcal vaccines recommended being administered in high-risk populations, such as elderly (over 65 years of age) and younger adults with underlying health problems such as chronic obstructive pulmonary disease (COPD), diabetes mellitus (DM), congestive heart failure (CHF), and sickle-cell anemia. Patients with diseases that impair the immune system (such as acquired immune deficiency syndrome AIDS) and those undergoing cancer therapy or organ transplantation, or patients with other chronic illnesses are particularly vulnerable and therefore need to be vaccinated (3). Besides, immunizing eligible patients with influenza and pneumococcal vaccines is considered an inpatient quality healthcare standard. Eventually, vaccination can help in prevention and diminish antibiotic resistance through its ability to reduce their use. Furthermore, pneumococcal vaccination and influenza vaccine was found to have a cardioprotective effect (4). Of note, the administration of the influenza vaccine showed an additive

protective impact regarding in-hospital mortality from pneumonia and cardiac failure among elderly patients (5).

More than 90% of all pneumococcal infections can be prevented by a single pneumococcal vaccine, which protects against 23 different types of streptococcus pneumonia (5). Approximately 50% of these deaths could be avoided through the use of the pneumococcal vaccine (6). Simonsen et al. suggested that patients over 18 years old are the age group with more than 90% of the benefit for vaccination regarding death and hospitalizations (7).

On the other hand, a meta-analysis of 22 randomized and non-randomized clinical studies evaluating the efficacy of the pneumococcal polysaccharide vaccine showed that the vaccine doesn't appear to be effective against pneumonia, even among the recommended population (8).

A double-blind, randomized control, single-centre trial covering 84,496 patients randomly assigned to receive either the 13-valent polysaccharide pneumococcal vaccine or a placebo, with a four-year follow-up, showed a 45% reduction of vaccine-type community-acquired pneumonia (CAP) (p = 0.0006), a 45% reduction in non-invasive/non-bacteremia CAP (p = 0.0067), and a 75% reduction in invasive vaccine-type pneumococcal disease. Additionally, the study emphasizes a favorable safety profile (1).

There is a scarcity of data about the pneumococcal vaccine effectiveness amongst the Middle East and North Africa (MENA) region and particularly in Qatar. Hence, the vaccine effectiveness in term of hospitalization and ICU admission reduction was

evaluated amongst a group of patients who received the pneumococcal vaccine during the study period in a tertiary teaching hospital

Aim of the study

To evaluate the effectiveness of pneumococcal vaccines in reducing hospital and intensive care unit admissions due to pneumonia in immunized adult patients within two years of immunization compared with the cross-matched case group in age and comorbidities.

Method

Study design and setting.

This retrospective study included all adult patients (18 years of age or older) who were admitted to the medical ward for any medical reason, and received a pneumococcal vaccine (Pneumococcal conjugate vaccine (PCV-13) and/or pneumococcal polysaccharide vaccine (PPV-23)) upon there discharge from Hamad General Hospital, Qatar, between June 2012 and June 2013.We excluded pregnant women, patients on dialysis and patients who had organ transplants mainly kidney or liver on regular immune suppressants. Hamad General Hospital is a 603-bed tertiary care center that covers all specialties except for hematology, oncology, cardiology, and obstetrics. It has been accredited by Joint Commission International (JCI) since 2006.

Source of information and data collection.

Data were collected from a quality project done in Hamad General Hospital in 2012 and 2013(9). The project aimed to estimate the rate of the hospital compliance with the recommendations from national and international guidelines, such as the Center for Disease Control and Prevention guidance (CDC). Followed by a retrospective chart

review for all hospital and ICU admissions two years before the vaccination year June 2012 to June 2013(June 2010 to June 2012) and two years after (June 2013to June 2015). Data were secured in a particular form that included patient demographics, clinical characteristics, laboratory results, and outcomes. This study was approved by the Hamad General Hospital research committee as well as the Hamad Medical Corporation institutional review board (IRB),

Diagnosis of Pneumonia was considered according to Physician's notes, X-rays, microbiological results. Patients who had an admitting diagnosis of pneumonia with chest X-ray changes with or without microbiological results—were counted as a pneumonia-related infection.

Outcomes

The primary outcome was an evaluation of the rate of hospital and ICUs admissions due to pneumonia. The secondary outcome was an evaluation of the effectiveness of pneumococcal vaccines amongst different comorbidities.

Statistical analysis

Data were analyzed descriptively using percentages, frequencies and means standard deviations for interval variables. Chi-square tests were performed to identify significant associations between pneumococcal vaccinations in medical ward and ICU hospital admissions. All analysis was conducted using SPSS.PASW. Statistical software version 18.

Results

The study included 161 patients, of them 60% were male, and 52% were in the age group 64-85 years old. Comorbidities included diabetes (57% of patients), hypertension (70%) and COPD or asthma (45%) as displayed in (Table 1). The rate of hospital admission due to pneumonia was significantly reduced within two years after vaccination, from 71% to 39% ($p < 0.001$), as illustrated in (Fig. 1). There was a trend towards reduced ICU admissions, (12.4% to 10.6%) but the results did not achieve statistical significance ($p >0.72$).

For the secondary outcomes, diabetic and hypertensive patients who were vaccinated had a statistically significant reduction in hospital admission after vaccination. Hospital admission dropped from 70.7% to 37.0% ($p < 0.0001$) for patients with diabetes and from 71.7% to 39.8% ($p < 0.0001$) for those with hypertension. However, there was no statistically significant reduction in ICU admission—14.1% to 12% ($p >0.824$) and 12.4% to 13.3% ($p > 1.0$) for diabetes and hypertension, respectively (Fig. 2). In patients who had asthma or COPD, vaccination did show significant reduction in hospital but not in ICU admissions 75.0% to 36.1% ($p < 0.001$) and 11.1% to 8.3% ($p > 0.774$), respectively.

Table 1: Baseline Characteristics	
Gender	
Male	97 (60%)
Female	64 (40%)
Age Group	
Group 1 (18–40 yrs.)	16 (9.9%)
Group 2 (41–63 yrs.)	35.4 (22.3%)
Group 3 (64–85 yrs.)	84 (52.0%)
Group 4 (≥86 yrs.)	26 (15.8%)
Comorbidities	
Diabetes	(57.0%)
Hypertension	(70.0%)

Asthma/COPD	(44.7%)

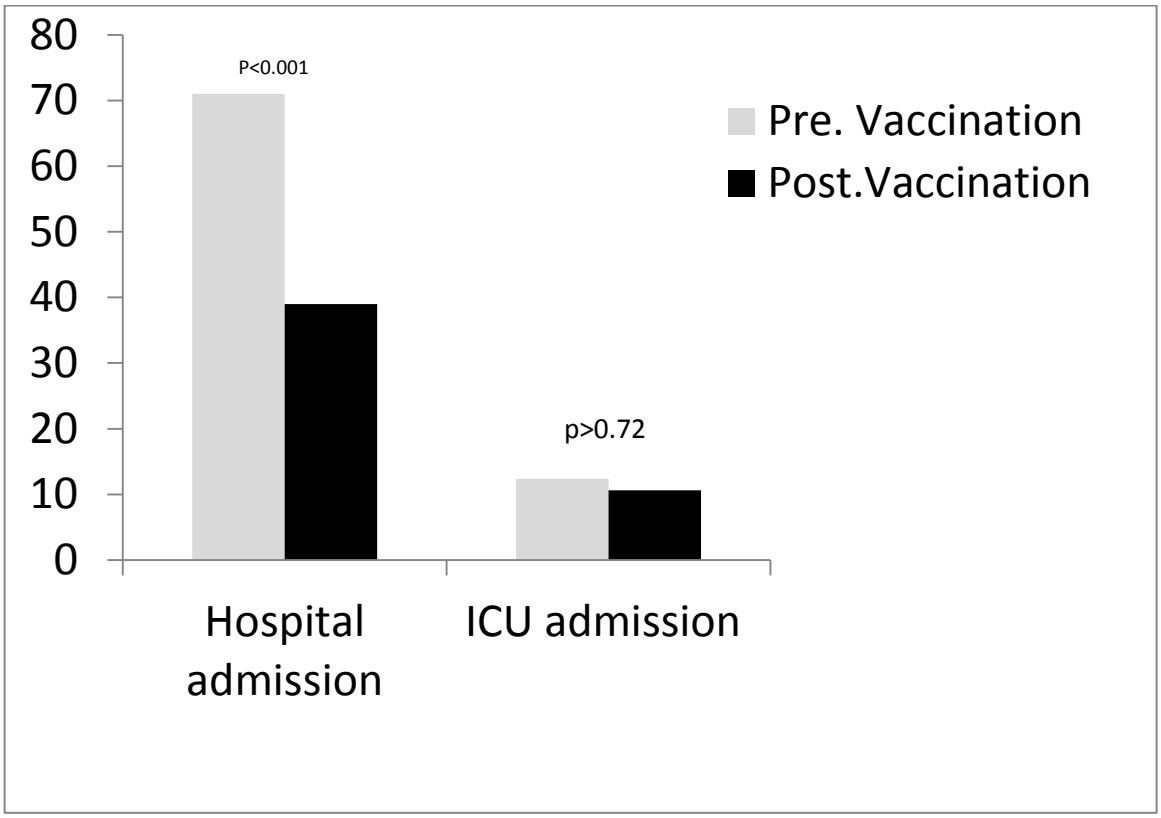

Fig. 1, Percentage of hospital and ICU admissions due to pneumonia pre and post vaccination

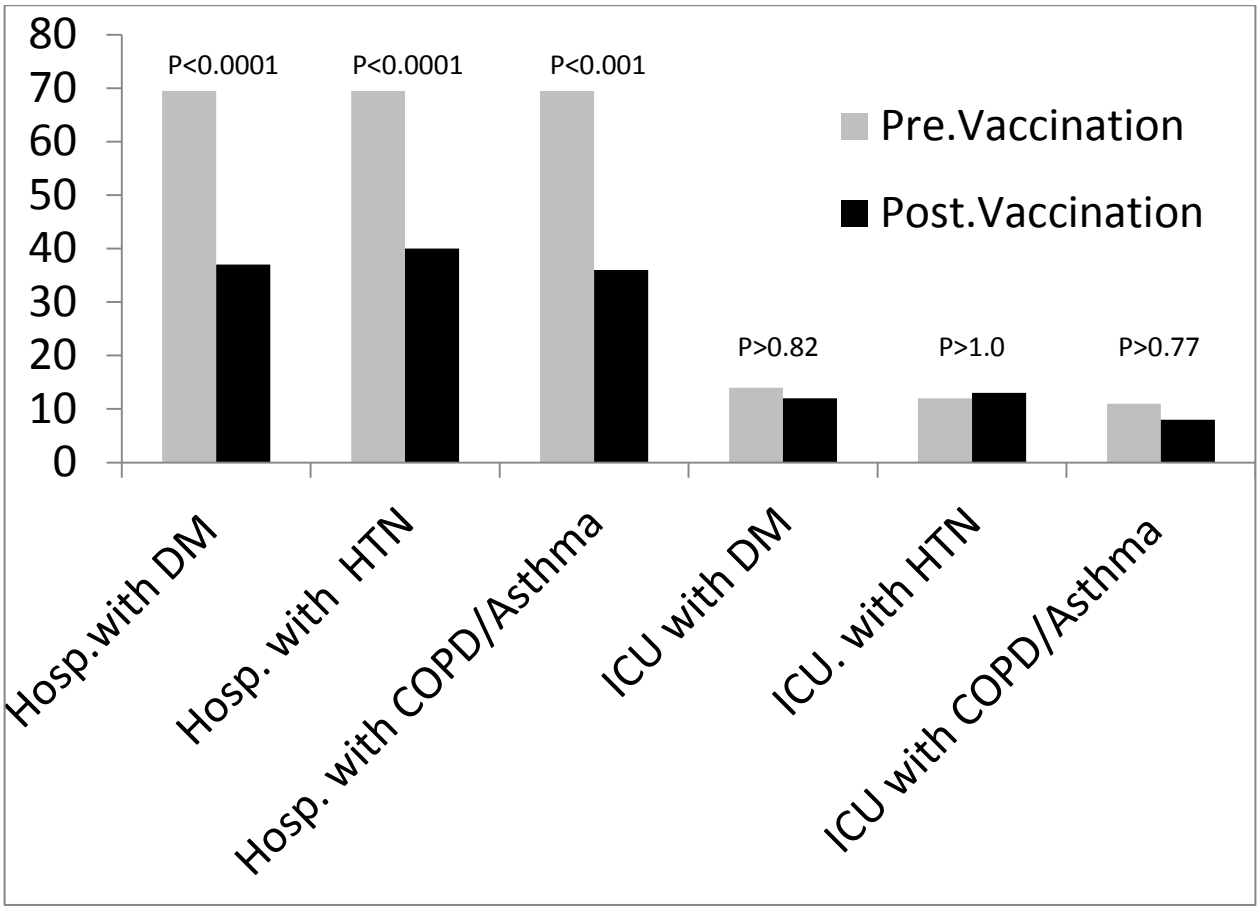

Fig. 2, Sub-group analysis of hospital and ICU admissions pre and post vaccination due to pneumonia according to patient's comorbidities (HTN, DM and COPD/Asthma)

Discussion

The results of this study show that pneumococcal vaccines reduced hospital admissions among adults. It also shows some protection against hospital admissions for pneumonia with specific comorbidities. Our findings are supported by the recommendation of the scientific committee of the Infectious Disease Society of America (IDSA) in its

guidelines for the management of community-acquired pneumonia CAP in adults (10).In which those groups with similar comorbidities are eligible for pneumococcal vaccination. (10). Pilishvili et al. found that hospitalization notably declined in older adults (age > years old) where the disease burden from pneumonia was substantial and in-hospital mortality was estimated at up to 12% (11).

The current study appears to be the first to evaluate and differentiate the vaccine effectiveness in regards to different hospital admissions (Hospital and ICU admissions). Pneumococcal vaccines showed a decreasing trend in ICU admissions related to pneumonia, but it was not statistically significant; however, this could be attributed to the small sample size. These results were consistent with a meta-analysis of 22 trials that included 101,507 participants, which found that vaccinations didn't prevent death, pneumonia, or invasive pneumococcal infections. However, this meta-analysis did not take into consideration the rate of hospitalization (8).

Ortqvist et al. conducted the first randomized control trial that evaluated the effectiveness of PPV-23 in preventing pneumonia in the elderly. This was a multicenter study that included 691 participants aged 50–85 years. Participants were randomized to receive PPV-23 or a placebo after being hospitalized for CAP and were followed up within 2.5 years. In the vaccinated group, 19% developed pneumonia versus 16% in the placebo group. The relative risk for the placebo group was 0·83 (95% CI 0.58–1.12, $p = 0.31$). However, this study was underpowered, and the new recommendations came with the administration of PCV followed by PPV, or vice versa according to age and comorbidities (12,13).

Johnstone et al. followed up two thousand nine hundred fifty patients who received PPV while being admitted with CAP, for five years after discharge. In this population-based cohort study, Johnstone et al. did not find a significant reduction in either death or hospitalization with PPV. However, the inclusion of some co-infected pneumonia patients was considered as a study drawback 14).Despite being the first study to measure the vaccines' efficacy on preventing ICU admission, the current study had several limitations. Neither the mortality cases that were admitted to the ICU due to pneumonia, nor the 28 days mortalities after ICU discharge were considered because the study was examining the risk and the probability of decreasing admission. It was challenging to include or consider cardiovascular patients in a subgroup analysis because those patients will be admitted to the heart hospital, which is a different facility with its ICU. Including patients vaccinated with pneumococcal and annual influenza vaccine is a significant limitation of this study. However, this was considered as the data collection was during the immunization season e. Differentiating and subgrouping the patients to further two groups according to each pneumococcal vaccine was hard to attempt, as the data was taken from a quality project that was done to ensure that eligible patients were vaccinated. The new recommendations are that each patient will receive the two types of vaccination but through different time intervals. Giving that our study proved that any of the pneumococcal vaccines had a protective role in regards to hospital admission.

In the findings for asthma and COPD one of the highest-risk groups for pneumonia infection and admissions, the vaccine showed an ability to protect and only reduce hospital and ICU admissions. Several explanations could be behind these findings; one of

the most cited reasons is the failure of the vaccine to maintain antibody response. Musher et al. studied participants who received PPV then PCV after six months (15), or vice-versa. The patients' immunoglobulin G (IgG) was measured at baseline, four to eight weeks, and six months after each vaccine. At six months, the IgG had returned to its original baseline levels, questioning the beneficial effect of pneumococcal vaccines in adults (15).

Conclusion

The pneumococcal vaccine is effective in reducing hospital admission amongst diabetic, hypertensive and COPD/Asthma patients, however **t**he clinical significance of pneumococcal vaccines in decreasing hospital and ICU admissions as well as the age-specific concomitant comorbidities that will highly benefit from the vaccine and the timing of the booster doses must be determined in more extensive long-term clinical trials in the future.

References

1.Bonzo, Reddick, and Kimberly Howe. “The Impact of Pneumonia Guidelines and Core Measures on Patient-Oriented Outcomes.” North Carolina Medical Journal, vol. 74, no. 5, 2013, pp. 434–437.

2.National Center for Health Statistics. “Deaths: Final Data for 2006.” National Vital Statistics Report, vol. 57, no. 14, April 2009.

3.Lieberman, David,Shimoni Avi, Shemer-Avni Yonat, Karen-naos Ayelet, Shtainberg Rachel . “Respiratory Viruses in Adults with Community-Acquired Pneumonia.” Chest, vol. 138, no. 4, 2010, pp. 811–816.

4. Ciszewski A. Cardioprotective effect of influenza and pneumococcal vaccination in patients with cardiovascular diseases. Vaccine. 2018

5.Nichol, Kristin L.,Nordin James,Mullooly John, Lask Richard, Fillbrandt Kelly, Iwane Marika. “Influenza Vaccination and Reduction in Hospitalizations for Cardiac Disease and Stroke among the Elderly.” New England Journal of Medicine, vol. 348, no. 14, 2003, pp. 1322–1332.

5.Pneumococcal Disease Fact Sheet for Media. (2019). Retrieved from http://www.nfid.org/idinfo/pneumococcal/media-factsheet.html

6. Assaad U, El-Masri I, Porhomayon J, El-Solh AA. Pneumonia immunization in older adults: review of vaccine effectiveness and strategies. *Clin Interv Aging*. 2012;7:453-61.

7.Simonsen, Lone, J.Taylor Robert, Young-Xu Yinong, Hader Michael,May Larissa, Klugman Keith. "Impact of Pneumococcal Conjugate Vaccination of Infants on Pneumonia and Influenza Hospitalization and Mortality in All Age Groups in the United States." mBio, vol. 2, no. 1, 2011, pp. e00309–10

8. Huss, Anke, Scott Pippa, Stuck Andreas, Trotter Caroline, Egger Matthis. "Efficacy of Pneumococcal Vaccination in Adults: A Meta-Analysis." Canadian Medical Association Journal, vol. 180, no. 1, 2009, pp. 48–58.

9. Albumahmood Z, Mahmoud R. Utilization of pneumococcal and influenza vaccines among pneumonia patients at academic teaching hospital in Qatar, prospective observational study. Poster presented at ASHP 2014 Midyear Clinical Meeting; 2014 Dec 7-11; Anaheim, CA

10.Mandell, Lionel A., RG Wiunderink, A Anzueto, GD Campbell, NC Dean SF Dowell et al.. "Infectious Diseases Society of America/American Thoracic Society Consensus Guidelines on the Management of Community-Acquired Pneumonia in Adults." Clinical Infectious Diseases, vol. 44, supp. 2, 2007, pp. S27–S72

11.Pilishvili, Tamara, Lexau Catherine, M.Farley Monica, Hadler James, Harrison Lee, M.Bennett Nancy, et al. "Sustained Reductions in Invasive Pneumococcal Disease in the Era of Conjugate Vaccine." The Journal of Infectious Diseases, vol. 201, no. 1, 2010, pp. 32–41

12.Ortqvist, Ake, J Hedlund, LA Burman, E Elbel, M Hofer, M Leinonen, et al. "Randomised Trial of 23-valent Pneumococcal Capsular Polysaccharide Vaccine in Prevention of Pneumonia in Middle-aged and Elderly People." The Lancet, vol. 351, no. 9100, 1998, pp. 399–403.

13.Fedson, David S. “The Clinical Effectiveness of Pneumococcal Vaccination: A Brief Review.” Vaccine, vol. 17, 1999, pp. S85–S90.

14.Johnstone, Jennie,T.Eurich Dean, K.Minhas Jasjeet, J.Marrie Thomas, R.Majumdar Sumit, et al. “Impact of the Pneumococcal Vaccine on Long-term Morbidity and Mortality of Adults at High Risk for Pneumonia." Clinical Infectious Diseases, vol. 51, no. 1, 2010, pp. 15–22.

15.Musher, Daniel M.,B.Manoff Susan, Liss Charlie, D.McFetridge Richard, D.Marchese Rocis, Bushnell Bonnie, et al. “Response to Pneumococcal Polysaccharide and Protein-Conjugate Vaccines Singly or Sequentially in Adults Who Have Recovered from Pneumococcal Pneumonia.” The Journal of Infectious Diseases, vol. 198, no. 7, 2008, p. 1019

Figure legends list

Fig. 1, Percentage of hospital and Intensive Care Unit admissions due to pneumonia pre and post vaccination

Fig. 2, Sub-group analysis of hospital and Intensive Care Unit admissions pre and post vaccination due to pneumonia according to patient’s comorbidities (HTN, DM and COPD/Asthma)

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