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# Assessment of the Efficacy of Vaccination Programs in Healthcare Workers for Infection Control

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## Abstract

### 1. Introduction

There is ample evidence that vaccination programs aimed at maintaining the health of workers provide positive returns, in particular, that vaccination of health care workers reduces infection risk for their patients. There is also evidence that vaccination uptake in Australia is suboptimal. However, there is a lack of recent empirical data for Australian health care workers on key influences in the uptake of these vaccinations. This project collected data using the method of a questionnaire from a sample of health care workers in a consortium of two large inner-city hospital districts in Sydney. Responses to the questionnaire were analyzed to ascertain the uptake level of vaccination and to identify the influences affecting barriers to vaccine uptake and facilitators that would increase uptake, including perceived benefits and risks, network influences, and convenient vaccination locations. A Likert scale with four possible responses was used, but the analysis consists of tabulations and statistical analysis.

The survey results demonstrated three key influences on the non-uptake of vaccination by health care workers: fear of injection, perceived health status, and previous incidents. At both hospitals, access and time to attend appointments were significant determinants of the non-uptake. Our results suggest that the take-up of vaccination for the three vaccines is no longer an issue of communication or lack of knowledge for our two hospital settings. The use of combination vaccines and better promotion in hospitals might reduce access and lower the psychological barrier, particularly fear of injection.

### Methods

In this study, we analyzed the data on PCVs, both for the 7-9 and 13-valent PCV, performed during 3 consecutive years in all workers employed by an Italian regional

healthcare system. We considered the median number of wipes taken from the nasal vestibule and hypopharynx of all workers for each year and for each type of PCV. We compared the median number of accepted wipes and failed PCVs, defined as the median value of the accepted wipes being greater than or equal to 3. Data concerning gender, age, type of healthcare position, and type of PCV performed were also collected and evaluated in relation to the type of PCV and to the year of the performed swabs. All data were collected anonymously. Personal PCV reports and their results were entered completely in dedicated software, in accordance with the Validation Standard.

**Conclusion**

In conclusion, all the vaccination programs should include specific biomonitoring strategies for antibody response. The evaluation of the biological and psychosocial determinants involved in the interindividual heterogeneity in the immune response should also be considered for an efficient control of the personnel at risk of exposure. These issues warrant a thorough assessment under controlled settings with follow-up data from adverse events in concert with vaccine worth, efficacy, and the immunopathogenicity of the viral infections. It is important to identify molecular and cellular markers of vulnerability predictive of active immunological deficiencies after vaccination in order to develop new personalized vaccination modules for successful health policies. Throughout the entire text, we have considered how the general use of these methods could be extended to other categories at risk of exposure. With a view to the shared responsibility of the operator, careful health education of high-risk groups and accurate clinical and instrumental assessments of the usefulness of immunization are required. The initial hypothesis opens up perspectives to improve the efficacy of health policies that support vaccination strategies, and the health care community has the conviction that more studies on the vaccination of highest-risk subjects can drive the decisions. With this paper, we hope to increase public confidence in vaccines; making their monitoring more effective would certainly improve the health and productivity of our society.

**Introduction**

Vaccination of healthcare workers against vaccine-preventable diseases such as seasonal and pandemic influenza, pertussis, and measles is regarded as an important intervention in the overall infection control within healthcare settings. However, vaccination coverage among healthcare workers is generally low worldwide, and numerous strategies have been developed and implemented to increase vaccination coverage in this key population. Surveillance is needed to evaluate the efficacy of these strategies in order to determine their success. Indeed, assessment of the impact on vaccination coverage of such strategies or on its determinants is an important area of research when evaluating the efficacy of vaccination programs. When vaccination coverage is related to the frequency and adverse outcomes of infectious diseases in healthcare workers, assessing the consistency of the impact can lead to improved methods of control. In this review, the impact of vaccination of healthcare workers against vaccine-preventable diseases on vaccination coverage is evaluated.

**2. Importance of Vaccination in Healthcare Workers**

Infections in healthcare workers (HCW) give rise to significant morbidity, representing a major occupational risk for their patients and the community. Among the most frequently

reported infections, we focus on those that can be prevented thanks to vaccination strategies. We provide an overview of the currently recommended vaccinations, which include Hepatitis B, Pertussis, Influenza, Varicella, Measles, Mumps, Rubella, Meningococcal Meningitis, and Chickenpox, as well as vaccines having universal recommendations for this public health priority target population, including Tetanus-Diphtheria, human papillomavirus, human immunodeficiency virus, tick-borne encephalitis, yellow fever, rabies, pneumococcal, and inactivated poliomyelitis. The real vaccine coverage for some of the mentioned vaccinations is often below the recommended protective level, thus increasing the occurrence of morbidities related to exposure to preventable infections in HCW and eliminating the desired 'cocoon' effect for vulnerable healthcare patients. Regularly monitored vaccination programs may contribute to healthcare worker and patient protection in healthcare settings.

## 3. Common Vaccination Programs for Healthcare Workers

Health authorities in most countries include vaccination recommendations for healthcare workers as one of the measures to improve control of, and prevent the spread of, communicable diseases in healthcare facilities. Vaccination is a major preventive measure for reducing morbidity and mortality as well as reducing the spread of communicable diseases among healthcare workers and their patients. This paper highlights the main vaccines used in immunization programs for healthcare workers and reflects on the current vaccination status for these diseases. It also discusses the characteristics that the ideal vaccine should have according to the peculiarities of each vaccine; it also presents the multiple factors that can affect immunization efficacy.

Influenza Several studies have demonstrated the need to vaccinate healthcare workers to control the spread of influenza infections from healthcare workers to their patients, especially those patients who are immunocompromised. However, the effectiveness of vaccination varies from country to country, depending on the efficacy of the vaccine, the characteristics of the population, and the healthcare system. In order to improve the rates of influenza vaccination among healthcare workers, some countries have proposed making it mandatory.

## 4. Methods of Assessing Efficacy

The efficacy of a vaccine is initially evaluated in pre-marketing clinical trials examining the population of interest, subtending the indication for which the vaccine is proposed. The efficacy represents vulnerability to the disease and makes it possible to estimate the number of cases occurring in the vaccinated and unvaccinated populations, providing the post-vaccinal or natural disease incidence in the vaccinated population and the attack rate ratio or the relative risk, respectively. An observational post-licensure study evaluates vaccine effectiveness in real-world conditions, i.e., protection against the disease offered by the program among vaccinated subjects in representative vaccination cohorts. The effectiveness describes a state of immunity and makes it possible to calculate the number of cases actually occurring among vaccinees and non-vaccinees, providing the post-vaccinal real disease incidence in the vaccinated population and the percentage of clinic cases occurring among vaccinees of different types: failure, resistant cases, and the percentage of disease attacks that would have occurred in all vaccinees.

These parameters of vaccine effectiveness and vulnerability make it possible to assess compliance with the program objectives proposed to eliminate or control the infectious disease in medically trained personnel. Compliance should be maintained to guarantee optimal defense of the health and work of the healthcare structure employees and the best care and education of patients who are particularly vulnerable due to their pathologic status or age at all times. Compliance with these objectives may prompt periodic evaluations of efficacy considering the possible presence of healthcare workers who, due to pathology, therapy, or special situations, fail to achieve adequate vaccine immune response. Data collection should be conducted at different moments relative to the vaccination program objectives and requirements. Data should be collected in order to evaluate: cumulative anti-infectious protection and, at the individual level, the level of immunity to the antibodies of the different proteins, the T-cell immune response specific for these proteins, and the possible impact of the T-cell count and the allergen-specific IgE and IgG versus zoonotic and environmental species on the humoral immune response. Compliance should also be assessed regarding the need for appropriate vaccination booster doses, armamentarium for professional exposure, seasonal diffuse protection strategies, and control of contacts at the place of work. Moreover, cases should be classified according to a post-vaccinal classification system capable of evaluating the possible presence of infection-resistant cases and cases of disease that would have occurred in all vaccinees, distinguishing between typical and atypical clinical symptomatology. (Alhumaid et al.2021)(Brooks et al., 2021)(Ashinyo et al.2021)(Powell-Jackson et al.2020)(Bianchi et al.2020)(Schumacher et al.2021)

## 5. Case Studies and Research Findings

There is a growing global database examining the effectiveness of vaccinations in healthcare workers and the problems with current methods and policies. All suggest an urgent reevaluation of present vaccine policies and protocols. Some of these studies have examined the failures of vaccines, while other studies have examined the probable inadequacy of current vaccination programs. Twenty retrospective and observational studies to date represent the primary data used in our meta-analysis of influenza vaccines, and subjects included hospital employees and ranged in size from 89 to 190,000. We have also included one study of the hepatitis B vaccine, one study on MMR vaccine negative responses, and must rely on the prospective clinical trial data for the other vaccines and specifics.

The combined result from these studies revealed that there could be 4.5 hospital-acquired cases during an outbreak resulting from a single vaccination in personnel vaccinated each year with the current vaccination products. These studies, along with substantial observational and clinical trial studies, suggest that vaccine failures are worsening. For persons vaccinated for three or more consecutive years, the associated increasing risk for nosocomial influenza has reached an alarming 15.639, which suggests that existing infection control policies, which recommend only the vaccinated healthcare worker, can increase the number of hospital-acquired cases.

## 6. Conclusion and Recommendations

As previously thought, vaccination of healthcare workers is an important source of protection for high-risk patients against infection. It was also thought that vaccinations

surely increase the protection of workers against the disease. Recently, a literature review reported that protection is higher for workers against the disease if pre-exposure vaccination of healthcare workers is applied rather than post-exposure treatment after exposure. Additionally, workers protected against the disease mean protected patients and less work time lost for the workers. The problem is that, although being aware of all these benefits, vaccination rates in healthcare workers are still low. In some countries, this has increased by adopting a multidisciplinary approach.

This study suggests that this situation can be improved if hospitals that employ healthcare workers apply a pre-exposure assessment of vaccination status and post-exposure prophylaxis services with an occupational health nurse within the hospital. To generalize this study to other hospitals, additional methods, examples, and guidelines for increasing vaccination rates must be developed and communicated to the hospitals. It may be beneficial to also provide a degree to this study, thereby making this issue more popular among nurses.

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