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Vaccination of healthcare personnel: Spotlight on groups with underlying conditions

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ABSTRACT

Healthcare personnel (HCP) are at increased risk of acquiring vaccine-preventable diseases (VPDs). Vaccination protects HCP and their patients from nosocomial transmission of VPDs. HCP who have underlying diseases (e.g., immunocompromised, HIV-infected, or those with chronic diseases) and HCP in particular phases of life (e.g., pregnant, elderly) require special consideration in regards the provision of vaccines. On the one hand, live virus vaccines may be contraindicated (e.g., pregnant HCP, immunocompromised HCP), while on the other hand, vaccines not routinely recommended (e.g., pneumococcal) may be indicated (e.g., elderly or immunocompromised HCP). It is not known how many HCP with underlying conditions require special consideration in the healthcare setting. This is an important issue, because the risk for serious morbidity, complications and mortality for HCP with underlying conditions will only increase. The prevention of nosocomial infections requires comprehensive occupational safety programs. The healthcare system must engage HCP and occupational physicians to ensure sufficient vaccination rates as part of an effective nosocomial infection prevention and HCP safety strategy.

1. Introduction

Vaccinations have led to dramatic declines in the incidence or even eradication of many vaccine-preventable diseases (VPDs) during the second half of the 20th century [1]. Healthcare personnel (HCP) are at occupational risk for a vast array of VPDs [2–7]. Data from a communitywide outbreak showed that HCP had a nearly 19-fold higher risk of acquiring measles than the general population [6,8]. Similarly, HCP are at significantly higher risk of influenza [9] and pertussis [10]. Infectious HCP have been identified as being the source of many health-care associated outbreaks of VPDs, including influenza, pertussis, measles, rubella, varicella, hepatitis A and hepatitis B [10–16]. Vaccinating HCP not only protects the individual staff member but also reduces the risk of transmission to patients and to other HCP, as well as their families and friends. HCP vaccination should be interpreted as a professional responsibility in order to ensure patient and HCP safety [17].

In the USA, it is recommended that HCP be immune to hepatitis B (HBV), measles, mumps, rubella (MMR), varicella, pertussis and influenza [18]. However, HCP should also be provided with vaccines that are recommended for the general population (e.g., tetanus, diphtheria) [18–20]. Inline with the recommendations from the USA, the Australian Immunization Handbook outlines that all HCP (including all workers and students directly involved in patient care or the handling of human tissues) are recommended to have hepatitis B, influenza, MMR (if non-immune), pertussis (dTpa) and varicella vaccines (if non-immune). In addition, if the HCP works in remote Indigenous communities or with Indigenous children, they are recommended to have hepatitis A vaccine [21]. Unlike the US and Australia, there are currently no consistent recommendations in Europe regarding the vaccination of HCP [20]. For example, while vaccination against hepatitis B and seasonal influenza are almost universally recommended for HCP in Europe [20], recommendations for HCP vaccination against mumps, measles, rubella and varicella are only present in half of the countries in Europe [20].

In summary, considerable country-to-country variation exists in policies regarding occupational vaccination of HCP worldwide. National policies should be re-evaluated on a risk-assessment basis for HCP subgroups and different health-care settings, taking into consideration the potential for exposure to various infectious agents and the international and local epidemiological trends. Consensus-based, worldwide policies on HCP vaccinations are desirable [20].

Chronic diseases, such as heart disease, stroke, cancer, chronic respiratory diseases and diabetes, are by far the leading cause of

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Table 1
Recommendations on vaccination of healthcare personnel with underlying conditions.

Vaccine	HIV-infected HCP <200 cells/μl	HIV-infected HCP >200 cells/ul	Immunocompromised HCP	HCP with chronic diseases (e.g. heart or lung disease)	Elderly HCP	Pregnant HCP
Hepatitis B	Recommended	Recommended	Recommended	Recommended	Recommended	Recommended
Influenza	Recommended	Recommended	Recommended	Recommended	Recommended	Recommended
MMR	Contraindicated	Recommended	Contraindicated	Use if indicated	Use if indicated	Contraindicated
Pneumococcal	Recommended	Recommended	Recommended	Use if indicated	Recommended	Use if indicated
Varicella	Contraindicated	Recommended	Contraindicated	Use if indicated	Use if indicated	Contraindicated
Pertussis	Recommended	Recommended	Recommended	Recommended	Recommended	Recommended

HIV, human-immunodeficiency virus; HCP, healthcare personnel; MMR, measles-mumps-rubella.

mortality in the world, representing 63% of all deaths [22]. In 2005, 133 million Americans, almost 1 out of every 2 adults, had at least one chronic illness [23]. Globally, an estimated 35.3 (32.2–38.8) million people were living with HIV in 2012. As more people receive the life-saving antiretroviral therapy, their life expectancy has increased considerably and it is estimated that more than two out of three HIV-infected people held down a regular job [24].

The aging of the population is a major demographic trend in the European Region. A rise in chronic health problems in aging populations has increased the demand for HCP. Furthermore, the health workforce itself is also aging in many countries, e.g., in Denmark, France, Iceland, Norway and Sweden, the average age of nurses employed today is 41–45 years [25].

HCP with medical conditions may require special consideration in regards to the provision of vaccination, however most vaccination recommendations for HCP do not focus any attention on the issue [26]. It is important that focus is given, especially as there are some vaccines that are contraindicated (e.g., live virus vaccines for pregnant and/or immunocompromised HCP), while there are other vaccines that are not routinely recommended (e.g., pneumococcal) which may be indicated (e.g., elderly or immunocompromised HCP) (Table 1). Overall, vaccination of immunocompromised HCP and other specific groups of HCP with underlying conditions is of the outmost importance, given the fact that they are at increased risk for serious morbidity, complications or even a fatal outcome in association with VPDs and occupational infections. This article examines the value of vaccination in reducing the burden of infectious diseases in HCP with special risks (Table 2).

2. Vaccination of human immunodeficiency virus (HIV)-infected HCP

More than 90% of HIV-infected HCP in the US have nonoccupational risk factors reported for acquiring their infection. However, at least 57 documented seroconversions to HIV following occupational exposures and in addition, 143 possible cases of HIV infection have been reported from 1981 to 2010 among HCP in the US [27].

HIV infection increases the risk of serious morbidity from common VPDs, and might affect the person's immune response against natural infection or vaccination [28]. When recommending vaccines to HIV infected HCP, it should be noted that the infection has been previously found to impair the effectiveness of vaccines. Secondly, the risk of serious side effects from live vaccines for HIV-infected persons with severe immunosuppression is also heightened. Lastly, the level of the antibody response after vaccination is often inversely correlated with the CD4 T-lymphocyte count and antibody concentrations of HIV-infected persons frequently wane faster [29].

Inactivated vaccines can be administered safely to HIV-positive persons at the usual recommended doses and schedules. However, the effectiveness of such vaccinations can be suboptimal [29,30]. HIV-infected persons of any age, whose disease is well controlled, on combination antiretroviral therapy and with undetected or low viral load with good CD4+ lymphocyte counts are likely to respond satisfactorily to vaccines [21].

Live-vaccines can be administered to HIV-positive persons who are not severely immunosuppressed (depending on their CD4 cell count). With severe immune suppression (CD4% T cells <15%) live-virus vaccines (e.g., MMR and varicella) are contraindicated [29]. Given the increased risk for acquisition of these VPDs by susceptible HCP, it is of particular importance that these vaccines are administered as early as possible in the course of the HIV infection to ensure an adequate immune response and occupational safety for the HIV-infected HCP. The bacille Calmette-Guerin (BCG) vaccine should not be given to HIV-infected persons [31].

Pneumococcal vaccine is recommended for persons with HIV-infection or AIDS. Pneumococcal vaccine-naïve persons should receive a dose of pneumococcal conjugate vaccine (PCV13) first, followed by a dose of pneumococcal polysaccharide vaccine (PPSV23) at least 8 weeks later. HIV-infected persons who previously have received PPSV23 should be given a PCV13 $\geq$1 year after the last PPSV23 dose was received [32].

Vaccination with hepatitis B (HBV) vaccine is recommended for all HIV-infected persons without immunity to HBV. However, HIV-infected adults have poorer responses to HBV vaccine than HIV-uninfected persons [33,34]. Regular (e.g., once a year) post vaccination testing for anti-HBs is recommended and vaccine non- and low-responders should undergo booster vaccinations [35].

Inactivated influenza vaccine is recommended for persons with HIV-infection or AIDS. Recent studies suggest that influenza vaccine is effective in preventing influenza infection in HIV-infected adults [36]. A meta-analysis regarding the efficacy and clinical effectiveness of influenza vaccines in HIV-infected persons showed that the incidence of influenza was lower in the vaccinated compared to unvaccinated HIV-infected subjects with risk difference ranging from −0.48 (95% CI: −0.63, −0.34) to −0.15 (95% CI: −0.25, 0.05) [37]. In the same meta-analysis it was estimated that between three and seven HIV-infected individuals would need to be vaccinated to prevent one case of influenza [37]. Due to the increased risk of HCP for influenza and hepatitis B infection, vaccinating HIV-infected HCP against influenza and HBV is of utmost importance.

Following the vaccination of HIV-infected HCP with either tetanus toxoid, influenza, pneumococcal and hepatitis B vaccines, activation of T-lymphocytes could potentially lead to transient elevations of HIV-RNA plasma levels which could last several days [29]. However, the studies were relatively small and covered only few individuals [38]. There are other studies that have found that most patients did not have a significant increase in HIV viral load or decrease in CD4 cell count after vaccination [39,40]. Given the increased risk of acquiring an occupational infection, HIV-infected HCP who are not severely immunosuppressed should receive all recommended vaccines (Table 3).

3. Vaccination of immunocompromised HCP

During the last decade the number of people with an impaired immune response has increased rapidly. There may be a wide range

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