Vaccination of Healthcare Professionals and Protection of Hospitalized Adults and Nursing Home Residents

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Vaccination is a topic that has long been the subject of debate, and this debate covers both individual and collective issues. At the individual level, there is primarily the individual's perception of the efficacy of vaccines and their potential to give rise to adverse reactions. In addition, public opinion regarding vaccination is strongly influenced by media coverage, sensational news stories and anecdotal evidence. However, at collective level, like most public health challenges, vaccination policy is dependent on overall public health policies, in particular taking account of the cost-effectiveness ratio and the measure of the individual versus the collective interest [1].

In the United States, the Advisory Committee on Immunization Practices recommends that all healthcare workers (HCWs) be vaccinated annually against influenza (flu). From an opt-in Internet panel survey of 1882 HCW conducted in April 2014 to estimate flu vaccination coverage among HCW during the 2013–2014 season, the Center for Disease Control (CDC) found that, overall, 75.2% of participating HCW reported receiving an influenza vaccination during the 2013–2014 season. Interestingly, HCW working in settings where vaccination was required had higher coverage (97.8%) compared with those working in settings where flu vaccine was not required but promoted (72.4%) or settings where there was no requirement or promotion of vaccination (47.9%).

In France, mandatory vaccines are taken up by over 90%, underlining that target vaccination can be reached when vaccination is obligatory. In a national cross-sectional survey among 452 HCWs working in clinics and hospitals in France, vaccination coverage was found to be over 90% for compulsory vaccines such as

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hepatitis B, diphtheria-tetanus-polio and BCG. Conversely, when vaccination was only recommended, uptake was found to be very low, ranging from 49.7% for at least one dose of measles to as low as 11.4% for the booster of the DTP pertussis-containing vaccine [2].

There is a clear rationale for vaccinating HCW. Firstly, they are in regular close contact with numerous microorganisms, and therefore, protecting them against the work-related infectious risk from vaccine-preventable diseases (VPDs) is justified. In addition, through their contact with pathogens, they constitute a reservoir for ongoing transmission to subsequent patients in contact with that HCW for whom infection could pose a serious health threat. Therefore, vaccination of HCW also serves to protect patients from nosocomial transmission of VPDs via herd immunity [3].

While this equation may appear simple, its implementation is challenging. Indeed, there are a range of different risks and types of transmission, with different attack rates between diseases. Therefore, finding a vaccination strategy that fits every setting is particularly complex. Hepatitis B is an illustrative example. The prevalence of hepatitis B is around 0.1 to 20% worldwide and <2% in Europe [4, 5]. Yet, in Europe, direct or indirect contamination from patients to HCW or vice versa is very rare. Thus, the goal is to protect HCW and a low number of patients in care situations (e.g. surgery). However, the major difference underpinning vaccination practices is the perception of the disease. Indeed, hepatitis B is perceived as a harmful disease, whereas the flu is not considered to be dangerous. Yet, in 2014–2015, there were 410 outbreaks and, in 2017, more than 800 outbreaks and more than 20,000 excess deaths in the flu season. Flu may not be directly responsible for all these deaths but contributes at least partially. In addition, one must also consider the collateral burden represented by the disability induced by flu, which is often not taken into account. The estimations of flu-related deaths also have to be interpreted in the context of a comparison to the normal rate of death outside of the flu season, which may be unknown or fluctuating. Despite these uncertainties, it remains clear that influenza infections are more common among HCW than in the common population with attack rates ranging from 13% to 23%. HCW may be responsible for 10–50% of outbreaks among nosocomial outbreaks, since they are often asymptomatic in the first days of infection, and death rates from nosocomial flu reportedly vary from 5% to 60%.

In summary, there is a clear rationale for vaccinating personnel working in the healthcare system, primarily for their own protection against the acquisition from patients of vaccine-preventable diseases such as hepatitis. The goal is thus to decrease absenteeism and loss of productivity from illness among the HCWs, to prevent further spread of the disease to colleagues and, more importantly, to prevent the onward transmission to patients of infections such as flu, measles, pertussis, varicella or mumps. Reducing nosocomial infection in turn helps to minimize the length of stay, medical costs and potential risk of mortality. In this regard, both HCW and patients are affected by VPDs within the healthcare system, but they are affected at different levels, with different levels of risk according to the season. The vaccination of HCWs represents the front line of this battle. This is particularly

important for diseases such as pertussis, where immunity among the general population is low because of insufficient vaccine coverage among children, combined with waning immunity among the elderly. There is therefore a substantial risk of transmission from HCW to patient, and outbreaks in the hospital or other healthcare settings, although sporadic, generate significant morbidity, physical and emotional stress and are resource-intensive and disruptive for the institution concerned [6].

In this context, are there efficient vaccines available to protect HCWs? Undoubtedly, the answer is a resounding yes. Inactivated flu vaccines are 50–70% efficacious in preventing influenza-like illness (ILI) among healthy adults, and vaccination among HCWs has been shown to reduce absenteeism [3, 7, 8]. Adverse drug reactions may occur and include tenderness, pain and fever, while neurological disorders remain extremely rare with a frequency of <1/10,000.

Mortality in nursing home residents decreases with increasing vaccination of HCWs, regardless of the vaccine status of the residents or their functional status. In a study by Carman et al. [9], HCW in 20 long-term residential nursing homes were randomly offered vaccination or not in a cluster-randomized design stratified for the policy for vaccination of residents. They reported that vaccine uptake was 50.9% in hospitals where vaccination was routinely offered versus only 4.9% when it was not routinely proposed. In addition, there was a significant decrease in uncorrected mortality rates in vaccine hospitals (13.6% death rate) compared with no-vaccine hospitals (22.4%) (OR 0.58, 95% CI: 0.40–0.84, $p = 0.014$), indicating that vaccination of HCW is associated with a significant decrease in mortality among patients. Similarly, in a pair-matched, cluster-randomized trial in large private chain of UK care homes conducted over two winter periods of influenza circulation, Hayward et al. [10] reported that vaccination uptake was 48.2% (407/884) in intervention nursing homes and 5.9% (51.859) in control establishments for the 2003–2004 season and, respectively, 43.2% (365/844) and 3.5% (28/800) in 2004–2005. In the 2003–2004 period of intense influenza activity, there was a significant decrease in mortality among residents in the intervention nursing homes, compared to control homes (5 fewer deaths per 100 residents in intervention compared to control homes—95% CI: 2–7, $p = 0.002$), and a significant reduction in influenza-like illness ($p = 0.004$), again underlining that vaccinating nursing home staff against influenza can prevent deaths among residents. Similarly, a third cluster-randomized trial by Lemaitre et al. [11] among 40 nursing homes reported vaccination uptake of 69.9% in the intervention arm (comprising influenza vaccination with volunteer staff after a face-to-face interview), versus 31.8% in the control arm (no intervention). Although in this study, primary unadjusted analysis did not show significantly lower mortality in residents in the vaccination arm (OR = 0.86, $P = 0.08$), adjusted multivariate analysis showed 20% lower mortality ($P = 0.02$) and a strong correlation between staff vaccination coverage and all-cause mortality in residents (correlation coefficient = −0.42, $P = 0.007$). Furthermore, in the vaccination arm, the rate of influenza-like illness in residents was 31% lower ($P = 0.007$), and sick leave from work in staff was 42% lower ($P = 0.03$), supporting a benefit of vaccination among staff caring for elderly patients in nursing homes, independently of the residents' vaccination status or functional status.

Surprisingly, two Cochrane systematic reviews published at 3 years interval failed to find conclusive evidence of benefit of HCW vaccination programmes on specific outcomes of laboratory-proven influenza, its complications or all-cause mortality in people aged over 60 living in long-term care institutions [12, 13]. The discrepancies in these findings may be due to the fact that the systematic reviews by Thomas et al. did not necessarily consider the primary endpoints reported in the individual trials included in the review, and the risk of bias in methodology led the authors of the review to downgrade some of the evidence coming from the individual trials included. Therefore, Thomas et al. conclude that further high-quality randomized controlled trials are required to test the efficacy of vaccination and other combinations of hygiene and prevention measures.

All the trials mentioned above were performed in the setting of long-term care, but it is almost impossible to perform studies (and definitely not RCTs) about the efficiency of vaccines in other wards over the flu season. Indeed, it is hard to distinguish the contribution of HCW vaccination in protecting patients. In high-risk wards, at least, nosocomial influenza may occur in 20–60%, despite other strategies, such as hygiene, handwashing, masks, etc. There may also exist a link between vaccine programmes and reductions in nosocomial flu infections. Indeed, in an 8-year study, Frenzel et al. [14] found that a multifaceted approach including mandatory influenza vaccination significantly improved vaccine uptake rates among the targeted HCWs and led to a reduction in the proportion of nosocomial influenza infections in immunocompromised cancer patients.

However, vaccine uptake varies among HCWs in nursing homes and may vary especially from year to year, as a result of public health campaigns, introduction of mandatory vaccine programmes or other measures. Several reports relaying vaccination coverage rates for VPDs such as influenza, hepatitis B and measles show alarmingly low uptake rates [15, 16]. For the flu vaccine in particular, rates range from 0% in Norway to 18% in Ireland through 33.6% in France and up to 85% in Japan [15–20]. Indeed, there are wide discrepancies across countries in terms of recommended vaccines, indications and legislative frameworks, and even now, there are countries in Europe where no vaccination policy is in place for HCWs [21]. Mandatory status for vaccination is rare, and most countries only have recommendations in place, often for specific subgroups of the population. Yet, this wide variability in practices is not explained by any specific different background for many of the vaccines concerned.

In view of the mediocre uptake rates and varying policies, one might wonder what barriers prevent people, particularly HCWs, from receiving vaccination. These may include individual reasons relating to the flu vaccine, such as a lack of time and/or motivation, a perceived lack of efficacy of the vaccine, fear of the injection itself or adverse effects, reported alternative protection such as homeopathy, etc. [22]. Other reasons may relate to the disease itself. First and foremost among these is the idea that influenza is not a serious disease. Other misconceptions include the idea that it is only problematic in frail individuals, or that it is not contagious, or there is a low risk of nosocomial transmission [22]. In addition, organizational factors may play a role, for example, the cost (if borne by the HCW), the general

inconvenience or a lack of access to flu shots in the workplace [22, 23]. Indeed, occupational medicine may be the responsibility of different organisms across different countries, and in some places, there may be no systematic occupational medicine follow-up or no provisions for systematic flu vaccination through occupational medicine services. Therefore, in practical terms, we have to think about how can we reach HCWs to implement vaccination, across specialties and among different types of HCWs, since practices are different between disciplines. In this regard, Landelle et al. reported in their study of flu vaccine coverage among patients and HCWs in four wards of a large university hospital that physicians were significantly more likely to be vaccinated than the rest of staff (adjusted OR 8.29, 95% CI: 1.58–43.41), while residents and staff from the geriatrics unit were more likely to be vaccinated, albeit without reaching statistical significance [24].

The determinants of vaccination uptake are multifactorial. Paterson et al. performed a review of 185 articles in the literature dealing with vaccine hesitancy among HCWs and the influence of their own vaccine confidence or vaccination behaviour on their recommendations to others [25]. Overall, they found that increased knowledge about vaccines, their efficacy and their safety helped to build confidence among HCWs, thus increasing their willingness to recommend vaccination to others. Endorsement from influential leaders and individuals and societal and colleague support were also found to be important vectors for building combating vaccine reluctance. This is important, because HCWs remain the most trusted influencers of vaccine decisions among patients, who look to their healthcare provider for advice and guidance in this regard [25]. HCWs must be sufficiently well informed to be able to respond adequately to the questions of patients, particularly in the face of the growing anti-vaccine public.

In an effort to identify and address the determinants of reluctance for vaccination in nursing homes, our group performed a programme of education and communication over three seasons (the VESTA study) [26, 27]. The programme included identification of the factors determining vaccination reluctance, followed by an education programme and a communication campaign. Between June and September 2005, 2485 HCWs (vaccination coverage: 23.4%) from 53 French geriatric units were included in the study. Cluster analysis determined three composite profiles, namely, HCWs for whom information programmes on vaccination can be useful (59%), those who were staunchly opposed to vaccination (36%), and those were sceptical (5%) [26, 27]. Finding that the flu vaccine had a very bad image among the participants in the programme, we constructed an educational programme to take action against this particular point. After the failure of a first educational programme giving scientific information, a second programme was designed with the help of marketing experts, 1 year after Programme 1. The objectives were to involve HCWs in the creation of "safety zones" and to give personal satisfaction. Programme 2 was tested during the 2006–2007 influenza season; 20 of the 24 healthcare settings from the Programme 1 cluster were included in Programme 2, totalling 1814 HCWs, and 23 healthcare settings totalling 2435 HCWs were included in the Control 2 cluster. Whereas Programme 1 had failed to increase HCW vaccination coverage (Programme 1: 34%; Control 1: 32%; $p > 0.05$), Programme 2 increased the vaccine

coverage rates among HCWs (Programme 2: 44%; Control 2: 27%; $p < 0.001$), regardless of their occupational group, but only in the non-previously vaccinated subgroup [26, 27]. Indeed, while the rate of vaccination remained relatively stable among previously vaccinated HCWs, it increased twofold in the group of those who were previously unvaccinated over the whole programme duration [27]. Overall, these programmes revealed that there must be some incentive and acknowledgement of a positive attitude towards vaccination, and education alone via the provision of scientifically factual information is clearly not sufficient. A programme that yields personal satisfaction and takes account of the specificities of non-vaccinated HCWs is more effective in obtaining good adherence and avoiding rejection of top-down hierarchical recommendations for vaccination.

Communication is key in this regard, and potentially useful approaches include the use of leaflets and posters, information campaigns by key opinion leaders, intensive vaccination campaigns including incentives for those who comply and simplified organizational access to vaccine shots, e.g. through mobile vaccination teams [16, 28, 29]. Educational programmes aimed at improving knowledge about vaccines and dispelling myths and misconceptions can also be implemented. However, despite the numerous possibilities for short-term actions to achieve efficacy, the results are short-lived. For long-term efficacy, long-term plans are required. In the United States, Nace et al. conducted a needs analysis to determine the organizational and individual level barriers to influenza vaccination of staff in long-term care facilities. Using data from 1996 to 1997 as baseline, they reported that staff immunization rates improved from around 55% to between 74% and 95% over 4 years, through the implementation of systems changes, educational interventions and reminders under the leadership of an involved quality improvement team and medical director [28]. Indeed, long-term programmes are fundamental to achieving a cultural shift in the paradigm that can lead to definitive changes in behaviour.

One simple and rapid means to achieve high vaccine uptake rates within a very short time is to make vaccination mandatory. Talbot et al. reported that immunization rates among HCWs ranged from 50 to around 90% the year prior to implementation of a mandatory vaccination programme at selected health institutions, whereas all establishments displayed rates in excess of 95% up to almost 100% the year after the mandate [30]. It should be noted however that all “mandatory vaccination” programmes are not the same, with variations in the actual requirements and the penalties for non-compliance. Indeed, the highest rates of compliance are observed in institutions where there are consequences for non-compliance [31]. Other approaches for achieving higher vaccine uptake rates among HCWs, including declination forms and requirements for mask use among unvaccinated HCWs, have shown varying efficacy [32, 33].

Mandatory vaccination policies are fraught with a number of ethical issues. Arguments in favour of mandatory vaccination include the fact that influenza, for example, is a highly prevalent disease with a substantial impact. However, evidence is more equivocal as regards the potential benefit of HCW vaccination and the achievement of herd immunity with this policy. It would seem logical that such would be the situation in nursing homes, for example, where the population is frail

and their main contact is with HCWs, but two Cochrane reviews provide evidence to the contrary [12, 13]. Similarly, to justify mandatory vaccination, we need to have observed a failure of voluntary programmes, and here again, the evidence in this regard is unconvincing, and voluntary programmes may take several years to yield results, making it difficult to conclude regarding their efficacy. Arguments against mandatory vaccination are largely based on the principle of HCW autonomy, but there is ongoing debate as to whether the importance of HCW autonomy counterbalances the deleterious effects of disease, the failure of voluntary programmes and the lack of political will from public health institutions.

In conclusion, at a scientific level, there is a compelling need to clearly determine the burden of influenza disease and to better explain the high variability between flu seasons and in the impact on patients. In this regard, HCW vaccination will impact differently in place and in time. At an organizational/institutional level, there was an urgent need for clear European guidance for HCW vaccination, and this has now been achieved since the publication in 2016 of clinical practice guidelines from the ESCMID Vaccine Study Group (EVASG), the European Geriatric Medicine Society (EUGMS) and the World Association for Infectious Diseases and Immunological Disorders (WAidid) [34]. To achieve a harmonious policy suitable for implementation across Europe, with its highly variable healthcare systems, it is necessary to determine who will provide the vaccine, who will control the vaccination uptake and who are the target populations. Among HCWs in particular, there remains a lack of knowledge regarding the issues surrounding vaccination, but acquiring knowledge is complex in this population. Implementing multidimensional programmes adapted to each disease or vaccine is possible, but this solution is time-consuming and costly and demands strong political will and financial support, although it can lead to a durable shift in culture. Mandatory vaccination is cheaper and quicker but requires political will in order to be activated, and there may be ethical issues involved that could give rise to debate and/or reluctance at local, national or international levels.

In the meantime, while these questions remain unresolved, it should be remembered that prevention is also a whole set of basic actions that can be implemented everywhere, by everyone, and without raising ethical issues: handwashing, face masks, early detection of laboratory-proven flu, quarantine of units, avoiding new admissions, prompt use of antivirals and eviction of workers with infection.

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