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Immunity against vaccine-preventable diseases in Finnish pediatric healthcare workers in 2015

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ABSTRACT

Healthcare workers (HCWs) pose a risk to themselves and their patients if not protected against vaccine-preventable diseases. Alarming, lacking immunity has been reported in several studies. We assessed the immunity against vaccine-preventable diseases in 157 pediatric HCWs in Helsinki Children's Hospital. The HCWs enrolled answered a questionnaire and gave a serum sample. Antibodies were measured with EIA against MMR-diseases, tetanus and diphtheria toxins, Hepatitis B (HBV), Hepatitis A (HAV), varicella zoster and pertussis toxin. Neutralizing antibodies against poliovirus 1, 2 and 3 were measured. All of the HCWs had antibodies against tetanus and 89.8% against diphtheria. All had measurable levels of polio antibodies to all three polioviruses. 41% had suboptimal levels of antibodies against at least one of the antigens tested: MMR-viruses, diphtheria, HBV or polio. Measles, mumps and rubella antibodies were detectable in 81.5%, 89.2% and 93%, respectively. Only one HCW had no varicella-antibodies. Hepatitis B surface antibodies (HBsAb) were detected in 89.8% of the nurses. 67.5% had HAV-antibodies. A poor correlation between detected antibody levels and reported vaccination history was noticed, indicating a need for a universal record system for registering the vaccines given to each individual.

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1. Introduction

Healthcare workers (HCWs) working in direct contact with patients are susceptible to transmittable diseases and may play a role in nosocomial transmission of infectious diseases. When not protected against vaccine-preventable diseases, they pose a risk to themselves and their patients, especially in an outbreak situation. Alarming, several studies have reported lacking immunity against vaccine-preventable diseases in HCWs [1–3].

Numerous measles outbreaks have recently occurred in Europe [4,5]. The proportion of HCWs with suboptimal levels of antibodies against measles has varied from 1.6% to 19% in European studies done in this century [6]. A study in the UK recently assessed the immunity of 3921 newly employed HCWs who did not have documentation of immunization for measles-mumps-rubella (MMR). Out of this cohort, 11.8% did not have antibodies against measles, 31.2% against mumps and 6.1% against rubella [7]. In an Italian study of 333 HCWs, antibodies against measles (98.2%) and rubella (97.6%) were seen in most of the studied HCWs, but mumps antibodies were somewhat less frequent (85.9%) [8]. In a study in

Catalonia, anti-rubella IgG was measured in 642 HCWs. Even though most of them had sufficient anti-rubella IgG-levels, the lowest prevalence of rubella antibodies was seen in HCWs less than 30 years of age [9]. In another study of 537 HCWs in Catalonia, anti-tetanus and -diphtheria antibodies were shown to be at suboptimal levels or totally missing in the older HCWs [10].

Pertussis has been re-emerging in industrialized countries in the past decade. Antibodies are shown to wane quite rapidly in the years following vaccination with acellular pertussis vaccine [11,12]. A recent study in Spain showed that 51.7% (238) of the 460 HCWs tested had pertussis IgG, thus raising the question whether the remaining HCWs were susceptible to the disease [13].

Vaccine-preventable diseases are rare in Finland due to the high vaccination coverage achieved by the national vaccination program. As thousands of asylum seekers from countries with disrupted vaccination programs have entered Europe and Finland during the previous year, diseases that have been rare or nonexistent in Finland may reappear with this trend. Examples of this have already been seen in Europe as Germany and France have experienced measles epidemics among the asylum seekers [5,14], and polio cases have been reported during the war in Syria [15].

HCWs in clinical work have an increased risk of exposure to Hepatitis B (HBV) through contact with body fluids. In 2003 the

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immunity against HBV was assessed in 702 HCWs in a study in Turkey. Close to 70% of the HCWs had vaccine derived immunity, which is in correlation with the level of HBV-immunity seen in the general Turkish population [16].

Although the Finnish vaccination program [17] is well organized, a national database on vaccination records has been lacking until 2009, and the database does not capture previously administered vaccines. Thus, individual vaccination history is based on each HCW's personal records and knowledge on vaccines received, and may therefore be unreliable.

The aim of this study was to assess the immunity against vaccine-preventable diseases in HCWs working in pediatric wards at Helsinki University Hospital. We studied antibodies against tetanus, diphtheria, polio, pertussis, HAV, HBV, MMR-diseases and varicella zoster.

2. Methods

2.1. Study design

HCWs were eligible for the study if they were 18–65 years old and their job description included at least 50% clinical work with patients. HCWs who had received immunizations, blood products or immunoglobulins during the previous two months were excluded.

HCWs were recruited from pediatric wards in Helsinki University Hospital during October and November in 2014. Recruitment was done by e-mail and posting flyers in the wards. Participating was voluntary. HCWs willing to participate were advised to contact the research personnel and give their personal contact information. Enrollment was continued until each of the four designed age categories (<30 years, 30–40 years, 40–50 years, >50 years) had 38–40 participating nurses (Table 1).

The HCWs enrolled answered a questionnaire regarding their vaccination history based on recollection or by viewing their possible written vaccine records.

2.2. Laboratory methods

Blood samples were taken between December 2014 and March 2015 from 157 recruited HCWs. The sera were analyzed at HUSLAB with EIA techniques during fall 2015. Varicella IgG was measured using an inhouse VZV-IgG EIA test [18,19]. Measles and mumps IgG antibodies were measured using commercial ELISA-assay (Measles Virus, Human-ELISA-IgG-Antibody-Test, Human Gesellschaft für Biochemica und Diagnostica mbH, Wiesbaden, Germany and Mumps IgG: Mumps Virus, Human ELISA-IgG-

Antibody-Test, Human Gesellschaft für Biochemica und Diagnostica mbH, Wiesbaden, Germany). Rubella, diphtheria and tetanus IgG antibodies were measured by an inhouse EIA test. The samples were tested for antibodies against HBV surface antigens (HBsAb) (Architect anti-HBs Reagent Kit, Abbott) and HbCAb as well as antibodies for HAV (Architect HAV-IgG Reagent Kit, Abbott) and Hepatitis C virus (HCV, Architect anti-HCV Reagent Kit, Abbott).

Varicella, measles and mumps antibodies were defined positive or negative according to the manufacturer's guidelines. Rubella antibodies were considered non-protective when titers less than 15 EIU were detected. Tetanus and diphtheria antibody titers less than 0.1 IU/ml were defined as not protective [20]. HBsAb over 10 mIU/ml was considered positive. HAV IgG was defined either positive or negative.

Neutralizing antibodies against polioviruses 1, 2 and 3 (PV1, PV2, PV3) were tested for at Finland's National Institute for Health and Welfare [21]. Titers less than 1:32 were considered inadequate.

IgA and IgG antibodies against pertussis toxin (PT) were tested at the national pertussis reference laboratory at the University of Turku (UTU). IgG and IgA antibodies were measured with EIA techniques (provided by GlaxoSmithKline, Belgium) [22].

2.3. Statistical analysis

Statistical analysis was performed with IBM SPSS Statistics version 22. Categorical variables were compared with Pearson chi square test or Fisher's exact test.

2.4. Ethics approval

The study protocol was approved by the Ethics committee of the Medical Faculty at Helsinki University hospital. A written consent was requested from every HCW participating in the study.

3. Results

A total of 157 out of 785 (20%) nurses employed by the Children's Hospital were included in the study. Most of the participants, 151/157 (96%), were female. The age-range of the participants was from 22 to 64 (Table 1). All of them answered a questionnaire on their personal vaccination history.

All 157 nurses had high anti-tetanus toxoid antibody-levels, and all of them could recall being vaccinated against tetanus and diphtheria. Altogether 141/157 (89.8%) of the nurses (95% CI 85.1–94.5) had diphtheria antibodies >0.1 IU/ml. There was no

Table 1
Age breakdown of study population, self-reported immunity and seropositivity to MMR-diseases.

Age	<30 years	30–40 years	40–50 years	>50 years
Nurses (n)	38	40	40	39
Female	38	38	37	38
Male	0	2	3	1
<i>Immunity status</i>				
MMR vaccination	95% (36)	93% (37)	65% (26)	13% (5)
Not known	5% (2)	8% (3)	15% (6)	23% (9)
No answer	–	–	20% (8)	64% (25)
<i>History of infection</i>				
Measles	–	–	38% (15)	69% (27)
Mumps	–	8% (3)	50% (20)	51% (20)
Rubella	–	5% (2)	20% (8)	41% (16)
<i>Seropositivity</i>				
Measles	66% (25)	70% (28)	90% (36)	100% (39)
Mumps	82% (31)	95% (38)	93% (37)	87% (34)
Rubella	76% (29)	95% (38)	100% (40)	100% (39)

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